Is Shutting Krugman's Liquidity Trap the Answer to Japan's Problems?

Paul Krugman has argued that the primary source of Japan's current problems is that the economy faces a liquidity trap. According to Krugman, this has occurred because Japan confronts negative equilibrium real interest rates for a substantial period. To escape the trap, the Bank of Japan must generate inflationary expectations. This paper extends Krugman's argument to consider the impact of demographic change on savings and investment and finds that Japan's equilibrium real interest rate is unlikely to be negative for any considerable period. It argues instead that *real* forces, particularly productivity shocks and the problems of reallocating resources in their wake, are important contributors to Japan's predicament. Consequently, simply generating inflation may not deliver sustained improvements in the macroeconomic situation. Successful reform, particularly to the banking sector, may be more important to a sustained recovery.

Introduction

In a recent *Brookings Paper*, Paul Krugman proposed a radical diagnosis and cure for Japan's current recession (Krugman 1998). According to his diagnosis, the Japanese economy is stuck in a liquidity trap and can expect to remain there for many years. The only way out is for the Bank of Japan to shut the trap by committing to a substantial period of inflation, which Krugman suggested should be 4 per cent for the next fifteen years. These proposals have caused apoplexy among Bank of Japan officials, but they have provoked interest (and some support) elsewhere, particularly among policymakers and academics outside Japan.

The Krugman thesis comes in two basic parts. The first (theoretical) part of the argument is that liquidity traps – where monetary policy becomes impotent because nominal interest rates cannot fall below zero – are consistent with modern macroeconomic models based on solid microeconomic and intertemporal foundations. Liquidity traps arise when the equilibrium real interest rate – the rate required to reach potential output – is negative. In this case, even zero nominal rates will be insufficient to bring desired savings and investment into balance and the economy *needs* rising prices to ensure full employment. Unless prices are perfectly flexible, the central bank must be able to generate inflation to avoid recession.

The second (empirical) part of the argument is that the Japanese economy is actually in precisely this situation – and not just temporarily. Krugman maintains that the equilibrium real interest rate in Japan is plausibly negative over a considerable period. The main reason he gives is that the Japanese work force is declining. As a result, desired savings exceed desired investment even at zero real interest rates and will continue to do so for some time. In stating this case, Krugman argues particularly strongly against the conventional wisdom that Japan's banking sector problems are an important part of its current macroeconomic problems.

It is important to realise that the two parts of the Krugman thesis can be completely separated. It is perfectly consistent to think that Krugman has proved the theoretical point without buying his conclusions that Japan is entering a prolonged period where liquidity trap conditions apply. Krugman rests both halves of his argument on a startling feat of simple but elegant modeling. What is perhaps most startling of all is that he relies heavily on a series of models that contain neither savings, investment or population growth. These models are perfectly sufficient to illustrate the theoretical consistency of the liquidity trap. But because most of the relevant parameters are not even included, they cannot give a clear indication of how likely it is that the conditions for a liquidity trap will arise in a real-life economy.

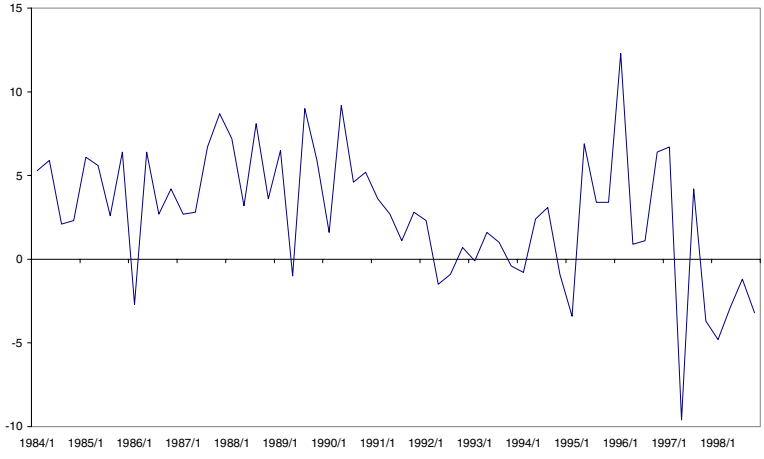
The first half of this paper examines the conditions for liquidity traps to arise in models that allow for saving, investment and population growth. While doing so does not invalidate the general conclusion that liquidity traps are possible, it does suggest that the conditions for a real interest rate to be negative are pretty stringent and probably too stringent to be met over the medium term by today's Japan. The second half of the paper presents an alternative diagnosis of Japan's malaise and discusses its policy implications.

Japan's malaise

There is no doubt that the Japanese economy is in serious trouble. Following the bursting of an asset price bubble in 1989–90, the economy stagnated, moving into outright recession in late 1997 (Figure 1).

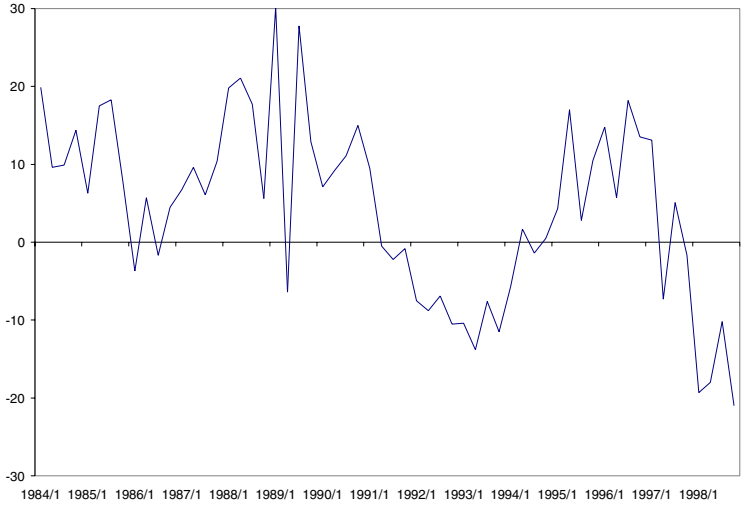
Investment is falling (Figure 2), consumer spending is weak (Figure 3), unemployment has risen and the growing trade surplus has provoked increasing criticism (and protectionist responses) from the US. This gloomy situation persists despite the government's attempts to turn the economy around. Monetary policy has been progressively loosened since 1991 and

Figure 1 Real GDP growth 1984–98 (per cent)



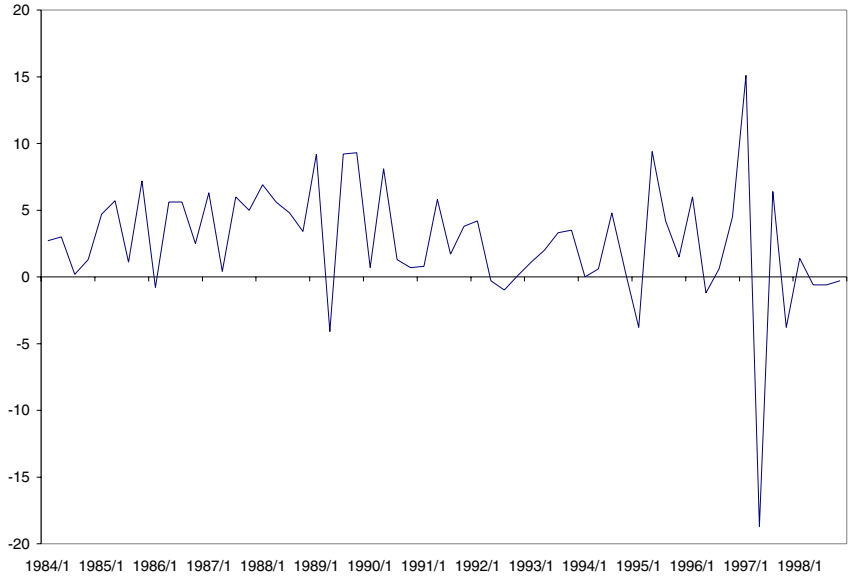
Source: Nikkei database, AJRC

Figure 2 Growth in private capital expenditure, 1984–98 (per cent)



Source: Nikkei database, AJRC

Figure 3 Consumption growth 1984–98 (per cent)



Source: Nikkei database, AJRC

interest rates are at a record low (with an overnight call rate of 0.03 per cent as at September 1999). The government has pushed through fiscal packages totaling in excess of 36 trillion yen ($US300 billion) in the last year. This spending has slowed the decline in growth, at least over the past six months, but at the cost of a massive deficit (predicted to be around 10 per cent of GDP in 1999) and rising public debt (now over 100 per cent of GDP) according to the OECD (1999). Despite all this, prices continue to fall.

The banking sector is in a fragile condition. Total bad loans in 1998 were estimated to be between 77 and 100 trillion yen (US$540–740 billion) (OECD 1999). The government has begun to move more aggressively to reform the banking system. Two banks (the Long Term Credit Bank and Nippon Credit) were nationalised in the last quarter of 1998 and the process of reassigning their assets has begun. Other major banks recently received a large injection of public funds to help recapitalisation. The increase in optimism about bank reform has brought about a significant rise in bank stocks since October 1998, although bank balance sheets are still weak, almost without exception.

Japan's slowdown is partly cyclical, but no-one expects a return to the high-growth era of the 1960s to 1980s, as the population is entering a period of slow but sustained decline. The Ministry of Health and Welfare has projected that the population will fall by around 0.2 per cent a year between 2000 and 2025 (Ministry of Health and Welfare 1997). The labour force is projected to fall even faster, at around 0.7 per cent a year over the same period (OECD 1997). This prediction does not, however, allow for the possibility of increased participation rates, which are still low by international standards, particularly for women. The OECD estimated participation to have grown by about 0.8 per cent annually over the past ten years and if this trend continues, the decline in the labour force could be slowed to as little as 0.3 per cent annually until 2025.

As the economy has matured, total factor productivity (TFP) growth appears to have slowed. The OECD (1998) is projecting TFP growth of around 0.9 per cent per year for the next few decades. This projection is acknowledged to be low, since there may be substantial scope for increased efficiency if the deregulation programme is successful, particularly in Japan's notoriously sluggish services sector. Even this low rate would be sufficient to offset the effect on growth of the decline in the labour force. Despite Japan's unfavourable demographics, the number of effective workers (the number of workers multiplied by the level of total factor productivity) is likely to continue to rise slowly, although this will not bring a return to rapid growth.

Questioning Krugman's analysis

Krugman's analysis convincingly demonstrates that liquidity traps are consistent with modern macroeconomic models based on intertemporal utility maximisation and that they occur when the real equilibrium rate of interest in an economy is negative. This is an important theoretical contribution that adds a great deal of clarity to Japan's problems. In effect, it reduces the issue of whether Krugman's policy conclusions are correct to the question of whether the real equilibrium interest rate in Japan over the next couple of decades *is* plausibly negative. Since this is a real (as opposed to a monetary) question it can, for the most part, be addressed by models that leave money to one side.

The bulk of Krugman's analysis takes place in a one-good representative-agent model, where a consumer receives an endowment of the good in each period, like manna from heaven. The assumption of fixed endowments helps enormously in simplifying the algebra. But it

turns out that the starkness of some of the results relies more heavily on this assumption than Krugman acknowledges. One of the hallmarks of intertemporal economics is that it acknowledges that people have the capacity to react to foreseeable events (like a slowing in labour force growth) and to reallocate consumption and savings across time in powerful and surprising ways. By largely eliminating this option, the models Krugman uses exaggerate the prospects for extreme responses to unusual developments.

The same kind of model that Krugman uses can be extended to allow for savings, investment and population growth, to allow goods to be produced instead of donated, and to allow consumers to reallocate resources over time. The simplest model that lets us do that is a version of the Ramsey growth model, which can be formulated so that it explicitly considers the impact of demographic change on savings, investment and the real interest rate.

The closed economy

A consumer derives utility from consumption, C, and maximises:

$$\int_{t=0}^{\infty} \frac{C^{1-\theta}}{1-\theta} e^{-\rho t} dt \tag{1}$$

where ρ is the rate of time preference and θ is the reciprocal of the intertemporal elasticity of substitution (assumed constant), which reflects the willingness of consumers to reallocate consumption across time. Instead of receiving endowments (as in Krugman's models) the economy produces a good according to a production function:

$$Y = F(K, AL) \tag{2}$$

The labour force is assumed to grow at a constant rate l and the economy experiences labour-augmenting productivity growth of x. Population grows at rate n, which may differ from l. The production function can be written in effective worker terms:

$$y = f(k) = rk + w \text{ where } y = Y/AL;\ k = K/AL \tag{3}$$

Aggregate consumption can be written:

$$C = ce^{\phi t} \quad \text{where } \phi = x + l - n;\ c = C/AL^{1} \tag{4}$$

The economy accumulates capital according to the following process:

$$\dot{k} = f(k) - c - (x + l + \delta)k \tag{5}$$

where δ is the depreciation rate. This system can be solved in the usual way from the first-order conditions of the Hamiltonian:

$$H = \{u(ce^{\phi t}) + \lambda[rk + w - c - (x + l + \delta)k]\}e^{-\rho t} \tag{6}$$

The Keynes–Ramsey rule defines consumption along the optimal path:

$$\frac{\dot{c}}{c} = \frac{1}{\theta}\left[r - \delta - \rho - \theta(l + x) + (\theta - 1)n\right] \tag{7}$$

The steady state occurs when $\dot{c} = 0$ and $\dot{k} = 0$. Using $r = f'(k)$ these conditions imply that the steady state capital stock per effective worker, k^*, is given by:

$$f'(k^*) - \delta = \rho + \theta(l + x) - (\theta - 1)n \tag{8}$$

The left-hand side of equation (8) represents the marginal product of capital, net of depreciation. It is properly interpreted as the risk-free rate of return that a consumer receives on savings and so constitutes the appropriate definition of the real interest rate in this model.[2] The presence of depreciation means that the net real interest rate, $(r - \delta)$ can be negative, even though the marginal product of capital must always be greater than zero.

Equation (8), however, implies that in the steady state the real interest rate is pegged by the values of the various parameters. How do these look for Japan? Projections of productivity growth and demographic change imply that n = -0.2 per cent per year, x = 0.9 per cent per year and l =-0.3 to -0.7 per cent per year (OECD 1998). θ is commonly estimated to be between 1 and 2 (Barro and Sala-i-Martin 1995) and estimates of the discount rate that yield plausible predictions for the savings rate generally put it at around 1–2 per cent per year. From equation (8), this gives a predicted steady-state real interest rate in Japan of between 1.2 per cent and 3.4 per cent. While there are good reasons to believe that the actual rate lies near the bottom of this range, the basic Ramsey model suggests that it is highly unlikely that Japan faces a negative steady-state real interest rate.

Of course, Japan may not be on its steady-state growth path and so the model does not rule out the possibility that the current equilibrium real interest rate in Japan is negative even for these estimates of the parameter values. But in this model, a negative real interest rate can only occur if Japan is above its steady state – in other words if there has been overinvestment in capital. If that is true, the equilibrium path will be one on which capital stock and output per effective worker are falling. Since growth in Japan's effective workforce is acknowledged to be weak, this would imply that a large part of the stagnation in output and investment was an equilibrium response to a situation where the economy had invested too much. Real stagnation of this sort could not be reversed by monetary policy and, in this case, a liquidity trap might slow the decline by keeping interest rates artificially high relative to the rate of time preference.

These results indicate that allowing consumers to allocate resources optimally across time places additional constraints on the conditions under which negative real interest rates may arise. But this simple model suffers from three weaknesses as a guide to Japan's situation: it presumes a closed economy, savings and investment decisions are not separately defined, and the model does not allow for changes in the price of capital. As Krugman points out, expected changes in the price of capital – Tobin's q – may be another way in which the real return on capital may come to be negative.

The open economy

To remedy this, we now assume that the economy can borrow and lend freely at the world interest rate r and introduce costs to the installation of capital goods.[3] The consumer's utility function is still given by (1), but the budget constraint is now defined in terms of the accumulation of foreign debt per effective worker, b:

$$\dot{b} = c + i\left[1 + \frac{\phi}{2}\left(\frac{i}{k}\right)\right] - f(k) + (\rho - (l + x))b \tag{9}$$

where:

$$\dot{k} = i - (l + x)k \tag{10}$$

Equation (9) states that the change in foreign debt is equal to the difference between expenditure (on investment, consumption and interest on existing debt) and output.[4] It can

be seen from (9) and (10) that it now takes $i\left[1+\frac{\phi}{2}\frac{i}{k}\right]$ units of output to achieve i units of investment per effective worker. The installation cost per unit of investment increases with the size of the investment relative to the capital stock.

$$H=\left[u(ce^{\phi t})-\mu\left\{c+i\left[1+\frac{\phi}{2}\frac{i}{k}\right]+(\rho-(l+x))b-f(k)\right\}+\mu q\{i-(l+x)k\}\right]e^{-\rho t} \tag{11}$$

where q can be interpreted as the shadow price of capital. The first-order conditions (set out in the appendix) imply that:

$$i=\frac{(q-1)}{\phi}k \tag{12}$$

$$\dot{q}=\rho q-f'(k)-\frac{\phi}{2}\left(\frac{i}{k}\right)^2 \tag{13}$$

Equation (12) says that investment is an increasing function of q, while (13) defines q's path. Together with (10) they imply that the steady state is defined by:

$$\tilde{q}=1+\phi(l+x) \tag{14}$$

$$f'(\tilde{k})=\rho(1+\phi(l+x))-\frac{\phi(l+x)^2}{2} \tag{15}$$

The interesting feature of equation (13) for our purposes is that it defines the optimal path of q without reference to l, n or x. Equation (13) can be rewritten as:

$$\rho=\frac{\dot{q}+\left[f'(k)+\frac{\phi}{2}\left(\frac{i}{k}\right)^2\right]}{q} \tag{16}$$

The right-hand side of (16) is simply the expected rate of return on capital (the equivalent of the real interest rate in this model). It is the sum of the ratio of the marginal product of capital (including adjustment costs) to its price and the expected change in the price of capital. Equation (16) states that the real interest rate must be equal to the rate of time preference, ρ, at all points along the optimal path. In other words, as long as ρ is positive, the equilibrium real interest rate will be positive regardless of the values of the other parameters and the shadow price of capital, q, will adjust to ensure that this is so.[5] The conclusions of the open

economy adjustment-cost model are even stronger than in the basic Ramsey model. If the rate of time preference is positive, the real interest rate can never be negative, even when the economy is above its steady state. In other words, even if we allow for changes in the price of capital there does not seem to be a sound basis for negative real interest rates in Japan.

Liquidity traps in the presence of positive returns overseas

In the open economy adjustment-cost model, the rate of time preference was assumed to be equal to the world interest rate. This assumption raises an important practical question: if the world interest rate is positive, why don't Japanese consumers, faced with negative interest rates at home, simply escape Krugman's trap by investing their savings abroad? Without a convincing answer to this question, a liquidity-trap explanation for Japan's recession cannot be sustained.

One answer, probably true in practice, is that capital mobility is far from perfect. But Krugman's answer is different. He argues that even with perfect capital mobility and positive interest rates abroad, Japan's real interest rate in terms of consumption goods can still be negative because goods markets are not perfectly integrated. Krugman illustrates his point in an endowment economy with two goods: a traded good, T, and a nontraded good, N. Consumers maximise:

$$U = \int_{t=0}^{\infty} [\pi \ln c_T + (1-\pi) \ln c_N] e^{-\rho t} dt \tag{17}$$

which implies that utility is separable across tradables and nontradables. As Krugman observes, the consumption path of both goods over time must then satisfy the relationship:

$$\frac{\dot{c}_i}{c_i} = r_i - \rho \qquad i = N, T. \tag{18}$$

where r_i is the real interest rate in terms of good i. While the consumption path of traded goods will adjust to the world real interest rate, the real interest rate in terms of nontraded goods will have to adjust to the path of production, because consumption and production of these goods must be equal. As a result, it is possible that the real interest rate in terms of nontraded goods may be negative; and if nontradables are a large share of the consumption basket, the overall domestic interest rate might then be negative, even though the world real interest rate is not.

While there is nothing wrong with this argument in theory, it turns out that Krugman's result is greatly helped by the assumption of an endowment economy. Real interest rates in terms of the two goods are described by:

$$r_T = r; r_N = r - \frac{\dot{m}}{m} \tag{19}$$

where m is the relative price of the nontraded good. In other words, with a positive world real interest rate, r, the real interest rate in terms of nontraded goods, r_N, can only be negative if the relative price of nontraded goods is expected to rise significantly.

What would cause a sustained rise in the relative price of nontradables? In Krugman's endowment economy, this will occur when future endowments of nontraded goods are low relative to current ones. But in a production economy where both goods are produced, we know that if factor markets are fully integrated, then profit maximisation requires that each factor in both sectors is paid its marginal product, that is:

$$r = A_T f_T'(k_T) = mA_N f_N'(k_N) \tag{20}$$

$$A_T\left[f(k_T) - k_T f'(k_T)\right] = A_N\left[f(k_N) - k_N f'(k_N)\right] = w \tag{21}$$

With r given by world capital markets, these two relationships are sufficient to fix the relative price of nontraded goods. By implication, the real interest rate in terms of tradables and nontradables will be equal.

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In this economy, only sustained differences in productivity growth between the two sectors will change the relative price of nontraded goods in any permanent way (an explanation, incidentally, that has nothing whatsoever to do with demographics).

How likely is it that productivity differentials could lead to sustained negative real interest rates in Japan? If labour's share of income in the two sectors is assumed to be roughly equal, log-differentiating (20) and (21) and substituting gives:

$$\frac{\dot{m}}{m} = \frac{\dot{A}_T}{A_T} - \frac{\dot{A}_N}{A_N} \tag{22}$$

In other words, the rate of change in the relative price of nontraded goods is equal to the difference in productivity growth in the two sectors. If we take Krugman's estimated share of 0.2 for the tradable sector and make the extreme assumption that all of Japan's predicted overall TFP growth of 0.9 per cent will occur in the traded sector, this implies 4.5 per cent productivity growth in the traded sector (and none in the nontraded sector). From (22), this would lead to a 4.5 per cent annual rise in the relative price of nontradables. With a world real interest rate of 4 per cent, Japan's real interest rate would be 4 per cent in terms of tradables and -0.5 per cent in terms of nontradables. The overall consumption-based real interest rate would then be 0.4 per cent[6]– low but positive. Even under this extreme assumption about the distribution of Japan's productivity growth, a negative equilibrium real interest rate seems implausible.

This example is stylised. Since it assumes perfect factor mobility occurs, it is only really appropriate for medium-term analysis. But it illustrates the general point that in a production economy, supply responses to shifts in current and future demand and supply may be extremely important. If, for instance, there is a prospect of imbalance in future demand and supply for nontraded goods, incentives to move production in that direction will tend to dampen any expected price rise, at least over the medium term. Supply responses of this kind make it much less likely that domestic real interest rates can be negative in a situation of positive world rates and capital mobility.

In a mature economy (where productivity differentials should be low) a persistently negative real interest rate in terms of nontraded goods but not in terms of traded goods would indicate a misallocation of resources. Current resources would be skewed too far toward nontraded goods and future resources too far toward traded goods at prevailing prices. This may indeed be a problem in Japan. But it is a problem arising more from inefficient domestic resource allocation, the difficulty in moving resources between sectors, and a possible misalignment in the exchange rate than from capital immobility.

It would be possible to continue to make the point that negative real interest rates are an unlikely prospect by examining a broader range of models. Further variations on infinite horizon models are unlikely to give substantially different results. The key alternative approach would be to use a version of an 'overlapping generations' model. Although the dynamics of these models are likely to differ in some important respects, it is unlikely that an optimising model could generate negative real interest rates given that the effective workforce in Japan is predicted to rise. The possibility of investing abroad at positive rates

of return would in any case still place limits on the liquidity trap scenario, as it did in the previous models. Japan's real interest rate may be low as a result of the prospective decline in its labour force, but the conditions for it to be negative are tough to meet, particularly in a situation where capital is internationally mobile.

An alternative diagnosis

There is another reason to be skeptical of a demographic explanation for Japan's present woes. As Krugman acknowledges, these demographics have been common knowledge for a long time. As a consequence, it is difficult to use them to explain the abrupt change from significant positive growth in the 1980s to stagnation in the 1990s. Growth in consumption, investment and output fell sharply in 1991 and, except for a brief resurgence in 1995–96, have not recovered since.

What *did* happen around that time that can give us clues to what may have prompted the decline? There is an obvious candidate. Between 1989 and 1991, the Japanese asset price bubble burst, bringing with it a string of bankruptcies and financial sector problems. The fact that the bursting of the bubble coincided with the onset of Japan's malaise is of course no good reason to think that the asset price collapse *caused* Japan's current problems. But it is reasonable to conjecture at the very least that whatever shift in policy or sentiment burst the bubble also played a role in moving Japan to its current low-growth environment. The most plausible explanation as to what that shift was involves some kind of downward revision of current and future productivity levels in the Japanese economy. Working through the implications of these kinds of shocks can reveal much about what has happened in Japan.

A shock to productivity levels

Consider a simple version of the open economy adjustment-cost model of the previous section. For convenience, we now assume that there is no growth in the number of effective workers (or the population), which given Japanese parameters is a reasonable approximation. Simplifying the model in this way means that the paths of k and q set out in (12) and (13) can be rewritten as:

$$\dot{k} = i = \frac{(q-1)}{\phi} k \qquad (12a)$$

$$\dot{q} = \rho q - f'(k) - \frac{\phi}{2}\left(\frac{i}{k}\right)^2 \tag{13a}$$

and the model's steady state is now defined by:

$$\tilde{q} = 1 \text{ and } f'(\tilde{k}) = \rho \tag{23}$$

Taking first-order Taylor expansions means that the system near the steady state can be approximated by:

$$\begin{pmatrix} \dot{k} \\ \dot{q} \end{pmatrix} = \begin{pmatrix} 0 & \tilde{k}/\phi \\ -f''(\tilde{k}) & \rho \end{pmatrix} \begin{pmatrix} k - \tilde{k} \\ q - 1 \end{pmatrix} \tag{24}$$

The simplest way to visualise the steady state and the path to it is to draw the phase diagram for the system in k - q space, which is shown in Figure 4. The $\dot{q} = 0$ locus is downward sloping. The set of points that satisfies the $\dot{k} = 0$ locus is a straight line at $q = 1$. If q is greater than 1, investment will be positive. If it is less than 1, the economy has more capital per worker than it wants and will disinvest. The steady state is defined by the intersection of the two lines. Figure 4 shows the steady-state saddle path.

With the Japanese economy in a steady state at point X, imagine that Japanese consumers realise that they have been overestimating the productivity of existing assets. Without changing their assumptions about productivity growth (which is assumed to be zero in this simple model), they revise downwards their expectations of the level of productivity at all points in time, so that output per worker is now given by:

$y = (1 - s) f(k)$ where $0 < s < 1$.

The figure illustrates what happens to the steady state and saddle path. The $\dot{k} = 0$ locus is unchanged. But the $\dot{q} = 0$ locus will shift to the left. The new steady-state capital stock per worker, k, will lie below the old one.

Figures 4 and 5 trace out the consequences of this downward revision in productivity as the economy moves to its new steady state. The immediate result will be a fall in q (which can be thought of as a stock-market indicator).[7] With q below 1, net investment will fall and

Figure 4 Productivity shock in an open economy

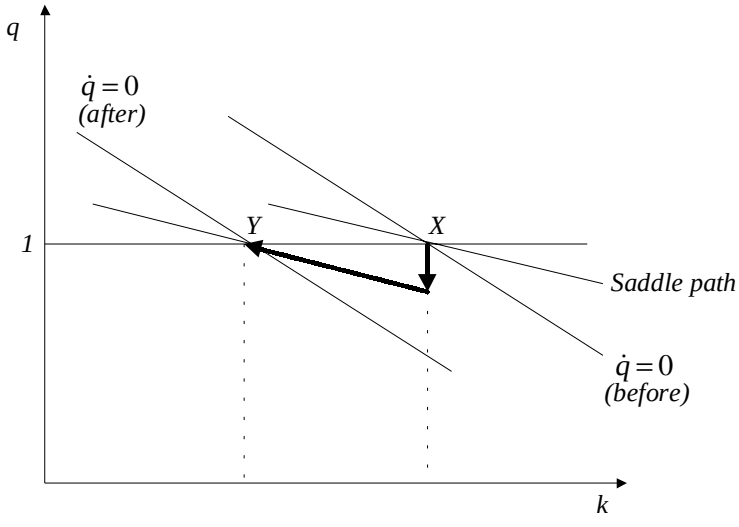
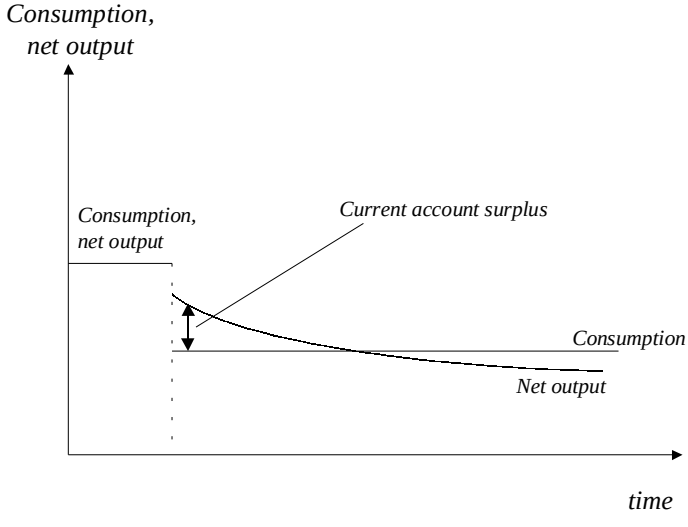


Figure 5 The path of consumption and the current account



the economy will decumulate capital.[8] In this model, consumption is given by integrating forward a version of (9):

$$\int ce^{-\rho t}dt = \int \left\{(1-s)f(k) - i\left[1 + \frac{\phi}{2}\frac{i}{k}\right]\right\} e^{-\rho t}dt - b_0 = w_0 \tag{25}$$

$$c = \rho w_0 \tag{26}$$

As (25) indicates, consumption is a function of the discounted value of net output (output minus investment) and the initial stock of foreign debt, and is constant over time. In the face of a shock to s, the $\dot{q} = 0$ discounted value of net output will fall and so will consumption. With investment now negative, the economy moves to its new lower level of net output and capital stock. In the short term, the current account will move into surplus and the country will accumulate foreign assets. As output falls, the current account will move toward deficit and the accumulated assets will be run down.

In other words, the economy's equilibrium response to the productivity shock is a period where investment and consumption fall (relative to trend), where foreign assets are accumulated and where the stock market falls below equilibrium (and historic) values. At no point during this process, however, is the equilibrium real interest rate negative.

A shock to productivity growth

The case of a shock to productivity levels may not seem as realistic as a shock to productivity growth. The idea that the asset price collapse was triggered by a more pessimistic appraisal of future productivity fits well with the casual commentary on the bubble. The full version of the open economy q-model set out in the appendix can trace out this shock, but since the intuition behind that model can be a little hard to untangle it is easier to use a simpler two-period version of the model.[9] Output in each period is produced according to the production function:

$$Y_i = \chi_i F(K_i, \bar{L}) \tag{27}$$

where χ_I is a period-specific measure of productivity. The economy can still borrow and lend freely on world markets at an interest rate of r. The capital stock in period 2 is simply the first period stock plus investment in period 1, I, that is:

$$K_2 = K_1 + I \tag{28}$$

Because of the opportunities available in world capital markets, I will be chosen so that:

$$\frac{dY_2}{dK_2} = 1 + r^* \tag{29}$$

This determines an investment schedule:

$$I = K_2(r^*, \chi_2) - K_1 \quad \text{where } \frac{\partial K_2}{\partial \chi_2} > 0; \frac{\partial K_2}{\partial r^*} < 0 \tag{30}$$

The economy's budget constraint is defined by the condition that the present value of consumption is equal to the present value of wealth, W.

$$C_1 + \frac{C_2}{1+r} = W = H + V \tag{31}$$

Wealth has two components – the discounted value of firms' profits, V, and the discounted value of wages, H:

$$V = (Y_1 - w_1\bar{L} - I_1) + \frac{(Y_2 - w_2\bar{L})}{1+r} \tag{32}$$

$$H = w_1\bar{L} + \frac{w_2\bar{L}}{1+r} \tag{33}$$

$$W = (Y_1 - I_1) + \frac{Y_2}{1+r} \tag{34}$$

Preferences are assumed to be homothetic, so that consumption in both periods is linear in wealth.

We can now consider the effect of a fall in future productivity, χ_2 (which for a given value of χ_1 is equivalent to a fall in the rate of productivity growth). The macroeconomic impact of a shock to productivity growth is in many respects similar to a shock to productivity levels. From (30), current investment falls because lower future productivity reduces the desired

level of the future capital stock, K_2. The fall in future productivity (and the future capital stock) lowers wealth and so consumption also falls in both periods. With first-period consumption and investment both falling, the current account surplus ($Q_1 - I - C_1$) will again increase.

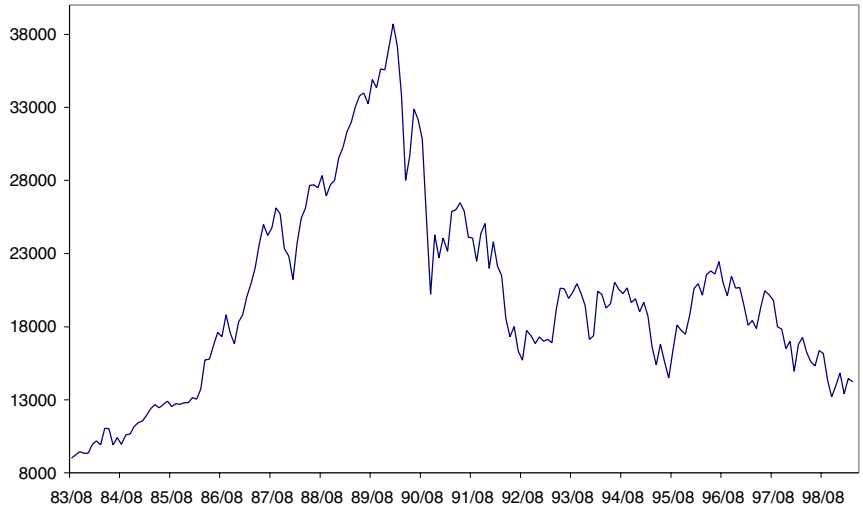
The fit with Japan's experience

Could shocks to expectations of either the level or growth of productivity explain elements of Japan's recent economic performance? We have seen that both kinds of shocks have similar implications for macroeconomic aggregates. As lifetime wealth falls, households reduce current consumption. The stock market falls, as does current investment. Initially, the slack is taken up by a wider current account surplus, though accumulated assets will eventually be used to finance consumption in the future. A crucial part of the predicted response is that after expectations are revised, firms realise that they are overinvesting relative to the new steady-state path for the capital stock. As a result, the economy undergoes a correction in which net investment is likely to fall. If growth in the effective workforce is low, net investment might actually be negative for a period. The growth rate in output per worker will decline because of the fall in productivity growth. But during the adjustment to the economy's new steady state, it will also fall because of the reduction in net investment.

A closer look at the Japanese evidence is supportive of this interpretation. The downward revision in expectations about productivity did constitute a massive shock. Total capital losses between 1990 and 1996 were estimated to be around 970 trillion yen, roughly twice the level of annual Japanese GDP (OECD 1998). From its peak in 1989 to its trough in 1998, the Nikkei fell by around two-thirds (Figure 6). Price–earnings ratios, which provide some indication of expected future productivity growth, dropped by over 50 per cent. As a result of declining asset values, nonfinancial companies suffered a decline in net worth of around 16 per cent of their total balance sheets over the same period, leading many companies into bankruptcy or near-bankruptcy.

As the simulations of the previous section would predict, there was a widespread perception in the post-bubble period that the buildup of physical capital stock in the 1980s was excessive for the requirements of the 1990s. The OECD (1998) notes that this was an important factor behind the fall in business fixed investment in 1992–94 following the bursting of the bubble. In the Tankan survey, which monitors company sentiment on a range of issues, manufacturing enterprises judged their capacity to be excessive over this period

Figure 6 Nikkei stock price index, 1983-98



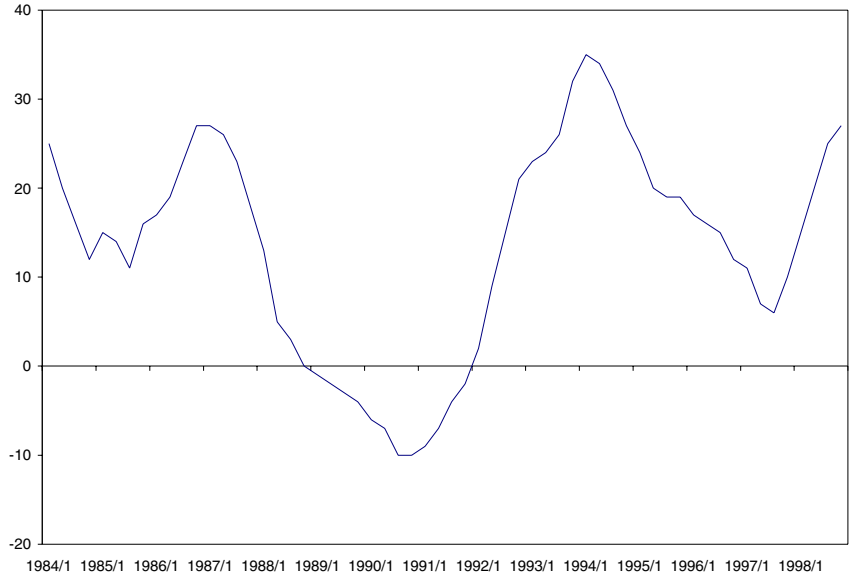
Source: Nikkei database, AJRC

(Bank of Japan 1998). The gap had narrowed significantly by the end of 1997, but widened again through 1998 (Figure 7).

The real effects of the burst bubble on consumer spending were equally dramatic. The shock to consumers' financial wealth brought about by collapsing stock and land prices has been estimated at about 450 trillion yen over the period 1990–95, or around 90 trillion yen a year (OECD 1998). There is considerable uncertainty over how strongly changes to wealth effect consumption in Japan, but one estimate was that consumption falls by about 4 per cent of any capital loss, with a lag of one year (Economic Planning Agency 1992). On that basis, the direct effects of the shock to wealth would be expected to reduce consumption by around 3.6 trillion yen a year, or by around 1 percentage point relative to trend, which was not far off the actual outcome.

The bubble burst in 1990, and the bulk of the wealth shock occurred between 1991 and 1993. Although private investment began to pick up again in 1995, indicating that the downward adjustment in the capital stock might have been completed, the economy is still in recession. Is it plausible that the effects of downward revisions in productivity occurring at the beginning of the 1990s could be responsible for continued stagnation?

Figure 7 Judgement of excessive capacity in manufacturing (per cent)



Note: The higher the percentage, the higher the capacity.
Source: Nikkei database, AJRC

Some of the post-1995 weakness has clearly been due to demand-side shocks like the government's decision to tighten fiscal policy in 1997 and the drop in external demand following the Asian financial crisis. In addition, the preannouncement of an increase in the consumption tax rate in early 1997 led consumers to bring consumption forward, which created a large spike and subsequent fall in consumer demand between the second and third quarters of 1997.[10] There are also good reasons to believe that the original revision in future prospects that accompanied the bursting of the asset price bubble has had longer-term effects that have increased supply-side stagnation and that have themselves served to reduce current productivity levels and growth beyond the initial correction.

The real responses traced out above imply substantial sectoral reallocation. Production for domestic consumption and investment contracts. Production by exporters (and import-competing industries) increases initially to generate the trade surplus. In market-clearing models, these shifts take place instantaneously, smoothly and automatically, and demand-side effects are assumed away. In the real world, where there are substantial wage and price rigidities, and factor mobility is imperfect, large-scale sectoral reallocation is not so easy. In

practice, the initial result of a shock to productivity is that firms producing for the domestic market will face reduced demand for their products. In response, they are likely to cut prices, reduce investment and lay off workers. If they have borrowed heavily, they may face bankruptcy. Those industries that have invested most and are most dependent on domestic consumption, like the construction industry, are likely to be the worst affected. As unemployment and bankruptcies rise, domestic demand is likely to fall further for Keynesian reasons, leaving it below potential output.

In the interim, resources will continue to be owned by firms that have badly deteriorated balance sheets or face permanently lower demand and so cannot earn the required returns. What should follow is a release and transfer of resources from these firms to more productive ones. This process is never as smooth as the models imply, but it has been particularly difficult in Japan. The Japanese employment system has tended to discourage labour mobility (except within company groups) and sluggish bankruptcy procedures prevent the smooth transfer of capital assets. The Japanese asset price shock left a large amount of the economy's capital in the hands of firms that faced prolonged weakness in demand or were in severe financial distress. Some sectors, notably construction and real estate, and some individual borrowers were particularly badly hit. What was needed was a reallocation of resources away from bloated sectors; away from bankrupt or near-bankrupt firms, particularly small and medium-sized enterprises (SMEs); and away from the nontraded goods sector to the tradables sector. Instead banks were slow to wind up nonperforming borrowers and the process of reassigning assets has only recently begun to proceed at a reasonable pace.

As a result, the adjustment has been slow and staggered. Large numbers of unproductive or financially distressed firms managed to hang on by the skin of their teeth (and the forebearance of their banks). An immediate consequence of this has been a steady and persistent drop in the utilisation of resources as firms retain resources in the face of weak demand. MITI's index of capacity utilisation dropped by 20 per cent between 1990 and late 1993 (OECD 1998). It recovered less than half of that ground between 1995 and 1997 but then fell back in 1998 below its previous trough. A further sign that adjustment has not taken place is that sectors that were using too much of the economy's resources before the shock do not look significantly less bloated now. The financial sector is still hugely over-resourced. The construction sector accounted for 10.1 per cent of GDP and 9.7 per cent of employment in 1990 and these shares grew to reach 10.3 per cent of GDP and 10.5 per cent of employment in 1996 (OECD 1998).

With large parts of the economy's resources still owned by firms that cannot employ them productively even several years after the shock, Japan has become in some respects a dual economy, in that reasonably productive firms and sectors operate alongside persistently poor performers, particularly small and medium-sized firms. (According to the Bank of Japan (1999), the average return on assets for small and medium-sized firms in 1998 was a little over 2 per cent compared to 3.5 per cent for larger ones). The decline in the overall productivity of existing resources has compounded the initial downward revisions to productivity growth. The average return on capital has fallen and interest rates have in a sense been forced to follow it down to avoid even greater bankruptcy problems. It is hard to believe that massive bankruptcies have not led to the loss of 'firm-specific capital' with negative impacts on potential output.

Productivity growth has also suffered. When firms are underutilising resources, demand is low and the ability to raise finance is constrained, the incentives to invest or improve productivity performance are likely to be weak. Given firm-level evidence that a substantial portion of aggregate productivity growth comes from the entry of high-productivity firms and the death of low-productivity firms (Aw et al. 1997), the falling entry and exit rates of Japanese firms are also likely to be bad news for productivity growth.

Delayed and staggered adjustment across sectors has also prolonged the effects of the initial shock on business investment. The cutback in investment spending by manufacturing firms was sharp and fairly swift, largely taking place in 1992 and 1993 (Table 1). But smaller enterprises and firms in the nontraded goods sector in many cases started adjusting their investment spending in earnest much later. The real estate sector conducted large-scale cutbacks only in 1994 (and again in 1997), while the bulk of the reduction in construction investment occurred in 1996 and 1997. Outside of the manufacturing sector, investment has continued to stagnate, reflecting prolonged weaknesses in balance sheets, particularly among small firms. Structural adjustment now appears to be accelerating, but structural adjustment has itself constituted a secondary shock. While restructuring is necessary, the uncertainty in the labour market and growing unemployment have dampened consumer spending.

A breakdown in consumption spending into its components illustrates how the initial and secondary shocks can be differentiated. Between 1992 and 1994, falling consumption was driven by cutbacks by wealthier employees and retirees, reflecting the adverse wealth effects of the initial asset price shock (Table 2). By 1995–97, it was the self-employed and the lower

Table 1 Investment and leverage in Japanese firms

A. Business investment by industry

	All industry	Construction	Manufacturing	Wholesale and retail	Real estate	Transport & telecoms	Services
1990	11.1	19.7	11.6	10.3	21.0	17.9	10.3
1991	6.4	11.2	11.4	–0.9	–10.2	1.3	4.8
1992	–5.8	–1.7	–15.6	–6.8	4.3	4.3	0.1
1993	–10.4	–6.2	–18.3	–7.6	–6.0	–6	–13.5
1994	–5.5	–4.0	–9.2	–11.6	–33.3	9	–8.4
1995	4.7	–1.1	12.2	1.0	–6.3	5.8	7.2
1996	9.4	–12.2	9.1	3.2	16.5	9.1	25.0
1997	4.7	–10.7	8.5	3.6	6.2	14.7	14.2

B. Business investment by firm size

	Manufacturing firms			Nonmanufacturing firms		
	Large	Medium	Small	Large	Medium	Small
1990	18.4	27.4	15.1	18.4	10.7	6.9
1991	3.8	9.3	21.2	14.1	12.9	8.4
1992	–20.4	–19.6	–21.2	–0.7	–4.5	–13.6
1993	–20.7	–24.0	–24.4	–9.0	–22.0	–14.5
1994	–9.9	–5.1	–6	–10.3	0.2	–2.9
1995	10.6	10.6	–4.1	–2.1	–7.5	–8.3
1996	7.3	8.7	2.2	4.1	–0.3	4.1
1997	5.7	–0.8	3.7	–6.0	–6.2	–7.9

C. Leverage by industry and firm size (per cent)

	Manufacturing		Construction		Real estate		Other nonmanufacturing	
	Large	SMEs	Large	SMEs	Large	SMEs	Large	SMEs
1985	29.2	56.8	20.3	54.5	62.6	77.4	85.2	56.0
1990	31.1	67.2	36.0	65.8	104.5	90.3	83.0	57.3
1996	31.4	105.6	41.0	136.3	215.2	365.1	103.5	158.5

Source: OECD (1998)

Table 2 Real consumption growth rate by family type (per cent)

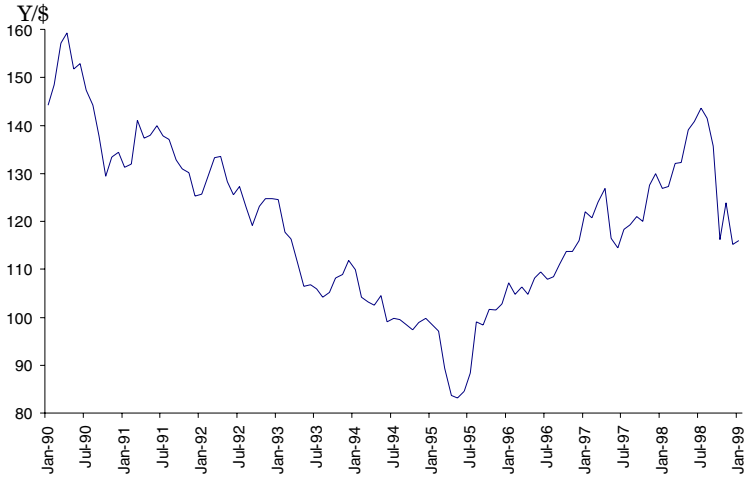
	All households	Employee households						Non-employee households		
			Yearly income quintile groups							
		Total	I	II	III	IV	V	Total	Individual proprietors	No. of occupations
1989–91	1.0	1.1	1.0	0.8	1.9	1.2	0.7	1.2	0.8	2.6
1992–94	–0.4	–0.4	0.5	–0.1	–0.6	–0.2	–0.8	–0.7	0.3	–0.8
1995–97	–0.5	0.0	–1.1	–0.5	0.2	0.6	0.2	–1.1	–1.1	0.0

Source: OECD (1998)

income workers who were reducing spending, as uncertainties surrounding restructuring began to bite. The collapse of two major banks at the end of 1997 appears to have led to a further downward revision of future prospects which, combined with the drop in spending following the consumption tax hike, finally drove the economy into recession.

The simple models used to analyse the effects of productivity shocks suggest that rises in the trade surplus should provide relief against falling consumption and investment. In the real world, however, there is unlikely to be a smooth transfer of resources into the tradable sector. The real exchange rate has to move clearly and permanently to induce the transfer of resources and even if that occurs it may take many months before the depreciation feeds into improved profitability for producers of tradables. Despite the macroeconomic situation in Japan, the yen appreciated over much of the period that the economy was stagnating, although nominal interest rates were generally significantly lower than elsewhere. In only two out of eight years of stagnation was the real effective exchange rate lower at the end of the year than at the beginning. As a result, the economy received no clear signal that resources should be transferred to the traded goods sector. The reason for the dramatic appreciation of the yen between 1991 and 1995 remains something of a puzzle, but it seems to have been driven by portfolio shifts rather than by macroeconomic factors. A further reason is that in mid-1997, the East Asian financial crisis precipitated a fall in the currencies and output of a number of key trading partners. The resulting external shock reduced Japanese exports and led to an appreciation in the effective yen exchange rate of around 15 per cent from mid-1997 to February 1998. That appreciation was reversed through 1998 (although a sharp appreciation did occur in November 1998) (Figure 8).

Figure 8 Yen–dollar exchange rate, 1990–99



Source: Nikkei database, AJRC

Japan needed a sharp and sustained depreciation to give a clear signal to transfer current resources to the tradables sector or future resources to the nontraded sector. The yen appreciation adversely affected business and consumer confidence and prevented the transfer of resources to the part of the Japanese economy – its large traded goods companies – that is relatively healthy and productive.

Banking and structural reform

The diagnosis that an important element of Japan's stagnation is the result of real-side forces related to productivity shocks has significant implications for the appropriate policy responses. If this interpretation is correct, not only is it misleading to interpret the full decline in growth relative to trend as an 'output gap' but monetary policy may not be as effective in restoring growth as might otherwise be expected. The notion that an important part of Japan's problems is the result of attempts to reallocate resources in the wake of falling expectations of future growth implies that lifting expectations of future performance may play a central role in easing the pain. If the government could restore faith in Japan's productivity

performance, private spending might be revived and the need for a dramatic sectoral reallocation would be reduced. It is here that structural reform and the rehabilitation of the banking sector may have important roles to play.

Krugman's analysis argues against the conventional wisdom that the banking sector has been a major contributor to Japan's problems. Krugman's basic arguments are that bank reform is essentially a microeconomic policy; that it is the attempts to clean up the banking sector, not bank problems themselves, that have led to the credit crunch; and that in normal circumstances (i.e. in the absence of a liquidity trap) any negative macroeconomic effects from the credit crunch could be offset with looser monetary policy.

It is certainly true that the credit crunch became more serious when banks came under pressure to improve their balance sheets in late 1997. That, however, does not invalidate the point that to the extent that disintermediation is occurring, the monetary authorities' capacity to influence investment may be curtailed. Krugman argues that if the economy is in a liquidity trap, expanding the monetary base will have little effect on broader aggregates. As a result, he states, 'the observation that the central bank has slashed interest rates and pumped up the monetary base, but that the broader money supply has not grown, does not necessarily imply that the fault lies in the banking system'. Equally, however, it does not imply that disintermediation is not occurring, and there is substantial anecdotal evidence that it is. This means that the Bank of Japan is likely to continue to encounter difficulties in stimulating investment through monetary expansion until the bank clean-up is completed.

The enforcement of capital adequacy standards is not the only way in which the banking clean-up may affect the real economy. The process of recovering bad loans and putting idle assets back onto the market may also put downward pressure on asset prices and depress new investment (Gower and Wilson 1998) – a case of 'asset overhang'. Japan's real estate sector is a prime example of this phenomenon. With a surplus of empty properties likely to move onto the market as banks retrieve collateral, real estate activity will almost certainly remain depressed for some time.

But while these side effects of bank reform are important, there is a much more direct link between the banking sector's problems and macroeconomic outcomes. Krugman argues that banking reform is simply a microeconomic policy 'undertaken to remove the distortion in the direction of investment that results from moral hazard'. But this sharp distinction between what is 'micro' and what is 'macro' is precisely what much of modern intertemporal macroeconomics has sought to remove. Successful reform of the banking sector has implica-

tions for future productivity, both in its own right and as a signal of the government's ability to carry out other necessary reforms. And we have already seen that expectations about productivity are critical determinants of macroeconomic behaviour.

It is generally agreed that Japan's banks cannot allocate savings to their most productive uses and that their efforts to do so have been nothing short of dismal. Unless the banking system is reformed, Japanese savings will continue to be poorly allocated and Japanese resources will be less productive than they should be. If this analysis is correct, successful banking sector reform and the more efficient allocation of resources would imply a rise in the future level of productivity in the Japanese economy of the kind analysed earlier. As bank reform will lead to the winding up of nonperforming borrowers and the reassignment of their assets to productive firms, it is likely to improve the allocation of existing as well as future resources. In either case, the macroeconomic consequences are likely to boost current consumption, investment and the stock market.

Is the effect of banking sector reform on future productivity likely to dramatically improve prospects for Japan? Although there is little doubt that the banking sector is critical to allocative efficiency in modern economies, the answer is probably a qualified no. The qualification, however, is crucial. Japan's banking sector reforms will have far greater consequences for the macroeconomy than their own direct impact suggests, to the extent that they can signal the government's ability to tackle a large range of structural problems. Banking reform may plausibly lead to quite large upward revisions in expectations of Japan's future productivity, even if there is little belief that much of the increased productivity gains will be delivered by bank reform itself.

To give this idea a little more substance, consider a version of the two-period model that now introduces uncertainty. Output in period 1 is still given:

$$Y_1 = \chi_1 F(K_1, \bar{L}) \tag{35}$$

Imagine, however, that the future is uncertain and that there are two paths that Japan can take. Under the first scenario, the government carries out half-hearted banking reform, further deregulation proceeds at a snail's pace and productivity growth remains sluggish. In this low-productivity future, output in period 2 is:

$$Y_2^L = \chi_2^L F(K_2, \bar{L}) \tag{36}$$

In the second scenario, governments act aggressively to clean up the banking system and then embark on a vigorous programme of broader deregulation and tax reform. In this rosier case, output in period 2 is:

$$Y_2^H = \chi_2^H F(K_2, \bar{L}) \quad \text{where} \quad \chi_x^H > \chi_2^L \tag{37}$$

Assuming that Japanese consumers assign a probability p to the good outcome, and that preferences are logarithmic, consumers maximise expected utility:

$$U = \ln C_1 + \frac{p\log(C_2^H) + (1-p)\log(C_2^L)}{1+\rho} \tag{38}$$

We continue to assume that consumers can lend and borrow riskless assets on world markets at rate r. But we now also assume that they can buy or sell contingent claims to output in the two possible future states.[11] If the world prices for these assets are actuarially fair, then the relative prices for contingent claims in the two states will be equal to their relative probabilities. This means that the budget constraint in terms of present wealth, W, can be written:

$$W = Y_1 - I_1 + \frac{pY_2^H + (1-p)Y_2^L}{1+r} \tag{39}$$

Investment in period 1 will now be determined so that the expected value of a unit of invested capital is equal to the return on world capital markets:

$$p\frac{dY_2^H}{dK_2} + (1-p)\frac{dY_2^L}{dK_2} = 1 + r^* \tag{40}$$

Given χ_H^2 and χ_L^2 this implies an investment schedule:

$$I = K_2(r^*, p) - K_1 \quad \text{where} \quad \frac{\partial K_2}{\partial p} > 0; \frac{\partial K_2}{\partial r^*} < 0 \tag{41}$$

Solving the consumer's optimisation problem gives optimal consumption in the first period, C_1:

$$C_1 = \frac{W(1+\rho)}{(2+\rho)} \tag{42}$$

Similar expressions show that C_2^H and C_2^L are also increasing in W. If the probability of the good outcome, p, rises, (36) shows that W will rise and current consumption will rise. From (38), a rise in p also raises current investment.

If banking sector reform is being interpreted as a signal of the government's ability to take Japan up a high productivity path, indications of successful banking sector reform are likely to boost current consumption, investment and the stock market. Whether the government's success on banking reform is a good signal that accurately captures the uncertainty over Japan's future prospects is a point that can be argued, but it appears that commentators and the markets are to some degree interpreting the bank reform plan in this way.[12]

Uncertainty may have wider effects on macroeconomic outcomes than in this simple model. In the model, only the expected values of future output matter for consumption and investment, not their variance. Equation (40), for instance, implicitly assumes that firms invest until the expected incremental value of a unit of capital is just equal to its cost. Pindyck and Dixit (1994) argue that this is not an accurate characterisation since most investments are irreversible and their timing is subject to discretion. A decision to undertake current investment also involves the surrender of an option to invest with greater information at a later date, and they state this should be included in the cost of current investment. The value of this option will depend, among other things, on the variance of future returns as well as their expected value. At times of high uncertainty over Japan's future productivity levels and the government's ability to undertake reform, there may be strong incentives to delay investment projects. Decisive government action might promote investment through these channels as well as those already mentioned. Since consumer spending on durables can be interpreted as an investment decision, unusually high uncertainty would also be expected to delay spending on durables.

In the model, the consumer's problem is also predicated on the ability to insure fully through a complete set of futures markets. In practice, insurance and futures markets are imperfect and incomplete. If consumers cannot insure against all possible states of the world, but can only invest in the 'nonstate contingent' asset at rate r, the consumer's problem has a different solution. While the exact solution will depend on the utility function, risk-averse consumers will in general be more responsive to changes to the probability of a bad outcome

than when markets are complete . They will also reduce consumption in response to increases in the variance of future income, which is irrelevant when complete insurance is possible.[13] These kinds of effects may be particularly relevant in the context of uncertainty in the Japanese labour market. In general, consumers cannot insure fully against the risk of unemployment. If consumers are highly risk averse, even a small risk of a large fall in income which cannot be hedged may reduce current consumption quite significantly.

Conclusion

Krugman's analysis that Japan is stuck in a liquidity trap because its equilibrium real interest rate is negative now and will be for some considerable time essentially diagnoses Japan's predicament as one of too little demand. Because nominal interest rates cannot be pushed below zero, there is too much saving and too little investment to reach potential output, in the absence of inflation. The only way to lower real interest rates to the required level is to generate inflation to shut the liquidity trap. Lower real interest rates (and the resulting depreciation in the yen) will not, according to Krugman, greatly affect Japan's trade balance. So in order to be effective in raising demand, the fall in rates must raise either consumption, investment or both. It is not entirely clear which component of spending Krugman thinks is the most likely to respond, though it is clear that he thinks that at current interest rates, Japanese consumers are spending too little.

It is certainly true that the balance of risks is such that the Bank of Japan should be prepared to countenance some inflation and an even more aggressive monetary expansion, and there are signs that this is what it is now doing. But Krugman's view can be challenged on five central points:

1. It seems unlikely that Japan faces a considerable period of equilibrium negative real interest rates. We have seen that the conditions for real interest rates to be negative are pretty stringent in most optimising models. For plausible parameter estimates, the conditions do not appear to be satisfied any time in the near future. The availability of positive returns abroad means that it is particularly unlikely that Japan is stuck in any medium-term trap. There may be cyclical reasons for pushing interest rates below their current equilibrium and encouraging inflation, but that is all.

2. There are good reasons to think that real forces are suppressing domestic spending. Japan's current crisis was heralded by the collapse of an asset price bubble – an event that

can be plausibly interpreted as resulting from a downward revision in assessments of Japanese productivity levels and productivity growth. The predicted response to shocks of this kind is likely to involve a reduction in consumer spending and stagnation in investment and output. In that case, Japan's problems may have arisen not simply because of demand deficiency, but because the economy is trying to engineer a sectoral reallocation in the presence of rigidities and imperfect factor mobility.

3. Consumption and investment may be less responsive to further interest rate falls than expected. If low consumer spending is the result of real forces and Japanese consumers are in fact spending close to their desired 'equilibrium' levels, further falls in interest rates may have smaller effects than Krugman predicts. The evidence supports this real-side view. Interest rates have been falling since mid-1991 and are historically low, but consumer spending is yet to pick up. It is easier to believe that Japanese investment lies below its equilibrium path and that some kind of accelerator mechanism is operating, with investment now falling on the back of stagnating output. But it is important to remember that the overinvestment that occurred in the late 1980s and pessimism about future productivity make it unlikely that investment will return to previous heights even with considerably lower interest rates. In any case, the credit crunch has weakened the Bank of Japan's leverage over investment finance conditions.

4. A sustained increase in the trade surplus may be a natural part of Japan's recovery. With falls in the desired paths of consumption and investment, market-clearing models predict that an increase in the trade surplus should take up some of the slack. Although the surplus has increased, the traded sector has not provided the significant relief that these models would predict. One problem may be that the Japanese exchange rate has not provided a clear signal. Depreciation did not begin until mid-1995, well after stagnation had set in. Even then, the large depreciation to June 1998 was reversed by intervention and the yen bounced sharply upwards following the unwinding of the 'yen carry' trades in November 1998. Given the state of the economy, pressure for further appreciation in the yen, a development apparently favoured by the US Treasury, does not seem warranted. Keeping the yen high because of concerns that a low yen would slow structural reform may hurt macroeconomic recovery. The political difficulties of expanding the surplus particularly vis-à-vis the United States, a problem that Krugman dismisses, are very real constraints as there is evidence that Japanese producers in some sectors are now exercising export restraint in the middle of a deep recession.

5. Banking sector and government reform may have important macroeconomic consequences, particularly for domestic demand. If the slump in domestic spending has important real elements, then real changes may be needed to lift domestic spending to previous levels. This would lessen the pressure to carry out a large and costly sectoral reallocation and reduce the need for an export-led recovery in an environment where export growth has been slow to materialise and the trade surplus is already increasing political tensions with the US. It may be more important than Krugman acknowledges to carry out a swift and successful cleanup of the banking system, particularly if bank reform is taken as a signal of the government's ability to reform in other areas. With real-side factors partly responsible for low domestic spending, a recovery is as likely to be generated by positive news on this front as by further monetary expansion.

Given the current state of the Japanese economy, it is unsurprising that, like Krugman, a growing number of commentators now take the view that even quite significant inflation is probably justified. Certainly, the current deflation is not helping matters. The problem with Krugman's belief that Japan's problems are the result of a long-term liquidity trap is not that the risks of following an inflationary strategy are unbearably high. It is simply that if that diagnosis is incorrect – and there are reasons to be skeptical – then a fifteen-year commitment to inflation may be both unnecessary and unsuccessful. Japan's banking sector problems and other structural issues that are behind the pessimism about future productivity may be more important to macroeconomic outcomes than this diagnosis implies. And, if that is true, simply shutting Krugman's liquidity trap may not be enough to pull Japan quickly out of stagnation.

Notes

1 Implicit in this formulation is that the ratio of effective workers to population at t=0 has been normalised to 1.

2 If consumers demand an equity premium, p, over riskless assets, as Krugman suggests they might, r should then be thought of as the return on physical capital less this premium (i.e. $r = f'(k) - p$).

3 This section is based on a model set out by Blanchard and Fischer (1989), Ch. 2.

4 It is assumed from here on that r, the rate of time preference, is equal to r, the world interest rate. This somewhat arbitrary restriction is necessary in models of this kind to rule out explosive paths.

5 In fact, in the open economy model described here, r is not only positive but is also equal to the world interest rate, r. To a large extent, this is simply an arbitrary modeling assumption, necessary to rule out unusual solutions. A closed economy version of the same model would generate an equivalent condition to equation (16), though in this case r would not be constrained to a particular value.

6 The consumption-based interest rate is the weighted average of interest rates in terms of the two kinds of goods, i.e. (0.2 x 4 + 0.8 x -0.5) =0.4

7 Strictly speaking, the exact equivalence of 'marginal' q, as represented in the model, and 'average' q, as represented by a firm's stock market value holds only with first-degree homogeneity of the production and adjustment cost functions (Hayashi 1982).

8 With depreciation, gross investment would not in fact need to be negative to have net disinvestment.

9 This model is a simplified version of Sachs (1981).

10 More generally, it seems likely that the large increases in Japanese government spending are partially responsible for the sluggishness in private demand. The phenomenon of 'Ricardian equivalence', whereby debt-financed government spending crowds out private consumption, is a well-known theoretical property of forward-looking models. Although in practice Ricardian equivalence does not hold absolutely, increases in debt-financed spending do appear to reduce private consumption to a considerable extent.

11 The assumption of complete asset markets may seem unrealistic, a point considered in more detail below.

12 With the banks' applications for public funds completed, the Nikkei index has risen to levels above 17,000 in recent months. Much of the broader gain has come on the back of strengthening bank stocks.

13 This phenomenon, which is a form of 'precautionary saving', can be derived formally from a variation of Hall's permanent income model (see Hayashi 1997, Ch. 1).

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Appendix: First order conditions of the open economy q-model.

$$H_C = 0 \Rightarrow u'(ce^{\phi t})e^{\phi t} = \mu \tag{1A}$$

$$H_i = 0 \Rightarrow 1 + \phi\frac{i}{k} = q \tag{2A}$$

$$\frac{d[-\mu e^{-\rho t}]}{dt} = (\rho - (l + x))\mu e^{-\rho t} \tag{3A}$$

$$d[\mu q e^{-\rho t}] = -\mu e^{-\rho t}\left[f'(k) + \frac{\phi}{2}\left(\frac{i}{k}\right)^2 - q(l + x)\right] \tag{4A}$$

and two transversality conditions.

(2A) can be rewritten as equation (12).

Expanding (4A) and substituting from (1A) and (3A) then gives (13).

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