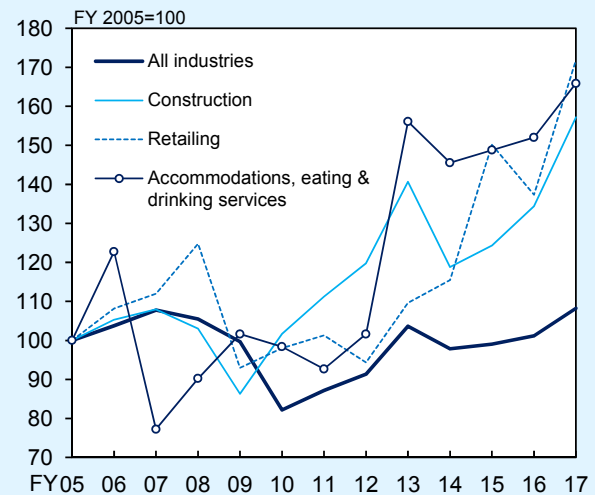


(Box 3) Firms' Measures to Address the Labor Shortage and Their Relationship with Prices

In order to address the acute labor shortage comparable to the bubble period, it seems that firms have taken the following various measures to absorb the upward pressures on prices stemming from wage increases.³⁴

First, mainly in labor-intensive sectors -- such as "retailing," "accommodations, eating and drinking services," and "construction" -- firms have been increasing labor-saving and efficiency-improving investment in recent years that makes use of information technology, in order to avoid situations where a labor shortage will be a constraint on business expansion or a rise in wages will lead directly to an increase in costs (Chart B3-1). So far, firms in Japan have taken advantage of hiring highly-educated and diligent workers, mainly among the elderly and women, at relatively cheap wages as part-time employees compared to those in the United States and Europe. However, going forward, as the labor shortage becomes more acute and wages of part-time employees continue to increase clearly, it is expected that it will become more difficult to hire part-time employees at cheap wages, which increasingly will tend to induce the substitution of capital for labor shortage through labor-saving investment, taking advantage of information technology.

Chart B3-1: Software Investment (*Tankan*)



Source: Bank of Japan.
Note: Figures up through fiscal 2016 are actual results. Figures for fiscal 2017 are forecasts from the June 2017 survey.

³⁴ For firms' recent measures to address the labor shortage, see the annex paper to the *Regional Economic Report*, "Kaku Chiiki ni okeru Jyosei no Katsuyaku Suishin ni muketa Kigyō tou no Torikumi (Firms' Initiatives toward Promoting Women's Empowerment in Each Region)" released in June 2017 (available only in Japanese).

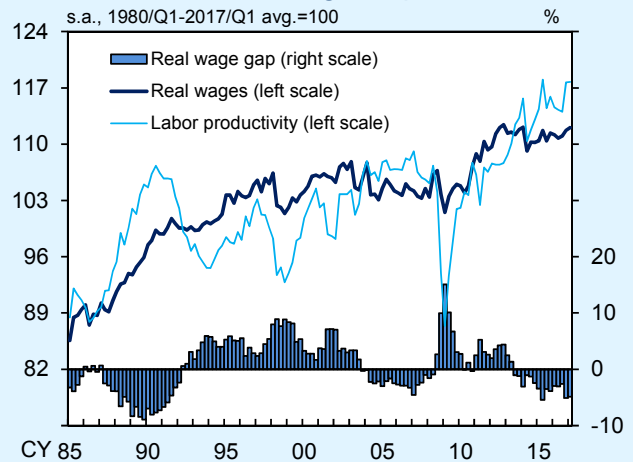
Second, along with the substitution of IT capital for wages of part-time employees, firms have been streamlining the existing business process. This includes reviewing whether labor costs are squared with the profitability of certain services that had been taken for granted, such as conducting business late at night and early in the morning, and considering whether to continue with providing those services. Some cases already have been spotted where such streamlining leads to improvement in labor productivity, as seen in sales having dropped by less than the decrease in labor input. This is equivalent to proceeding with labor-saving technological progress on a macro basis.

The rise in real wages has been restrained in comparison with the supply-demand conditions in the labor market, as discussed in Boxes 1 and 2, while labor productivity has improved. Therefore, the real wage gap, defined as the gap between real wages and labor productivity, has been declining recently (Chart B3-2). This is considered to be contributing to the downward pressure on prices.

In order to quantitatively gauge this point, a Phillips curve has been estimated by explicitly incorporating the real wage gap (Chart B3-3).³⁵ The estimation results show that the real wage gap has been pushing down the inflation rate by about 0.2 percentage point recently, although its

³⁵ In this estimation, the hybrid-type Phillips curve, taking into account both the forward-looking and adaptive inflation expectation formation, is used as a benchmark.

Chart B3-2: Real Wage Gap



Sources: Ministry of Finance; Cabinet Office.
 Notes: 1. The real wage gap is defined as the deviation of real wages from labor productivity.
 2. Real wages = personnel expenses / number of employees / GDP deflator
 3. Labor productivity = (operating profits + personnel expenses + depreciation expenses) / number of employees / GDP deflator
 4. Variables such as personnel expenses are based on the "Financial Statements Statistics of Corporations by Industry, Quarterly" and exclude "finance and insurance."

Chart B3-3: Phillips Curve Specifications

(a) Specifications

<Model 1: Not including real wage gap>

$$\pi_t = \beta_0 + \beta_1 \times \pi_t^e + (1 - \beta_1) \times (\pi_{t-1} + \pi_{t-2})/2 + \beta_2 \times ygap_t + \Omega \times (\text{dummy variables for one-off factors})$$

<Model 2: Including real wage gap>

$$\pi_t = \beta_0 + \beta_1 \times \pi_t^e + (1 - \beta_1) \times (\pi_{t-1} + \pi_{t-2})/2 + \beta_2 \times ygap_t + \beta_3 \times (wgap_{t,2} + wgap_{t,3})/2 + \Omega \times (\text{dummy variables for one-off factors})$$

π_t : CPI less fresh food, energy, and house rent (seasonally adjusted q/q % changes, annualized).
 π_t^e : medium- to long-term inflation expectations (%).
 $ygap_t$: output gap (%). $wgap_t$: real wage gap (%).

(b) Estimation Results

	Model 1	Model 2
β_0	-0.35 **	-0.30 **
β_1	0.34 ***	0.30 ***
β_2	0.12 ***	0.19 ***
β_3	—	0.05 *
Adj. R ²	0.60	0.62
S.E.	0.36	0.36

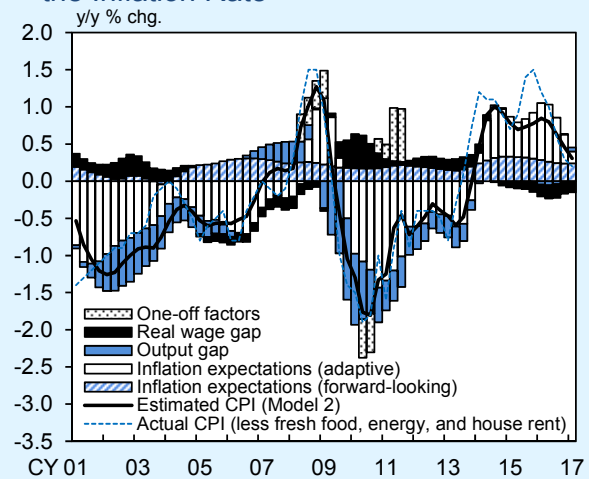
***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. S.E. represents the standard errors for the estimated y/y % changes. Estimation period: 1997/Q1-2017/Q1.

Sources: Ministry of Internal Affairs and Communications; Ministry of Finance; Consensus Economics Inc., "Consensus Forecasts," etc.
 Notes: 1. Figures for medium- to long-term inflation expectations are the expectations for the CPI 6 to 10 years ahead and are based on the "Consensus Forecasts."
 2. In the estimations, dummy variables are included in order to control for the estimated effects of one-off factors such as the introduction of a subsidy for high school tuition.
 3. The output gap is based on staff estimations.
 4. The CPI figures are adjusted for changes in the consumption tax rate.

statistical significance is not as high as that of the output gap and inflation expectations (Chart B3-4).

However, such downward pressure on prices resulting from the decline in the real wage gap is considered to be only transitory. In the long run, real wages are determined to be consistent with labor productivity, and thus the real wage gap is assumed to converge toward zero. The base pay function, shown in Chart B2-3, also demonstrated that labor productivity works positively on base pay increases in a statistically significant manner. It is therefore expected that, in the long run, the impact of the improvement in labor productivity pushing down prices will be limited.³⁶

Chart B3-4: Effects of Real Wage Gap on the Inflation Rate



Sources: Ministry of Internal Affairs and Communications; Ministry of Finance; Consensus Economics Inc., "Consensus Forecasts," etc.
 Notes: 1. The estimated inflation rate is based on Model 2 shown in Chart B3-3.
 2. The effects of the constant term are evenly allocated to the contributions of inflation expectations (forward-looking and adaptive).
 3. Figures for the CPI are adjusted for changes in the consumption tax rate.

³⁶ The improvement in labor productivity can contribute to pushing up prices. If the growth rates are raised in the long run along with the improvement in labor productivity, the output gap will improve as business fixed investment and private consumption increase through the rise in expected profits and permanent income. If the natural rate of interest also goes up at the same time, the monetary easing effects are expected to increase even if the current policy rate is unchanged.