Wage Inflation and Labor Market Pressure: A Principal Components Approach

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Abstract

In this paper, we investigate what is the best measure of labor market pressure for predicting wage inflation in Japan. Principal components analysis is used to select a subset of independent variables from 11 labor market variables. The first component is interpreted as the active opening rate and the second component is interpreted as total hours worked. We estimate a standard Phillips curve for wage inflation that incorporates the active opening rate and total hours worked as regressors. We find that (hourly) real wage growth is positively related to the active opening rate and negatively related to total hours worked. The second component (representing total hours worked) may help explain why wage inflation has not risen substantially despite Japan experiencing high active opening rates in the mid-2000s, when both total hours worked and active opening rates increased. Although higher active opening rates put upward pressure on real wage growth, this upward pressure is offset by longer working hours, which tend to reduce (hourly) real wage growth.

1. Introduction

Wage inflation is one of many economic indicators that are closely monitored by policymakers to predict inflation. Most economists believe that the Japanese GDP gap has turned from approximately zero to be positive in 2006, and that this positive GDP gap will soon pull up wages and prices. In fact, the active opening rate, which reached a low of 0.48 in 1999, rose steadily thereafter, increasing from 0.83 in 2004 to 1.06 in 2006. The active opening rate in 2006 was at its highest level since the early 1990s. Despite this tight labor market, the inflation rate failed to rise.[1]

On the other hand, other indicators, such as unemployment, suggest that the labor market was weaker than the active opening rate suggests. The unemployment rate, which hit a peak of 5.38 percent in 2002, did not decline substantially; it was still as high as 4.14 percent in 2006.

The purpose of this paper is to build a measure of labor market pressure that explains wage inflation in Japan. In particular, this study focuses on the principal components of wage inflation and unemployment as a measure of labor market pressure.

Section 2 compares the evolution of the key labor market variables with the evolution of the first principal component. Section 3 estimates a wage Phillips curve with Japanese data. In the process, many issues in the specification of the wage equation are discussed. Section 4 uses more than one principal component to estimate the wage Phillips curve. Section 5 considers time-varying natural rate models. Section 6 concludes.

2. Labor Market Series and a Principal Components Approach

The unemployment rate and the active opening rate have been the leading indicators for measuring labor market pressure in Japan.[2] Both indicators are closely watched by

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[1] For a discussion of the inflation forecast in 2006–2007, see Nishimura (2007) and Ueda (2007). For recent empirical studies on the role of labor costs in price setting, see Rudd and Whelan (2007) and Kiley (2007).

[2] The active opening rate is the ratio of active job openings to the number of active applicants. That is, the active opening rate is the ratio of the number of job offers (new

policymakers. At times, however, the unemployment rate and the active opening rate have sent somewhat different signals. In 2006, for example, the active opening rate was quite high, suggesting a tight labor market in Japan. On the other hand, the unemployment rate remained high, by historical standards, although the rate had been declining since 2003.

This study follows the recent literature and estimates the common movement in a large set of correlated labor market variables using a principal components approach.[3] Principal components analysis is a statistical technique that linearly transforms an original set of variables into a substantially smaller set of uncorrelated variables. Its goal is to reduce the dimensionality of the original data set. Principal components analysis can be used in regression analysis. If the independent variables are highly correlated, then they can be transformed to principal components and the principal components can be used as the independent variables. This study uses 11 labor market variables to compute principal components. The first principal component accounts for 49 percent of the variance of the 11 labor market variables.

Figure 1 compares the active opening rate and the reciprocal of the unemployment rate with the first principal component.[4] The figure shows that the active opening rate closely tracks the first principal component. Both series indicate tight labor markets in the periods 1988–1992 and after 2005, and loose ones in the periods 1975–1987 and 1993–2003. In contrast, the reciprocal of the unemployment rate tracks the principal

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jobs plus those carried forward from the previous month) to the number of job seekers registered at public employment security offices ("Hello Work") throughout the country. The active opening rate indicates the number of job offers per job seeker and is published monthly by the Ministry of Health, Labor and Welfare.

[3] See, for example, Stock and Watson (2002a, 2002b), Bernanke and Boivin (2003), Bernanke, Boivin, and Eliasz (2005), and Barnes, Chahrour, Olivei, and Tang (2007).

[4] Figure 1 plots the values of the first principal component. To make the labor market indexes comparable with the principal component series, we rescale the labor market indexes to have the same mean and standard deviation as the principal component over the sample period.

component poorly. Hence, the figure suggests that the active opening rate captures labor market pressure better than the unemployment rate in Japan.

3. Estimates of the Wage Phillips Curve

This section estimates a wage Phillips curve and examines the relationship between wage inflation and labor market indexes. The Phillips curve specification follows Blanchard and Katz (1997), Katz and Krueger (1999), and Ball and Moffitt (2001).[5]

In the wage Phillips curve specification, we assume that the difference between expected real-wage growth and labor-productivity growth depends on excess demand, as follows:

$$\left(\omega - \pi^e\right) - \theta = D, \tag{1}$$

where ω is nominal-wage growth, π^e is expected inflation, θ is labor-productivity growth, and D is excess demand. This equation implies that expected real wages tend to grow faster than productivity when labor market variables indicate tight employment conditions.

The data are annual. The wage-inflation rate ω is the change in the log of employee compensation per hour. Productivity growth θ is the change in the log of output per hour.[6] All these series are taken from the *System of National Accounts* produced by the Cabinet Office.

Before estimating the effects of labor market pressure on wage inflation, we need to discuss several issues in the specification of the wage equation.

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[5] On the dynamic path of inflation and unemployment in response to monetary policy shocks, see Mankiw (2001).

[6] Output per hour may be an imperfect measure of labor productivity because labor input varies when work effort changes. Basu and Kimball's (1997) method is used to estimate the relation between labor productivity and the business cycle. The result shows that the coefficient on the changes in hours is wrong signed. Hence, we do not adjust our measure of labor productivity to cyclical movements in effort.

Indexes of Excess Demand

The gross domestic product gap, the unemployment rate, the active opening rate, and the rate of capacity utilization are commonly used as measures of excess demand. This study focuses on the unemployment rate and the active opening rate, which are more relevant to the labor market.

(Univariate Analysis: The Unemployment Rate and the Active Opening Rate)

The unemployment rate gap is one of the most widely used indexes measuring labor market pressure. A recent study by Barnes, Chahrour, Olivei, and Tang (2007) shows that the unemployment rate gap is a good summary statistic for the current state of the labor market.

In the case of Japan, however, the unemployment rate is not a good indicator for predicting inflation. Labor hoarding prevents the unemployment rate from fluctuating much over the business cycle. Because of the lack of responsiveness of the unemployment rate to the business cycle, unemployment is found to be statistically insignificant in most regressions of the Phillips curve.[7] It is only after the 1990s that the unemployment rate in Japan starts to fluctuate over the business cycle.

Because the unemployment rate in Japan was very low and stable in the 1970s and the 1980s, an alternative variable, i.e., the active opening rate, is often used to estimate the Phillips curve. In this paper, we use both the unemployment rate and the active opening rate. The correlation between the two series is –0.54.

(Multivariate Analysis: A Principal Components Approach)

As we have seen, a single variable such as the unemployment rate is often used to capture labor market conditions. In this case, one has to select one variable as the best measure of labor market activity. An alternative is to use multivariate procedures that

[7] A number of studies have considered the development of more accurate measures of labor market pressure in Japan. For example, Fujiki, Nakada, and Tachibanaki (2001) calculate the discouraged workers adjusted-base unemployment rate. They find that the fall and rise in the discouraged workers adjusted-base unemployment rate is faster compared with the official rate.

transform a set of variables into a smaller set of variables. The procedure that we focus on in this paper is principal components analysis.

The 11 series are taken from the 'Labor and Wages' section of the *Financial and Economic Statistics Monthly* published by the Bank of Japan. Seven of the 11 series are originally produced by the Ministry of Health, Labor and Welfare: new job openings; new job openings to applicants ratio; active opening rate; total hours worked; nonscheduled working hours; regular employees: all enterprises; and regular employees: manufacturing. The remaining four series are maintained by the Ministry of Internal Affairs and Communications: labor force: employed; labor force: unemployed; ratio of unemployed in labor force; and employees.[8]

The principal components are extracted from the 11 labor market series over the period 1968 to 2006. The first principal component explains 49 percent of the variability in the original data. The correlation between the first principal component and the unemployment rate is –0.59, whereas the correlation between the first principal component and the active opening rate is higher at 0.85.

The Shape of the Phillips Curve

Two functional forms of the excess demand function are considered. One is a linear model $D = \alpha + \gamma U$, where U is either the unemployment rate, the active opening rate, or the first principal component. The other is a nonlinear model, where U is the reciprocal of the unemployment rate. The nonlinear model implies that the wage Phillips curve is vertical at high levels of wage inflation and it becomes flat at low levels of wage inflation.

Expected Inflation

Expected inflation π^e is equal to a weighted average of past inflation, and past inflation is measured by either wages (a wage–wage specification) or prices (a wage–price specification).[9] The wage–wage Phillips curve reflects the institutional framework

[8] Additional details are given in the Appendix.

[9] Expected inflation could be modeled as a forward-looking function. Thus, we apply the method proposed by Carlson and Parkin (1975) and estimate the expected inflation

in which workers compare their wages with wages paid to the same worker in the past and with wages paid to other workers of the same type.

The wage–price Phillips curve captures the fact that some labor contracts have indexation clauses and include catch-up provisions related to past inflation. For the wage–price specification, we need to select a price index that feeds back to wage setting. In theory, the price affecting labor supply is a consumer price index (CPI) while the variables affecting labor demand are the producer price index (PPI) and the wholesale price index (WPI). These price index series are from the *International Financial Statistics* of the International Monetary Fund.

Hence, the three variables—wage inflation, the consumer price index, and the producer (wholesale) price index—are considered as a measure of price feedback.

Lag Length on Prices (or Wages)

Choosing the length of the distributed lag on prices or wages is a critical issue in that it determines the degree of inertia in the system. The wage regressions are compared with lags of one to four years.

The sum of the distributed lag on the change in prices or wages is constrained to unity while no specific distribution is assumed for the shape of the lag. That is, $\pi^e = \sum_{i=1}^{n} \beta_i \pi_{-i}$ ($n = 1,2,3,and\,4$), where π is the change in nominal wages, the CPI, or the PPI (WPI). The restriction on the distributed lag $\sum_i \beta_i = 1$ implies that the long-run Phillips curve is vertical and there is no long-run trade-off between unemployment and inflation.

Estimates of the Wage Phillips Curve

We now estimate a wage Phillips curve of the form:

$$\omega - \theta = \alpha + \gamma U + \sum_i \beta_i \pi_{-i} + \delta z, \qquad \sum_i \beta_i = 1 .$$

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rate from qualitative survey data. However, so far, we have not found a way to make good use of these estimates of the expected inflation rate for predicting wage inflation.

This is the wage Phillips curve, equation (1), with the addition of a supply shock term. The supply shock is measured by a change in import prices.

Tables 1-1 to 1-3 present salient statistics for comparison of wage equations. Table 1-1 reports the results for the wage–wage specification, where π is the change in nominal wages. Tables 1-2 and 1-3 present the results for the wage–price specifications, where π is the change in the consumer price index or the producer (wholesale) price index.

We begin with a discussion on the choice of a wage–wage or wage–price model. For the wage–wage specification, the results in Table 1-1 show that the coefficient on the unemployment rate is positive, and the coefficients on the reciprocal of the unemployment rate, the active opening rate, and the first principal component are negative. These coefficients have the wrong sign, suggesting that the wage–wage models are not appropriate for explaining wage movements in Japan. For the wage–price specification, Tables 1-2 and 1-3 report the results for two measures of price feedback. In contrast to the wage–wage models, the coefficient on the unemployment rate is negative and the coefficients on the reciprocal of the unemployment rate, the active opening rate, and the first principal component are positive, as predicted by theory. All the coefficients on U are statistically significant at least at the 5 percent level.

The difference between Tables 1-2 and 1-3 is the choice of the price variable. Because the regressions using the consumer price index produce a larger adjusted R^2 than those using the producer (wholesale) price index, the consumer price index seems more appropriate for a price variable in the wage–price models.

As for the measure of labor market pressure, the regressions using the active opening rate yield the largest adjusted R^2 in Table 1-2, and thus fit the data better than those using the unemployment rate, the reciprocal of the unemployment rate, and the first principal component.

Regarding the best-fitting lag length, Table 1-2 compares regressions with lags of one to four years. The fit improves moving from lags of two to three years and then edges down from lags of three to four years.

These results lead to the conclusion that the best-fitting wage equation is a wage–price model that uses the active opening rate to represent U and the consumer price

index to represent π, with π lags of three years. The best-fitting regression implies that the "natural" active opening rate is 0.925, and a one-point increase in the active opening rate raises real-wage growth by 6.4 percent.[10]

4. A Set of Principal Components

Up to now, we have focused on the *first* principal component. To further test the model, we now use more than one principal component as the measure of labor market pressure. We begin by using Kaiser's (1960) criterion to decide how many principal components to retain. Kaiser recommends discarding principal components with eigenvalues less than one. We then use the retained components as the independent variables in the regression analysis, and discard the components whose estimated regression parameters are statistically insignificant.

Table 2 presents a principal components analysis of the correlation matrix of the 11 labor market variables. Kaiser's criterion leads to the retention of the first two components.

The first principal component is highly correlated with eight variables (new job openings to applicants ratio, active opening rate, labor force: employed, labor force: unemployed, ratio of unemployed in labor force, regular employees: all enterprises, regular employees: manufacturing, and employees) and the correlations are of about the same magnitude. Therefore, the first component is interpreted as an equally weighted average of the eight standardized variables. Similarly, the second principal component can be interpreted as an equally weighted average of the remaining three standardized variables (new job openings, total hours worked, and nonscheduled working hours). The first two components account for 77 percent of the total variation.

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[10] Using the data for the entire sample period, 1968 to 2006, and for two subperiods, 1968 to 1987 and 1988 to 2006, we obtain three estimated regressions for each specification. Table A in the appendix presents the regressions for the data ending in 1987 and the data beginning in 1988. A Chow test fails to reject the null hypothesis that the coefficient vectors are the same in the two subperiods. Thus, a conventional statistical test suggests that the wage equation describes a stable relation between wage inflation and its determinants.

Table 3 presents wage Phillips curve estimates with the first and second principal components. In regression 3.2, the second principal component as well as the first component is statistically significant. The adjusted R^2 for the regression with the second principal component is larger than that for the regression without the second component: the adjusted R^2 for regression 3.2 is 0.78, compared with 0.71 for regression 3.1. The results suggest that the second principal component is an important indicator for predicting wage inflation.

What do the first and second principal components suggest about the recent state of the labor market? Figure 2 shows actual wage inflation and predicted wage inflation from the wage Phillips curves with and without the second principal component. We estimate the wage Phillips curves for 1968 to 2001, and using these estimates, we compute forecasts of wage inflation over the period 2002 to 2006. This figure shows that the wage equation without the second principal component overpredicts wage inflation in 2006. For the period 2002 to 2006, the equation without the second principal component overpredicts wage inflation by a total of 7.6 percentage points, while the equation with the second principal component underpredicts wage growth by a total of 2.4 percent.

The equation including the second principal component suggests less labor market pressure in 2006 than the one excluding the second component. This finding may be because of the change in the score on the second principal component, which can be interpreted as the change in total hours worked. [11] Low wage inflation in recent years can be explained by a combination of upward pressure on wages because of tight employment conditions (the first principal component) and downward pressure on

[11] Total hours worked is the sum of scheduled working hours and nonscheduled working hours. Scheduled working hours are the actual hours worked between the starting and finishing hours of employment according to the work regulations of the establishment. Nonscheduled working hours are those worked when reporting to work early in the morning, working overtime, being on call, or working when on leave. Information on hours worked is published monthly by the Ministry of Health, Labor and Welfare.

hourly wages because of the increase in total hours worked (the second principal component). In other words, upward pressure on wages caused by the tight labor market is canceled out by downward pressure on wages caused by the decrease in labor hoarding.

When we regress wage inflation on the changes in the active opening rate and the log of total hours worked, we find that:

$$\omega - \theta = -5.575 + \sum_i \beta_i \pi_{-i} + 4.975 AOR - 1.324 THW + 0.080 IMPORT, \quad \bar{R}^2 = 0.82.$$
$$\qquad\qquad (1.152) \qquad\qquad (1.382) \qquad (0.502) \qquad (0.027)$$

Numbers in parentheses are standard errors. The active opening rate (AOR) and the change in total hours worked (THW) are statistically significant at least at the 5 percent level. The regression implies that high growth rates of total hours worked reduce wage inflation.

As a matter of course, there will be an upper limit to which firms can increase total hours worked during an economic upturn. Once total hours worked reach this limit, a further increase in labor demand will surely raise wage inflation.

5. Time-varying Natural Rate of Unemployment (NRU) and Natural Active Opening Rate (NAOR)

Thus far, this paper has estimated constant-NRU and constant-NAOR models. However, the NRU and NAOR may change over time because of demographic and other factors.[12]

This study uses the Hodrick–Prescott filter to extract a trend in the labor market series, which represents our estimates of the time-varying natural rate.[13] We reestimate the wage Phillips curve with time-varying NRUs and time-varying NAORs. Table 4 presents the results. The unemployment rate, the reciprocal of the unemployment rate, and the active opening rate in regressions 4.2, 4.4, and 4.6 are expressed as the deviation from the Hodrick-Prescott trend. For regression 4.8, three new series are produced by detrending in new job openings, the active opening rate, and the ratio of unemployed in

[12] For a discussion of why the NRU changes over time, see Ball and Mankiw (2002).

[13] The filter has smoothing parameter 10^3.

the labor force. Then the principal components are reextracted from the 11 series, i.e., three new series plus the eight original series.

Table 4 presents the results for constant and time-varying natural rate models. The coefficients on the labor market variables and the adjusted R^2s for time-varying natural rate models are similar to those for constant natural rate models. Therefore, we conclude that our results do not depend crucially on the assumption of constant natural rates.

6. Conclusions

In this paper, we investigated what is the best measure of labor market pressure for predicting wage inflation in Japan. Principal components analysis was used to select a subset of independent variables from 11 labor market variables. The first component is interpreted as the active opening rate and the second component is interpreted as total hours worked.

We estimated a standard Phillips curve for wage inflation that incorporates the active opening rate and total hours worked as regressors. We found that (hourly) real wage growth is positively related to the active opening rate and negatively related to total hours worked.

The second component (representing total hours worked) may help explain why wage inflation has not risen substantially despite Japan experiencing high active opening rates in the mid-2000s. Although higher active opening rates put upward pressure on real wage growth, this upward pressure is offset by longer working hours, which tends to reduce (hourly) real wage growth.

However, there will be an upper limit to which firms can increase total hours worked during an economic upturn. Once total hours worked reach this limit, a further increase in labor demand will raise wage inflation.

Appendix

Data Description

/New job openings	First difference of logarithms
New job openings to applicants ratio	No transformation
Active opening rate	No transformation
Labor force: employed	First difference of logarithms
Labor force: unemployed	First difference of logarithms
Ratio of unemployed in labor force	No transformation
Total hours worked (2005 = 100)	First difference of logarithms
Nonscheduled working hours (2005 = 100)	First difference of logarithms
Regular employees: all enterprises (2005 = 100)	First difference of logarithms
Regular employees: manufacturing (2005 = 100)	First difference of logarithms
Employees	First difference of logarithms

Note: "Labor force: employed" and "Labor force: unemployed" are both adjusted for labor-force growth. The survey population for "Total hours worked," "Nonscheduled working hours," "Regular employees: all enterprises," and "Regular employees: manufacturing" is establishments with 30 employees or more through 1990 and establishments with five employees or more from 1991.

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Table 1-1 Wage Phillips Curves, 1968 to 2006

Wage–Wage Phillips Curves (Compensation of employees as regressor)

Unemployment rate as the measure of labor market pressure

Wage lag (yr)	1	2	3	4
Constant	–7.439***	–7.452***	–7.506***	–7.511***
Unemployment	1.233***	1.224***	1.188***	1.203***
Import Prices	0.080**	0.084**	0.079**	0.078**
$\overline{R}^2$	0.72	0.72	0.76	0.77

Reciprocal of the unemployment rate as the measure of labor market pressure

Wage lag (yr)	1	2	3	4
Constant	–0.262	–0.307	–0.643	–0.433
$(\text{Unemployment})^{-1}$	–8.594***	–8.523***	–8.096***	–8.421***
Import prices	0.090***	0.092***	0.086***	0.086***
$\overline{R}^2$	0.75	0.74	0.79	0.79

Active opening rate as the measure of labor market pressure

Wage lag (yr)	1	2	3	4
Constant	–2.848*	–3.041*	–3.692**	–3.547**
Active opening rate	–1.361	–1.170	–0.594	–0.734
Import prices	0.074*	0.076*	0.068*	0.069*
$\overline{R}^2$	0.65	0.65	0.70	0.69

PC1 as the measure of labor market pressure

Wage lag (yr)	1	2	3	4
Constant	–4.000***	–4.043***	–4.206***	–4.189***
PC1	–0.048	–0.046	–0.067	–0.074
Import prices	0.066*	0.071*	0.067*	0.067*
$\overline{R}^2$	0.65	0.64	0.70	0.69

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively.

Table 1-2 Wage Phillips Curves, 1968 to 2006

Wage–Price Phillips Curves (CPI as regressor)

Unemployment rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	2.079	2.078	2.073	2.036
Unemployment	–0.909**	–0.908**	–0.922**	–0.901**
Import prices	0.109***	0.109***	0.107***	0.106***
$\overline{R}^2$	0.69	0.68	0.70	0.69

Reciprocal of unemployment rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	–3.639***	–3.656***	–3.754***	–3.686***
$(\text{Unemployment})^{-1}$	7.314***	7.344***	7.467***	7.343***
Import prices	0.099***	0.099***	0.098***	0.097***
$\overline{R}^2$	0.72	0.72	0.73	0.72

Active opening rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	–5.709***	–5.761***	–5.948***	–5.889***
Active Opening Rate	6.215***	6.266***	6.430***	6.373***
Import prices	0.080**	0.082**	0.079**	0.079**
$\overline{R}^2$	0.77	0.77	0.79	0.78

PC1 as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	–0.427	–0.406	–0.439	–0.416
PC1	0.603***	0.620***	0.585**	0.579**
Import prices	0.104***	0.100***	0.101***	0.099***
$\overline{R}^2$	0.71	0.71	0.71	0.70

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively.

Table 1-3 Wage Phillips Curves, 1968 to 2006

Wage–Price Phillips Curves (PPI (WPI) as regressor)

Unemployment rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	5.951***	5.880***	5.852***	5.866***
Unemployment	–1.594***	–1.591***	–1.593***	–1.610***
Import prices	0.031	0.059	0.075*	0.089**
$\overline{R}^2$	0.46	0.51	0.58	0.59

Reciprocal of the unemployment rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	–3.594**	–3.739**	–3.798***	–3.918***
(Unemployment)$^{-1}$	11.723***	11.904***	11.959***	12.151***
Import prices	0.015	0.045	0.061	0.076*
$\overline{R}^2$	0.52	0.57	0.65	0.66

Active opening rate as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	–4.916*	–5.528***	–5.735***	–5.959***
Active opening rate	7.599***	8.230***	8.433***	8.649***
Import prices	0.001	0.032	0.048	0.064*
$\overline{R}^2$	0.52	0.60	0.68	0.70

PC1 as the measure of labor market pressure

Price lag (yr)	1	2	3	4
Constant	1.548**	1.485**	1.451**	1.421**
PC1	0.856***	0.849***	0.753***	0.750***
Import prices	0.028	0.055	0.072	0.084*
$\overline{R}^2$	0.46	0.50	0.55	0.55

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively.

Table 2 Eigenvectors and Eigenvalues of the Correlation Matrix of Labor Market Variables (N = 39)

	Eigenvector										
Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11
New job openings	0.151	–0.469	–0.346	–0.021	–0.227	–0.324	0.411	–0.153	0.054	0.530	0.061
New job openings to applicants ratio	0.372	0.109	–0.451	0.123	–0.024	–0.062	–0.132	0.151	0.265	–0.303	0.651
Active opening rate	0.373	0.138	–0.424	–0.035	–0.147	–0.064	–0.192	–0.075	0.205	–0.175	–0.721
Labor force: employed	0.325	–0.203	0.181	0.474	0.416	0.430	0.314	–0.149	0.329	–0.004	–0.096
Labor force: unemployed	–0.292	0.279	0.183	0.503	–0.409	–0.367	0.222	–0.259	0.297	–0.207	–0.011
Ratio of unemployed in labor force	–0.331	–0.235	–0.111	–0.306	–0.433	0.549	0.179	0.117	0.397	–0.193	0.004
Total hours worked	–0.078	–0.511	0.240	0.182	–0.035	–0.206	–0.639	0.198	0.371	0.111	–0.035
Nonscheduled working hours	0.044	–0.554	0.015	0.049	–0.019	–0.169	0.138	–0.074	–0.408	–0.682	–0.055
Regular employees: all enterprises	0.356	0.080	0.433	–0.277	–0.063	–0.286	0.360	0.576	0.207	–0.086	–0.080
Regular employees: manufacturing	0.361	–0.004	0.380	–0.426	–0.160	0.003	–0.155	–0.665	0.139	–0.048	0.177
employees	0.366	0.018	0.171	0.344	–0.606	0.336	–0.129	0.164	–0.406	0.168	0.030
Eigenvalue	5.434	3.057	0.902	0.600	0.332	0.283	0.172	0.087	0.070	0.057	0.007

Cumulative percent variance explained	49.40	77.19	85.38	90.83	93.85	96.42	97.99	98.78	99.41	99.93	100

Table 3 Wage Phillips Curves, 1968 to 2006

Wage–Price Phillips Curves (CPI as regressor, Price lag = three years)

	3.1	3.2
Constant	–0.439	–0.524
PC1	0.585**	0.501**
PC2		1.106***
Import prices	0.101***	0.100***
$\overline{R}^2$	0.71	0.78

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively. Regression 3.1 is originally reported in Table 1-2.

Table 4 Wage Phillips Curves, 1968 to 2006

Wage–Price Phillips Curves (CPI as regressor, Price lag = three years)

	4.1 Constant	4.2 Time-varying	4.3 Constant	4.4 Time-varying	4.5 Constant	4.6 Time-varying	4.7 Constant	4.8 Time-varying
Constant	2.073	–0.426	–3.754***	–0.459	–5.948***	–0.552	–0.439	–0.443
Unemployment	–0.922**	–2.399**						
$(\text{Unemployment})^{-1}$			7.467***	23.696***				
Active opening rate					6.430***	7.065***		
PC1							0.585**	0.553**
Import prices	0.107***	0.106***	0.098***	0.100***	0.079**	0.082***	0.101***	0.101***
$\overline{R}^2$	0.70	0.69	0.73	0.77	0.79	0.78	0.71	0.71

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively. Regressions 4.1, 4.3, 4.5, and 4.7 are originally reported in Table 1-2.

Figure 1: Reciprocal of the Unemployment Rate, Active Opening Rate and First Principal Component (PC1) (1968-2006)

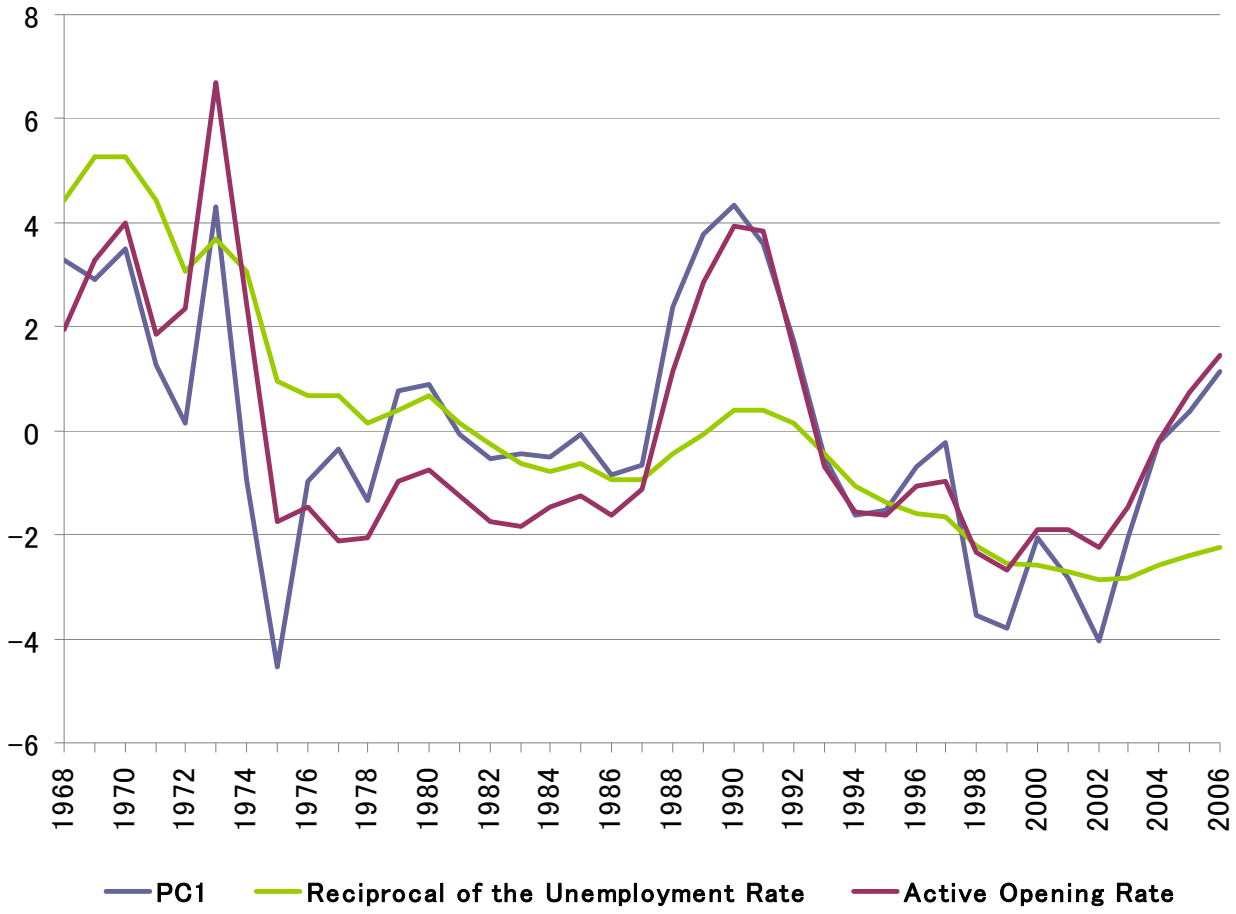

Figure 2: Wage Inflation Forecasts

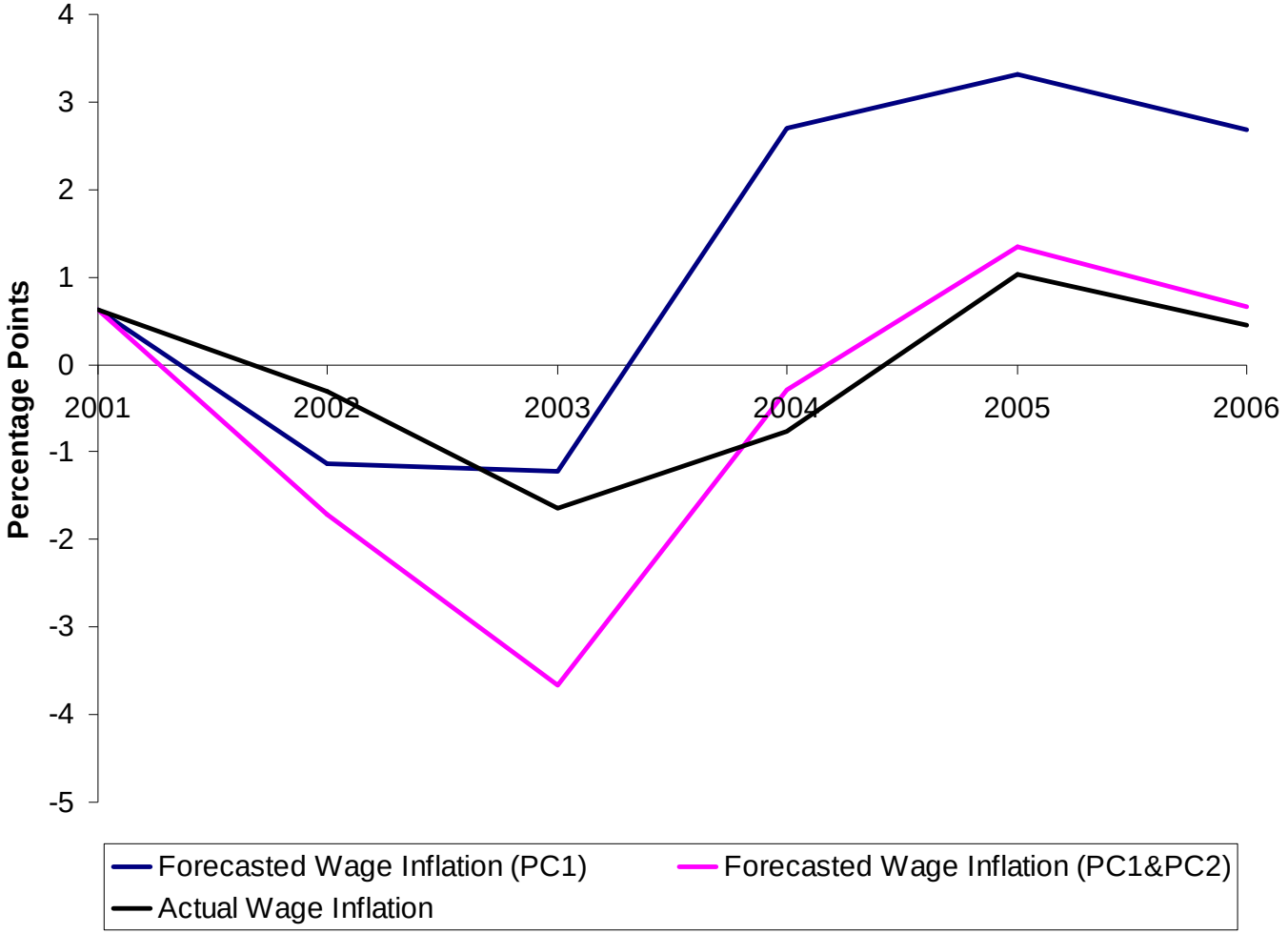

Table A Sensitivity to Sample Splits of Wage Equations

Wage–Price Phillips Curves (CPI as regressor, Price lag = three years)

Sample period	1968–1987	1988–2006	1968–1987	1988–2006	1968–1987	1988–2006	1968–1987	1988–2006
Constant	5.788	2.232***	–6.305*	–3.715***	–7.875***	–3.444***	–0.375	–0.649**
Unemployment	–3.023	–0.829***						
$(\text{Unemployment})^{-1}$			10.867*	9.544***				
Active opening rate					8.899***	3.202***		
PC1							1.201**	0.335***
Import prices	0.096	0.028	0.103*	0.035	0.080*	–0.030	0.105**	–0.029
$\bar{R}^2$	0.51	0.82	0.55	0.82	0.71	0.75	0.57	0.75

Note: ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively.