Preliminary and Incomplete

HELICOPTER DROPS FOR JAPAN

Laurence Ball

Johns Hopkins University

June 2004

I. INTRODUCTION

Japan's economy has slumped since the early 1990s. Deflation has occurred since 1998. This situation has persisted because policymakers lack the usual tools for stimulating the economy. Interest rates are near zero, so the Bank of Japan cannot lower them further. The government is unwilling to expand fiscal policy aggressively because its debt is already rising rapidly.

Economists have suggested a number of non-standard policies to help Japan escape its slump. This paper examines one such policy: a fiscal expansion financed by printing money. This policy is known to academics as a "helicopter drop" of money. Proponents include Mankiw (1999), Bernanke (xxxx), and Stevens (xxxx). They argue that a helicopter drop would stimulate the economy in the same way as a bond-financed fiscal expansion, but without the side effect of higher government debt. And the usual argument against helicopter drops - they are inflationary - is not compelling in Japan, where inflation is currently too low.

The Bank of Japan has resisted this suggestion. Some policymakers worry that money creation would eventually lead to high inflation. Others suggest that, to control inflation, the BOJ would need eventually to absorb money through contractionary open market operations. This action would increase private holdings of government bonds, worsening the debt problem. The other side counters that expansionary policy would reduce the debt-income ratio by raising growth, inflation, and tax revenue.[1]

This paper examines these issues. It uses a textbook-style macro model calibrated to fit the Japanese economy. I determine how large a helicopter drop is needed to boost output to potential, and the effect on the monetary base. I also derive the economy's behavior after the helicopter drop, and compare it to a baseline case without this action.

The results are generally favorable to helicopter drops. Drops of moderate size return output to potential. For example, for base parameter values, drops of 3.4% of GDP for three years are sufficient. As output recovers, inflation rises to positive but low levels. Initially, helicopter drops cause a sharp fall in the debt-income ratio. As suggested by helicopter skeptics, the BOJ must eventually contract the monetary base, and debt

[1] Miyako Suda of the BOJ Policy Board discussed helicopter drops in a speech in November, 2002: "This policy measure would stimulate the economy, which could end deflation and generate inflation. After deflationary expectations have been eliminated, inflationary expectations may not stay at a moderate rate. The BoJ will be required to prevent the inflation rate from overshooting and maintain inflation within a range of price stability by absorbing funds from the markets through outright sales of bills issued by the BOJ and/or government securities....The important point to note is that such a policy would impose an additional fiscal burden in the end instead of increasing private sector wealth."

rises at that point. However, for most reasonable parameters, the debt-income ratio stays below its level under the no-drop scenario. At worst, helicopter drops raise debt slightly after many years.

The rest of this paper contains eight sections. Section II presents additional background and Section III presents the model. Section IV derives the economy's behavior in the baseline case, and Section V adds helicopter drops. Section VI considers variations on policy, and Section VII studies robustness. Section VIII compares helicopter drops to other policies proposed for Japan. Section IX concludes.

II. BACKGROUND

This section reviews Japan's recent history and the basic rationale for a helicopter drop.

A. Japan's Slump

Figure 1 presents annual data on Japan's economy from 1990 to 2003. I use the experience of this period to guide my modeling of the economy. The situation in 2003 is summarized in Table I. In simulating alternative policies, I use data from 2003 as initial conditions.

The top panel of the Figure shows the log of real output. Output growth averaged 1.3% per year over 1990-2003, compared to xx% from 1980 to 1990. Early in the slump, some blamed it on slow growth of potential output due to “structural” factors. Today, however, most economists agree that output has fallen below potential because of deficient demand. Apparent demand shocks include a collapse in asset prices, a credit crunch, and policy mistakes (see. e.g. Hoshi and Kashyap, 2004, and Posen, 2004).

There is, of course, uncertainty about the gap between output and potential output. Following McCallum (xxxx) and Hoshi-Kashyap, Figure 1 presents a path for potential based on the assumption that it has grown 2% per year since 1990. This assumption implies an output gap of -9% in 2003. Using production functions, some researchers have estimated gaps around -5% in recent years (e.g. Ahearne et al, 2002; Leigh, 2004). In my simulations, I assume an initial output gap of -7.5%.

Figure 1 also shows inflation, as measured by the GDP deflator and by core CPI. The slump of the 90s dragged inflation down, as predicted by the accelerationist Phillips curve. In 2000, inflation reached about -1% (a bit higher for the CPI and a bit lower for the deflator). Since then, inflation has remained fairly constant. I use -1% as the initial value of inflation.

The stability of inflation since 2000 is _not_ consistent with a conventional Phillips curve. Such an equation predicts accelerating deflation when the output gap is negative. The cause of this anomaly is unclear, but Blanchard (xxxx) suggests one possibility. The accelerationist Phillips curve is based on the assumption that expected inflation equals past inflation. This relation breaks down under deflation if people view this situation as transitory - if they expect a return to non-negative inflation. In this case, an output slump causes deflation but not accelerating deflation. I will incorporate this idea in the paper's model.

The last two panels of Figure 1 show the behavior of monetary policy. The BOJ responded to the slump and falling inflation by cutting the short-term interest rate. Leigh (2004) shows that a conventional Taylor rule captures this behavior up to 1999. At that point, the Taylor-rule interest rate became negative, and the actual rate hit the zero bound. The interest rate has stayed close to zero since then.

The monetary base grew steadily as the interest rate fell. This growth accelerated under the policy of "quantitative easing": the base grew xx% in 2002 and xx% in 2003. The ratio of the base to GDP reached 20% in 2003. With the interest rate stuck at zero, rapid base growth did not have obvious effects on output or inflation. This experience is consistent with a textbook liquidity trap.

B. A Fiscal Solution?

The classic solution to a liquidity trap is a fiscal expansion. However, Japanese policymakers are reluctant to try this policy, for two reasons. First, many argue that fiscal policy is ineffective in raising output. Second, a fiscal expansion would exacerbate the problem of a growing national debt.

This paper rejects the first reason. It is based on the view that Japan tried fiscal expansions in the 90s without success (e.g. Friedman, 2001). This view has been debunked by Posen (1998) and Kuttner and Posen (2001). They show that several "expansion" programs failed because they were not really expansions - they consisted mainly of normal expenditures. There were large fiscal deficits, but these reflected revenue losses from the slump. In periods of true fiscal loosening, such as xxxx, output responded.

Kuttner and Posen also estimate multipliers for fiscal policy in Japan. They use the structural VAR approach of Blanchard and Perotti (xxxx), which controls for the cyclical behavior of deficits. Kuttner and Posen find that a 100 yen tax cut raises output a year later by about 125 yen.

The second objection to fiscal expansion is more persuasive. Figure 2 shows the path of privately-held government debt as a percent of GDP. In 2003, this debt-income ratio is 0.8 and rising rapidly. Projections of future deficits are horrific because of Japan's aging population. In 2002, Moody's and Standard and Poor's downgraded Japanese government debt to xxx, the level for many developing countries. Policymakers are unwilling to undertake a fiscal expansion that would exacerbate this problem. [ADD QUOTE]

In this situation, a helicopter drop is a natural policy. It produces the same increase in disposable income, and therefore in spending, as a bond-financed fiscal expansion. Yet it does not increase government debt, at least initially. The rest of this paper explores these ideas quantitatively.

III. THE MODEL

Japan's problems are largely explained by textbook macro models. A fall in aggregate demand has reduced output, and monetary policy is ineffective because the interest rate has hit zero. Kuttner and Posen say "the lesson of the Great Japanese recession is to trust what you learned in intermediate macro." In that spirit, I study a model with textbook equations such as an IS curve and a money demand function. I add simple dynamics following Svensson (1997) and Ball (1999). The only unorthodox equation is the Phillips curve, which is modified to capture Japan's steady deflation.

A. Assumptions

Output: Potential output Y^* grows at a rate of g percent per year. Actual output Y deviates from potential according to an IS equation:

$$(1) \qquad (Y_t - Y^*_t)/Y^*_t = \lambda(Y_{t-1} - Y^*_{t-1})/Y^*_{t-1} - \beta(r_{t-1} - r^*_{t-1}) + \delta(G_{t-1}/Y^*_{t-1}),$$

where t indexes years, G is real transfers from the government, r is the real interest rate, and r* is the "neutral" rate. The real rate r is $i-\pi$, where i is the nominal rate and π is inflation. In words, the output gap depends on the lagged output gap, the lagged real interest rate, and lagged transfers. The one-year lags are consistent with evidence for Japan (see Kuttner and Posen).

Inflation: Inflation is determined by an expectations-augmented Phillips curve:

$$(2) \qquad \pi_t = \pi_t^e + \alpha(Y_{t-1} - Y^*_{t-1})/Y^*_{t-1} ,$$

where π^e is expected inflation. A conventional assumption is that expected inflation equals lagged inflation, $\pi_t^e = \pi_{t-1}$. I assume instead that

$$(3) \qquad \pi_t^e = \max\{\pi_{t-1}, 0\}.$$

The conventional assumption holds when lagged inflation is non-negative, but expectations do not follow actual inflation below zero. When $\pi_{t-1} \geq 0$, (2) and (3) imply that output determines the change in inflation. When $\pi_{t-1}<0$, output determines the level of inflation, as suggested by Blanchard.

Section VII replaces equation (3) with the assumption that π_t^e always equals π_{t-1}. This change does not greatly affect the economy's response to helicopter drops. It does change the baseline case without drops. In this case, the economy falls into a deflationary spiral if $\pi_t^e = \pi_{t-1}$.

Money Demand: The demand for base money, M, is given by

$$(4) \qquad \ln(M_t/P_tY_t) = k - \gamma i_t \, , \qquad i_t > 0 \; ;$$

$$\qquad \qquad \qquad \quad \$ \;\; k \, , \qquad \qquad i_t = 0 \, ,$$

where P is the price level. Figure x shows the money demand curve in a graph. Equation (4) imposes a unit income elasticity of money demand (which is consistent with Japanese data). At positive interest rates, the interest-rate semi-elasticity is γ. Money demand becomes flat at i=0, as money and bonds become perfect substitutes.

The Money Stock: I assume that the transfer G is financed by creating base money. Transfers raise the nominal money stock by PG. Money also changes through open market operations. Let Z be central bank purchases of government bonds (Z<0 means sales of bonds). Money evolves according to

$$(6) \qquad M_t = M_{t-1} + Z_t + P_tG_t \; .$$

Debt: I measure Japan's fiscal problem with privately-held debt, which excludes debt held by the central bank. Thus I ignore the separate balance sheets of the government and central bank and treat them as one entity. Nominal debt D_t evolves according to

(7) $D_t = D_{t-1} + i_{t-1}D_{t-1} - Z_t + \theta(P_tY_t - P_tY^*_t)$.

Debt is past debt plus changes from three sources. The first is interest payments and the second is open market purchases, which reduce debt. This variable is the difference between government spending and taxes, ignoring the money-financed transfer. Equation (7) assumes the primary surplus is zero when output equals potential. The surplus varies procyclically when output fluctuates.

In reality, Japan's primary surplus would probably be negative even if output were at potential. However, ignoring this fact helps us isolate the fiscal effects of helicopter drops. Section VII extends the model to include a primary deficit when Y=Y*.

B. Calibration

Table 2 presents base values for the model's parameters. Section VIII considers robustness to changes in these parameters. [I welcome references to Japanese evidence on the parameters.]

In the IS equation, I set β, the coefficient on the real interest rate, to 1.0. This follows Ball's (1999) calibration for the U.S. (I have not found Japanese evidence). For the other IS parameters, I use Kuttner and Posen's econometric results. Their tax multiplier implies δ=1.25. They find an effect of lagged output, λ, of 0.6.

I also use Kuttner and Posen's estimate of θ, the effect of output on the deficit. They find θ=0.25. (This appears conservative, as taxes are 20% of Japanese output and marginal taxes are higher than average taxes.)

The Phillips curve slope, α, is 0.2. This number is based on studies at the BOJ [give cites]. (The Phillips curve appears flatter in Japan than in the U.S., where α is often estimated around 0.4.)

In the money demand equation, the interest rate semi-elasticity, γ, is 0.05 (a guess in the absence of Japanese evidence). The parameter k is the point at which the money demand curve hits an interest rate of zero. I calibrate it using the historical evidence in Figure 1. When the interest rate reached zero in 1998, the ratio of the monetary base to GDP was about 0.1. This implies k=ln(0.1).

The growth rate of potential output, g, is 2% per year.

C. The Neutral Interest Rate

It remains to calibrate the neutral real interest rate, r*. This is a thorny issue. There is debate about whether this parameter is positive or negative in Japan (e.g. Krugman, xxxx). My view is that r* is currently negative, but unlikely to stay negative forever. My calibration will capture this idea.

The neutral interest rate is the rate that produces Y=Y* in the absence of helicopter drops. It seems clear that this parameter is currently negative. The actual real rate has been about 1% in recent years, and Y is far below Y*. Thus r* must be well below 1%. I assume an initial r* of -2%, which implies r-r* = 3%. For this calibration, a lagged output gap of 7.5% implies a current gap of 7.5%. Thus the calibration captures the idea that output is stuck at a low level.

The negative value of r* reflects an inward shift of Japan's IS curve. It arises from such factors as the credit crunch and low confidence. It is likely that these problems will someday abate. Eventually, a cleanup of banking may spur greater lending. Or a recovery due to external demand will raise confidence and improve balance sheets. Whatever the reason, the IS curve will shift and r* will reach the positive range seen in most economies.

I assume that r* eventually rises to +2%. Of course it is hard to guess how quickly this will happen. In the base specification, I assume that r* rises linearly from -2% to +2% over ten years. The IS curve shifts outward, but slowly. Since this assumption is arbitrary, variations on the r* path are a top priority among robustness checks.

IV. A BASELINE CASE

This section derives the path of the economy if there are no helicopter drops: G_t=0 for all t. In period 0, the economy starts with the initial conditions in Table 1. This exercise provides a baseline for measuring the effects of helicopter drops.

A. Monetary Policy

In the absence of helicopter drops, I assume the BOJ pursues "normal" monetary policy. I define normalcy using the experience of the 1990s. Recall that Japan appeared to follow a Taylor rule until the interest rate hit zero. I capture this behavior with the following rule:

$$(8) \qquad i_t = \max\{i^T_t, 0\} ,$$

$$i^T_t = r^*_t + \pi_t + a(Y_t - Y^*_t)/Y^*_t + b(\pi_t - \pi^*) ,$$

where π^* is an inflation target. The variable i^T is the interest rate dictated by a Taylor rule: it depends on the output gap and inflation. The BOJ sets an interest rate of i^T if i^T is positive, and zero if i^T is negative.[2]

When this rule delivers a positive interest rate, the money demand equation determines M. M and lagged M determine open market purchases, Z. However, when i=0, the interest-rate rule does not determine M, because money demand is flat. In this case, I make the additional assumption that Z=0, so M equals lagged M. The BOJ does not undertake open market operations when they would not affect the interest rate.

In the Taylor rule, the coefficients a and b are chosen as follows. Taylor rules with certain parameters are equivalent to

[2] Shirakawa and Ueda (2004) assume a similar policy rule for the BOJ.

“flexible” inflation targeting: a policy that returns inflation to π* at a fixed rate (see Svensson [1997] and Ball [1999] for proofs in similar models). I assume that inflation moves halfway to its target each period. One can show that this implies a=1.1 and b=2.5.

I assume an inflation target π* of 3%. This is higher than Japan’s target in the 1990s, which Leigh (2004) estimates at 1%. However, many economists have suggested a target around 3% going forward (e.g. Krugman, 1997, Posen, 1998, Leigh 2004).

Given initial conditions and the policy rule, it is straightforward to derive the evolution of the economy. Each period, Y and π are determined by past conditions through (1)-(3). Inflation π determines the price level P. The policy rule determines i, M, and Z, as described above. Finally, equation (7) determines D.

B. Results

Figure 3 shows the evolution of key variables: the output gap, π, i, and the ratios of Z, M, and D to GDP. Starting from period 0, output stays in a deep slump for several years and then slowly recovers as r* increases. The output gap rises above -5% in year 6, and it becomes positive in year 10. There is a large cumulative output loss in years 1-9.

Inflation inches up as the economy recovers, and becomes positive in year 11. Through this year the Taylor rule prescribes a negative interest rate, so i is stuck at zero.

In year 12, the recovery pushes the Taylor-rule rate above zero. The Taylor rule starts to operate, and it guides inflation smoothly to the target of 3%. The output gap is positive while inflation rises from zero to 3%.

In the first 11 years, the money/GDP ratio declines slowly, as M is constant and GDP rises (the growth of Y* exceeds the fall in P). In year 12, the money/GDP ratio drops by more than 1/3, which requires a contractionary open-market operation of 5% of GDP. This action is needed because of the high level of money at the start of the simulation. Even though the money/GDP ratio declines in years 1-11, it remains above the level that produces a positive interest rate. Thus a large money absorption is needed when the Taylor rule takes effect in year 12.

The debt-income ratio rises initially, because the output slump produces primary deficits. It peaks at 0.86 in year 5. As the economy recovers, the debt-income ratio falls slowly. It jumps up in year 12, when the large monetary contraction occurs. This rise is modest, however, as the effect of open-market operations is partly offset by high output and a negative real interest rate.

In steady state, the debt-income ratio falls slowly. The primary deficit is zero, and interest payments are balanced by income growth, since r=g=2%. The fall in the debt ratio results from seignorage revenue, as Z>0 in steady state. The ratio reaches 0.71 in year 25.

V. HELICOPTER DROPS

This section examines how helicopter drops change the evolution of the economy.

A. The Policy

In this experiment, interest-rate policy is the same as before: $i=\max\{i^T,0\}$. And once again, Z=0 when i=0.

But now there are transfers of money: $G_t>0$ for some t. There are many possible choices of the size and timing of these transfers. I will not derive the optimal policy by any criterion; instead, I will simply try out a few policies. The goal is to find policies that end the output slump quickly and also have benign effects on inflation and the debt/income ratio.

This section focuses on two cases. In the first, there is a single transfer in period 0. It is the smallest transfer that produces non-negative output gaps in periods 1,2,.... I find this policy by searching over transfers of different sizes.

It turns out that the required transfer is 10.2% of potential output. Such a transfer is large by historical standards. One might worry about analyzing such a large intervention with my model, which is at best a linear approximation to reality. Therefore, I also examine a policy in which transfers are spread over years 0-2. If each of the three transfers is 3.4% of potential output, the output gap is non-negative starting in year 3. Fiscal expansions of 3.4% are not extraordinary.

B. Results

Figure 4 shows the effects of helicopter drops. It compares the one-drop and three-drop versions of the policy (the dashed lines) to the baseline policy from Figure 3 (the solid lines).

By construction, the helicopter drops return output to potential quickly. Most of the long slump in the baseline case is eliminated.

Because of the faster recovery, π and i become positive sooner with helicopter drops than without. Once the Taylor rule takes effect, it guides the economy to 3% inflation, as before.

Helicopter drops raise the money/income ratio at the start of the simulations. In the one-drop case, the ratio rises by about 50% in year 0. In the three-drop case, it rises about 15% per year for three years. These increases are moderate compared to money growth in Japan's recent history.

After its initial rise, the money/income ratio starts falling, as in the baseline case. The ratio jumps down when the interest rate becomes positive. This jump is larger than in the base case, because the extra money created at the start must be taken back.

With helicopter drops, the debt/income ratio drops at the start of the simulations as output returns to potential. The ratio falls well below its level without helicopter drops, because of higher output, inflation, and revenue. For each of the helicopter-drop cases, the debt ratio reaches about 0.6 before the interest rate becomes positive. When the Taylor rule takes effect, contractionary open market operations raise the debt ratio to about 0.7. Thereafter, it is closer to the level under the baseline policy, but still below it. Once again the ratio declines slowly in steady state. In year 25 it is less than 0.66 in the helicopter cases, compared to 0.71 in the baseline case.

Overall, helicopter drops are a win-win proposition. They quickly return output to potential, and inflation goes smoothly to its target. In the short run, the debt/income ratio is much lower than in the baseline case; in the long run it is moderately lower. The upward jump in the debt ratio when money is absorbed is smaller than the earlier reductions from growth and inflation.

Table 1

Conditions in 2003 (Initial Conditions for Simulations)

Output gap = 7.5%

Inflation = -1.0%

Nominal interest rate = 0

Base/GDP = 0.20

Debt/GDP = 0.80

Table 2

Base Parameter Values

IS: β=1.0, λ=0.6, δ=1.25

Revenue: θ=0.25

Phillips curve: α=0.2

Money demand: γ=0.05, k=ln(0.1)

Potential output: g=0.02

Neutral rate: r*=-0.02 in year 0; grows linearly to +0.02 in year 10