

Estimating Potential GDP and Forecasting Deflation

1. Introduction

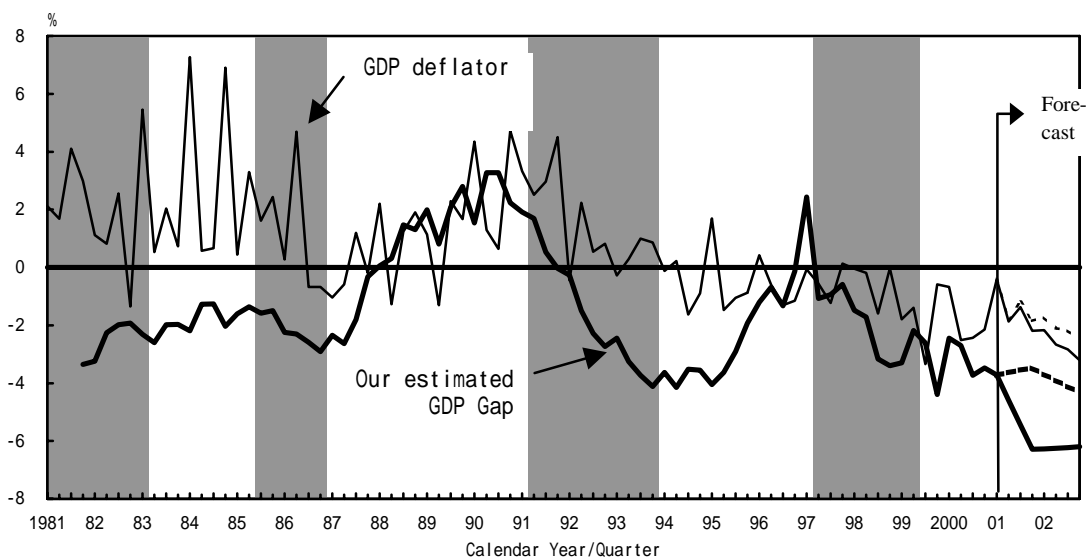
In this chapter we use the GDP deflator as an indicator of deflation, and the GDP gap as that of an indicator of the health of the economy to provide a measure of whether a deflationary spiral is occurring. The GDP deflator is an indicator that shows trends of price movements in the entire economy as opposed to for example, the consumer price index (that covers only those goods and services purchased by the average consumer). The GDP gap, compared to the Index of Business Conditions is a more useful indicator for our purposes in that it gives a quantitative measure of the economy. The results of this chapter have been summarized in this chapter: (See figure 1-1)

*The GDP deflator began falling over the previous year in 1994. It has continued to shrink since then and has been falling at a year-on-year rate of about 2%.

* The GDP Gap has been negative since 1991 with the exception of early 1997 when a rushed demand occurred before the onset of the hike in the consumption tax. In particular, it has been falling more rapidly since 1998 -- at a rate of 2-5%.

*With the method we use here, we can estimate the GDP gap using only two sets of data, the GDP deflator and real GDP. By using the GDP deflator, the fit of the recent GDP gap to the actual economy has been improved over Hirose and Kamada (2001).

Figure 1-1. GDP Deflator and GDP Gap



Notes:

- 1) The “GDP deflator” line shows the annualized quarter-on-quarter rates.
- 2) The effects of the introduction of, or the subsequent hike in the consumption tax have been removed.
- 3) The broken line forecasts represent OECD forecasts. The solid line forecasts are IMF forecasts.
- 4) The shaded areas represent economic recessions.

Sources: Cabinet Office “System of National Accounts Annual Report”, IMF “ World Economic Outlook ”
OECD “ OECD Economic outlook ”

*We forecast the GDP deflator using our estimated Philips Curve and the forecasted GDP of other

research institutes. For Q4 2001, the GDP deflator is estimated to shrink by 1.8-2.2%, and in Q4 2002, it is estimated to fall further, by 2.5-3.2%. This suggests that at the end of 2002, it could fall to 10 points lower than its peak in 1994.

*We estimate real interest rates from our forecasted GDP deflator rates.

For Q3 2002, the real call rate (the cost of funds for large corporations) rises to 2.1-2.6%, while the real newly contracted lending rates (the cost of procuring funds for small and medium-sized enterprises) rises to 2.7-4.3%, inciting concerns about a further recession in the economy.

2. The GDP Gap as an indicator of Economic Well-being

2.1 Definition of GDP Gap

The GDP Gap is a measure of the difference rate between potential GDP -- the GDP that the economy has the capacity to produce, and the actual real GDP -- and can be expressed by the following:

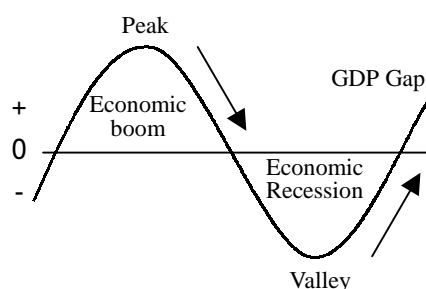
$$\text{GDP Gap} = \frac{\text{Actual GDP} - \text{Potential GDP}}{\text{Potential GDP}}$$

The GDP Gap shows the state of the economy.

When the GDP value is positive, the economy is

booming, while when it is negative, the economy is in a recession. Furthermore, when the GDP gap is in transition from a growth to a contractionary phase, the economy is at its peak. In the same way, when the GDP gap is turning from a contractionary phase to a growth phase, the economy is at its trough (See Figure 1-2).

Figure 1-2. Concept Diagram of GDP Gap



2.2 Finding the Potential GDP

If we divide the various definitions of Potential GDP into two large groups, they can be categorized into 1) The GDP that would be attained if all factors of production in a country were utilized to their maximum capacity and 2) The GDP level corresponding to a growth rate sustainable into the medium and long-terms. In this chapter, we define potential GDP using 2) as a basis, but adding the condition that this GDP is an “inflation-neutral” GDP, that is, causing neither to raising nor lowering the rate of inflation.

Since Potential GDP is not a value that can be observed, there are many methods to estimate the value. For example, some methods use the production function and others do not. If we input the maximum factors of production that are available input the time, we arrive at Potential GDP as in 1) above. If we take the historical average of the capacity utilization rate, or the maximum capacity utilization rate that does not lead to increased inflation, then we arrive at the Potential GDP as in 2) above.

A typical method to find Potential GDP without the use of a production function is to use actual real GDP and run it through a Hodrick-Prescott filter (HP filter). The HP filter, decomposes time series data into growth and cyclical components, and interprets the growth component to be the Potential GDP. This is a very convenient method, since we need only look at one economic indicator, that is, real GDP. However, we need be aware that this measure cannot account for trends in economic factors occurring outside of the GDP, such as structural changes in the factors of production. In this regard, Hirose and Kamada (2001), are able to incorporate some of these other economic conditions that are reflected in the inflation rate, as they use the HP filter and integrate it with a Philips curve relationship

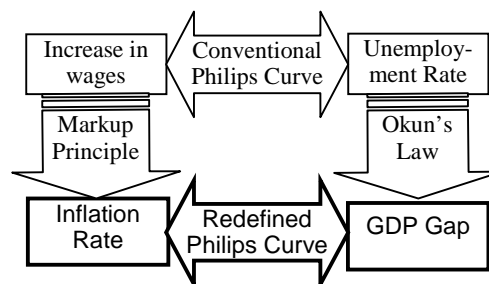
2.3 Inflation and the GDP Gap

In this chapter, we interpret “medium to long-term sustainability” to equal “inflation neutrality” for our definition of potential GDP, but a Philips curve relationship is assumed at the onset . The Philips Curve shows a negative correlation between nominal wage increases and the unemployment rate. If we integrate into this relationship the following two components, then we can find a relationship between the inflation rate and the GDP gap: 1)

The markup principle, that states that wage levels are the basis for the determination of the price of produced goods and 2) Okun’s Law that states that there is a positive correlation between the inflation rate and the GDP Gap.

This “redefined” Philips curve, that now shows the relationship between the rate of inflation and the GDP Gap, establishes the following relationship: when the GDP Gap is positive, there are positive effects on the inflation rate, and when the GDP Gap is negative, there are negative effects on the inflation rate. In times of economic boom, demand for the factors of production are large, and this accelerates the inflation rate, while in times of recession the demand is small and inflation slows down.

Figure 1-3. The Philips Curve Redefined



Source: Yamasawa and Saito (2001)

Edited by authors.

3. Prices

3.1 Price indicators

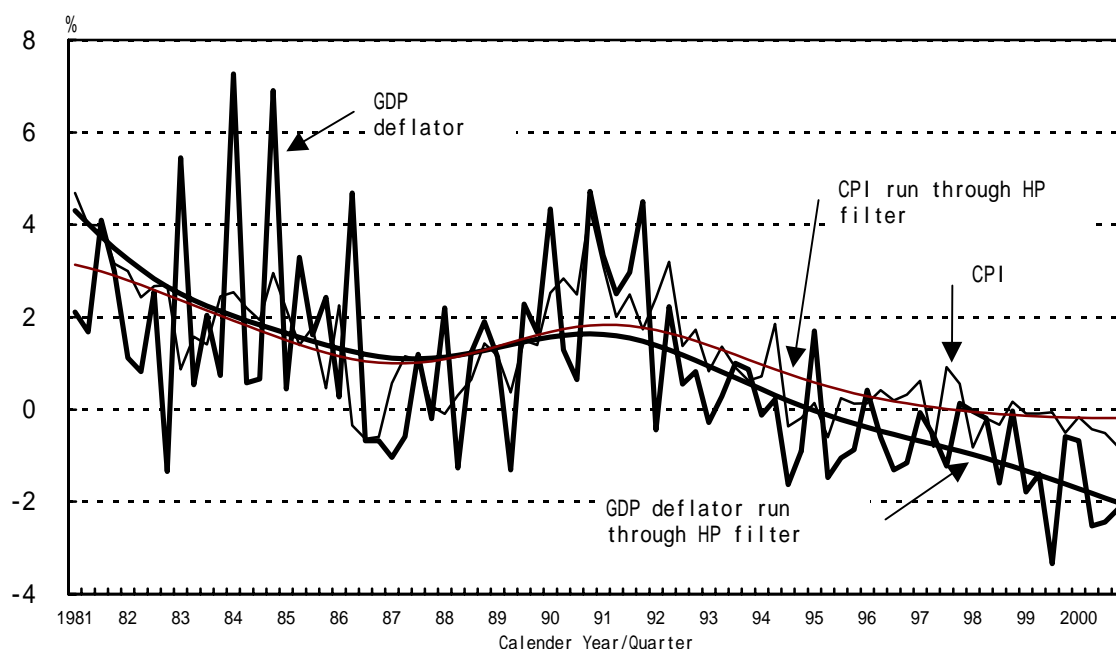
The price indicators – consumer price index (CPI), wholesale price index (WPI) and the GDP deflator – all have differing goods and services in their baskets and thus are different in nature. The following three points set apart the CPI from the GDP deflator.

- 1) The CPI encompasses prices of all goods and services purchased by consumers, whereas the GDP deflator incorporates prices of all goods and services produced in Japan.
- 2) The CPI includes prices of imported goods, whereas the GDP deflator includes prices only of goods and services produced in the country.
- 3) The CPI is found using the Laspeyres method (with a fixed basket), whereas the GDP deflator used the Paasche method (changing basket). The CPI may overestimate prices.

3.2 Trends in prices

In Table 1-4, we show the CPI (Total index, excluding perishable food items) and the quarter-on-quarter changes in the GDP deflator (effects of the consumption tax have been removed, seasonally adjusted figures using the X12 seasonal adjustment method), and the trend lines of both of these found after putting them through the HP filter.

Figure 1-4. Trends in the CPI and the GDP Deflator



Notes

- 1) CPI has been adjusted for the consumption tax as follows: 1.8% after Q2 1989, 1.94% after Q2 1997. The GDP deflator has been adjusted 1.31% after Q2 1989, and 1.3% after Q2 1997.
- 2) Annualized quarter-on-quarter growth rates

Source: Cabinet Office “Annual Report of System of National Accounts”

Ministry of Public Management, Home Affairs, Posts and Telecommunications Statistics

Bureau “Annual Report of Consumer Price Index”

The quarter-on-quarter annualized rates of change of the CPI showed growth rates about 2-2.5% from 1990 to 1992, but since 1998, they have been negative. The GDP deflator also grew over 2.5% in 1990 and 1991, but started falling in 1994, and has fallen to minus 2.5% in 1999 and 2000, confirming the deflationary concerns. The two indicators began to diverge around 1992 at the burst of the economic bubble, and have deviated further from each other after Q1 1995. The difference is particularly marked after the financial crisis, from Q1 1998. We see that when notable changes occur in the economic environment, prices are also affected. Although the extent of the decline is different between the two, the trend of falling prices is clear.

4. Our estimation results

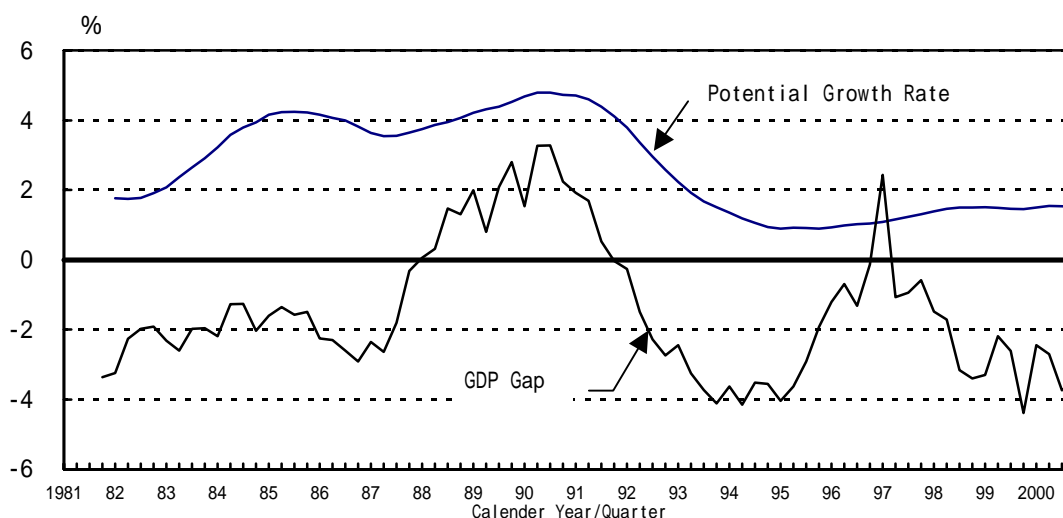
4.1 Estimation results of Potential GDP growth and the GDP Gap.

Here we examine the potential GDP, the GDP Gap and the Philips Curve as we estimated using the GDP deflator as the inflation rate indicator. (See Figure 1-5). We used data from Q1 1981¹⁾.

We can see from the Potential GDP growth rates estimated that the levels of the rates have changed significantly after the economic bubble period. For the past 2-3 years, the potential growth rate has been about 1.5%.

¹⁾ If we add 1-4th period data to the data we estimated here, the results show large fluctuations, demonstrating the extent of the effects of the oil shock (Supplement B)

Figure 1-5. Potential Growth Rate and GDP Gap (Results from our Estimation)



Note: Potential Growth Rates are annualized quarter-on-quarter rates.

Source: Cabinet Office “Annual Report of System of National Accounts”

The GDP Gap changed to a positive value in Q1 1988, and grew to its peak in Q3 1990. With the burst of the economic bubble, the GDP Gap turned to a negative in Q4 1991. In 1996, it fell to about negative 1%, temporarily turned to a positive figure in Q1 1997 due to the rush demand before the hike in the consumption tax, but then became negative again and marked -4.4% in Q4 1999. For Q4 2000, the GDP Gap is measured at about 3.5%.

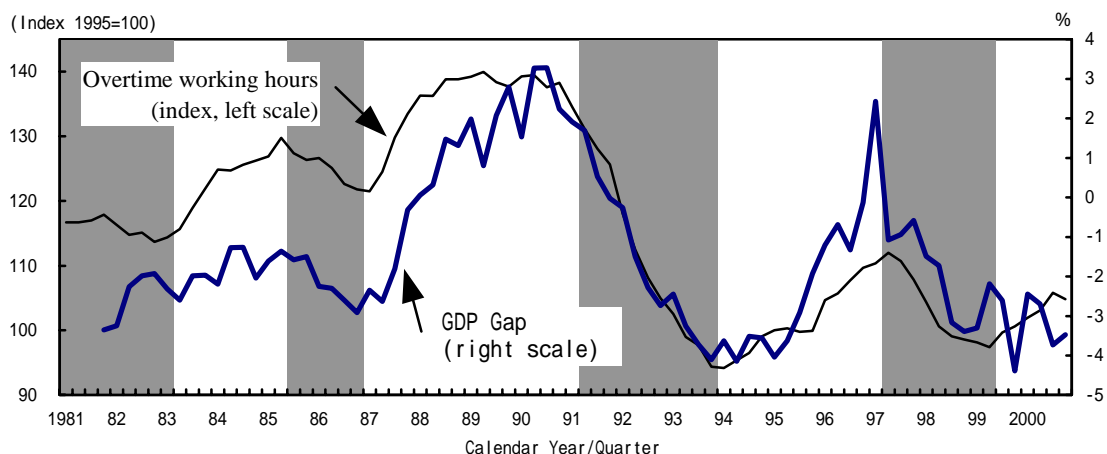
4.2 Examination of estimation results

Comparing the GDP estimates with the peaks and valleys of the economic cycle released by the Cabinet Office, we observe that they both essentially show the same trends. (Figure 1-6). Then, if we take such typical economic indicators as overtime working hours (index) and the capacity utilization index, we see that they also show the same trend (Figures 1-6, 1-7). The trough in the business cycle, overtime working hours and the capacity utilization index in October 1993 were all lower than the trough in the business cycle of November 1986, and this can be explained by the GDP Gap that we estimated.

We also compared our results with some estimation results found through other estimation methods. If we compare these figures with estimates found using the production function, we see that they move similarly from 1984 to the present (Figure 1-8).

What is particularly noteworthy is that the levels of the GDP Gap during recessionary periods we found are lower than those found using other estimation methods. Comparing 1994 and 2000, the results from Hirose and Kamada (2001) show a higher GDP Gap for the year 2000. However, in our study, the GDP Gap for the two years are at about the same level, and also show similar trends from other estimation methods. Looking at absolute levels, however, the potential GDP found using the HP filter, as well as the estimation results of Hirose and Kamada (2001) show it lingering around the zero level. These are around the same low levels as the estimates found using the production function, and suggest that we are still in a recession.

Figure 1-6. Overtime Working Hours and the GDP Gap



Notes:

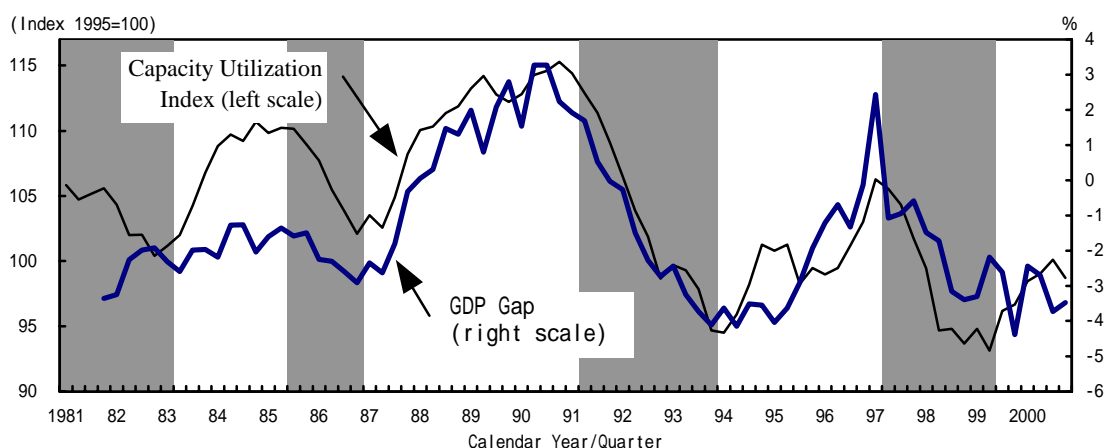
- 1) Overtime working hours are from enterprises of over 30 persons, all industries.
- 2) The shaded areas are economic downturns.

Sources:

Ministry of Health, Labor and Welfare “Monthly Labour Survey”

Cabinet Office “Annual Report of System of National Accounts”

Figure 1-7. Capacity Utilization Rates and the GDP Gap



Notes

Capacity Utilization rates are from the manufacturing sector

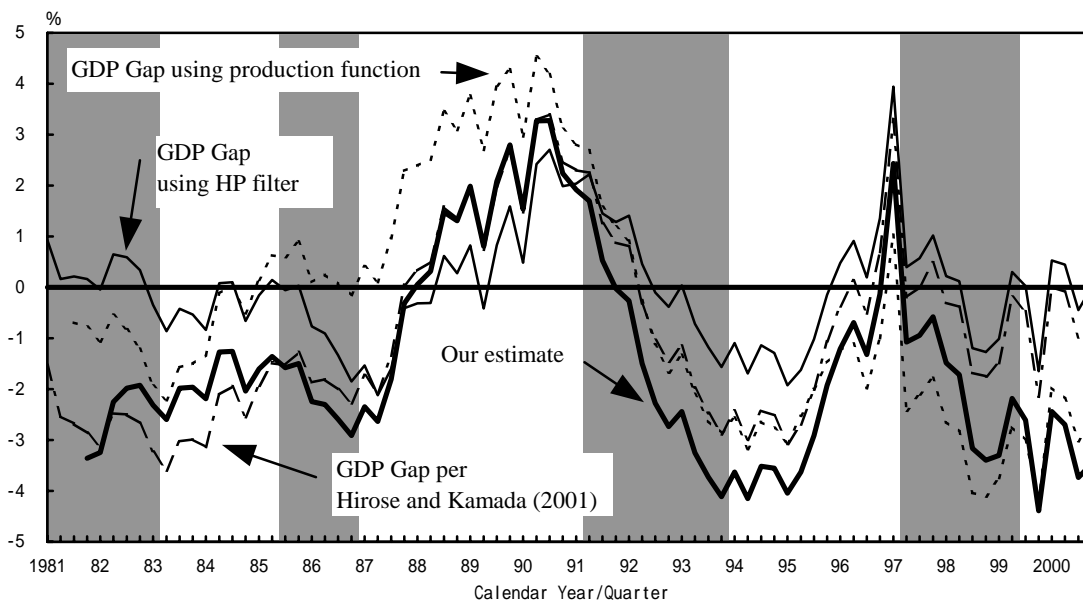
Shaded areas are economic downturns

Sources:

Ministry of Economy, Trade and Industry, “Annual Report of Indices of Industrial Production”

Cabinet Office “Annual Report of System of National Accounts”

Figure 1-8. Examination of the Estimation Results

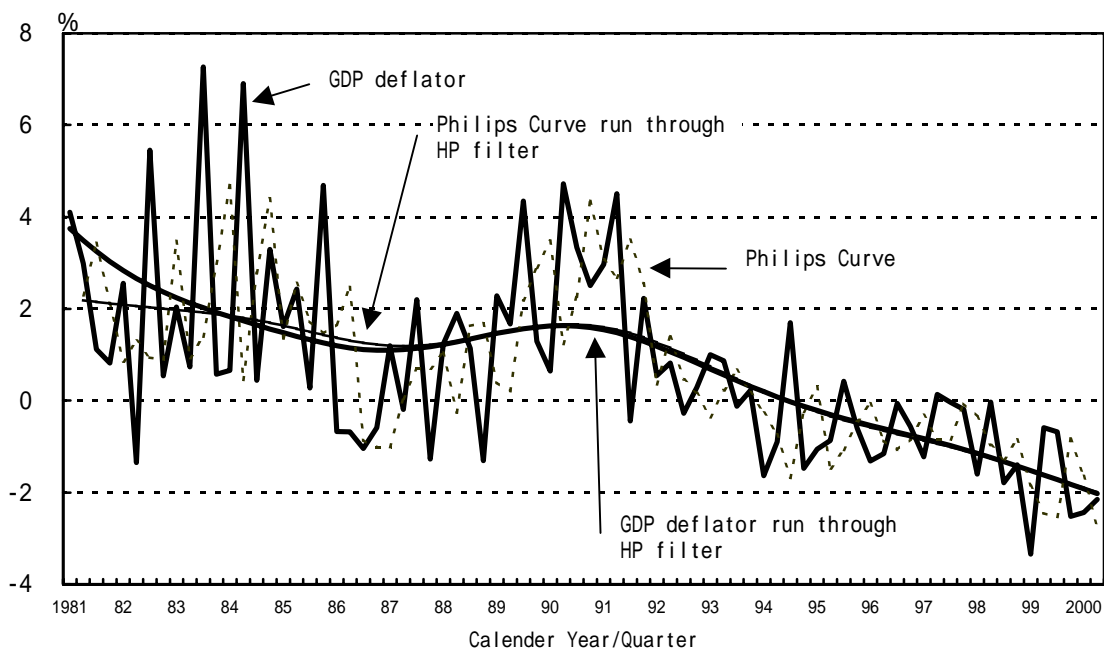


Notes

- 1) Potential GDP, GDP Gap using the production function as estimated by the short-term economic forecasting team of the Japan Center for Economic Research (SA111, Sept, 2001)
- 2) Potential GDP, GDP Gap using HP filter found with actual GDP from Q1 1980 to Q4 2000, run through HP filter with a smoothing parameter of 1600.
- 3) Shaded areas are times of economic downturn

Source: Cabinet Office “Annual Report of System of National Accounts”

Figure 1-9. The Fit of the Philips Curve



Note: The inflation rate used is the GDP deflator’s annualized quarter-on-quarter growth rate.

Source: Cabinet Office “Annual Report of System of National Accounts”

4.5 The Philips curve

In this section, we estimate the Philips curve that shows the relationship between prices and the GDP Gap.

The Philips Curve, estimated simultaneously as the Potential GDP can be expressed as in (1-1) below:

$$\pi_t = \alpha \pi_{t-1} + (1 - \alpha) \pi_{t-2} + \beta (y_t - y_t^N) + \epsilon_t \quad (1-1)$$

The estimation results are as follows:

$$\pi_t = 0.365 \times \pi_{t-1} + 0.635 \times \pi_{t-2} + 0.019 (y_t - y_t^N) + \epsilon_t$$

(5.9) (10.2) (1.2) Figures in parentheses are t values.

R squared: 0.12 R squared adjusted for degrees of freedom: 0.09 standard error: 0.005 DW: 2.57

π_t : GDP deflator at time t (change over previous period) y_t : natural logarithm of real GDP at time t

y_t^N : natural logarithm of potential GDP at time t

As we can see from the expression, the inflation rate at any time is more strongly influenced by the inflation rate not from one, but two periods ago, and moves with a lag (Figure 1-9). The R squared for this equation is at 0.12 and does not appear to be a very good fit at all. However, if we compare the trends run through the HP filter, we see that they pretty well match after 1987, and we believe this to be useful in foreseeing future trends.

5. Forecasting deflation

5.1 Forecasting future price fluctuations

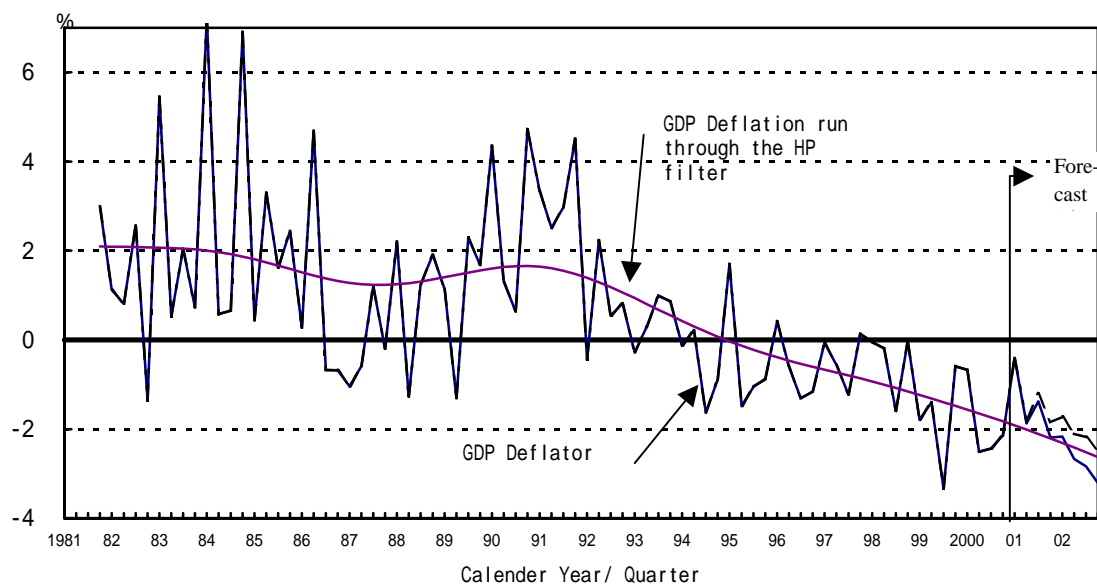
We can use the parameters found in 4.5 to forecast the changes in the GDP deflator. However, since we cannot forecast values beyond 2001 from the expression (1-1) if we do not know the GDP Gap, we use forecast values of real GDP and potential GDP²⁾. For real GDP figures for Q2 2001, we used a range of forecasts: IMF forecasts released after the terrorist attacks in September as the lower end of a range (minus 0.5% in 2001, 0.2% in 2002), and OECD forecasts released before the terrorist attacks as the higher end (1.0% in 2001, 1.1% in 2002). As for the growth in potential GDP, we used the average of our estimated values, about 1.5% for 1999, and 2000 for potential GDP beyond January-March 2001.

We found that using these figures, in Q4 2002 the GDP Gap would be negative 4.3% using the OECD estimates for GDP and negative 6.2% using the IMF forecasts. (Figure 1-1) As for the changes in the GDP deflator, it was a positive 3.4% on an annualized basis in Q1 2001 and negative 2.2% in just the previous quarter. Because of the high volatility in the observations, we used the average figure for the three quarters, Q3 and Q4 in 2000, and Q1 in 2001³⁾. The results of the estimation were as follows: The GDP deflator for Q4 2001 would fall 1.8-2.2% annualized over the previous quarter. For Q4 2002, it would decline by 2.5-3.2% (Figure 1-10). Because we used a range of data for real GDP in the forecast, the forecast deflation rate ranges from 1.3% in Q4 2001 to 0.7% in Q4 2002. Economic conditions, however continue to deteriorate and it is doubtful whether the higher end figures can be

²⁾ Although preliminary figures for Q2 2001 had already been released, the seasonal adjustment method has been changed from this period, and rather than use these figures, we preferred to use the forecasted figures.

³⁾ We can surmise that the reason for this volatility lies in the 7.8% jump in prices of perishable food items over the same period in the previous year, but the cause is difficult to pinpoint as the CPI and GDP Deflator show very different movements. In Q2, 2001, the method of seasonal adjustment was changed and it fell 7.4% over the same period in the previous year, and we chose not to use this figure in our calculations.

Figure 1-10. Forecast Inflation Rates



Notes:

- 1) The “GDP deflator” line shows the annualized change over the previous quarter. Figures from 1981-2000 are actual data while that of Q1 2001 is the average of Q3, Q4, 2000 and Q1, 2001.
- 2) The broken line in the GDP deflator forecast are results from using OECD forecasts, the solid line from IMF forecasts.

Sources:

I M F “ World Economic Outlook ”, O E C D “ OECD Economic Outlook ”
 Cabinet Office “Annual Report of System of National Accounts”

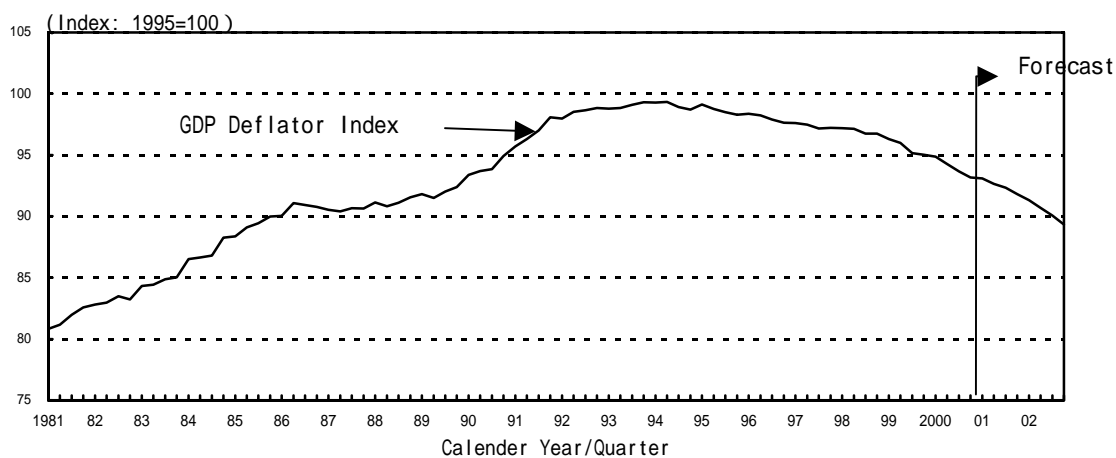
5.2 Deflationary spiral

It is difficult to measure the effects the deflationary trend is having on the Japanese economy. It would be imprudent to simply sit back and pretend that lower prices are good for the consumer. Stagnant demand has led to corporations trying to cut costs by making adjustments in employment, and to shift their production overseas where labor is cheaper. This, of course, leads to unemployment, lower wages, and further sluggishness in consumption. With consumers anxious about the future, sales of large-ticket items such as housing and automobiles have been adversely affected, and the rise in real interest rates due to deflation have kept investment in check. At the same time, the real debts of corporations and individuals swell up, and the repayment burden increases, thereby making the bad loan situation of financial institutions even more serious. Banks have thus far been unable to secure the lending margins from corporations that accurately reflect the risk of default, despite the higher risk of corporate bankruptcies, and are putting their own health in jeopardy. And in Japan’s case, asset deflation -- as in the softening of stock and land prices -- is also occurring, having further adverse effects on consumption (through negative wealth effects).

The CPI has been falling since Q1 1998, while the GDP deflator has been declining since 1994. Figure 1-11 shows the GDP deflator adjusted for the effects of the consumption tax. It peaked in Q2, 1994 and has been declining since then, falling 6 percentage points from this peak by Q4 2000. If this trend continues, the GDP deflator may be 10 percentage points lower its peak in Q4 2002. As a point

Japan Financial Report No.5, October 2001
 “Deflation & Financial System Reform in Japan” Japan Center for Economic Research
 of reference, during the depression of the 1920-30s, prices in the US fell as much as 23.3% from 1929
 (Figure 1-12).

Figure 1-11. A Deflationary Spiral?

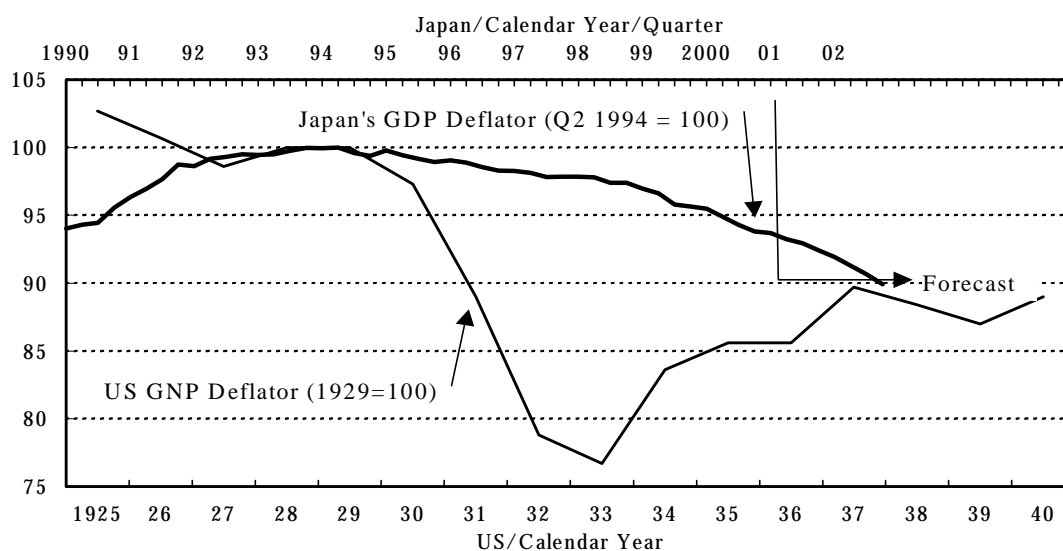


Notes:

- 1) Effects of the consumption tax have been removed from the GDP Deflator figures.
- 2) IMF forecasts used for forecast figures

Source: Cabinet Office “Annual Report of System of National Accounts”

Figure 1-12. Prices during the Great Depression of the 1920-30s in the US and the Current Deflationary Trend in Japan



Notes:

- 1) Effects of the consumption tax have been removed from the GDP Deflator figures.
- 2) IMF forecasts used for forecast figures

Sources: Cabinet Office “Annual Report of System of National Accounts”, Gordon (1987)

5.3 Rising real interest rates due to deflation.

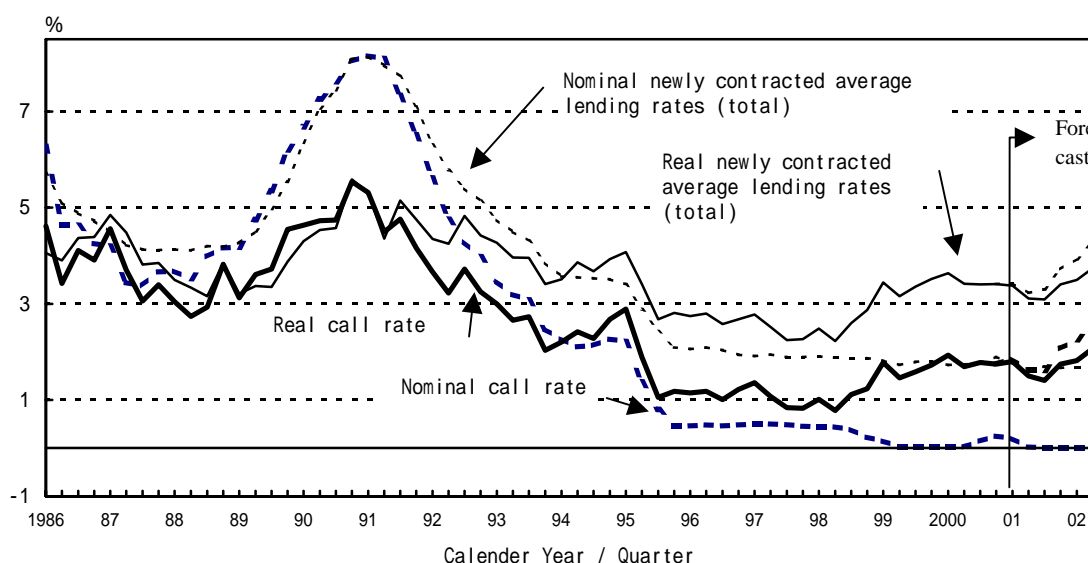
We forecast real interest rates to Q3 2002 using our estimation results (Figure 1-13.)

As a measure of the interest rate paid by large corporations that can procure funds directly from the financial markets, we use the overnight uncollateralized call rate. For a measure of the interest paid by small and medium sized enterprises, we use the newly contracted average lending rate (total). For interest rates beyond Q3 2001, we use forecasts.

In Q2 2001, nominal interest rates were 0.02% for the uncollateralized call rate and 1.63% for the newly contracted average lending rate (total). We subtracted the changes in the GDP deflator from the nominal interest rates to find the real rates and found that they are 1.5-1.6% for the real call rate, and 3.1-3.2% for the real contracted average lending rate.

We forecast that the real call rate will rise to 2.1-2.6% in Q3, 2002, while the real contracted average lending rate will increase to 3.7-4.3%. This translates into a 0.6-1.0 percentage point rise in the real call rate, and a 0.6-1.1 percentage point increase in the real contracted average lending rate in one year’s time. According to the macroeconomic model of the short-term economic forecasting team of the Japan Center for Economic Research, a 1 point increase in long-term interest rates will lower real GDP by 0.14 percentage points in the first year, and 0.49 percentage points in the second year. Real GDP in the year 2000 came in at 530 trillion yen. A rise in real interest rates of 1% will work to lower this by 2.6 trillion yen in two years. Rising interest rates adversely affect the debt burdens of corporation and can lead to corporate bankruptcy and unemployment. We look forward to seeing some dramatic monetary policies implemented by the government and the Bank of Japan so that economic conditions and poor corporate performance does not lead to reduced wages, unemployment, stagnant consumption and a further deterioration of corporate performance and a deflationary spiral.

Figure 1-13. Rising Real Interest Rates due to Deflation (Forecast)



Notes:

- 1) We used IMF forecasts (broken line) and OECD forecasts (solid line) to obtain real GDP deflator values. However, to avoid large volatility in the GDP deflator we took the average of five periods: the two previous periods, the current period, and the two following periods.
- 2) For interest rates beyond Q4 2002, we used 0.01% for the call rate assuming that the monetary easing would continue. For the contracted average lending rates, we used the average of the previous two periods.

Sources:

Bank of Japan, “Financial and Economic Statistics Monthly”
 Cabinet Office “Annual Report of System of National Accounts”