A Wage Curve for Japan: Further Evidence from Panel Data

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1. Introduction

The negative relationship between individual wages and regional unemployment, first observed by Blanchflower and Oswald (1994), has come to be known as the *wage curve*[1]. Several authors have offered explanations for this empirical relationship which includes a bargaining model (Blanchflower et al., 1994) and an efficiency wage model (Shapiro and Stiglitz, 1984). This relationship suggests that when all else is the same, wages offered by employers tend to be lower in regions where higher unemployment persists, and vice versa. Academic research in this area has seen a proliferation of bourgeoning literature over the past two decades following the seminal work by David Blanchflower and Andrew Oswald (1990). Blanchflower and Oswald (2005) report the results on 43 countries. The model has been replicated for a number of countries. The relationship is relevant owing to its implications on the regional labour markets. In addition, within the standard labour market models, a rise in unemployment implies an excess supply of labour, which lowers wages, thus producing an upward-sloping labour supply curve. Sato (2000) argues that the equilibrium unemployment models are consistent with the wage curve. In addition to providing an analytical tool for assessing a tight labour market, the presence of a wage curve reveals aspects of a non-competitive labour market. The negative relationship suggests the tightness of the labour market and is related to the workers' earnings function, which is based on personal and demographic characteristics such as age, gender, and educational levels (Heckman and Polachek, 1974).

Despite the absence of a theoretical basis, Blanchflower and Oswald (1994) suggest that the wage elasticity with respect to unemployment is around –0.1 for developed nations. While accepting the considerable heterogeneity across studies in terms of the data and the estimation strategy, the estimates obtained for the elasticity for several other nations have led to a general acceptance of the value as an empirical fact. Card (1995) calls this finding an 'empirical law of economics', which is a phrase he has also used in his works on immigration (Card, 2001). However, to date, the evidence for Japan–the second largest world economy–has been found to

[1] Over 150 (?) empirical studies have examined this relationship. This differs from the Phillips curve that deals with the relationship between the *rate of change* in *nominal* wages and the unemployment rate and uses macro data. The wage curve deals with the effect of unemployment on the *level* of *real* wages and uses micro data. Blanchflower and Oswald (2005) argue that an augmented wage curve (includes a lagged wage) better describes the wage-setting behavior in the US than a Phillips curve.

vary widely across studies. As Blanchflower & Oswald (1994) observe, the wage elasticity can vary by the countries studied and specification used. Arguably, Japan's labour market is significantly different from that of other developed economies. Hence, further research to establish the quantitative magnitude for elasticity should help better understand the nature of the regional labour market in Japan. The motivation for the paper is driven by this reasoning.

The objective of this paper is to offer further empirical evidences in support of a wage curve for the Japanese economy. We present results obtained from the random effect, fixed effect, GMM(Generalized method of moments), and instrumental variable estimations. The paper presents a broader set of results in an effort to examine the regional and gender-specific differences in the Japanese labour market. Although changing gradually for reasons such as external shocks, the labour market in Japan has preserved its own long-standing traditions that are unique. This fact alone demands further academic research in its own right. Thus, the paper contributes to the literature by considering the institutional features, both in terms of robustness and applicability, of Blanchflower and Oswald's (1994) model to the Japanese data.

The rest of the paper is organised as follows. Section II provides a brief review of wage curve research. Section III is a description of the national and regional labour market trends in Japan since the 1980s. Section IV reports the findings of the paper, and the final section provides a summary and conclusion.

2. Brief review of the literature

Blanchflower et al. (1994) describe three alternative models to explain the inverse relationship between the unemployment rate and wages at the local or regional labour markets, and Campbell and Orszag (1998) add a fourth model. The latter authors modify the model of the lump-sum labour turnover costs of Salop (1979) and Phelps (1984). Card (1995) evaluates the alternative approaches. Sato (2000) develops a wage curve within the search theory model. In a subsequent paper, Blanchflower and Oswald (2005) argue that the recent US evidence weighs more in favour of the efficiency wage theory. Poot and Doi (2005) offer a simple demand-supply model to explain the observed inverse relationship for the wage curve. In the labour contract model, firms and workers agree on a state-contingent employment level and a state-contingent wage level along the implicit contract models á la Azariadis (1975) and Baily (1974). Higher wages are to coincide with a higher level of contract employment to compensate for the higher income risk. However, differences in regional amenities can produce differences in equilibrium wages and employment. In other words, regions with the best amenities will

match low long-run wages and high long-run unemployment rates, and vice versa. This is consistent with the wage models that incorporate pecuniary and non-pecuniary benefits.

A bargaining model dating back to De Menil (1971) also provides a second theoretical logic for the wage curve, wherein workers in the unionized production sector extract a higher wage premium from employers in the conditions of a tight labour market. This results in a postulated inverse relationship if 'collective bargaining' at the local levels actually takes place. The wage curve tends to be less elastic if wages are nationally determined and more elastic if enterprises are based on local bargaining (Buettner and Fitzenberger, 2001). In the Shapiro and Stiglitz (1984) model, monitoring workers' productivity is costly, compelling the employers to offer a premium on the competitive wage and dissuading workers from shirking. Ringuedé (1998) argues that this premium might be higher for larger enterprises owing to higher monitoring costs (For more on this see, e.g., Coles, 1999; Johansen et al., 2001). Campbell and Orszag's (1998) theory is based on the idea of 'cost economizing'. The model argues that jobs that are abandoned by existing workers in a tight labour market situation can be costly.

In this paper, we split the labour market by gender as in Prot and Doi (2005). In addition, we divide the period of study into two groups and obtain results for each of the periods and for the combined time period. This classification by time periods should capture the effects of the bubble of the 1980s. The latter has had a profound impact on the economic activities of Japan. We found the wage elasticity for male workers in Japan close to –0.1 for all the periods. For the female workers, however, our results vary widely from those of other studies. The unemployment elasticity of pay is greater for men than for women. We also estimate regional wage curves using time-series data. The male wage curve elasticity is close to 0.10, but for women it is about half of that. Poot and Doi (2005) have recently studied the wage curve using y-pooled cross-section data for the period from 1981–2001. They also report a lower elasticity for women compared to men. Further, the elasticity varies across regions.

Evidence, to date, supports the existence of a wage curve (Rebick, 1993; Montgomery, 1994; Kano, 2003, Prot and Doi, 2005). Kano (2003) studied the pseudo panel of 5091 cohorts in 1984, 1989, and 1994 and found that, depending on the specification used, wage curve elasticities vary from −0.047 to −0.273. When performing a comparative study of the adjustment of the regional labour market in the US and Japan, Montgomery (1994) found some interesting aspects in the Japanese labour markets. He found that at the prefectural level (same as regional), data exhibits larger persistence compared to the state-level markets in the US, which might be due to

rigidities in the Japanese labour market (also see, e.g., Ono and Rebick, 2003). Montgomery's study used pooled labour market averages from 46 prefectures for 1970, 1975, 1980, and 1985. He also found that the wages, unemployment, and migration behaviour appear to be driven by similar factors. However, wages appear to be more sensitive to demand shifts in Japan compared to the US, and the unemployment seems to be much less sensitive[2]. The paper found that wage elasticity for Japan ranges between −0.15 and −0.1. The data used refers to the average monthly contractual earnings, which may include the response of monthly pay to changes in working hours or bonus payments.

The past three decades has seen a seismic shift in the economy of Japan that began with the 'bubble economy' of the 1980s. A buoyant economy and a tight labour market were the result of a speculative boom that ended in a crash in the late eighties. Thereafter, Japan has faced several recessionary bouts and episodes of modest comebacks. To address the chronic economic troubles, Japan initiated a series of measures in the late 1990s. The aim was to achieve a sustained growth rate through a set of economic reforms to reduce structural inefficiencies.

Poot and Doi (2005) discuss the effect of structural changes on the wage curve and provide tentative estimates for region-specific wage curves. They also provide gender-based measures of elasticity. On the other hand, the results of Kano (2003) are biased because he estimates the effect of the unemployment of a 'group' on the wages of 'individuals' (Moulton, 1990). Poot and Doi have shown a robust wage curve for the Japanese economy, albeit for male workers, where the elasticity ranges from −0.037 to −0.179 prior to the onset of the crash in the 1990s. The wage curve becomes more elastic in the post-bubble, relative to the pre-bubble time. Although wide, it is still not out of range in relation to other nations.[3] In their meta-analysis, Nijkamp and Poot (2005) compare the results from over 30 developed and transition economies to examine the differences in empirical results across studies.

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[2] From 1970 to 1985, the regions in Japan stayed reasonably similar with regard to the distribution of wages, unemployment, employment growth, and migration.

[3] These studies were different according to the choice of the country of interest, types of data or variables (micro or aggregates; education, age, occupation, sector/industry, cost of living; unionization, gender, etc.), and estimation strategy (OLS, panel, etc.). The elasticities range from −0.5 and +0.1, excluding outliers. The wage curve is found to be robust, with a mean elasticity of about −0.1. To control this publication bias, the authors argue that the elasticity is −0.07. Their analysis shows that the typical elasticity with respect to the hourly wage still comes close to −0.05.

As noted, the empirical relation captured by the 'wage curve' has been verified for several countries including Australia (Kennedy and Borland, 2000*), Italy (**), Russia (Shillov and Moller, 2008), the US (Blanchflower and Oswald, 1994a, b, 2005; Townsend, 2005; and Bratsberg and Turunen, 1996), Germany (Wagner, 1994; Baltagi et al., 1998; Baltagi et al., 2000; Baltagi and Blien, 1998; Pannenberg and Schwarze, 1998), the UK (Blanchflower and Oswald, 1990, 1994a, b), Eastern and Central Europe (Blanchflower, 2001), Spain (García and Montuenga, 2003), and Canada (Blanchflower and Oswald, 1994a, b). Additional evidence in favour of the wage curve is provided in Groot et al. (1992) for the Netherlands, Janssens and Konings (1998) for Belgium, Baltagi and Blien (1998) for West Germany; and Balgati (200*) and Pannenberg and Schwarze (1998) for East Germany.. Estimates of a wage curve have also been provided for Eastern Germany. Card (1995) provides an excellent review of the benefits and limitations of the wage curve. Blanchard and Katz (1997) discuss the relationship between the wage curve and the Phillips curve.

3. Empirical analyses

In this section, we estimate the wage curves in Japan for the period from 1983 through 2009. There are a few empirical studies on the wage curves for this period although it has been pointed out that the labour market in Japan had faced some drastic changes.

From the late 1990s to the beginning of the 2000s, the labour market in Japan experienced unprecedented changes such as a sharp rise in the unemployment rates, growth in the proportion of non-regular employees to the total labour force, decline in trade union coverage, and decreases in the labour share.

In the beginning of the twenty-first century, unemployment rates declined (Figure 1). However, unemployment rates could not recover from the levels they had been at before the bubble burst. In particular, youth unemployment was slow to recover despite labour market reforms introduced by the government. The labour demand for youths slumped. This caused the migration of the labour force to metropolitan areas. The proportion of non-regular employees to the total labour force continued to rise, although the business cycle exhibited an upward trend.

Have these changes in the labour market of Japan caused any changes in the wage curves? In this section, we try to find breaks in the wage curves after the bubble burst, using panel data from 47 prefectures for 27 years.

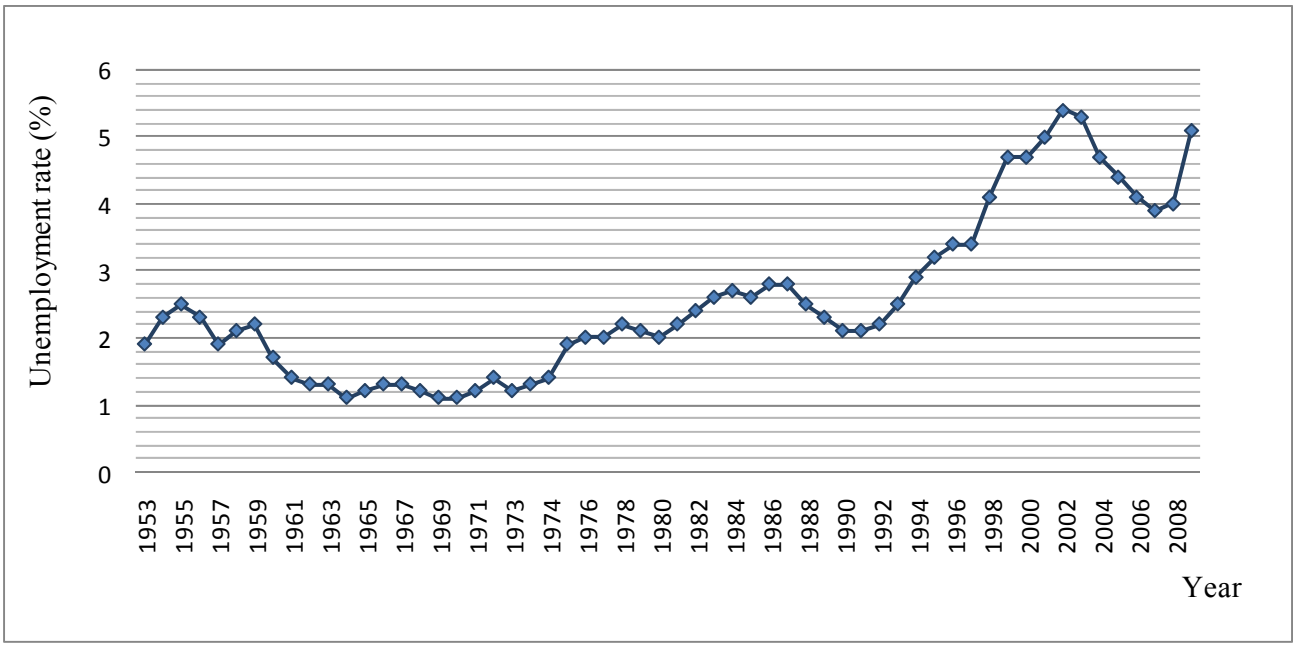

Figure 1: Unemployment rates in Japan, 1953–2009

3.1 The data

The explanatory variables are the unemployment rate (u); the regional cost of living index (LC); workforce size, represented by the total number of regular employees (WS); the percentage of workers between the ages of 45 and 59 years (WA); and the firm size, represented by the percentage of employment in firms with 1,000 workers or more (FS). The descriptive statistics for the variables used in our estimation is listed in the appendix table.

We use two kinds of post-bubble dummy variables; one is D_{91_00}, which implies the years from 1991 through 2000 and zero otherwise, and the other is D_{01_09}, which implies the years from 2001 through 2009 and zero otherwise. The purpose of introducing two kinds of dummy variables is to find if there are multiple breaks in the wage curves after the bubble burst.

The unemployment rates used in this paper are the annual averages of ten regions obtained from the *Annual Report on the Labor Force*. On the other hand, the number of employees is obtained from the *Basic Survey on Wage Structure*. The wage rates for both sexes for each

prefecture and year are also taken from the *Basic Survey on Wage Structure.* The wages in this paper include fixed contractual wages, good attendance allowances, family and commuting allowances, overtime payments, and annual bonuses, and it is reported on the basis of the actual hours worked. We divided the yearly wage incomes, including bonuses, by the actual hours worked, including overtime hours, to obtain the hourly wage rates.

The regional cost of living indexes are obtained from the *Annual Report on the Consumer Price Index* prepared by the Statistics Bureau. We used the cost of living indexes for the capital city of each prefecture.

3.2 Estimated Results

3.2.1 Structural changes in the wage curves

We estimate the wage curves for the period of 1983–2009 for the following three categories: men only, women only, and both sexes together. Three types of model specifications are considered, namely, the fixed-effects model, random-effects model, and the GMM estimation. Equation (1) is for the fixed-effects model.

$$(1)\quad \log w_{it} = \alpha_i + \gamma_1 \log u_{it} + \gamma_2 D_{91\_01} \log u_{it} + \gamma_3 D_{02\_09} \log u_{it} + \gamma_4 \log LC_{it} + \gamma_5 \log WA_{it} + \gamma_6 \log WS_{it} + \gamma_7 \log FS_{it} + \gamma_8 T + \varepsilon_{it}$$

Here, w_{it} is the real wage rate, and i and t indicate the prefecture and year, respectively. α_i is the fixed effect for the ith prefecture. u_{it} indicates the unemployment rate, and the dummy variables D_{91_01} and D_{02_09} are as discussed in the previous section. The wage curve elasticity for the period from 1983 through 1990 is estimated as $\hat{\gamma}_1$, while those for the periods from 1991–2000 and 2001–2009 are estimated as $\hat{\gamma}_1 + \hat{\gamma}_2$ and $\hat{\gamma}_1 + \hat{\gamma}_2 + \ddot{\gamma}_3$, respectively.

Furthermore, α_i is the constant that represents the fixed effect of region i, LC is the regional cost of living index, WA is the proportion of the workforce between the ages of 45 and 59, WS is the total number of regular employees in establishments with 10 or more regular employees, FS is the proportion of labour employed in firms with 1000 or more employees, T is the linear time trend, ε is the error term, and the γs are the coefficients. All the variables except for the time trend are transformed into logarithmic values.

The results are shown in Tables 1 through 3. T Table 1 shows the estimated wage curves for men; Table 2, for women; and Table 3, for both sexes. The results of the Hausman specification test to choose between the fixed-effect and random-effect models supported the fixed-effect specification.

Table 1

Table 2

Table 3

The unemployment elasticity of pay ($\hat{\gamma}_1$) is negative and statistically significant in all three tables. The level of the wage curve elasticity is approximately –0.1 for both men and women. This estimate is not inconsistent with the empirical findings in other countries.

As shown in Tables 1 to 3, the sign of the coefficient of the unemployment rate interacting with the dummy variable D_{91_01} is positive and significant for men, women, and both sexes. That is, the wage curve became less elastic in the 1990s than in the 1980s. This result is different from that of Poot and Doi (2006), in which the coefficient of the interactive term of the unemployment rate and the post-bubble dummy was negative and statistically significant. The wage curve elasticity, $\hat{\gamma}_1 + \hat{\gamma}_2$, obtained from the fixed-effect model for the period of 1991–2001, are 0.032, 0.086, and 0.074 for men, women, and both sexes, respectively. The estimates based on the GMM method, on the other hand, are –0.005, 0.009, and –0.026 for men, women, and both sexes, respectively.

The sign of the coefficient of the unemployment rate interacting with the dummy variable D_{02_09} is negative and statistically significant except for men, women, and both sexes. This implies that the wage curves became more elastic in the beginning of the twenty-first century than what they were in the 1990s. For the period from 2002 through 2009, the wage curve

elasticity, $\hat{\gamma}_1 + \hat{\gamma}_2 + \ddot{\gamma}_3$, based on the fixed-effect model is –0.005, 0.038, and 0.001 for men, women, and both sexes, respectively. The GMM coefficient for this period, on the other hand, is –0.012, 0.003, and –0.099 for men, women, and both sexes, respectively.

As for the explanatory variables other than the unemployment rates, the workforce size measured by the number of regular employees has a significant positive effect on log wage incomes. The proportion of employees in their forties and fifties has a positive effect on male wages while exerting a negative effect on female wages. The regional cost of living costs are found to have significant positive effects on regional wage incomes, as expected.

To sum up, wage curve elasticity, which was approximately –0.1 in the 1980s, became close to zero shortly after the bubble burst. Wage curves became more elastic in the beginning of the twenty-first century than what they were in the 1990s. However, wage curve elasticity is still smaller than it was in the 1980s.

Figures 2 to 10 plot the predicted log wage rates against the log unemployment rates. The predicted values for log wages are obtained from the fixed-effect model. They depict that the downward-sloped wage curves almost disappeared after the bubble burst and are re-emerging for men, women, and both sexes alike.

3.2.2 Robustness of the estimated results

It is possible that the unemployment rate is an endogenous variable affected by regional labour market conditions such as total employment, the ratio of job openings, and the proportion of employees, excluding those self-employed in the total labour force. We re-estimate the wage curves, using them as instrumental variables. The model used in this procedure is as shown in (2).

$$
\begin{aligned}
(2)\quad & \log w_{it} = \beta_i + \delta_1 \log u_{it} + \delta_2 D_{91\_01} \log u_{it} + \delta_3 D_{02\_09} \log u_{it} + \delta_4 \log LC_{it} \\
& + \delta_5 \log WA_{it} + \delta_6 \log WS_{it} + \delta_7 \log FS_{it} + \delta_8 T + \nu_{it} \\
& \log u_{it} = \xi_i + \eta_1 \log(Jopening)_{it} + \eta_2 \log(Eratio)_{it} + \eta_{it} \log WS_{it} + u_{it}
\end{aligned}
$$

Jopening and *Eratio* refer to the ratio of active job openings and the proportion of employees to the total labour force for each prefecture. The number of regular employees, *WS*, is added to the right-hand side variable, as it is possible that it has a negative effect on regional unemployment. β_i and ξ_i are the fixed-effects for the wage rate and unemployment rate for each prefecture, respectively. ν_{it} and u_{it} are the error terms.

The results based on equation (2) are listed in Table 4. The signs for the coefficient of the unemployment rate interacting with the dummy variables, D_{91_01} and D_{02_09}, are the same as those obtained from the fixed effects and the GMM estimations. According to Table 4, for the period from 1991 through 2001, the wage curve elasticity, $\hat{\delta}_1 + \hat{\delta}_2$, was 0.016, 0.018, and 0.044 for men, women, and both sexes, respectively. For the period from 2002–2009, on the other hand, the wage curve elasticity, $\hat{\delta}_1 + \hat{\delta}_2 + \hat{\delta}_3$, was –0.018, –0.023, and –0.025 for men, women, and both sexes, respectively.

4. Concluding remarks

This paper estimated the wage curves in Japan for three periods: 1983 through 1990, 1991 through 2001, and 2002 through 2009. We found that the elasticity of wage curves for the three periods differ from each other. The negative slopes for the wage curves were almost non-existent in the period from 1991 through 2001. However, the negative relationship between wage rates and unemployment rates has been re-emerging since 2002.

In this paper, we used four kinds of methods to estimate the wage curve elasticity and its changes. As different methods lead to different estimates, we cannot draw any conclusion as to the magnitude of the changes in wage curve elasticity. However, it is clear that the wage curve elasticity in recent years is larger than it was in the 1990s.

There could be a number of reasons for the changes in wage curves in Japan such as increase in non-regular employment, decrease in the number of regular employees, decline in

the trade union coverage, and increase in the internal population migration to metropolitan areas. Our next step is to find the effect of such factors on the changes in wage curves.

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Table 1: Estimated wage curves for men, 1983–2009

Dependent variable: log (real wage rate)

Dependent variable: log real wage rate		Men 1983-2009		Men, 1983-2009			Men 1983-2009	
		Rendom-effect		Fixed-effect			GMM, One step result	
		Eestimated coefficient	z-value	Eestimated coefficient	t-value		Eestimated coefficient	z-value
lag of log(hourly wage)						L.logW	0.6633	16.97 ***
log unemployment	log u	-0.083	-13.81 ***	-0.0769	-13.11 ***	log u	-0.0532	-11.78 ***
(Dummy for 91-01)*log unemployment	D_{91_01}*log u	0.115	22.00 ***	0.1088	21.44 ***	D_{91_01}*log u	0.0480	7.45 ***
(Dummy for 02-09)* log unemployment	D_{02_09}*log u	-0.040	-14.00 ***	-0.0373	-13.15 ***	D_{02_09}*log u	-0.0067	-2.48 **
age40_59	log WA	0.031	2.02 **	0.0562	3.68 ***	log WA	0.0209	0.61
Work force size	log WS	0.106	13.02 ***	0.1470	11.31 ***	log WS	0.0808	2.39 ***
firm size(over1000 employees)	log FS	0.079	8.68 ***	0.0731	7.83 ***	log FS	0.0721	5.78 ***
living costs for regions	log LC	0.274	2.33 **	0.2937	2.42 **	log LC	0.0709	0.40
time trend	Year	0.007	13.62 ***	0.0064	13.88 ***	Year	0.0009	3.12 ***
Intercept		-14.464	-13.69 ***	-14.7922	-14.22 ***		-2.5831	-1.94 ***
Regressioin diagnostics	observations	1269		1269		Observations	1175	
	N of groups	47		47		N of instruments	34	
	sigma_u	0.055		0.108				
	sigma_e	0.039		0.039				
	rho	0.673		0.887				
	R-sq : within	0.8548		0.8563				
	: between	0.5615		0.5256				
	: overall	0.6588		0.6161				
	Wald chi2	Wald chi2(8) = 6856.49 Prob > chi2 = 0.000					Wald chi2(9) = 9228.99 Prob > chi2 = 0.000	
	F test that all u_i=0			F(46, 1214) = 90.49 Prob > F = 0.0000				

Table 2: Estimated wage curves for women, 1983–2009

Dependent variable: log real wage rate		Women, 1983-2009		Women, 1983-2009			Women, 1983-2009	
		Random-effect		Fixed-effect			GMM	
		Eestimated coefficient	z-value	Eestimated coefficient	t-value		Estimated coefficient	z-value
lag of log(hourly wage)						L.logW	0.7967	27.80 ***
log unemployment	log u	-0.044	-5.38 ***	-0.047	-5.58 ***	log u	-0.0375	-7.52 ***
(Dummy for 91-01)*log unemployment	D_{91_01}*log u	0.132	22.26 ***	0.132	22.93 ***	D_{91_01}*log u	0.0465	8.22 ***
(Dummy for 02-09)* log unemployment	D_{02_09}*log u	-0.047	-12.72 ***	-0.048	-13.25 ***	D_{02_09}*log u	-0.0064	-2.98 ***
age40_59	log WA	-0.107	-7.03 ***	-0.097	-6.39 ***	log WA	-0.1024	-3.90 ***
Work force size	log WS	0.052	5.81 ***	0.029	2.07 **	log WS	0.0382	2.41 **
firm size(over1000 employees)	log FS	0.066	7.34 ***	0.050	5.43 ***	log FS	0.0544	6.42 ***
living costs for regions	log LC	-0.021	-0.15	-0.423	-2.86 ***	log LC	-0.0879	-0.72
time trend	Year	0.013	22.69 ***	0.013	23.68 ***	Year	0.0014	2.91 ***
Intercept	Intercept	-25.174	-20.52 ***	-23.473	-19.36 ***	Intercept	-2.7075	-2.74 ***
Regressioin diagnostics	Observations	1269		1269		Obzervations	1175	
	N of groups	47		47		N of instruments	334	
	sigma_u	0.050		0.099				
	sigma_e	0.047		0.047				
	rho	0.534		0.818				
	R-sq : within	0.9004		0.9014				
	: between	0.5352		0.5057				
	: overall	0.7382		0.6757				
	Wald chi2	Wald chi2(8) = 10389.28 Prob > chi2 = 0.000					Wald chi2(9) = 18277.64 Prob > chi2 = 0.0000	
	F test that all u_i=0			F(46, 1214) = 58.93 Prob > F = 0.0000				
	Hausman test	Chi2(8) = 190.92		Prob > chi2 = 0.000				

Table 3: Estimated wage curves for both sexes, 1983–2009

Dependent variable: log real wage rate		Both sexes, 1983-2009 Rendom-effect		Both sexes, 1983-2009 Fixed-effect			Both sexes, 1983-2009 GMM	
		Eestimated coefficient	z-value	Eestimated coefficient	t-value		Eestimated coefficient	z-value
lag of log(hourly wage)						L.logW	0.7869	44.75 ***
log unemployment	log u	-0.1232	-14.45 ***	-0.1115	-13.34 ***	log u	-0.0815	-20.27 ***
(Dummy for 91-01)*log unemployment	D_{91_01}*log u	0.1949	28.02 ***	0.1850	27.74 ***	D_{91_01}*log u	0.0553	12.12 ***
(Dummy for 02-09)* log unemployment	D_{02_09}*log u	-0.0765	-19.61 ***	-0.0728	-19.02 ***	D_{02_09}*log u	-0.0728	-19.02 ***
age40_59	log WA	0.1306	5.12 ***	0.1825	7.33 ***	log WA	0.0204	0.85
Work force size	log WS	0.1912	14.03 ***	0.2252	9.22 ***	log WS	0.1285	4.09 ***
firm size(over1000 employees)	log FS	0.0832	6.85 ***	0.0604	4.72 ***	log FS	0.0572	5.16 ***
living costs for regions	log LC	0.2483	1.63	0.1060	0.66	log LC	0.1072	0.85
time trend	Year	0.0122	19.05 ***	0.0121	19.86 ***	Year	0.0011	3.79 ***
Intercept	Intercept	-25.8214	-18.44 ***	-25.6438	-18.66 ***	Intercept	-3.1459	-3.62 ***
Regressioin diagnostics	Observations	1269		1269		Obzervations	1175	
	N of groups	47		47		N of instruments	334	
	sigma_u	0.0489		0.1137				
	sigma_e	0.0505		0.0505				
	rho	0.4836		0.8349				
	R-sq : within	0.9155		0.9168				
	: between	0.5448		0.4813				
	: overall	0.7647		0.7148				
	Wald chi2	Wald chi2(8) = 12155.00 Prob > chi2 = 0.000					Wald chi2(9) = 19969.16 Prob > chi2 = 0.0000	
	F test that all u_i=0			F(46, 1214) = 54.82 Prob > F = 0.0000				
	Hausman test	Chi2(8) = 382.46		Prob > chi2 = 0.000				

Notes for Tables 1 through 3

1. *, **, and *** refer to the statistical significance at the 1%, 5%, and 10% levels, respectively.

2. Observations are for 47 prefectures X 27 years.

3. Wage rates are defined as follows: {(monthly wages including family and commuting allowances, overtime payments, etc.) X 12 + (annual bonuses)}/cpi

4. GMM estimation is corrected for heteroschedasticity.

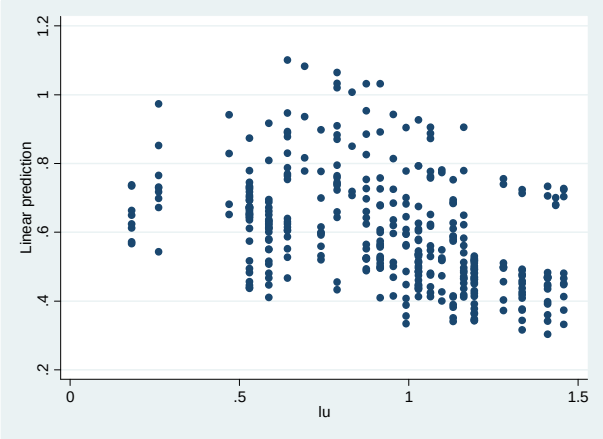

Figure 2: Predicted log wage rate and log unemployment for men, 1983–1990

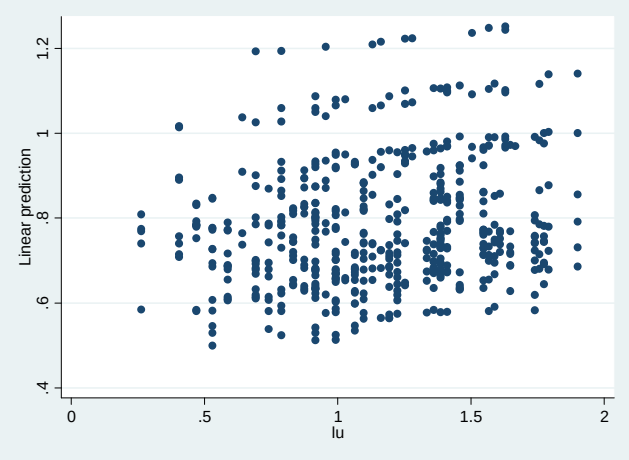

Figure 3: Predicted log wage rate and log unemployment for men, 1991-2001

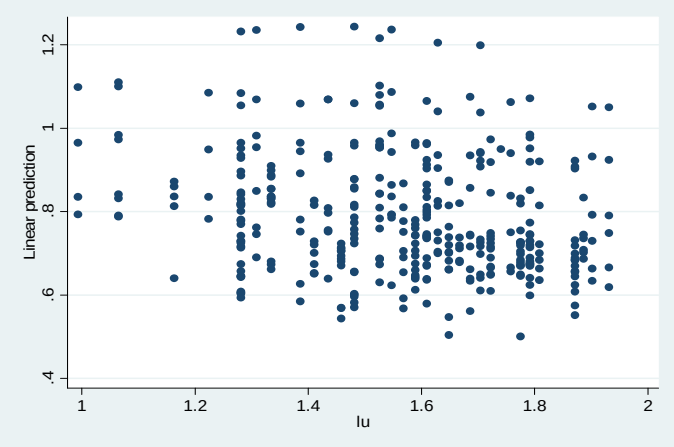

Figure 4 Predicted log wage rate and log unemployment for men, 2002-2009

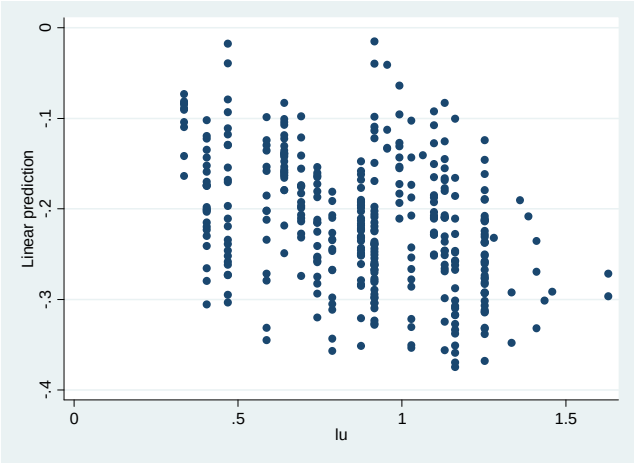

Figure 5: Predicted log wage rate and log unemployment for women, 1983–1990

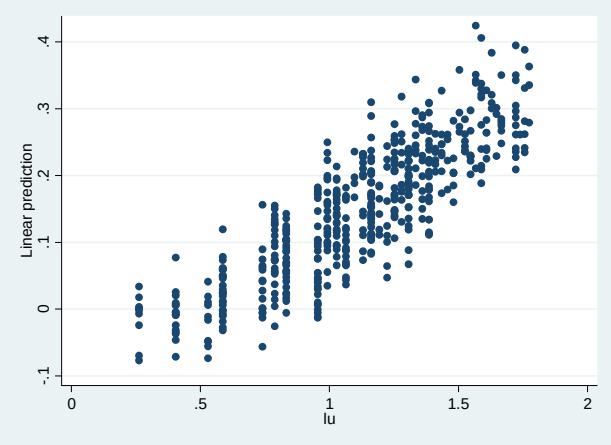

Figure 6: Predicted log wage rate and log unemployment for women, 1991–2001

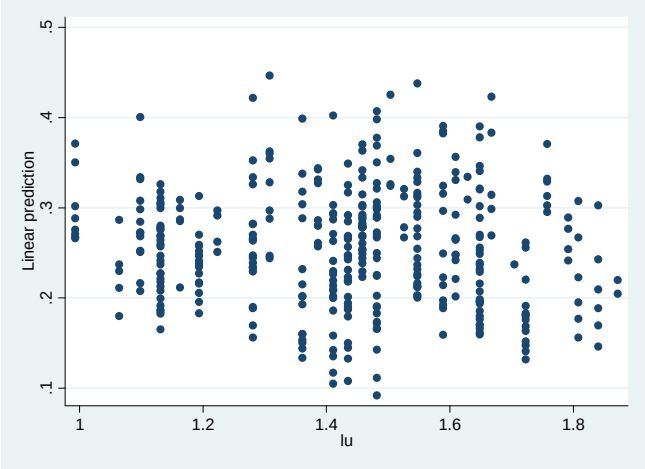

Figure 7: Predicted log wage rate and log unemployment for women, 2002–2009

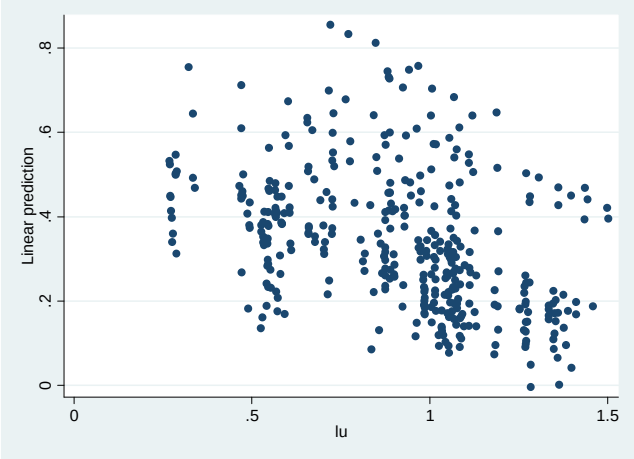

Figure 8: Predicted log wage rate and log unemployment for both sexes, 1983–1990

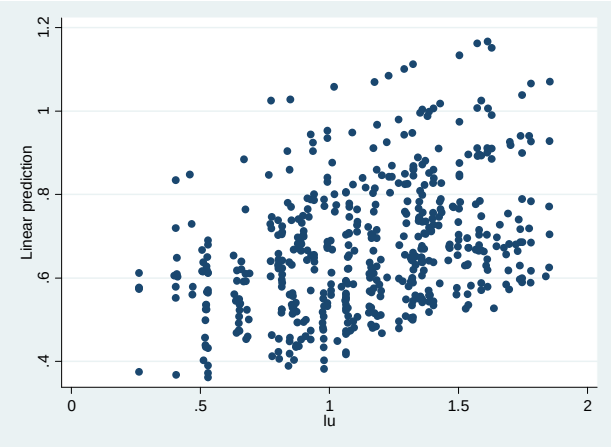

Figure 9: Predicted log wage rate and log unemployment for both sexes, 1991–2001

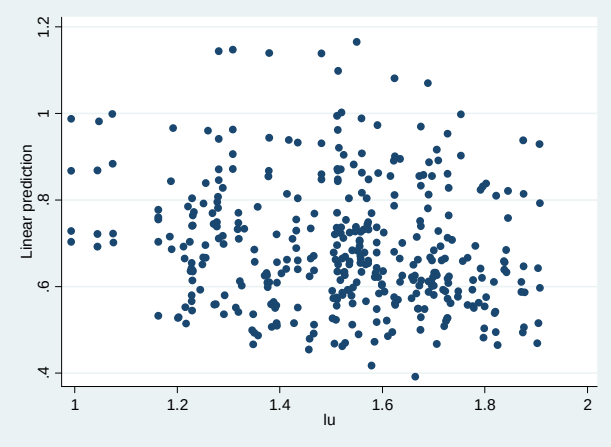

Figure 10: Predicted log wage rate and log unemployment for both sexes, 2002–2009

Table 4: Instrumental variable results

Dependent variable: log real wage rate		Men, 1983-2009		Women, 1983-2009		Both sexes, 1983-2009	
		IV		IV		IV	
		Eestimated coefficient	z-value	Eestimated coefficient	z-value	Eestimated coefficient	z-value
log unemployment	log u	-0.105	-12.04 ***	-0.146	-10.54 ***	-0.161	-12.69 ***
(Dummy for 91-01)*log	$D_{91\_0}1$*log u	0.121	20.74 ***	0.164	23.49 ***	0.205	26.46 ***
(Dummy for 02-09)* log unemployment	D_{02_09}*log u	-0.034	-11.69 ***	-0.041	-10.63 ***	-0.069	-17.41 ***
age40_59	log WA	0.033	2.05 **	-0.133	-8.07 **	0.141	5.34 **
Work force size	log WS	0.136	10.18 ***	-0.035	-2.10 **	0.188	7.29 **
firm size(over1000 employees)	log FS	0.071	7.47 ***	0.037	3.82 ***	0.052	3.96 ***
living costs for regions	log LC	0.363	2.94 ***	-0.291	-1.86 *	0.193	1.18
time trend	Year	0.006	13.52 ***	0.013	22.74 ***	0.012	19.63 ***
Intercept	Intercept	-14.810	-14.11 ***	-23.858	-18.61 ***	-25.818	-18.51 ***
Regressioin diagnostics	Observations	1269		1269		1269	
	N of groups	47		47		47	
	sigma_u	0.1027		0.1228		0.1042	
	sigma_e	0.0389		0.0493		0.0513	
	rho	0.8745		0.8611		0.8052	
	R-sq : within	0.8536		0.8899		0.9144	
	: between	0.5428		0.0005		0.4991	
	: overall	0.6340		0.5202		0.7390	
	Wald chi2	Wald chi2(8) = 12155.00 Prob > chi2 = 0.000		Wald chi2(8) = 60157.02 Prob > chi2 = 0.000		Wald chi2(8) = 174811.57 Prob > chi2 = 0.000	

Notes:

1. The instrumental variables are as follows: Dummy for 91–01, Dummy for 02–09, log WA, log WS, log FS, log LC, ratio of active job openings, proportion of employees to total labour force.

2. *, **, and *** refer to the statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix: Descriptive statistics

	Men				Women				Both sexes			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max				
wage income (1,000 yen)	2.058	0.408	0.791	3.256	1.359	0.302	0.682	2.198	1.827	0.384	0.791	3.052
unemployment rate (%)	3.609	1.365	1.2	6.9	3.325	1.156	1.3	6.5	3.504	1.278	1.3	6.7
log wage income	0.475	0.207	-0.436	0.933	0.073	0.238	-0.578	0.588	0.579	0.223	-0.235	1.116
log unemployment	1.207	0.400	0.182	1.932	1.138	0.365	0.262	1.872	1.184	0.383	0.262	1.908
fixed hours of work	174.310	7.343	160	195	172.409	7.912	157	192	173.673	7.448	159.436	193.809
overtime hours of work	16.073	3.002	6	25	7.173	2.058	4	22	13.091	2.514	6	22
proportion of employees aged 45-59	0.451	0.068	0.187	1.062	0.405	0.080	0.202	2.218	0.241	0.076	0.063	0.466
number of regular employees	32917.300	44766.070	4882	315701	14873.350	16546.520	3111	122987	47790.660	61074.540	8585	438688
proportion of employees in firms with 1,000 or more	0.258	0.082	0.056	0.495	0.207	0.066	0.075	0.438	0.434	0.049	0.274	0.770
regional cost of living	101.1968	2.7901200	95.0	112.4	101.197	2.7901200	95.0	112.4	101.197	2.7901200	95.0	112.4