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Who Bears the Cost of the Business Cycle?

Labor-Market Institutions and Volatility of the Youth Unemployment Rate

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Abstract

The way age-specific unemployment rates fluctuate over the business cycle differs significantly across countries. This paper examines the effect of labor-market institutions on the fluctuations of age-specific unemployment rates based on panel data of 18 Organisation for Economic Co-operation and Development (OECD) countries between 1971 and 2000. Empirical results suggest that the cost of the business cycle disproportionately falls on youths in countries with stricter employment protection and higher union coverage. These results are consistent with a theoretical prediction that a higher adjustment cost of an existing workforce induces the employment adjustment of new entrants into the labor market.

JEL classification: E24, J80.

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1. Introduction

Although the unemployment rate fluctuates in line with the business cycle, the fluctuation of age-specific unemployment rates differs significantly across Organisation for Economic Co-operation and Development (OECD) countries. Figure 1 is a time-series plot for the age-specific male unemployment rate in the US, France, and Japan for the 1960-2008 period. The way age-specific unemployment rates fluctuate over the business cycle significantly differs across these three countries. First, youths' (15-24) and adults' (45-54) unemployment rates move in parallel in the US. Business-cycle fluctuations seem to be absorbed equally across generations. Second, youths' unemployment rate fluctuates more sharply adults' unemployment rate in France. This implies that employment adjustments occur more often for youths than for adults in France. The Japanese trend lies somewhere between those of the US and France. Shocks to the economy are equally absorbed by generations in the US, while they are intensively absorbed by younger generations in France. To see the heterogeneity of the age distribution of unemployment-rate volatility adjusting for the difference in the levels of unemployment rates by age groups, Table 1 reports the coefficient of variation of the unemployment rates for these three countries. Again, we find that the youths' unemployment-rate volatility relative to adults' employment-rate volatility is higher in France than in the US or Japan. What factors cause this international difference in the responses of age-specific unemployment rates over the business cycle?

Previous literature has shown that the youths' unemployment rate is more cyclically sensitive than that of adults (Clark and Summers, (1981), Alba-Ramirez (1995), Bertola, Blau, and Kahn (2007)). Many theoretical and empirical investigations also account for higher unemployment rates for youth than for adults. Literature has shown that stricter employment protection or a higher unionization rate raises the unemployment rate of youths relative to adults (Canziani and Petrongoro (2001), Jimeno and Rodriguez-Palenzuela (2003), Bertola, Blau, and Kahn (2007), Kahn (2007), Modesto (2008)). These papers study how employment protection or wage-setting institutions affects the levels of unemployment rates of youths and adults. In other words, these studies examine the long-run effect of employment protection or wage-setting institutions on the unemployment rate of youths relative to that of adults.

To the best of our knowledge, none of the existing studies explain why the fluctuations of age-specific unemployment rates differ across countries. It is important to study which age groups of workers absorb the short-run macroeconomic shocks from the point of view of inter-generational risk-sharing. Economies where macroeconomic shocks are disproportionately absorbed by younger generations place more burdens of the business cycle on youths, who presumably have a lower capacity for absorbing risks because of a lower level of asset accumulation. Neumark (2000), von Wachter and Benders (2006), and Genda, Kondo and Ohta (2010) report that the employment status

of youths has prolonged effects on the employment status of adults because of the hysteresis of employment status over a life cycle. Thus, short-run macroeconomic shocks experienced when workers are young may well have a considerable long-run effect on their welfare, and workers belonging to different birth-year cohorts may have significantly different levels of welfare in an economy where short-run macroeconomic shocks are absorbed disproportionately by young workers.

This paper explores the extent to which labor-market institutions, such as the degree of employment protection, affect the heterogeneous responses of age-specific unemployment rates to macroeconomic shocks. We introduce a theoretical model that analyzes firms' employment policies in a dynamic setting when the adjustment of labor input is costly. Numerical results indicate that existing workers' higher adjustment costs make firms adjust labor input by reducing new hires from the labor market. Our empirical analysis is based on panel data of the male unemployment rate of 18 developed countries spanning the period between 1970 and 2000. By regressing changes of age-specific unemployment rates on overall unemployment rate, the heterogeneity of the responses of age-specific unemployment rates to a macroeconomic shock is estimated. We further examine how this heterogeneity depends on various labor-market-institution indexes, published by Blanchard and Wolfers (2000) and others.

Our results indicate that stricter employment protection amplifies the effect of the cyclical unemployment rate on youths' unemployment rate. This implies the cost of the business cycle disproportionately falls on youths in the countries with stricter employment protection and high union-coverage rates. Other institutions, such as the unemployment insurance system and the wage-setting institution, do not have significant impacts on the cyclical sensitivity of age-specific unemployment rates.

The rest of this paper is organized as follows. Section 2 provides a simple model of a firm's decision to hire youth and adult workers and shows that the firing cost disproportionately insulates adult workers' employment. Section 3 discusses the empirical strategy. Section 4 describes our data. Section 5 reports the empirical results. Section 6 provides conclusions.

2. Theoretical background.

In this section, we introduce a theoretical model that analyzes the firms' employment policy in a dynamic setting when the adjustment of labor input is costly.

We consider a firm that operates infinitely, discounting future profit with a constant interest rate. The firm produces output using L_{Yt} young workers, and L_{Ot} adult workers as inputs. Young and adult workers are combined by the CES production technology with the elasticity of substitution $\sigma = 1/(1-\rho)$:

$$Y_t = A_t\left(L_{Yt}^{\rho} + L_{Ot}^{\rho}\right)^{\frac{1}{\rho}}, \rho \leq 1,$$

where A_t is the total factor productivity, which takes either a high or low value and follows a first-order Markov process. We denote transition probabilities as $P_{H|H}, P_{L|H}, P_{H|L}, P_{L|L}$ where $P_{j|i}$ stands for the probability of transition from state *i* to *j*. Hence, the firm has an incentive to adjust employment, responding to productivity realization in each period. We assume that the number of young workers in the previous period becomes the number of adult workers at the beginning of a period. The firm bears the labor adjustment cost when it decides to change the number of adult employmees from this initial value, as well as hiring costs for the young workers.

Given the wage rate of young workers W_{Yt}, and adult workers W_{Ot},, its profit in period *t* is represented as follows;

$$\pi_t = A_t(L_{Yt}^{\rho} + L_{Ot}^{\rho})^{1/\rho} - W_{Yt}L_{Yt} - W_{Ot}L_{Ot} - g(L_{Ot} - L_{Yt-1}) - h(L_{Yt}),$$

where $f(.)$ is a hiring cost function for young workers and $g(.)$ is an adjustment cost function for adult workers. In the above setting, the firm's employment policy must be consistent with the following Bellman equations, with the current state variables (A_t, L_{Yt-1}).

$$V(A, L_{Y,-1}) = A(L_Y^{\rho} + L_O^{\rho})^{1/\rho} - W_Y L_Y - W_O L_O - g(L_O - L_{Y,-1}) - h(L_Y) + \beta EV(A', L_Y),$$

where $L_{Y,-1}$ is the number of youths employed in the previous period (initial old), β is a discount factor, and A' is productivity realization in the next period.

We solve the model numerically with parameters in Table 2 and simulate the economies for 10,000,000 periods. Specifically, we conduct them with three different sets of $(\sigma, P_{i|i})$, each of which is calculated with three different values of α. We calculate the mean, standard deviation, and coefficient of variation (CV) of the simulated path of age-specific unemployment. Then, we calculate the relative CV between youth and adult workers.

Results are presented in Table 3. In the table, all three cases (a)-(c) show that with higher α, the relative CVs of the young workers also mark a higher value. That is, the higher adjustment cost of existing workers makes firms adjust labor input by reducing new hires from the labor market. This inclination is more evident in the case of the higher substitutability of youth and adult workers (higher σ) or lower uncertainty (higher $P_{i|i}$).

More volatile labor demand for youths leads to higher volatility of youths' unemployment rate with some degree of rigidity in the wage setting (Shimer (2005a) and Hall (2005a)). In the following

empirical sections, we test whether the higher adjustment costs of adult workers as compared with young workers results in a higher volatility of youths' employment relative to that of adults.

3. Empirical Strategy

Theoretical analysis in the previous section emphasizes the role of adjustment cost on labor-demand fluctuation by age groups. The degree to which this demand fluctuation is transmitted to unemployment rate fluctuation crucially depends on wage rigidities. Thus, other labor-market institutions, such as unemployment-insurance systems, unions, and wage-setting institutions, which differ across countries, may well affect unemployment rates by age groups. Hence, we control for those labor-market institutions as well.

The literature adopts labor productivity as a measurement of productivity shock to the labor market (Shimer (2005b), Hall (2005b), Fujita and Ramey (2009) and Fujita (2011)). Labor-productivity shocks, however, affect the unemployment rate through inflow to and outflow from unemployment with a complex lag structure. Accordingly, there is no consensus on a time-series relation between a positive shock to labor productivity and the unemployment rate. Given this state of the literature, we avoid directly estimating the relation between the labor-productivity change and the change of unemployment rates by age groups. Instead, the shock to the labor market is approximated by the unemployment rate defined over all age groups, and the relation between the overall unemployment rate and the age-specific unemployment rate is examined. Particularly, we specify a model as follows.

$$\Delta\left(UE_{\mathrm{it}}^{\mathrm{age}}\right) = \beta_0 + \Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right)\beta_1 + INS_{\mathrm{t}-1}\beta_2 + \left[\Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right) - \overline{\Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right)}\right] * INS_{\mathrm{it}-1}\beta_3 + \Delta\left(\frac{Y}{POP_{it}}\right)\beta_4 + \Delta\left(\frac{YA}{POP_{it}}\right)\beta_5 + c_i^{age} + e_{\mathrm{it}}^{\mathrm{age}} \quad (1)$$

where the age groups of 15-24, 25-34, and 45-54 are indexed by *age*; countries are indexed by *i*; years are indexed by *t*.; *INS* is the vector of seven labor-market institution indexes, which are normalized to mean 0 and standard deviation 1; *Y/Pop* is the ratio of 15-24-year-olds to 45-54-year-olds; *YA/Pop* is the ratio of 25-34-year-olds to 45-54-year-olds.

In equation (1), the coefficient on the overall unemployment rate of all ages identifies the impact of the overall change of the unemployment rate on the change of the age-specific unemployment rate. The coefficients on lagged labor-market institutions identify the long-run effect of labor-market institutions, such as firing restrictions, on the age-specific unemployment rate change. The coefficients on the interaction terms between the labor-market institution index and the overall unemployment rate change identify how the effects of overall labor-market shock on the age-specific

unemployment rates depend on labor-market institutions, such as firing restrictions, unemployment insurance, and wage-setting institutions.

Since the overall unemployment rate is the weighted average of age-specific unemployment rates, the overall unemployment rate is an obvious endogenous variable. This endogeneity is circumvented by instrumenting the overall unemployment rate by the weighted average of unemployment rates, excluding the unemployment rate of the target age group. We estimate the above equation with a random-effect IV model, assuming unobservable heterogeneity $c^{age}{}_i$ is not correlated with regressors.

In addition, we run regressions with the difference of the unemployment rate change by age group as dependent variables to quantify the difference of the coefficients across age-groups.

$$\begin{aligned}\Delta\left(UE_{\mathrm{it}}^{\mathrm{young}}\right)-\Delta\left(UE_{\mathrm{it}}^{\mathrm{old}}\right)&=\beta_0+\Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right)\beta_1+INS_{\mathrm{t}-1}\beta_2+\left[\Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right)-\overline{\Delta\left(UE_{\mathrm{it}}^{\mathrm{overall}}\right)}\right]*INS_{\mathrm{it}-1}\beta_3\\&+\Delta\left(\frac{Y}{POP}_{it}\right)\beta_4+\Delta\left(\frac{YA}{POP}_{it}\right)\beta_5+c_i^{age}+e_{\mathrm{it}}^{\mathrm{age}}\end{aligned}\quad(2)$$

4. Data

We build the cross-country time-series dataset from two sources. First, we draw age-group-specific and overall unemployment rates and population for male workers from the OECD Stat Extracts.[2] Age groups of our concern are 15-24, 25-34, and 45-54. Second, we draw labor-market-institution indices from the "CEP-OECD Institution Dataset," which is compiled by Center for Economic Performance (London School of Economics). This dataset is constructed on the basis of an earlier work by Nickell and Nunziata (2001), which is in turn based on the OECD Employment Outlook and other related research.

The CEP-OECD Institution Dataset contains the data of 20 OECD countries from 1960 to 2004. We restrict our sample to the 1970 to 2000 period of 18 countries, because some variables are not available for the whole period and all countries. First, year 2000 is the latest year of some indices for wage-setting institutions, which may have a potentially important role for employment fluctuations, that are available. Second, since there are no data of the union-coverage rate for Ireland and of population for Switzerland, we exclude these countries from the analysis.

Regression analyses are conducted with the following labor-market-institution indices: Employment Protection Legislation (hereafter, EPL) Index, Benefit Replacement Ratio Index, Benefit Duration Index, Union Density Ratio, Union Coverage Ratio, Bargaining Centralization

[2] http://www.oecd.org

Index, and Bargaining Coordination Index. Details of these indexes are summarized as follows.[3]

1. The EPL Index takes a higher value if employment protection legislation is more stringent. This index is essentially based on Blanchard and Wolfers (1994), which in turn is based on OECD (1994) and Lazear (1990). Blanchard and Wolfers (2000) extend an EPL measure of OECD (1994) by connecting with Lazear (1990). In particular, Blanchard and Wolfers (2000) use a measure named *version 1*, which is the longest series of the three measures published by the OECD. Here we only briefly explain the method for constructing the OECD's (1994) version 1 measure.[4] The measure is an unweighted average of the sub-indicators of regular and temporary contracts. These sub-indicators are aggregates of *basis measures*, which take a value of 0 to 6.[5] Blanchard and Wolfers (2000) constructed their EPL index for every five years, and then CEP (2006) interpolates them. The latest year of the index is 2003, when the US marked 0.07, France marked 1.0, and Japan marked 0.6.
2. *The Benefit Replacement Ratio Index* summarizes a benefit replacement ratio for various conditions. For many countries, the benefit replacement ratio depends on family structures and earnings before losing a job. The OECD calculates the replacement rates for the first five years of unemployment for three typical family structures and for two earnings levels, and takes the average of the figures. The latest year of the available index is 2003, when the US marked 13.8, France marked 39.4, and Japan marked 7.8.
3. *The Benefit Duration Index* captures the level of benefits available in later years of a spell relative to those available in the first year. This index is calculated as 0.6*brr23/brr1+0.4*brr45/brr1, where brr1 refers to benefits of the first year, brr23 the second and the third years, and brr45 the fourth and the fifth years. The latest year of the available index is 2003, when the US marked 0.2, France marked 0.5, and Japan marked 0.
4. The *Union Density Ratio* (%) is a ratio of the number of union memberships over employment

[3] Bertola, Blau and Kahn (2007) argue that it would not be appropriate to control for minimum wages, because the prevalence of unions may have a strong effect on the minimum wages, via the political process.

[4] See OECD (1994) and Nickell (2006) for more about the construction of version 1 of the EPL Index.

[5] For regular employment, there are 8 basis indicators (notification procedures, delay involved before notice can start, length of the notice period, severance pay, definition of justified or unfair dismissal, length of trial period, and compensation following unfair dismissal). For temporary workers, there are 6 basis indicators (valid cases for use of Fixed-Term Contract (FTC), maximum number of successive FTC, maximum cumulated duration of successive FTC, types of work for which Temporary Work Agency (TWA) employment is legal, restrictions on number of renewals, maximum cumulated duration of TWA contracts). See "Calculating summary indicators of employment protection strictness" (http://www.oecd.org/dataoecd/24/40/42740190.pdf) for details of these measures.

population. The latest year of the available index is 2003, when the US marked 12.9%, France marked 9.8%, and Japan marked 19.7%.

5. The *Union Coverage Ratio* (%) refers to a ratio of a number of workers covered by collective agreements over employment population. The latest year of the available index is 2000, when the US marked 14%, France marked 93%, and Japan marked 18%.

6. The *Centralization Index* takes a higher value if the bargaining process is more centralized. Bargaining may occur at several different levels, and this fact features the degree of centralization. The index is taken from Table 3.5 of OECD (2004).

1= Company- and plant-level predominant.

2= Combination of industry and company/plant levels, with an important share of employees covered by company bargains.

3= Industry-level predominant.

4= Predominantly industrial bargaining, but also recurrent central-level associations.

5= Central-level agreements of overriding importance.

In these decades, there is no country in which bargaining processes became more centralized, while several countries, such as New Zealand, Switzerland, and Denmark, became more decentralized.

The latest year of the available index is 2000, when the US marked 1.0, France marked 2.0, and Japan marked 1.0.

7. The *Coordination Index* summarizes a degree of coordination in bargaining processes on the employer's as well as the union's side. The index takes a higher value if the degree of coordination is higher.[6] This index is taken from Table 3.5 of OECD (2004).

1=Fragmented company/plant bargaining, little or no coordination by upper-level associations.

2=Fragmented industry and company-level bargaining, with little or no pattern-setting,

3=Industry-level bargaining with irregular pattern-setting and moderate co-ordination among major bargaining actors.

4=a) informal coordination of industry and firm-level bargaining by (multiple) peak associations;

b) Coordinated bargaining by peak confederations, including government-sponsored negotiations

(tripartite agreements, social pacts), or government imposition of wage schedules;

[6] "[D]egree of consensus between the collective bargaining partners" (OECD, 1997).

c) regular pattern-setting coupled with high union concentration and /or bargaining co-ordination by large firms;

d) government wage arbitration.

5=a) informal coordination of industry-level bargaining by an encompassing union confederation.

b) coordinated bargaining by peak confederations or government imposition of a wage schedule/freeze, with a peace obligation.

The latest year of the available index is 2000, when the US marked 1.0, France marked 2.0, and Japan marked 4.0.

In general, centralization may not necessarily mean coordination or vice versa (OECD, 1997). First, if there is a significant discrepancy between individual firm-level negotiated wage and globally negotiated wage, which is called wage drift, the extent of coordination may be weaker despite the centralized wage setting. Second, institutions such as pattern-setting may promote coordination, while it is also substitutable to institutions that are intended to promote centralization.[7] There are several different claims regarding the effect of centralization and coordination on unemployment rates. Nickell (1997) refers to the notion of OECD (1994, Table 5.16) that coordinative arrangements lower wages while centralized arrangements do not, and summarizes that the negative effects of unionization on employment are mitigated by coordination. In contrast, Calmfors and Driffill (1988) claim that the relation between centralization and employment is U-shaped.

Time-series, cross-section values of these indexes are summarized in Table 4. The indexes do not vary much over time within a country; thus the estimation mainly relies on the cross-country variation of labor-market institutions. The descriptive statistics of the analysis sample are summarized in Table 5. Since the values of the index of labor markets do not carry information in themselves, we normalize all the indexes for the purpose of comparing the relative importance of institutions in determining the change of unemployment rates.

5. Estimation Results

Table 6 reports the estimation results of equations (1) and (2). Columns (1) through (3) report the results for age-specific unemployment rate changes, among 15-24-year-olds, 25-34-years-olds, 45-54-year-olds, as dependent variables. Column (4) is the result with the difference of the unemployment rate change between 15-24-year-olds and 45-54-year-olds as the dependent variable. Column (5) shows the result with the difference between the unemployment rate change of

[7] Pattern setting is a type of arrangement in which representative employers and unions act as de-facto leaders and their agreements are taken as a pattern for all negotiations in the same industry.

15-24-year-olds and those of 45-54-year-olds as the dependent variable.

The coefficients of the overall unemployment rate are positive in each of the age groups. The estimated coefficients are larger for younger workers than adult workers, indicating that youths' unemployment rate is more procyclical than adults' unemployment rate.

Estimation results suggest that labor-market institution indexes, such as firing restrictions, unemployment system, and wage-setting institutions, are broadly irrelevant to unemployment fluctuation.

The coefficients of the interaction terms between institution indexes and the overall unemployment rate identify the heterogeneous impact of the macroeconomic shock on the change of age-specific unemployment rates by institutional setting. We first examine the results for employment protection. Table 3 shows that stricter employment protection amplifies the effect of overall shock on the unemployment change of young workers, while it has no effect on that of adult workers. This implies that firing restrictions mitigate the cyclical unemployment rate fluctuation for adults, while it does not for youths. These results are consistent with the theoretical result of the previous section. This also well explains why unemployment rates of all age groups move simultaneously in the US where firing restrictions are less stringent, while youths' unemployment rate fluctuates more than that of adults in France, where firing restrictions are more stringent.

Notable results other than that of firing restrictions (EPL) are coefficients of the interaction terms between the overall unemployment rate and union coverage. The estimated coefficient is positive and statistically significant for youths' unemployment rate change, but it is not statistically significant for adults' unemployment change. Put differently, the higher union coverage amplifies the difference between youths' and adults' unemployment rate change in response to macro shocks, and this implies that macroeconomic shocks are more likely to be absorbed by young workers in economies with higher union coverage.

Given that younger workers are less likely to be employed and so are less likely to be covered by union contracts, the above empirical results are consistent with the result of Blanchard and Summers's (1986) insider-outsider theory, where unions care about the employment of their members in the labor-bargaining process, resulting in fewer employment opportunities for outsiders.

These results imply that in economies with stringent firing restrictions or high union coverage, macro shocks are disproportionately absorbed by younger workers. This finding is also consistent with a robust findings that the role of seniority in determining the order of layoffs is greater in union sector than non-union sector (Abraham and Medoff (1984)).

The relative youth cohort size and relative young-adult cohort size are negatively correlated with unemployment rate of the young and both of them are statistically significant. These signs are consistent of Shimer's (2001) finding that an increase in the share of youth significantly reduces youths' unemployment rate in US state-level data.

6. Conclusion

In this paper, we empirically explore the effect of labor-market institutions on cyclical variations of age-specific unemployment rates. A theoretical model with a numerical simulation suggests that a firing restriction has the heterogeneous impacts of a macroeconomic shock on the fluctuation of age-specific labor demand. In particular, a high adjustment cost of adult workers amplifies the cyclical variation of labor demand for young workers, while it mitigates the fluctuation of such demand for adult workers.

Our empirical analysis from 18 OECD countries shows that the firing restriction amplifies the cyclical fluctuation of unemployment rate for youths, but not for adults. This implies that macroeconomic shocks are disproportionately absorbed by younger workers than older workers in economies with the stricter firing restrictions. The other notable result is that macroeconomic shocks are more likely to be absorbed by young workers in economies with higher union density.

Previous literature has shown that youths' unemployment rate is more cyclically sensitive than that of adults. Another strand of literature has shown that employment protection and wage-setting institutions tend to increase the long-run unemployment rate of young workers. On top of that existing knowledge, this paper adds a new finding that a stricter firing restriction and a higher coverage of workers by union contracts disproportionately insulates older workers from macroeconomic shocks at the cost of a fluctuation in younger workers' unemployment rate. Our results suggest the importance of paying attention to intergenerational risk sharing in discussions about designing labor-market institutions.

Even if younger workers are more likely to absorb the cost of the business cycle, no particular generation incurs more cost than others if employment status is mobile over a life cycle. In contrast, if employment status during workers' youth is persistent over a life cycle, the experience of unemployment at youth may significantly decrease the life-time welfare of a specific cohort. Hence, using cross-country panel data, calculating an average unemployment rate over the life cycle for each cohort, and examining how its inter-cohort variation depends on labor-market institutions are interesting areas for future research.

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Figure 1: Age-specific unemployment rate (US, France, and Japan)

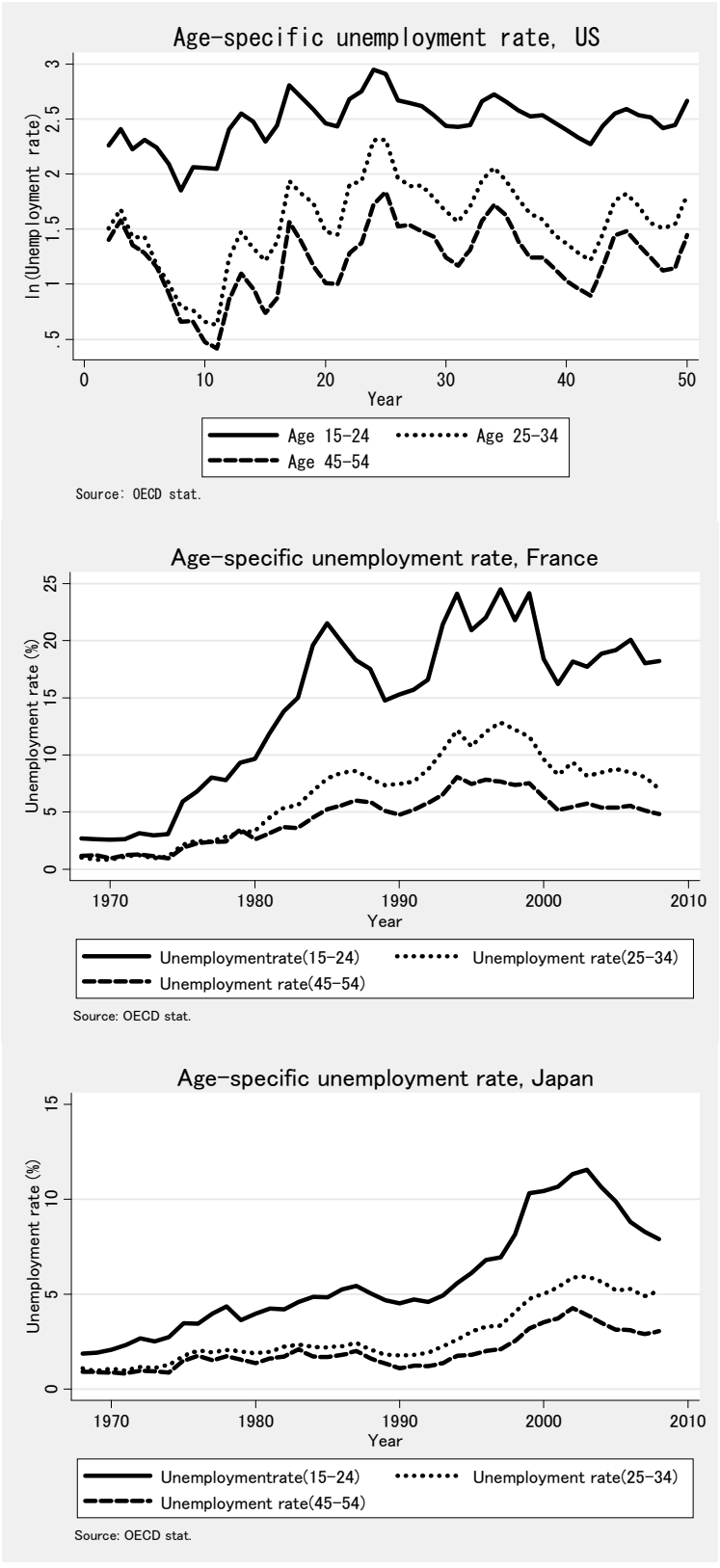

Table 1: Coefficient of variation of the age-specific unemployment rate in three countries.

	15-24	25-34	45-54	15-24/45-54	25-34/45-54
France	0.49	0.572	0.58	0.84	0.99
US	0.498	0.557	1.317	0.38	0.42
Japan	0.216	0.355	0.729	0.30	0.49

Table 2: Parameters of the dynamic stochastic labor-adjustment model

Discount factor	$\beta = 0.98$
Elasticity of substitution between young and adult workers	$\sigma = 2.0$ or 1.0
Parameter of adjustment cost of adult workers	$\alpha = 0.005, 0.010,$ or 0.015
Parameter of hiring cost of young workers	$\gamma = 0.005$
Persistence of technology shock	$P_{H\|H} = P_{L\|L} = 0.75$ or 0.50

Table 3: Simulation results

(a) Baseline case: $\sigma = 2.0, P_{i|i} = 0.75$

	Mean		S.D.		C.V.		
	Young	Old	Young	Old	Young	Old	Young/Old
α =0.005	0.3657	0.0819	0.055	0.0653	0.1504	0.7971	0.1886
α =0.01	0.3475	0.1924	0.0723	0.0875	0.2081	0.4547	0.4576
α =0.015	0.3466	0.2418	0.0748	0.0874	0.2158	0.3613	0.5972

(b) A case of less persistent shock: $\sigma = 2.0, P_{i|i} = 0.50$

	Mean		S.D.		C.V.		
	Young	Old	Young	Old	Young	Old	Young/Old
α =0.005	0.3657	0.0819	0.055	0.0653	0.1504	0.7971	0.1886
α =0.01	0.3475	0.1924	0.0723	0.0875	0.2081	0.4547	0.4576
α =0.015	0.3466	0.2418	0.0748	0.0874	0.2158	0.3613	0.5972

(c) A case of lower substitutability between youth and adult: $\sigma = 1.0, P_{i|i} = 0.75$

	Mean		S.D.		C.V.		
	Young	Old	Young	Old	Young	Old	Young/Old
α =0.005	0.361	0.0725	0.1136	0.6291	0.1136	0.6291	0.1805
α =0.01	0.3441	0.1871	0.0472	0.0534	0.1372	0.2855	0.4805
α =0.015	0.3452	0.2406	0.0471	0.0517	0.1365	0.2148	0.6356

Table 4: Labor-market institution indexes (five-year intervals)

Employment Protection Legislation Index

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000	2003
Australia					0.3	0.3	0.3	0.3	0.4	0.4
Austria								0.73	0.73	0.63
Belgium						1.07	1.07	1.07	0.73	0.73
Canada					0.27	0.27	0.27	0.27	0.27	0.27
Denmark						0.77	0.77	0.47	0.47	0.47
Finland		0.77	0.77	0.77	0.77	0.77	0.77	0.72	0.7	0.67
France			0.57	0.84	0.93	0.93	1	1	1	1
Germany			0.83	1.07	1.07	1.07	1.07	1.03	0.83	0.78
Ireland				0.26		0.3	0.3	0.3	0.3	0.37
Italy			1.2	1.2	1.2	1.2	1.2	1.2	0.86	0.63
Japan			0.71	0.71	0.71	0.71	0.71	0.71	0.6	0.6
Netherland							0.9	0.9	0.7	0.7
New Zealand							0.3	0.3	0.5	0.5
Norway				0.97	0.97	0.97	0.97	0.9	0.87	0.87
Portugal				1.08	1.34	1.4	1.37	1.28	1.23	1.23
Spain				1.33	1.29	1.27	1.27	1.04	0.97	1.03
Sweden		0	0.23	0.86	1.17	1.17	1.17	0.83	0.73	0.73
Switzerland								0.33	0.37	0.37
United Kingdom						0.2	0.2	0.2	0.23	0.23
US	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Note: Index of strictness of employment protection legislation, which is increasing in the degree of employment protection legislation.
Source: CEP (2006)

Benefit Duration Index

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000	2003 年
Australia					1.02	1.02	1.02	1.02	1	1
Austria								0.71	0.7	0.72
Belgium						0.8	0.78	0.76	0.79	0.86
Canada					0	0	0	0	0	0
Denmark						0.62	0.61	1	0.9	0.8
Finland		0	0	0.66	0.65	0.51	0.5	0.56	0.56	0.58
France			0.23	0.21	0.28	0.36	0.48	0.51	0.55	0.5
Germany			0.57	0.62	0.62	0.6	0.6	0.59	0.6	0.6
Ireland				0.42		0.43	0.5	0.75	0.88	1
Italy			0	0	0	0	0	0	0.44	0.45
Japan			0	0	0	0	0	0	0	0
Netherland							0.71	0.67	0.66	0.66
New Zealand							1.04	1.04	1	1
Norway				0.37	0.49	0.49	0.49	0.51	0.6	0.38
Portugal				0	0	0.05	0.33	0.38	0.52	0.46
Spain				0	0.1	0.25	0.25	0.44	0.42	0.41
Sweden		0	0	0.05	0.05	0.05	0.05	0.05	0.04	0.03
Switzerland								0.16	0.3	0.2
United Kingdom						0.72	0.68	0.73	0.88	0.84
US	0	0.16	0.17	0.23	0.17	0.15	0.21	0.16	0.21	0.2

Note: Index of the level of benefits available in the later years of spell relative to those available in the first year.
Source: CEP (2006).

Benefit Replacement Ratio

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000	2003 年
Australia					23.5	23.5	25.5	27	24.7	22.5
Austria								32.5	32.2	31.6
Belgium						43.1	41.8	38.7	38.7	42.2
Canada					18.1	19.3	19.3	19.3	15.3	15.1
Denmark						53.1	51.7	64.9	56	49.5
Finland		4.2	6.7	23.9	25.1	34.4	36.4	35.8	34.1	35.7
France			25.6	26.3	27.7	34.4	37.3	37.4	40.2	39.4
Germany			29.4	29.1	29.7	28.3	28.2	26.3	28.2	29.2
Ireland				21.3		28.3	28.2	26.3	32.5	38.1
Italy			2	1.9	0.8	0.4	2.6	19.3	34.3	33.7
Japan			12.7	13.4	8.7	10.3	10	10.2	10.7	7.8
Netherland							54.3	52.3	52.5	52.6
New Zealand							31.3	27.1	28.5	27.5
Norway				7.6	24.5	38.8	38.8	38.8	41.7	34.4
Portugal				5.4	8	21.7	33	35.4	42.9	40.8
Spain				21.3	24.6	34.4	33.7	39	37.1	36
Sweden		5.2	6.6	22	25.1	27.9	29.2	26.9	24	24.5
Switzerland								29.5	37.4	33.1
United Kingdom						20.7	17.7	17.8	16.6	16.3
US	7.1	9.1	10.3	12.1	13.1	14.7	11.2	11.9	13.5	13.8

Note: Average number across the first five years of unemployment for three family situations and two money levels (%).
Source: CEP (2006).

Table 4: Labor-market institution indexes (five-year intervals), continued.

Union Density

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000	2003 年
Australia					49.9	50	46.5	35.3	24.5	22.7
Austria								41.1	36.5	
Belgium						52.4	53.9	55.7	55.6	
Canada					34.9	35.4	34.4	33.8	30.9	30.2
Denmark						78.2	75.3	77	74.4	70.4
Finland		38.3	51.3	65.3	69.4	69.1	72.3	79.2	76.2	77.4
France			21.7	22.2	18.3	13.6	10.1	9.8	9.7	9.8
Germany			32	34.6	34.9	34.7	31.2	29.2	25	22.6
Ireland				55.3		54.1	51.1	47.1	37.8	34.7
Italy			37	48	49.6	42.5	38.8	38.1	34.9	33.7
Japan			35.1	34.5	31.1	28.8	25.4	24	21.5	19.7
Netherland							25.5	25.7	23.1	22
New Zealand							51	27.6	22.7	
Norway				53.8	58.4	57.5	58.6	57.3	54.3	54.1
Portugal					59.7	54.6	31.7	25.4	23.5	
Spain						8.9	11	16.3	13.9	14
Sweden		66.3	67.7	74.5	78	81.3	81.5	86.6	80.3	78
Switzerland								22.9	19.4	
United Kingdom						46.2	39.3	32.9	31.2	30.5
US	30.9	28.2	27.4	25.3	22.1	17.4	15.3	14.2	12.9	12.3

Note: Union density is defined as the ratio of union membership over total employment (%).
Source: CEP (2006)

Union Coverage Ratio

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000
Australia					84	85	81.5	80.5	83
Austria								98.8	98
Belgium						90	91.5	90.5	93
Canada					38.5	39	38	35.3	32
Denmark						74	71	71.3	83
Finland		95	95	95	94	95	94	94.7	93
France					84	92	92.5	94.7	93
Germany			90	90	87	90	86.5	88	68
Ireland									
Italy			88	85	84	85	83	82.2	83
Japan					28	25.5	23	20.5	18
Netherland							73	84.7	83
New Zealand							65	30.5	28
Norway				65	71.5	70	71.5	70.5	73
Portugal					71.5	73.8	76	73	83
Spain					65.5	70	74.5	78.8	83
Sweden					83	83.8	84.5	89.7	93
Switzerland								51.3	43
United Kingdom						62	48.5	38.8	33
US	29	27	27	24	23.5	21	18	16.5	14

Note: Ratio of workers covered by collective agreements (%).
Source: CEP (2006)

Bargaining Centralisation Index

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000
Australia					4	4	2.8	2	2
Austria								3	3
Belgium						3	3	3	3
Canada					1	1	1	1	1
Denmark						3	3	2.4	2
Finland			5	5	4.4	4.6	5	5	5
France			2	2	2	2	2	2	2
Germany			3	3	3	3	3	3	3
Ireland				4		1.9	3.4	4	4
Italy			2	2	2.9	2.6	2	2	2
Japan			1	1	1	1	1	1	1
Netherland							3	3	3
New Zealand							1.8	1	1
Norway				4.5	3.9	4.1	4.5	4.5	4.5
Portugal				4.4	3.4	3	3.6	4	4
Spain				4.4	4	3.7	3.2	3	3
Sweden			5	5	4.7	3.6	3	3	3
Switzerland								2	2
United Kingdom						1	1	1	1
US			1	1	1	1	1	1	1

Note: Index of the degree of bargaining centralization. The index is increasing in the degree of centralization.
Source：CEP (2006)

Bargaining Coodination Index

Year	1960	1965	1970	1975	1980	1985	1990	1995	2000
Australia					4.3	4.2	2.8	2	2
Austria								4	4
Belgium						4	4	4.3	4.5
Canada					1.8	1	1	1	1
Denmark						3.6	3.4	3.6	4
Finland			5	5	4.4	4.6	5	5	5
France			2	2	2	2	2	2	2
Germany			4	4	4	4	4	4	4
Ireland				4		1.9	3.4	4	4
Italy			2	2	2.9	2.6	2.6	3.6	4
Japan			4	4	4	4	4	4	4
Netherland							4	4	4
New Zealand							2.2	1	1
Norway				4.5	3.9	4.1	4.5	4.5	4.5
Portugal				4.4	3.4	3	3.6	4	4
Spain				4.4	4	3.7	3.2	3	3
Sweden			4	4	3.7	3.2	3	3	3
Switzerland								4	4
United Kingdom						1	1	1	1
US			1	1	1	1	1	1	1

Note: Index of the degree of bargaining coordination. The index is increasing in the degree of coordination.
Source：CEP (2006)

Table 5: Descriptive statistics, 1971-2000

	obs.	mean	s.d.	min	max
Unemployment rate for 15-24	404	13.73	7.51	0.47	39.27
Unemployment rate for 25-34	388	6.65	4.00	0.38	21.96
Unemployment rate for 45-54	404	4.34	2.60	0.00	14.01
Population 15-24 / Population 15-55 (%)	404	26.30	3.36	19.78	34.37
Population 25-34 / Population 15-55 (%)	404	27.64	2.10	22.21	33.96
Labor productivity	404	239.82	737.04	9.10	4232.30
Employment Protection Legislation Index（EPL Index）	404	0.00	1.00	-1.80	1.75
Benefit duration ratio	404	0.00	1.00	-1.37	1.76
Benefit replacement ratio	404	0.00	1.00	-2.00	2.66
Union density	404	0.00	1.00	-1.65	2.26
Union contract coverage rate	404	0.00	1.00	-2.26	1.18
Union centralization index	404	0.00	1.00	-1.34	1.86
Union coordination index	404	0.00	1.00	-1.67	1.46

Note: Each institution index is calculated as a deviation from the mean over the standard deviation for normalization.

Table 6: The impact of overall unemployment rate growth on the age-specific unemployment rate growth

Independent variable : Δ (Unemployment rate)$_{age,t}$

Macroeconomic shock: Δ (Unemployment rate)$_{age,t}$

Estimation Method: Random Effects IV using Δ (Unemployment rate)$_{-age,t}$ as IV

VARIABLES	(1) $\Delta UE_{15\text{-}24,\,t}$	(2) $\Delta UE_{25\text{-}34,\,t}$	(3) $\Delta UE_{45\text{-}54,\,t}$	(4) $\Delta UE_{15\text{-}24,\,t}$ $-\Delta UE_{45\text{-}54,\,t}$	(5) $\Delta UE_{25\text{-}34,t}$ $-\Delta UE_{45\text{-}54,\,t}$
ΔUnemployment Rate$_{all\ ages,\,t}$	1.78	1.03	0.64	1.10	0.39
	(0.065)	(0.025)	(0.024)	(0.076)	(0.038)
Employment Protection Legislation $_{t-1}$	0.07	0.01	-0.02	0.09	0.03
	(0.101)	(0.040)	(0.039)	(0.116)	(0.059)
Benefit Duration $_{t-1}$	0.08	-0.01	-0.03	0.11	0.02
	(0.082)	(0.033)	(0.031)	(0.094)	(0.048)
Benefit Replacement Ratio $_{t-1}$	-0.13	0.01	0.01	-0.15	-0.00
	(0.077)	(0.030)	(0.029)	(0.088)	(0.045)
Union Density $_{t-1}$	0.03	-0.02	-0.00	0.03	-0.02
	(0.063)	(0.025)	(0.024)	(0.072)	(0.037)
Union Coverage $_{t-1}$	-0.10	0.01	0.04	-0.14	-0.02
	(0.101)	(0.040)	(0.039)	(0.116)	(0.059)
Centralization $_{t-1}$	0.06	-0.03	-0.01	0.07	-0.02
	(0.100)	(0.040)	(0.038)	(0.115)	(0.059)
Coordination $_{t-1}$	-0.02	0.02	0.01	-0.03	0.01
	(0.090)	(0.036)	(0.035)	(0.104)	(0.053)
Employment Protection Legislation $_{t-1} \times \Delta UE_{all\ ages,\,t}$	0.18	-0.01	-0.08	0.28	0.07
	(0.087)	(0.034)	(0.033)	(0.101)	(0.051)
Benefit Duration $_{t-1} \times \Delta UE_{all\ ages,\,t}$	-0.03	-0.06	-0.02	-0.01	-0.04
	(0.072)	(0.028)	(0.027)	(0.083)	(0.042)
Benefit Replacement Ratio $_{t-1} \times \Delta UE_{all\ ages,\,t}$	-0.17	0.08	0.07	-0.25	0.01
	(0.088)	(0.034)	(0.032)	(0.103)	(0.052)
Union Density $_{t-1} \times \Delta UE_{all\ ages,\,t}$	0.01	0.00	-0.03	0.05	0.03
	(0.053)	(0.021)	(0.020)	(0.061)	(0.031)
Union Coverage $_{t-1} \times \Delta UE_{all\ ages,\,t}$	0.31	-0.00	-0.04	0.32	0.03
	(0.116)	(0.046)	(0.044)	(0.134)	(0.068)
Centralization $_{t-1} \times \Delta UE_{all\ ages,\,t}$	-0.07	0.08	0.02	-0.01	0.06
	(0.148)	(0.058)	(0.055)	(0.174)	(0.087)
Coordination $_{t-1} \times \Delta UE_{all\ ages,\,t}$	-0.18	-0.09	0.05	-0.30	-0.14
	(0.157)	(0.062)	(0.059)	(0.185)	(0.093)
Δln(15-24population)	-7.93	0.36	-1.47	-6.28	1.79
	(3.871)	(1.541)	(1.482)	(4.450)	(2.284)
Δln(25-34population)	-5.32	-1.82	0.01	-5.18	-1.85
	(2.868)	(1.142)	(1.098)	(3.298)	(1.692)
Constant	-0.34	-0.15	0.08	-0.42	-0.23
	(0.249)	(0.099)	(0.095)	(0.286)	(0.147)
Observations	363	363	363	363	363
Number of countries	18	18	18	18	18

Notes: Standard errors are in parentheses. Each institution index is computed as the deviation from the mean over standard error. All specifications include year dummy variables.