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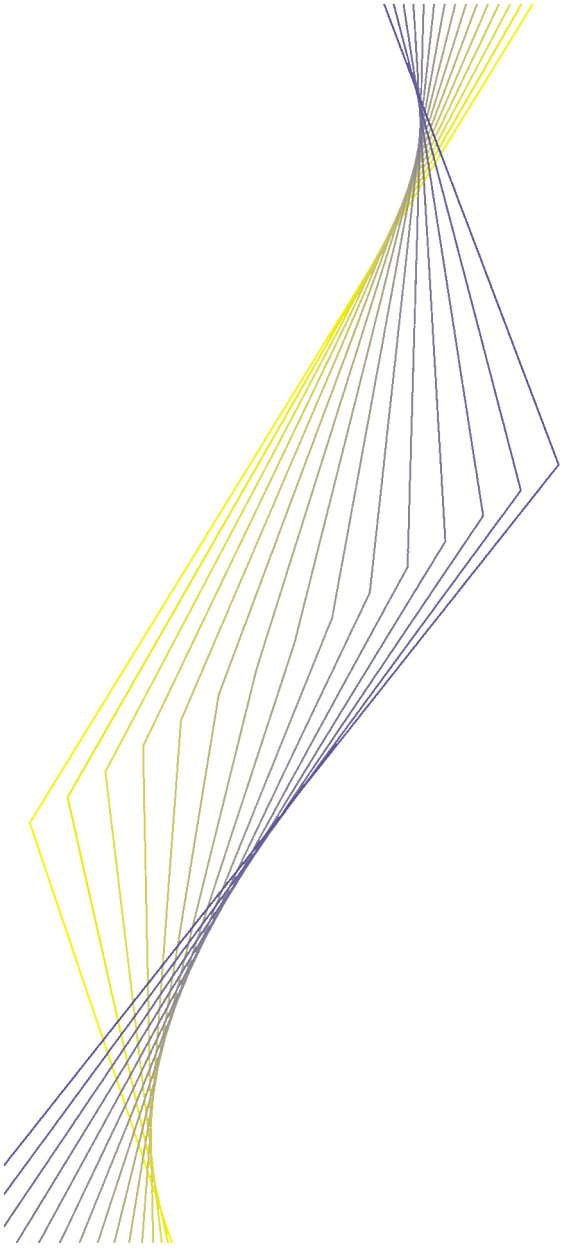

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YOUTH UNEMPLOYMENT IN THE OECD: DEMOGRAPHIC SHIFTS, LABOUR MARKET INSTITUTIONS, AND MACROECONOMIC SHOCKS[1]

BY JUAN F. JIMENO[2] AND DIEGO RODRIGUEZ-PALENZUELA[3]

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Abstract

We use a panel of OECD countries to gauge the relevance of the relative size of the youth population, labour market institutions and macroeconomic shocks at explaining observed relative youth unemployment rates. We find that the fluctuations of the youth population size caused by the baby boom of the 1950s and 1960s and the subsequent decline of fertility in many European countries are positively associated with fluctuations in relative youth unemployment rates. We also find that some labour market institutions contribute to increase youth unemployment, and that the adjustment to macroeconomic shocks has affected relatively more to young workers than to adult workers. To motivate the effects of institution on the relative unemployment rate of young workers, we lay out a simple theoretical model that builds on the imperfect substitutability of workers of different ages, and on the non-allocative role of (age specific) wages.

JEL Code: J64.

Keywords: youth unemployment, labour supply, labour market institutions.

Non-technical summary

The performance of the European economies in terms of unemployment rates has been in general dismal since the 1970s. Some significant improvements have only been seen in the recent years. Even within the EU there are some cross-country differences in the incidence of unemployment, which are more noticeable when unemployment rates are observed for particular demographic groups. While the unemployment rate of the prime age male workers has in most countries fluctuated around generally moderate average rates, those of the youth have fluctuated quite widely around considerably higher average rates. Therefore, a thorough understanding of the dismal performance of European labour markets should comprise an analysis of youth unemployment. Meanwhile, other motivations to study youth labour markets should not be discounted. First, the disaggregate analysis of unemployment across demographic groups might shed light on the precise workings of labour market institutions. Second, the analysis of youth unemployment could pave the way for the design of policies aimed at improving overall labour market performance. The beneficial effects of such reforms can hardly be exaggerated, as it has been well established by now that high youth unemployment rates have significant detrimental effects in factors that affect welfare in the longer term, like human capital accumulation and fertility rates.

This paper reviews the main factors explaining the unemployment rates of the youth. For this, we develop an analytical framework which suggests that to obtain a labour market equilibrium with broadly similar unemployment rates for prime age and young workers, a certain degree of wage flexibility must exist. In particular, two institutional characteristics would seem to be associated with high relative youth unemployment rates. First, those that have a positive impact on the overall cost of the standard labour contract (e.g. employment protection, a higher tax wedge, etc.) are likely to make young workers less attractive for firms, since given the average lower job experience of young workers their average productivity tends to be lower. Second, an instititutional setting that does not make provision for some contractual flexibility for the particular characteristics of the young workers (e.g. age-specific minimum wages, age-specific fiscal treatment) would leave the youth in disadvantage relative to more experienced prime age workers, if the general labour market setting is predominantly *rigid*.

The empirical results in the paper broadly confirm the insights in the theoretical part. Our main results follow the approach successfully implemented by Blanchard and Wolfers (2000) to study aggregate unemployment rates in OECD countries. This approach focuses primarily in the interaction of macroeconomic shocks and labour market institutions to account for countries unemployment performance. We implement this approach in a panel of OECD countries, to measure the joint effect of macroeconomic shocks, labour market institutions and

demographic developments to explain the (gender specific) youth relative unemployment rates (i.e. the difference between the youth unemployment rates -of men and women, respectively- and that of prime age male workers). The leading results indicate that -once the main relevant factors have been taken into account- demographic developments have a significant, albeit limited, impact on relative youth unemployment rates. In addition, it would appear that youth workers tend to play a role of a "buffer" to absorb macroeconomic shocks, through wider fluctuations in their unemployment rates. This is reflected in the very significant impact of cyclically-related variables in the relative youth unemployment rates (i.e. weaker activity along the economic cycle would have a strong impact on relative youth unemployment). Furthermore, this is reflected in the fact that cyclical variables seem to have a markedly stronger effects at higher (annual) frequencies than at lower (five year) frequencies. In addition, and in line with our model, we find that institutional settings that increase the overall rigidity of the labour market tend to increase the youth unemployment rate, and that specific institutional features that particularly reduce the restrictions affecting the youth labour markets (e.g. youth specific -lower- minimum wages, or lower strictness in temporary contractual forms) tend to somewhat reduce the relative youth unemployment rate.

1 Introduction

One of the main socioeconomic developments which has significantly challenged macroeconomists and labour economists in the last quarter of the 20th century is the rise in unemployment and its persistence at historically very high levels. Economists have been puzzled not only by the strikingly contrasting evolution of unemployment rates in the US, the EU and Japan, but also by significant differences across EU countries. The European unemployment experiences during the last quarter of the 20th Century are indeed markedly diverse. They range from the "success" stories of the Netherlands and the UK, which were able to revert the increase of unemployment after the mid-1980s (see Nickell and van Ours, 2000), to the partial success of Scandinavian countries, which with exception of the early 1990s were able to maintain relatively low unemployment rates, and finally to "failure" stories like, for instance, Spain, which sustained unemployment rates close to 20% during the 1980s and first half of the 1990s, although it has witnessed substantial progress in the fight against unemployment in the second half of the 1990s.

Many papers and much empirical effort have been devoted at explaining the causes of unemployment and its variability across countries and regions. The first vintage of papers in this branch of the literature used cross-sectional or pooled cross-sectional data on indicators of labour market performance and labour market institutions to account for unemployment differentials across countries (see Scarpetta, 1996, Nickell and Layard, 1999, Belot and van Ours, 2000). Recently, this literature has evolved into a new vintage of papers which try to explain unemployment differentials across countries by the interactions of macroeconomic shocks and labour market institutions (see Blanchard and Wolfers, 2000, and Bertola, Blau, and Kahn, 2002).[1]

There is another dimension of European unemployment which has received less attention in the macroeconomic literature, namely, the different incidence of unemployment and non-employment across gender and age population groups.[2] For instance, when comparing the EU and the US, it is the lower employment rates (higher unemployment rates) of youth, unskilled adult women, and workers

[1] There are also papers showing that, even within EU countries, labour market institutions seem to have different effects across regions creating persistent regional unemployment differentials (see Jimeno and Bentolila 1998, and Brunello *et al.*, 2001).

[2] Nonetheless, there have been many reports and conferences on the causes of youth and female unemployment, which are not very much cited in the literature about the macroeconomics of unemployment. See, for instance, the conferences and subsequent publications sponsored by the NBER, such as *The Youth Labor Market Problem*, 1982; *The Black Youth Employment Crisis*, 1986; *Training and the Private Sector, 1994*; *Youth Employment and Joblessness in Advanced Countries,* 2000, and by the OECD, such as *Youth Unemployment*, 1978; *The OECD Jobs Study*, 1994; *Employment Outlook*, 1986, 1996, 1998, 1999, and *From Initial Education to Working Life. Making Transition Works,* 2000.

aged 55-64 what explains the main bulk of the differences in aggregate employment and unemployment rates (see Dolado, Felgueroso, and Jimeno, 2001). Even within the EU, there is a clear division between the Nordic countries, where the gaps between female and youth unemployment rates and the aggregate ones are relatively small, and the Southern countries, where female and youth unemployment rates have been persistently at much higher levels than those of prime aged men. While it seems plausible that the lower employment rate of workers above 55 years of age is primarily the result of early retirement provisions rather than of any other labour market institutions (see Gruber and Wise, 1998), the unemployment rates of young, unskilled workers are most affected by labour market institutions which impose some kind of wage floors (like minimum wages, collective bargaining, employment protection legislation, unemployment benefits, and so on). As stressed by Bertola, Blau, and Kahn (2002) many labour market institutions have stronger and more clear cut implications for the *distribution* of wages than for the level of the *average* wage, and, hence, for the composition of employment and the incidence of unemployment across population groups with different levels of productivity.

The incidence of youth unemployment has been related to the effectiveness of the educational system at easing the transition from school to work (see, for instance, OECD, 2000), to some labour market institutions (such as unemployment benefits for the young, minimum wages, etc.), to the role of the family at providing income support (Bentolila and Ichino, 2000), and to the evolution of the relative size of the youth population (Korenman and Neumark, 2000).

As for demographic shifts, there have been indeed quite intense changes in the age composition of the labour force over the last three decades in OECD countries. The Figures in Appendix C (at the end of the paper) illustrate these changes by plotting the evolution of the youth population size (defined as proportion of the prime-aged population, that is, population aged 25-54, in the left scale)[3] together with the youth male and female unemployment rates and the unemployment rate of prime aged men (25-54 years of age, in the right-scale). All the countries in our sample experienced, first, an increase of the relative size of the youth population up to the early 1970s and then a decline (with the exceptions of Australia, Belgium, Germany, Italy, Spain, and the UK where this variable reached its peak in the early 1980s). Table 1 gives some descriptive statistics of the ratio of population aged 15-24 to the population aged 25-54. The range of variation over the sample of this variable is 11 percentage points. In Canada, The Netherlands and the US, the range of variation is above 20 percentage points.

[3]This is also the definition of relative size in Korenman and Neumark (2000). We choose for comparability with their results. But there is an additional justification. The participation rate of the population above 55 years age has been declining since the early 1980s in many countries, mainly due to early retirement and Social Security provisions.

Table 1. Relative size of youth population. Descriptive statistics

	Period	#obs	Mean	Std. Dev.	Min.	Max.
AUSTRALIA	1973-96	24	0.416	0.040	0.348	0.463
AUSTRIA	1988-94	7	0.342	0.036	0.293	0.392
BELGIUM	1983-96	14	0.344	0.036	0.293	0.398
CANADA	1973-96	24	0.419	0.084	0.298	0.518
DENMARK	1983-94	12	0.354	0.028	0.304	0.386
FINLAND	1979-96	18	0.325	0.040	0.279	0.391
FRANCE	1968-96	29	0.400	0.038	0.324	0.465
GERMANY	1968-94	27	0.355	0.042	0.261	0.406
IRELAND	1979-94	16	0.493	0.029	0.452	0.530
ITALY	1968-96	29	0.375	0.024	0.314	0.407
JAPAN	1973-96	24	0.338	0.025	0.302	0.393
NETHERLANDS	1972-96	26	0.399	0.059	0.277	0.483
NORWAY	1972-94	23	0.404	0.028	0.330	0.431
NEW ZEALAND	1986-96	11	0.428	0.034	0.376	0.481
PORTUGAL	1974-94	21	0.446	0.021	0.414	0.477
SPAIN	1972-96	25	0.431	0.017	0.388	0.450
SWEDEN	1979-96	18	0.335	0.022	0.292	0.354
UK	1970-96	27	0.386	0.042	0.296	0.435
USA	1968-96	29	0.439	0.079	0.313	0.524

As for youth unemployment, there are noticeable cross-country differences in prime age male unemployment rates, with the gap varying by gender, across countries, and across time. In most countries there is an increasing trend in youth unemployment rates (the exceptions being the US and, since the mid-1980s, Denmark, Ireland, The Netherlands and the UK). Youth unemployment rates have been particularly high in Belgium, Finland, France, Italy, and Spain, with a significant positive gap between men and women in the case of the last two countries, and to a lesser extent, in France. Table 2 reports some descriptive statistics of unemployment rates of the three population groups considered (men 15-24, women 15-24 and men 25-54)

Table 2. Unemployment rates. Some descriptive statistics

		Mean	Std. Dev.	Min.	Max.
Australia	Men, 15-24	0.132	0.047	0.031	0.208
	Women, 15-24	0.129	0.033	0.036	0.180
	Men, 25-54	0.049	0.023	0.008	0.089
Austria	Men, 15-24	0.055	0.007	0.046	0.066
	Women, 15-24	0.055	0.003	0.051	0.058
	Men, 25-54	0.054	0.007	0.045	0.065
Belgium	Men, 15-24	0.157	0.038	0.101	0.205
	Women, 15-24	0.236	0.049	0.152	0.303
	Men, 25-54	0.056	0.010	0.040	0.066
Canada	Men, 15-24	0.159	0.033	0.108	0.222
	Women, 15-24	0.130	0.022	0.081	0.168
	Men, 25-54	0.071	0.022	0.040	0.107
Denmark	Men, 15-24	0.111	0.030	0.070	0.181
	Women, 15-24	0.126	0.030	0.090	0.197
	Men, 25-54	0.067	0.017	0.040	0.101
Finland	Men, 15-24	0.165	0.109	0.074	0.371
	Women, 15-24	0.145	0.086	0.073	0.307
	Men, 25-54	0.069	0.045	0.023	0.159
France	Men, 15-24	0.123	0.073	0.026	0.242
	Women, 15-24	0.197	0.100	0.039	0.322
	Men, 25-54	0.044	0.028	0.008	0.097
Germany	Men, 15-24	0.048	0.033	0.001	0.104
	Women, 15-24	0.060	0.034	0.004	0.117
	Men, 25-54	0.035	0.024	0.002	0.066
Ireland	Men, 15-24	0.225	0.054	0.100	0.295
	Women, 15-24	0.177	0.045	0.081	0.232
	Men, 25-54	0.133	0.029	0.066	0.178
Italy	Men, 15-24	0.215	0.073	0.099	0.298
	Women, 15-24	0.288	0.122	0.103	0.422
	Men, 25-54	0.032	0.018	0.014	0.072

Table 2. Unemployment rates. (continued)

		Mean	Std. Dev.	Min.	Max.
	Men, 15-24	0.045	0.010	0.025	0.068
Japan	Women, 15-24	0.041	0.012	0.022	0.067
	Men, 25-54	0.017	0.004	0.010	0.025
	Men, 15-24	0.116	0.066	0.020	0.266
Netherlands	Women, 15-24	0.112	0.067	0.008	0.241
	Men, 25-54	0.052	0.031	0.012	0.122
	Men, 15-24	0.077	0.037	0.038	0.150
Norway	Women, 15-24	0.083	0.025	0.049	0.132
	Men, 25-54	0.021	0.018	0.004	0.057
	Men, 15-24	0.142	0.043	0.079	0.206
New Zealand	Women, 15-24	0.125	0.032	0.076	0.168
	Men, 25-54	0.058	0.023	0.023	0.088
	Men, 15-24	0.099	0.029	0.033	0.140
Portugal	Women, 15-24	0.194	0.068	0.051	0.282
	Men, 25-54	0.030	0.011	0.006	0.051
	Men, 15-24	0.245	0.115	0.046	0.393
Spain	Women, 15-24	0.336	0.170	0.028	0.510
	Men, 25-54	0.095	0.049	0.015	0.164
	Men, 15-24	0.113	0.082	0.039	0.277
Sweden	Women, 15-24	0.102	0.061	0.038	0.220
	Men, 25-54	0.037	0.032	0.011	0.096
	Men, 15-24	0.145	0.063	0.036	0.263
UK	Women, 15-24	0.109	0.052	0.017	0.198
	Men, 25-54	0.067	0.029	0.022	0.110
	Men, 15-24	0.126	0.029	0.062	0.191
USA	Women, 15-24	0.124	0.017	0.091	0.162
	Men, 25-54	0.046	0.016	0.016	0.082

The relevance of demographic changes at explaining youth unemployment is somewhat controversial. Korenman and Neumark (2000), using pooled cross-country data for some OECD countries, estimate the elasticity of the youth unemployment rate with respect to the youth cohort size to be around 0.5. Shimer (2001) challenges this result showing that across US states a higher share of the youth population *decreases* unemployment. Ahn, Izquierdo, and Jimeno (2000) find that, across Spanish regions, there seems to be a close positive relationship between the relative size of the youth population and youth unemployment. Bertola, Blau, and Kahn (2002) show that demographic shocks (i.e., changes in the youth population share) interacted with labour market institutions contribute

to explaining the difference in the aggregate unemployment rate and in the relative employment rates of young and female workers between the US and some EU countries.

In this paper we jointly estimate the relevance of demographic and institutional variables at explaining cross-country differences in youth unemployment rates. For this estimation, we construct a data set with gender and age specific unemployment rates, the relative size of youth population, and labour market institutions with information on 19 countries (the EU countries -excluding Luxembourg and Greece-, Norway, US, Canada, Australia, New Zealand, and Japan) over the 1968-1996 period.[4]

Before turning to the empirical analysis we present a theoretical framework to rationalise the relationship between the age composition of the labour force and labour market institutions, on the one hand, and the incidence of unemployment across different population age groups, on the other. The main assumption is that workers of different ages are not perfectly substitutes, so that, if some labour market institutions preclude the complete adjustment of relative wages, changes in the relative labour supply of workers of different ages will show up in different age specific unemployment rates. Thus, while in flexible labour markets (say, for instance, in the US) changes in the composition of the labour force would lead to changes in wage inequality, in countries in which labour market "rigidities" (e.g. minimum wages and other regulations with differentiated impacts on workers of different ages) keep wages above the clearing levels, we should expect a positive relationship between the relative size of youth population and youth unemployment. This conjecture is supported by the results in Bertola, Blau and Kahn (2002). Comparing the US and European experiences they identify some labour market institutions and the demographic evolutions that contribute to explaining both the low unemployment rate and the high wage inequality of the US relative to other OECD countries. However, it is plausible that both in "flexible" and "rigid" labour markets, relative wages adjust over the long-run, so that we should expect to observe a higher effect of demographics variables on unemployment differential on high frequency data than on low frequency data.

The rest of the paper is structured as follows. Section 2 presents a simple theoretical framework illustrating the relationship between the relative size of a given population group, relative wages and unemployment. Section 3 reports the relationship between youth unemployment and the relative size of youth population in our data set. Section 4 contains the main bulk of our empirical exercise, namely, the estimation of the relative importance of demographic shifts, institutional factors, and macroeconomic shocks at explaining the evolution of youth unemployment. For the estimation we use both annual data and five-year period averages to assess how long is the long run over which relative wages are supposed

[4]See Appendix A for the coverage of the sample and the definition of variables.

to adjust to demographic variables. Section 5 concludes.

2 Theoretical framework

2.1 Labour input, production and labour demand

In order to obtain a certain relationship between the age composition of the labour force and youth unemployment, the possibility of imperfect substitution between workers of different ages is introduced. Thus, let us assume that there are two "types" of workers, "young workers" (denoted by the subscript 1) and "adult workers" (denoted by the subscript 2), whose relative productivity is given by δ. Total labour input is a function of the two "types" of labour with a constant elasticity of substitution, i.e.,

$$N = [N_1^{\rho} + \delta N_2^{\rho}]^{1/\rho} \qquad 1 \geq \rho \geq 0$$

while the production function is given by

$$Y = [N_1^{\rho} + \delta N_2^{\rho}]^{\alpha/\rho} \qquad 1 \geq \alpha > 0$$

being α the degree of returns to labour. Firms produce to meet a constant elasticity demand curve, $Y = P^{-\theta}$, $\theta > 1$. The first-order condition of the cost minimization problem gives:

$$MRS = \delta \left(\frac{N_1}{N_2}\right)^{\frac{1}{\sigma}} \Rightarrow \frac{N_1}{N_2} = \left(\frac{w_2}{\delta w_1}\right)^{\sigma} \tag{1}$$

being $\sigma = \frac{1}{1-\rho} > 1$ the elasticity of substitution. Hence, the relative demand of young workers with respect to adult workers is decreasing in their relative unit labour costs, and the corresponding elasticity is given by the elasticity of substitution. This condition can be easily converted in labour demand curves for each worker type, which are given by:

$$N_1 = (\alpha k)^{\frac{1}{1-\alpha k}} w^{\lambda} w_1^{-\sigma} \tag{2}$$

$$N_2 = (\alpha k)^{\frac{1}{1-\alpha k}} w^{\lambda} \left(\frac{w_2}{\delta}\right)^{-\sigma} \tag{3}$$

being $k = 1 - \frac{1}{\theta} < 1$, a measure of the degree of competition in the product market, $w = \left[\delta^{\sigma} w_2^{1-\sigma} + w_1^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ the aggregate wage index, and $\lambda = \sigma - \frac{1}{1-\alpha k}$.

Condition (1) yields a relationship between relative unemployment, relative labour supply and relative wages. Let L_1 and L_2 be the labour supply of "young" and "adult" workers, respectively, so that $u_1 = \frac{L_1 - N_1}{L_1}$ and $u_2 = \frac{L_2 - N_2}{L_2}$ are the

unemployment rates of "young" and "adult" workers, respectively. Taking logarithms in equation (1) and using the approximation $\ln(1-u) \approx -u = \ln N - \ln L$, gives

$$\begin{aligned} u_1 - u_2 &= \ln L_1 - \ln L_2 - (\ln N_1 - \ln N_2) = \\ &= \sigma \ln \delta + \sigma(\ln w_1 - \ln w_2) + \ln L_1 - \ln L_2 \end{aligned} \tag{4}$$

Hence, the relative unemployment rate is determined by three factors: i) the relative efficiency of adult workers with respect to young workers, ii) relative wages, and iii) relative labour supply. Relative labor supply is determined by demographic evolutions. Relative efficiency is related to differences in efficiency across cohorts and, therefore, may depend upon technology requirements and the characteristics of educational systems. Finally, relative wages are affected by labor market institutions, such as minimum wages, employment protection legislation, unemployment benefits, etc. We now specify how relative wages are determined.

2.2 Wage determination

Under perfect competition relative wages adjust to clear the market. Under this institutional framework the reading of equation (4) is that there are exogenously given "full employment" unemployment rates for each group of the population (not necessarily equal across cohorts), and, hence, given the relative efficiency of adult workers and the elasticity of substitution, equation (4) yields a relationship between relative wages and relative labour supply. We consider an alternative institutional scenario in which wages are determined by collective bargaining between employers and workers. "Young" and "adult" workers have different reservation wages ($\overline{w}_1$ and $\overline{w}_2$, respectively) and different bargaining power (β_1 and β_2, respectively). Let Π be the firm's profit function. Wages are determined by the following Nash maximization problem:

$$\begin{aligned} &\max_{w_1,w_2} \left[(w_1 - \overline{w}_1) N_1\right]^{\beta_1} \left[(w_2 - \overline{w}_2) N_2\right]^{\beta_2} \Pi \\ \text{subject to} \quad : \quad &N_1 = (\alpha k)^{\frac{1}{1-\alpha k}} w^{\lambda} w_1^{-\sigma},\ N_2 = (\alpha k)^{\frac{1}{1-\alpha k}} w^{\lambda} \left(\frac{w_2}{\delta}\right)^{-\sigma} \end{aligned}$$

The first-order conditions can be expressed as:

$$\frac{\beta_1}{w_1 - \overline{w}_1} - \frac{\beta_1 \sigma}{w_1} = \left(\frac{\alpha k}{1-\alpha k} - \frac{\lambda(\beta_1 + \beta_2)}{w}\right) \left(\frac{w_1}{\overline{w}}\right)^{-\sigma}$$

and

$$\frac{\beta_2}{w_2-\overline{w}_2}-\frac{\beta_2\sigma}{w_2}=\left(\frac{\alpha k}{1-\alpha k}-\frac{\lambda(\beta_1+\beta_2)}{w}\right)\left(\frac{w_2}{\delta\overline{w}}\right)^{-\sigma}$$

where $\overline{w}=\left[\varphi\ln\overline{w}_1^{1-\sigma}+(1-\varphi)\overline{w}_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ is the aggregate workers' reservation wage (defined as the aggregate wage index corresponding to the reservation wages of each worker's type, being. φ the weight which depends upon relative supplies, $\varphi=\frac{L_1}{L_1+L_2}$). These two conditions yield

$$\frac{w_1}{w_1-\overline{w}_1}-\sigma=\gamma\delta^{-\sigma}\left(\frac{w_2}{w_2-\overline{w}_2}-\sigma\right)\left(\frac{w_1}{w_2}\right)^{1-\sigma} \tag{5}$$

where $\gamma\equiv\frac{\beta_2}{\beta_1}$ is the bargaining power of adult workers relative to the bargaining power of "young" workers.

The following particular case may be illustrative. Under a unit elasticity of substitution (Cobb-Douglas labour input function), the relative mark-up of wages over reservation wages of adult workers respect to younger ones is given just by the ratio of the relative bargaining power and the relative efficiency of adult workers:

$$\frac{w_1}{w_1-\overline{w}_1}-1=\frac{\gamma}{\delta}\left(\frac{w_2}{w_2-\overline{w}_2}-1\right)\Longrightarrow\frac{w_2-\overline{w}_2}{w_1-\overline{w}_1}=\frac{\gamma}{\delta}\frac{\overline{w}_2}{\overline{w}_1}$$

More generally, a number of results can be drawn from the model:

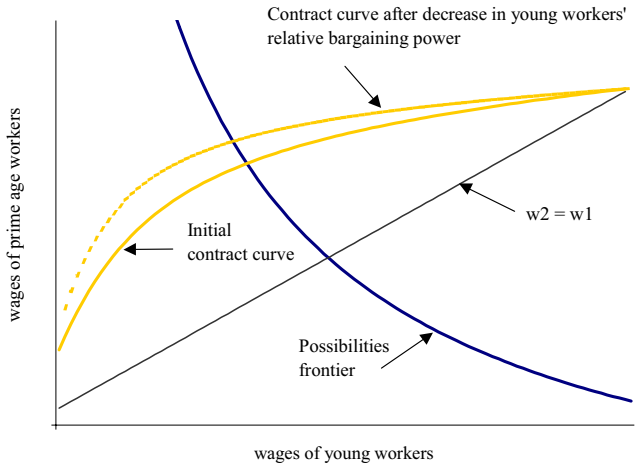
Proposition 1 *Let $w_2(w_1)$ be the function of w_1 implicitly defined by (5). $w_2(w_1)$ is the contract curve of older and young workers. Under $\gamma>1$ and $\overline{w}_2\geq\overline{w}_1>0$, it follows that:*

1. *$w_2(w_1)$ is increasing and concave. Moreover, $w_2(w_1)>w_1$.*
2. *An increase in relative bargaining power of older workers, γ, increases the relative wage of older workers w_2/w_1.*
3. *An increase in the relative efficiency of younger workers, δ, decreases the relative wage of older workers, w_2/w_1.*
4. *An increase in the aggregate wage w decreases the relative wage of older workers, w_2/w_1.*

Proof. See Appendix B. ■

Claims 1 and 2 are illustrated in Figure 1. The pairs of wages (w_2,w_1) that satisfy (5) (and which are always above the diagonal) is the increasing but concave

Figure 1: Effect of increase in youth relative bargaining power



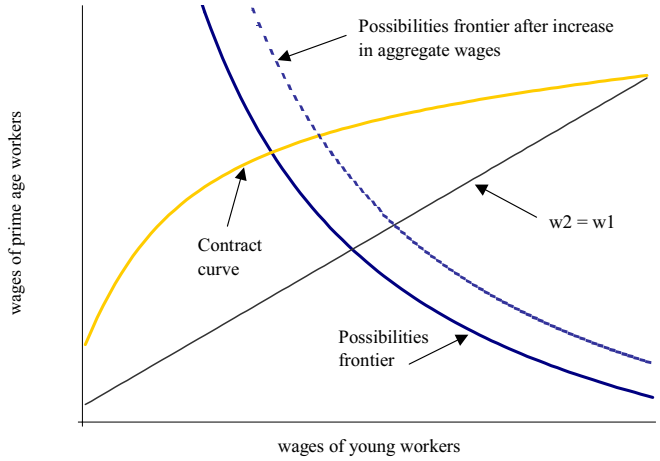
function in Figures 1 and 2. Increases in older workers relative bargaining power γ shifts this function upwards, particularly so for low values of w_1. Note in particular that a rise in γ not only increases the relative wage, but also decreases the youth wage w_1.

Claim 4 is similarly illustrated in Figure 2, which shows the effects of an increase in aggregate wages (resulting for example from an increase in aggregate labor demand or the aggregate reservation wage). An increase in the aggregate wage increases of course wages of both types of workers. But it also has an effect on wage inequality between young and older workers, which is reduced upon an increase in labor demand (as at the new equilibrium the contract curve is closer to the diagonal).

The combination of the results for relative wages in the Proposition and the relative unemployment rates equation (4) capture the links that go from labor market institutions (indexed by γ) and aggregate shocks (that affect labor demand), to the relative unemployment rate $(u_1 - u_2)$. Specifically, these variables are mainly related by the relative age-specific rent: $(w_2 - \overline{w}_2)/(w_1 - \overline{w}_1)$. In particular, since job tenure and longer work histories (which correlate with age) affect the bargaining power in a number of institutional contexts,[5] it seems natural to regard age as a variable correlated with bargaining power at wage setting.

[5] A number of labor market institution tend to favour the situation of older workers relatively to that of a recent entrant in the labour market. For example, in some countries unemployment benefits are only available to those losing an existing job, so that unemployed without a previous employment spells are not eligible. Also, firing costs typically increase with tenure.

Figure 2: Effect of increase in aggregate wages



As shown in Figure 1, the model implies in particular that institutional factors that increase adult workers' relative bargaining power, γ, increase the relative wage w_2/w_1 and therefore the relative labour market rent $(w_2 - \overline{w}_2)/(w_1 - \overline{w}_1)$. The effect of an increase in the relative wage of adult workers, in turn, makes young workers more attractive as hires, and the unemployment rate of the young *decreases* relative to that of the insiders, as equation (4) indicates.

Regarding the effects of aggregate shocks, as shown in Figure 2, shocks that increase aggregate labor demand (like increases in TFP or decreases in real rates), tend to decrease the *relative* wages of the older workers, therefore increasing the relative unemployment rate of the young. This result suggests that if a given institution (or shock) tends to increase the unemployment rate of the prime age workers but decreases the relative unemployment rate of the young, this institution could be generating, according to the model, relative rents to adult workers. We examine some of these hypothesis in the empirical section.

3 Empirical analysis I: Demographic shifts and relative youth unemployment

We start the empirical investigation of equation (4) above by estimating regressions where the dependent variable is the unemployment rate differential (the difference between the unemployment rate of the population aged 15-24 and the unemployment rate of male workers aged 25-54) and the independent variable is the relative size of youth population (defined as the size of population aged

15-24 over the population aged 25-54 in logarithms). Thus, the regression to be estimated is:

$$u1524_{it} - um2554_{it} = \mu_i + \mu_t + \beta\left[\ln(s1524)_{it} - \ln(s2554)_{it}\right] + \varepsilon_{it} \qquad (6)$$

where $u1524$ is the unemployment rate of men (women) aged 15-24, $um2554$ is the unemployment rate of men aged 25-54, $s1524$ is the relative size of population aged 15-24, and $s2554$ is the relative size of population aged 25-54. We include country and time specific fixed effects (μ_i, μ_t) but also report results when either time effects, or fixed effects or both are excluded from the regression. We run different regressions for men and women.

Results are reported in Table 3. The effect of the relative size of youth population on the youth unemployment differential is (almost always) positive and statistically significant. Overall, this effect seems to be higher for women than for men. Since it may seem too restrictive to impose a unit elasticity between the youth unemployment and that of men aged 25-54 over the business cycle, we also report the results from regressions where the (ln) unemployment rate of men aged 25-54 is included as an additional independent variable, which it turns out to be statistically significant in all specifications. In these regressions the coefficients on the relative size of the youth population remain positive, statistically significant, and within a same order of magnitude as in the regressions where youth unemployment rates are restricted to move with the unemployment rate of prime aged men one to one.

Overall the results are consistent with those obtained by Korenman and Neumark (2000) from a sample of 15 OECD countries over the period 1970-1994.[6] Moreover, the effect of demographic shifts on youth unemployment is not negligible. Being the coefficient of the demographic variable around 0.15 (roughly the average between the estimated coefficients for men and women in the regressions with country and time fixed effects) and since the mean unemployment rate of the population aged 15-24 in our sample is around 14%, the elasticity of the youth unemployment rate with respect to the relative size of the young population would be 1.07 and the observed variation of the latter would explain around 13% of youth unemployment and in the average country in our sample. A similar calculation yields that the elasticity of the youth unemployment differential with

[6] Notice, however, that Korenman and Neumark (2000) use a log-log specfication. Also, since there may be an endogeneity problem due to workers moving to low unemployment-high wage regions, some authors (Shimer, 2002, Korenman and Neumark, 2000, Bertola et al. 2002) use past birth rates as instruments in this type of regressions. However, their OLS results and IV results are not qualitatively different. The information in our sample for most countries span the period starting at the early 1970s, when international labour mobility became almost negligible. Hence, we find it non-necessary to perform IV estimation, which, given data availability, would require to exclude some countries from the sample and, hence, to reduce degrees of freedom, needed for other estimations to be performed.

respect to the relative size of the youth population is around 1.7 and that the latter explains roughly 20% of the youth unemployment differentials observed in our sample.

Table 3. Youth unemployment rate differentials and demographic shifts.

Dependent variable: u1524 − um2554	(A)	(B)
Men		
Includes constant	0.022 (1.3)	0.019 (1.3)
Includes country fixed effects	−0.049 (3.0)	0.053 (5.2)
Includes time fixed effects	0.111 (5.4)	0.044 (2.1)
Includes both country and time fixed effects	0.111 (5.5)	0.068 (4.6)
Women		
Includes constant	0.069 (2.4)	0.066 (2.4)
Includes country fixed effects	0.005 (0.2)	0.123 (6.1)
Includes time fixed effects	0.162 (4.6)	0.136 (3.5)
Includes both country and time fixed effects	0.224 (7.6)	0.186 (6.8)

Notes: Unsigned t-statistics in parentheses. $u1524$: unemployment rate of the population aged 15-24. $um2554$: unemployment rate of men aged 25-54 (A) Coefficient on the (ln) relative youth population size. (B) Coefficient on the (ln) relative youth population size when the unemployment rate of men aged 25-54 is included as an additional regressor.

4 Empirical analysis II: Demographic shifts, institutions, and interactions with shocks

We now turn to the analysis of the joint effects of a larger set of factors affecting age-specific unemployment rates. Our goals are twofold: i) to estimate the differential effects of demographic shifts, labour market institutions and macroeconomic shocks on the unemployment rates of three different population groups: men aged 15-24, women aged 15-24 and men aged 25-54, and ii) to assess the extent to which the effect of demographic shifts on youth unemployment rates vanishes over the medium run.

To achieve these goals we add to our data set the indicators of labour market institutions often used and some measures of macroeconomic shocks, namely, labour demand shifts, real interest rates and total factor productivity growth[7]. The information of labour market institutions is as in Blanchard and Wolfers (2000). It covers the unemployment benefits system (replacement rate and duration of benefits), the extent of active labour market policies (an instrumented measure of spending), wage determination (union density, union contract coverage, and the degree of coordination), the tax wedge, and the pervasiveness of employment protection legislation (from a ranking of OECD countries).[8] To this set of institutional variables we add a measure of relative minimum wages (computed on information from the OECD) and an indicator of the strictness of the legislation regarding the use of temporary contracts, two institutions which we expect to strongly influence youth unemployment through its effects on relative wages and hiring rates. As for macroeconomic shocks, we use Blanchard and Wolfers' (2000) measures of labour demand shifts, real interest rates, and total factor productivity growth.

Before commenting on the results there are some caveats to be made. First, when looking at the effects of labour market institutions on aggregate unemployment, it is reasonable to use medium-term averages to smooth out cyclical fluctuations in unemployment, even at the cost of reducing degrees of freedom (which are already quite limited in the typically available panel data set of this type). Given this restriction, when looking at the interactions of shocks and institutions, Blanchard and Wolfers (2000) and other papers using their data set (for instance, Bertola, Blau, and Kahn, 2002) impose some specific form of the interaction terms. Since we are interested not only in the medium-run evolution of the relative youth unemployment rate but also in its cyclical behaviour and its short-run response to the relative population size, we run our regressions with both annual data and five-year period averages as in Blanchard and Wolfers (2000).

Secondly, the use of time invariant labour market institutions may be contro-

[7] Ideally, the analysis of the effect of institutional variables on age and gender specific unemployment rates should include the role of age and gender specific labour market wages and rents, precisely as pointed out by the theoretical model above. Such data is available for some countries for some years, mainly from countries' labour force surveys (implying in particular that the information cannot be expected to be fully comparable across countries). Importantly, the availability of such evidence on age and gender specific wages clearly cannot match the coverage of our panel in terms of time period and number of countries (which is reflected in Table 1 above). Therefore, imposing ourselves the inclusion of demographically disaggregated wage data would imply a very considerable reduction on the final size of our data panel. Finally, the exclusion of wage data has the non-negligible advantage of facilitating the comparison of our results with the benchmark in Blanchard-Wolfers (2000). For all these reasons, we have chosen to analyse econometrically the *reduced-form* link between institutions and macroeconomic shocks to demographic unemployment performance.

[8] For a more detailed description of the variables, see Blanchard and Wolfers (2000).

versial. This implies that regressions including labour market institutions would be equivalent to regressions with country fixed effects. In other words, by choosing time invariant labour market institutions we renounce to controlling country fixed effects when estimating the impact of institutions on unemployment. Alternatively, we could have exploited changes in labour market institutions over the last decades, as done, for instance, in Nunziata (2001). In order to facilitate the comparability of our results with those of Blanchard-Wolfers (2000) for aggregate unemployment rates, we have chosen to stick to the time-invariant measures of institutional characteristics, leaving the analysis under time-varying institutional measures for further work.

The third caveat refers to the functional form of the unemployment equation to be estimated. Since our model is a labour demand model in which the equilibrium is defined in terms of relative employment rates, equation (4) links the unemployment differential between young and adult workers $(u_1 - u_2)$ and the rest of demographic and institutional variables[9].

Finally, it is becoming increasingly popular to use non-employment rates rather than unemployment rates when assessing the causes of different labour market performance across countries. This is quite sensible since very often the definition of unemployment has some country-specific component (like the verification of job search which is required for a non-working individual to be classified as unemployed) and the line between unemployed and non-participants in the labour markets is difficult to draw. However, for our interest in this paper, the use of youth employment rates would require to control for large changes occurring in demand and supply of education which affected participation of young workers in the labour market.

Given these qualifications, we start by performing the estimation following Blanchard and Wolfers' (2000) strategy of imposing a specific form of interaction between institutions and shocks. Tables 4 and 5 present the results regarding the effects of labour market institutions interacted with unobservable and observable shocks, respectively, on the prime age male unemployment rate, and on youth unemployment rates by gender, in levels, relative to the unemployment rate of prime age men, and in terms of the unemployment rate differential. Each Table has two panels reporting the results from estimation with annual data and with five-year averages.

The second column of Table 4a shows the effects of labour market institutions

[9] Alternatively, one could think of models in which the labour market equilibrium is defined in terms of *relative* unemployment rates, instead of *absolute differences* in unemployment rates (which are the focus of this paper). This would call for the estimation of unemployment equations in which the dependent variable is the (ln) of the youth relative unemployment rate $(\ln u_1 - \ln u_2)$. To avoid a rather lengthy set of results we report only the results from estimation of the first specification. Results for relative unemployment rates are available from the authors on request.

on the unemployment rate of men aged 25-54 ($um2554$). Higher replacement rates (*Rrate*), longer duration benefits (*Benefit*), stricter protection legislation (*EPL*), higher union density (*Udensity*), a higher tax wedge (*Twedge*), and lower coordination (*Coord*) all lead to higher unemployment of prime-age men, while the coefficients of expenditures on active labour market policies (A*lmp*) and union coverage (*Ucoverage*) are not statistically significant.[10] With the exception of the effect of active labour market policies, these results are very much in line with the results in Blanchard and Wolfers (2000) referred to the aggregate unemployment rate from five-year averages, which are replicated here in the second column of Table 4b. It turns out that when we estimate the equation with the observations grouped in five-year averages (as in Blanchard and Wolfers' (2000)), the effects of labour market institutions on the prime age male unemployment are qualitatively similar (see the third column in Table 4b), although standard errors are higher by the significantly lower number of observations (i.e., 404 observations in the regressions with annual data and 90 observations in the regressions with five-year averages).

Table 4a. Institutions interacted with unobservable shocks Annual data

	$um2554$		$u1524$		$u1524 - um2554$	
	Men		Men	Women	Men	Women
Rrate	0.016 (4.6)	0.011 (3.5)	0.006 (1.8)	0.002 (0.4)	0.001 (0.3)	−0.12 (1.6)
Benefit	0.166 (3.6)	0.099 (2.5)	0.089 (2.0)	−0.013 (0.2)	0.080 (1.4)	−0.224 (2.2)
Ucoverage	0.013 (0.1)	0.466 (2.3)	0.120 (0.5)	0.780 (2.2)	−0.188 (0.6)	1.712 (3.1)
EPL	0.032 (3.6)	−0.028 (1.5)	0.023 (1.1)	0.127 (4.7)	0.077 (2.9)	0.195 (5.1)
ALMP	−0.007 (0.8)	−0.006 (0.9)	0.001 (0.1)	0.017 (1.3)	0.003 (0.3)	0.052 (2.4)
Udensity	0.014 (2.7)	0.007 (1.5)	0.016 (3.1)	−0.013 (1.5)	0.024 (3.5)	−0.044 (3.0)
Twedge	0.022 (3.7)	0.023 (3.8)	0.046 (6.5)	0.054 (5.9)	0.064 (7.3)	0.073 (5.6)
Coord.	0.362 (5.7)	0.254 (3.8)	0.227 (3.1)	0.294 (2.6)	0.200 (2.1)	0.259 (1.6)
Ypop		1.251 (4.8)	1.062 (4.3)	0.258 (1.2)	0.858 (3.6)	0.941 (3.5)
Temp		1.683 (3.8)	0.502 (1.0)	1.200 (1.8)	−0.637 (1.0)	2.578 (2.4)
Rwmin		0.009 (0.5)	−0.033 (1.6)	−0.117 (3.8)	−0.077 (2.9)	−0.187 (4.2)
Adjusted R^2	0.923	0.933	0.937	0.954	0.933	0.957

[10] The variables *ALMP* and *Coord* are defined with a negative sign, so that increases in all institutional variables are expected to increase unemployment.

Notes: t-statistics in parentheses. Regressions include country and time fixed effects.

The rest of the columns in Tables 4a and 4b report the estimated effects of labour market institutions interacted with unobservable shocks on youth unemployment rates ($um1524$, for men, and $uf1524$, for women) and on the differential between youth unemployment rates and the unemployment rate of prime-aged men ($um1524-um2554$ and $uf1524-um2554$, respectively). In these regressions we also include the relative size of the youth population (*Ypop*, measured as the (log) ratio of the population aged 15-24 over the population aged 25-54) and two additional labour market institutions: the degree of strictness of regulation of temporary employment (*Temp*, taken from OECD, 1994) and the (log) ratio of the minimum wage applying to young workers over the minimum wage applying to prime-aged workers (*Rwmin*, also from OECD, 1994). In most countries this ratio is equal to one, since there are not sub-minimum wages for young workers, but it is below one in Australia (0.7), Belgium (0.9), France (0.8), Ireland (0.7) Netherlands (0.8) and Portugal (0.8).

Table 4b. Institutions interacted with unobservable shocks
Five-year averages

	u	$um2554$		$u1524$		$u1524 - um2554$	
		Men		Men	Women	Men	Women
Rrate	0.017 (4.9)	0.010 (1.6)	0.005 (1.2)	0.001 (0.2)	0.002 (0.2)	−0.004 (0.5)	−0.005 (0.5)
Benefit	0.202 (4.7)	0.191 (2.1)	0.070 (1.1)	0.077 (1.1)	−0.002 (0.0)	0.101 (1.1)	−0.155 (1.1)
Ucoverage	0.101 (0.5)	0.023 (0.1)	0.450 (1.5)	0.118 (0.3)	0.563 (1.1)	−0.215 (0.5)	1.055 (1.5)
EPL	0.044 (3.0)	0.040 (1.4)	−0.042 (1.5)	0.007 (0.2)	0.113 (2.7)	0.069 (1.6)	0.165 (3.2)
ALMP	0.017 (2.9)	−0.014 (0.9)	−0.009 (1.1)	0.004 (0.3)	0.009 (0.5)	0.015 (1.0)	0.025 (1.1)
Udensity	0.008 (2.0)	0.005 (0.5)	0.002 (0.3)	0.012 (1.6)	−0.007 (0.6)	0.020 (2.0)	−0.020 (1.2)
Twedge	0.018 (3.1)	0.009 (0.8)	0.014 (1.5)	0.036 (3.2)	0.047 (3.2)	0.057 (4.0)	0.067 (3.6)
Coord.	0.299 (5.1)	0.315 (2.5)	0.196 (2.0)	0.139 (1.2)	0.253 (1.4)	0.064 (0.4)	0.241 (1.1)
Ypop.			2.028 (4.8)	1.614 (3.5)	0.530 (1.4)	1.083 (2.4)	0.602 (1.5)
Temp			0.032 (1.1)	−0.021 (0.6)	−0.100 (2.0)	−0.086 (1.9)	−0.157 (2.5)
Rwmin			1.383 (2.1)	0.333 (0.4)	0.472 (0.5)	−0.679 (0.7)	0.817 (0.6)
Adjusted R^2	0.948	0.934	0.942	0.946	0.955	0.941	0.955

Notes: Unsigned statistics in parentheses. Regressions include country and time

fixed effects. The estimates for the total unemployment rate are from Blanchard and Wolfers (2000).

As for the effects on the level of youth unemployment, we find some differential effects of the institutions on male and female youth unemployment rates. Young men' unemployment rates are significantly increased by the duration of unemployment benefits, union density, the tax wedge and lower coordination. For young women, unemployment rates are increased by higher levels in union coverage, stricter employment protection legislation the tax wedge and by lower coordination. Furthermore, the sixth and seventh columns in Table 4a show that the youth unemployment *differential* increases with the strictness of employment protection legislation (EPL), union density, tax wedge and decreases with coordination, in the case of males. As for females, the differential increases with union coverage strictness of EPL, the tax wedge and the degree of strictness of temporary employment, and decreases with union density. When estimating with five-year averages we find that youth unemployment differentials increase with union density and the tax wedge, in the case of young men, and with the strictness of EPL and the tax wedge, in the case of young women.

We also investigate the relevance of the interactions between labour market institutions and some observable shocks at explaining cross-country differences in aggregate and youth unemployment rates, as in Blanchard and Wolfers (2000). As for observable shocks we consider the demographic shifts ($Ypop$), measured as the relative size of the population aged 15-24 over the population aged 25-54, and:

1. Shifts in labour demand ($LD\ shift$).
2. Ex-post real interest rates ($RIrate$), and
3. Productivity growth (TFP).

Equations (4) and (5) are useful to illustrate why these shocks may have a different impact on the youth unemployment rate with respect to the unemployment rate of prime aged men. First, shifts in labour demand translate into lower employment if real wages do not adjust, and, even if these shifts are evenly distributed across sectors and occupations, there are no reasons to expect that the wages of youth workers respond similarly to the wages of adult workers, particularly if collective bargaining, and concerns about wage compression, are widespread. Secondly, productivity growth may affect the relative efficiency of "young" versus "adult" workers (δ in Section 2). Higher productivity growth may result in lower employment opportunities for young, unskilled workers, if educational systems are not flexible enough to adjust for providing better professional qualifications. Finally, higher ex-post real interest rates imply a higher

cost of capital, and, hence, lower employment creation and, possibly, also higher gross rates of employment destruction, affecting most to capital intensive sectors. Thus, higher real interest rates are likely to have different effects on prime-age and younger, as workers different ages tend not to be evenly distributed across sector and occupations.

Tables 5a and 5b report the results from both annual data and five-year averages regressions on the effects of the interactions between labour market institutions and observable shocks on unemployment rates of young and prime age workers.

Table 5a. Institutions interacted with observable shocks
Annual data

	$um2554$		$u1524$		$u1524 - um2554$	
	Men		Men	Women	Men	Women
LD shift	0.342 (7.7)	0.315 (6.6)	0.773 (5.9)	0.699 (4.8)	0.462 (5.2)	0.016 (0.2)
RIrate	0.244 (4.8)	0.221 (4.5)	0.374 (3.0)	0.402 (3.3)	0.141 (1.9)	−0.000 (0.1)
TFP	−0.172 (5.0)	−0.162 (4.7)	−0.281 (3.6)	−0.070 (0.8)	−0.112 (2.5)	0.002 (0.2)
Ypop		−0.022 (1.6)	0.009 (0.3)	0.074 (2.0)	0.021 (1.0)	0.007 (0.2)
Rrate	0.002 (0.5)	−0.006 (0.9)	−0.001 (0.1)	−0.008 (0.6)	−0.009 (0.1)	−0.740 (0.2)
Benefit	0.178 (2.2)	0.157 (2.0)	0.280 (2.8)	0.350 (2.2)	0.379 (3.0)	−0.291 (0.2)
Ucoverage	−0.326 (0.9)	0.177 (0.5)	−0.686 (1.2)	−0.061 (0.0)	−1.572 (2.1)	0.348 (0.2)
EPL	−0.012 (0.5)	−0.019 (0.6)	0.017 (0.4)	0.041 (0.6)	0.069 (1.3)	0.361 (0.2)
ALMP	−0.012 (0.8)	−0.021 (1.5)	−0.012 (0.7)	0.006 (0.2)	−0.006 (0.2)	0.315 (0.2)
Udensity	0.008 (1.0)	−0.001 (0.1)	0.019 (1.5)	−0.002 (0.1)	0.036 (2.2)	−0.713 (0.2)
Twedge	0.032 (3.0)	0.026 (1.9)	0.046 (2.3)	0.080 (2.1)	0.060 (2.1)	0.336 (0.2)
Coord.	0.091 (0.8)	0.007 (0.0)	0.086 (0.5)	0.090 (0.3)	0.102 (0.5)	0.171 (0.2)
Temp		−0.045 (0.9)	−0.001 (0.0)	−0.080 (0.7)	0.027 (0.3)	0.020 (0.2)
Rwmin		1.473 (1.9)	0.136 (0.1)	1.941 (1.2)	−0.740 (0.6)	0.284 (0.2)
Adjusted R^2	0.883	0.884	0.881	0.875	0.874	0.874

Notes: t-statistics (in absolute value) in parenthesis. Regressions include country and time fixed effects.

Both for prime aged men and young workers, the unemployment rate increases with negative shifts in labour demand, the real interest rate, and TFP growth in the regressions with annual data.[11]. These effects are larger for young men, so that the difference between the unemployment rate of young men and that of prime aged men increases with negative labour demand shifts, interest rates and TFP growth in the short-run. Over five year periods, youth unemployment differentials increase with the real interest rate and decreases with TFP growth, while labour demand shifts become barely statistically significant. As for the coefficients on labour market institutions, in this specification the only variable

[11] TFP growth is multiplied by -1, so that a negative coefficient implies unemployment increasing with TFP growth.

with a consistently positive effect on the youth unemployment differential, both with annual data and five-year averages, is the tax wedge. As for the demographic variable, in this specification we find much lower coefficients, which are statistically significant only in the case of women. While the results from estimation with five-year averages are similar for labour demand shifts and real interest rates, the coefficient of TFP growth changes sign indicating a positive effect of TFP growth on unemployment. This is consistent with some macroeconomic evidence from Structural VAR estimation which finds that productivity growth raises unemployment at high frequencies, while this effect vanishes or become negative at low frequencies (see, for instance, Galí, 1999)

Table 5b. Institutions interacted with observable shocks
Five-year averages

	u	$um2554$		$u1524$		$u1524 - um2554$	
		Men		Men	Women	Men	Women
LD shift	0.319	0.301	0.323	0.623	−0.135	0.273	−0.143
	(2.5)	(3.6)	(3.6)	(2.7)	(0.7)	(1.9)	(1.0)
RIrate	0.470	0.383	0.395	0.828	0.765	0.429	0.587
	(5.0)	(4.2)	(3.8)	(3.3)	(3.1)	(2.8)	(3.1)
TFP	0.730	0.155	0.147	0.665	1.951	0.556	1.536
	(5.1)	(1.0)	(0.9)	(1.7)	(3.2)	(2.3)	(3.3)
Ypop			0.005	0.046	0.128	0.040	0.100
			(0.2)	(0.8)	(2.3)	(1.1)	(2.3)
Rrate	0.026	−0.005	−0.005	−0.003	0.027	−0.002	0.022
	(3.8)	(0.6)	(0.5)	(0.2)	(1.2)	(0.1)	(1.0)
Benefit	0.473	0.310	0.292	0.308	0.227	0.303	0.193
	(5.1)	(2.6)	(2.4)	(1.9)	(0.7)	(1.5)	(0.6)
Ucoverage	−0.453	−0.487	−0.090	−0.658	0.410	−1.263	0.085
	(1.0)	(0.9)	(0.1)	(0.7)	(0.2)	(1.1)	(0.0)
EPL	0.404	0.002	−0.027	0.018	0.127	0.075	0.167
	(7.1)	(0.1)	(0.5)	(0.3)	(0.8)	(0.9)	(1.0)
ALMP	0.030	−0.031	−0.036	−0.011	0.113	0.033	0.101
	(1.4)	(1.4)	(1.6)	(0.3)	(1.7)	(0.7)	(1.7)
Udensity	0.033	0.007	0.001	0.020	−0.005	0.042	0.000
	(2.9)	(0.5)	(0.1)	(1.1)	(0.2)	(1.6)	(0.0)
Twedge	0.034	0.026	0.010	0.046	0.083	0.092	0.087
	(2.4)	(1.7)	(0.4)	(1.5)	(1.7)	(2.2)	(1.8)
Coord.	0.421	0.116	0.151	0.1713	0.392	0.144	0.284
	(2.9)	(0.6)	(0.6)	(0.6)	(0.6)	(0.4)	(0.4)
Temp			0.029	0.010	−0.093	−0.035	−0.135
			(0.3)	(0.1)	(0.6)	(0.3)	(0.8)
Rwmin			1.354	0.040	2.068	−1.327	1.548
			(1.1)	(0.0)	(0.6)	(0.6)	(0.4)
Adjusted R^2	0.671	0.896	0.894	0.890	0.880	0.884	0.867

Notes: t-statistics (in absolute value) in parenthesis. Regressions include country and time fixed effects. The estimates for the total unemployment rate are from Blanchard and Wolfers (2000).

Finally, to further examine the effects of labour market institutions and macroeconomic shocks on youth unemployment we estimate additional regressions without imposing any specific forms of interaction between both. Table 6 reports the results from linear regressions including labour market institutions, macroeconomic shocks, the relative size of the youth population and time fixed effects. As for macroeconomic shocks, we continue finding that TFP growth increases the difference between the unemployment rate of young men and the unemployment rate of adult males at the annual frequency. And the relative size of youth population increases youth unemployment, with the corresponding elasticity of the same order of magnitude both at annual and five year period frequencies.

Table 6a. Shocks, Institutions, and Unemployment
Linear regressions. Annual data

	$um2554$	$u1524$		$u1524 - um2554$	
	Men	Men	Women	Men	Women
LD Shift	0.147	0.179	0.018	0.032	−0.129
	(8.7)	(4.3)	(0.3)	(1.0)	(2.5)
RIrate	0.004	−0.283	−0.343	−0.287	−0.347
	(0.1)	(2.0)	(1.8)	(2.7)	(2.0)
TFP	−0.189	−0.332	−0.170	−0.146	0.016
	(5.7)	(4.1)	(1.5)	(2.4)	(0.2)
Ypop	0.045	0.161	0.270	0.116	0.225
	(4.7)	(6.9)	(8.3)	(6.6)	(7.6)
Rrate	0.001	0.001	0.001	−0.001	−0.001
	(9.6)	(2.2)	(1.7)	(2.2)	(1.3)
Benefit	0.005	−0.007	−0.014	−0.013	−0.019
	(5.5)	(3.2)	(4.2)	(7.2)	(6.4)
Ucoverage	−0.005	0.039	0.054	0.044	0.060
	(1.0)	(3.2)	(3.2)	(4.8)	(3.9)
EPL	0.003	0.003	0.005	0.000	0.002
	(6.3)	(2.7)	(3.3)	(0.2)	(1.6)
ALMP	0.001	0.002	0.002	0.001	0.001
	(5.4)	(4.8)	(4.4)	(3.5)	(3.1)
Udensity	0.001	0.001	0.000	0.001	−0.001
	(7.8)	(4.7)	(0.2)	(2.0)	(2.3)
Twedge	0.001	0.002	0.002	0.002	0.002
	(1.9)	(5.1)	(4.4)	(5.8)	(4.3)
Coord	0.016	0.044	0.042	0.028	0.026
	(10.1)	(11.5)	(7.8)	(9.8)	(5.3)
Temp	−0.001	0.000	0.003	0.002	0.004
	(2.9)	(0.4)	(1.9)	(2.0)	(3.1)
Rwmin	−0.015	0.078	0.132	0.094	0.147
	(1.3)	(2.7)	(3.3)	(4.3)	(4.0)
Adjusted R^2	0.751	0.700	0.658	0.643	0.616

Notes: Unsigned t-statistics in parenthesis. Regressions include time fixed effects.

As regards the effects of labour market institutions, higher replacement rates and longer duration of unemployment benefits decrease the youth unemployment differential. This effect of the generosity of unemployment benefits on youth unemployment differentials could be expected from the fact that in some EU countries young unemployed workers without previous employment spells are non-eligible for unemployment benefits. That is, in this regard, these institutional factors would be primarily related to wage formation by prime age workers and only secondarily to wage developments of younger workers. This, together with the fact that these workers are mutually substitutes, could explain the effect of unemployment benefits on the relative unemployment rate. This precisely corresponds to the intuition derived from the model laid out above.

Table 6b. Shocks, Institutions, and Unemployment Linear regressions. Five-year averages

	$um2554$	$u1524$		$u1524 - um2554$	
	Men	Men	Women	Men	Women
LD Shift	0.127 (4.1)	0.157 (2.0)	0.055 (0.5)	0.029 (0.5)	−0.072 (0.7)
RIrate	0.155 (1.2)	0.119 (0.4)	0.203 (0.4)	−0.036 (0.2)	0.048 (0.1)
TFP	−0.407 (3.1)	−0.584 (1.7)	0.162 (0.3)	−0.177 (0.7)	0.569 (1.2)
Ypop	0.054 (3.0)	0.167 (3.7)	0.273 (4.0)	0.113 (3.3)	0.219 (3.6)
Rrate	0.001 (5.2)	0.001 (1.4)	0.001 (1.0)	−0.000 (0.9)	−0.000 (0.4)
Benefit	0.005 (2.8)	−0.007 (1.7)	−0.012 (1.8)	−0.012 (3.6)	−0.017 (2.8)
Ucoverage	−0.000 (0.0)	0.042 (1.8)	0.047 (1.4)	0.042 (2.4)	0.047 (1.5)
EPL	0.002 (2.7)	0.002 (1.1)	0.006 (2.0)	0.000 (0.0)	0.004 (1.4)
ALMP	0.001 (2.5)	0.001 (2.2)	0.002 (2.2)	0.001 (1.6)	0.002 (1.8)
Udensity	0.001 (3.9)	0.001 (2.6)	0.001 (0.8)	0.001 (1.4)	−0.001 (0.3)
Twedge	0.001 (1.5)	0.002 (2.7)	0.003 (2.2)	0.002 (2.8)	0.002 (2.0)
Coord	0.016 (5.8)	0.044 (6.3)	0.042 (3.9)	0.028 (5.3)	0.026 (2.7)
Temp	−0.001 (1.3)	0.001 (0.6)	0.003 (1.0)	0.002 (1.4)	0.004 (1.4)
Rwmin	0.009 (0.4)	0.112 (2.0)	0.131 (1.6)	0.103 (2.5)	0.122 (1.6)
Adjusted R^2	0.763	0.700	0.624	0.630	0.580

Notes: Unsigned t-statistics in parenthesis. Regressions include time fixed effects.

Regarding the institutional variables related to wage determination, higher incidence of unions and of collective bargaining increase the relative youth unemployment rate and the youth unemployment differential, something which Kahn (2000) also finds in a panel of 15 OECD countries over the period 1985-94. As unions compress wages, low productivity, unskilled, young workers are priced out of employment. This is also confirmed by the positive effect of relative statutory minimum wages (*Rwmin*) on the youth unemployment differential.[12] Moreover, a similar relative wage effect also appears through the tax wedge variable. Increases in the tax wedge have the strongest impact on the employment opportunities of workers at the *bottom* of the wage distribution, where restrictions from minimum wage legislation are frequently binding. Hence, as the tax wedge rises, youth unemployment rates ought to be expected to rise by more than prime age male unemployment, as it is the case according to the corresponding coefficients in Tables 4 and 5. As for EPL and the strictness of regulation affecting temporary employment, the ranking measures included in the regression do not seem to be associated with higher relative youth unemployment. As shown by Dolado, Felgueroso, and Jimeno (2002), countries with stricter employment protection legislation liberalised "atypical" employment contracts (temporary, fixed-term contracts) to a larger extent, which have resulted in a higher hiring rates for young workers. In fact, we find that the youth unemployment differential (in some specifications) is higher the stricter the regulation affecting temporary employment, although admittedly the estimated coefficients are not statistically significant in all our specifications.

Overall, we draw two main conclusions from the evidence presented in this paper. First, wage-compressing institutions increase the youth unemployment differential, in the spirit of the model in Section 2. Secondly, there is a large and significant effect of the relative size of the youth population both on youth unemployment rates and youth unemployment differentials with respect to the unemployment rate of prime age men. In this case, this effect seems to be of a similar order of magnitude in the short-run (annual data) and in the medium run (five-year period), suggesting that the effects of demographic shifts on youth unemployment differentials are not short-lived and that relative wages by age take time to adjust.

5 Concluding remarks

In recent work Korenman and Neumark (2000) explain cross-country differences in youth unemployment rates by demographic shifts causing fluctuations in the relative size of the youth population. Blanchard and Wolfers (2000) explain

[12] The measure of relative minimum wages is the ratio of young minimum wages to adult minimum wages as provided by OECD.

cross-country differences in aggregate unemployment rates by appealing to different labour market institutions, the different incidence of macroeconomic shocks, and the interaction between both. In this paper we have combined all these factors (demographic, institutional, and macroeconomic) to gauge their relative relevance at explaining cross-country differences in relative youth unemployment rates. Our data set is a non-balanced panel of 19 OECD countries over the 1960-1996 period. We perform estimation on a extensive number of specifications involving demographic, institutional and macroeconomic variables. Our results show that: i) the relative size of the youth population is a non-negligible factor at explaining cross-country differences in youth unemployment, ii) labour market institutions and macroeconomic shocks have had differential effects on age-specific unemployment rates, and iii) "more" rigid labour markets imply higher relative youth unemployment rates. We rationalise these results as the composition of imperfect substitution of workers of different ages in production and imperfect competition in the labour market delivering less than full adjustment of relative wages to relative supply.

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Appendix A: Data sources.

Our data set is constructed from three sources of information:

1. EUROSTAT (for EU countries) and UN *Population Statistics Yearbook* give annual information on the composition of population by ages and gender. For the US we took the information provided in the web page of the US Bureau of Labor Statistics (www.bls.org)

2. Data on age-specific unemployment and employment rates are from the *OECD Labour Force Statistics.*

3. Data on labour market institutions and macroeconomics shocks are from Blanchard and Wolfers' (2000) data set.

The following table gives the countries, period and number of observations included in our sample.

Table A1. Sample composition

Country	**Period**	**N^o obs.**
Australia	1973-96	24
Austria	1988-94	7
Belgium	1983-96	14
Canada	1973-96	24
Denmark	1983-94	12
Finland	1979-96	18
France	1968-96	29
Germany	1968-94	27
Ireland	1979-94	16
Italy	1968-96	29
Japan	1973-96	24
Netherlands	1971-96	26
Norway	1972-94	23
New Zealand	1986-96	11
Portugal	1974-94	21
Spain	1972-96	25
Sweden	1979-96	18
UK	1970-96	27
USA	1968-96	29

Appendix B: Proof of proposition 1

Equation (5) in the text is:

$$\frac{w_1}{w_1-\overline{w}_1}-\sigma=\gamma\delta^{-\sigma}\left(\frac{w_2}{w_2-\overline{w}_2}-\sigma\right)\left(\frac{w_1}{w_2}\right)^{1-\sigma}$$

From the first order conditions of the bargaining problem it follows that for $s=1,2:$ $\frac{w_s}{w_s-\overline{w}_s}-\sigma>0$, since the associated shadow variable is positive. Moreover, this equation can be rewritten as:

$$\frac{h\left(w_1,\overline{w}_1\right)}{h\left(w_2,\overline{w}_2\right)}=\gamma\delta^{-\sigma} \tag{7}$$

where $h\left(w_s,\overline{w}_s\right)\equiv\left(\frac{w_s}{w_s-\overline{w}_s}-\sigma\right)w_s^{\sigma-1}$, which implicitly defines $w_2\left(w_1\right)$. It is easy to show (using the previous inequality) that $\partial h/\partial w_s<0,\partial h/\partial\overline{w}_s>0,\partial h^2/\partial w_s^2>0$ and $\partial h^3/\partial w_s^3>0$.

To see for instance the first partial derivative, notice:

$$\begin{aligned}\frac{\partial h}{\partial w_s} &= \frac{\partial}{\partial w_s}\left(\left(\frac{w_s}{w_s-\overline{w}_s}-\sigma\right)w_s^{\sigma-1}\right)\\ &= -\frac{\overline{w}_s}{\left(w_s-\overline{w}_s\right)^2}+(\sigma-1)\left(\frac{1}{w_s-\overline{w}_s}-\frac{\sigma}{w_s}\right)\end{aligned}$$

Moreover, since $w_s-\overline{w}_s>0$,

$$sign\left(-\frac{\overline{w}_s}{\left(w_s-\overline{w}_s\right)^2}+(\sigma-1)\frac{1}{w_s}\left(\frac{w_s}{w_s-\overline{w}_s}-\sigma\right)\right)=$$

$$=sign\left(-\frac{\overline{w}_s}{w_s-\overline{w}_s}+(\sigma-1)\left(1-\sigma\frac{w_s-\overline{w}_s}{w_s}\right)\right)$$

The latter expression is bounded above:

$$\Rightarrow-\frac{\overline{w}_s}{w_s-\overline{w}_s}+(\sigma-1)\left(1-\sigma\frac{w_s-\overline{w}_s}{w_s}\right)<-\sigma+(\sigma-1)\left(1-\sigma\frac{w_s-\overline{w}_s}{w_s}\right)$$

and since $\sigma>1:$

$$=-\sigma+\sigma-\sigma^2\frac{w_s-\overline{w}_s}{w_s}-1+\sigma\frac{w_s-\overline{w}_s}{w_s}<0$$

so that the partial derivative is negative in the relevant range.
From this, and since $\overline{w}_2>\overline{w}_1$ and $\gamma\delta^{-\sigma}>1$, it is immediate that $w_2>w_1$.

With these results it then follows that:

$$\begin{aligned}
\frac{dw_2}{dw_1} &= -\frac{\partial h/\partial w_1}{\left(-\gamma\delta^{-\sigma}\right)\partial h/\partial w_2} > 0 \\
\frac{d^2w_2}{dw_1^2} &= \frac{\partial^2 h/\partial w_1^2 \cdot \partial h/\partial w_2 - \partial^2 h/\partial w_2^2 \cdot \partial h/\partial w_1}{\left(\gamma\delta^{-\sigma} \cdot \partial h/\partial w_2\right)^2} < 0
\end{aligned}$$

which proves claim 1. Claim 4 follows from this and the fact that aggregate wage increases shift the restriction away from the origin in the (w_2, w_1) space. Finally, Claims 2 and 3 follow from (7). ■

Appendix C: Proportion of youth population and group-specific unemployment rates in sample of countries.

Figure 3:

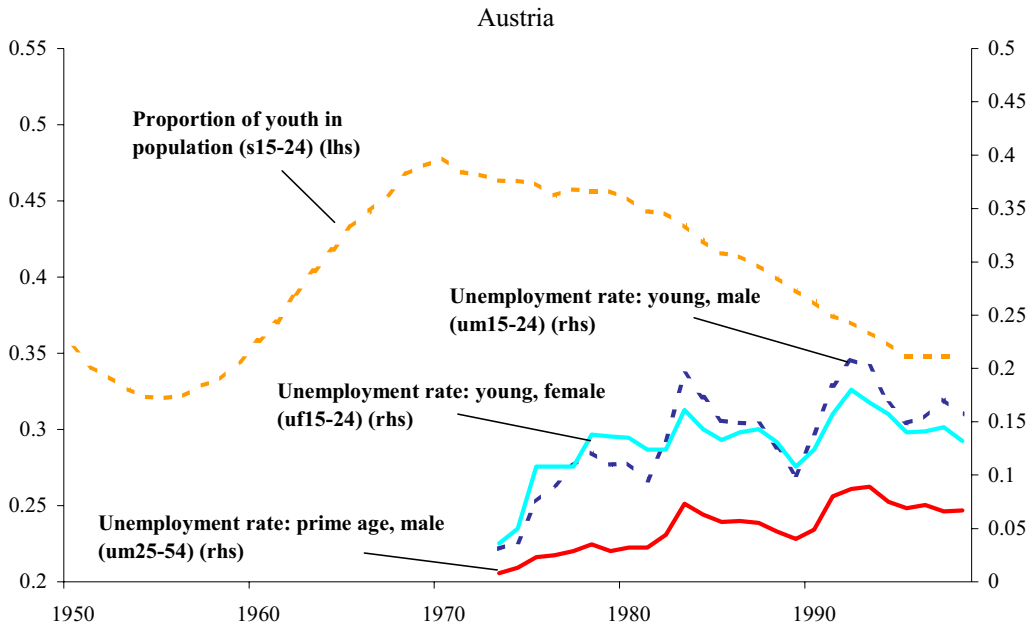
Austria
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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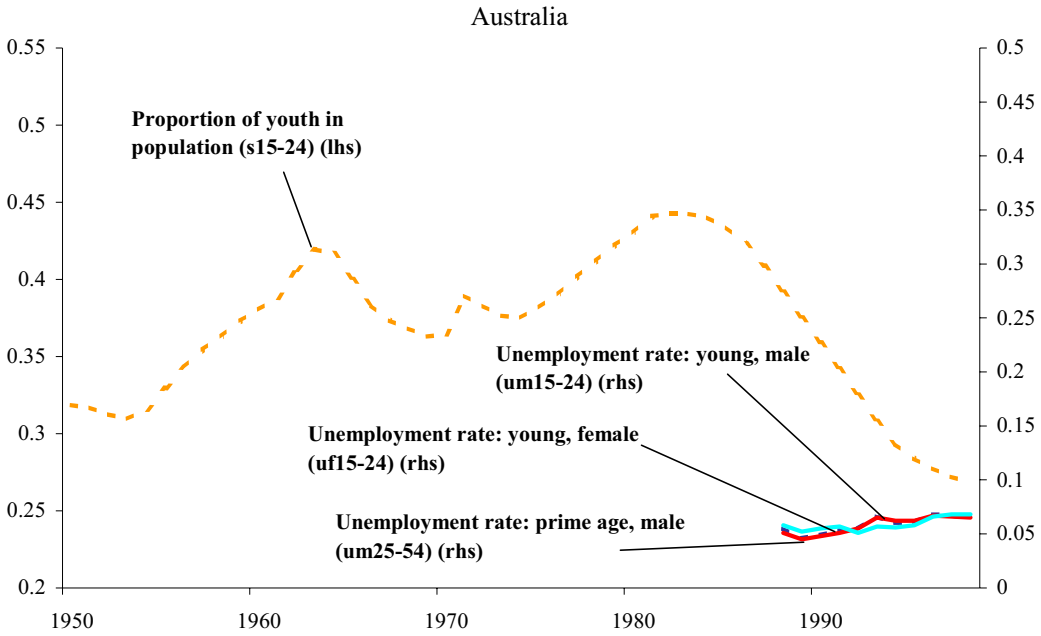
Figure 4: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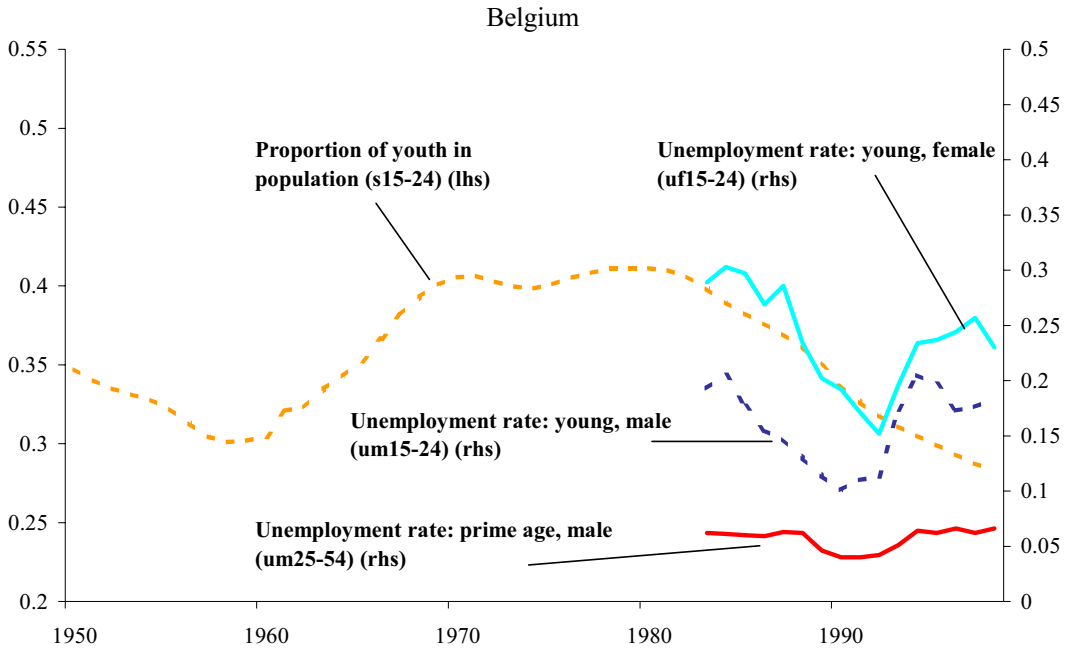
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 5: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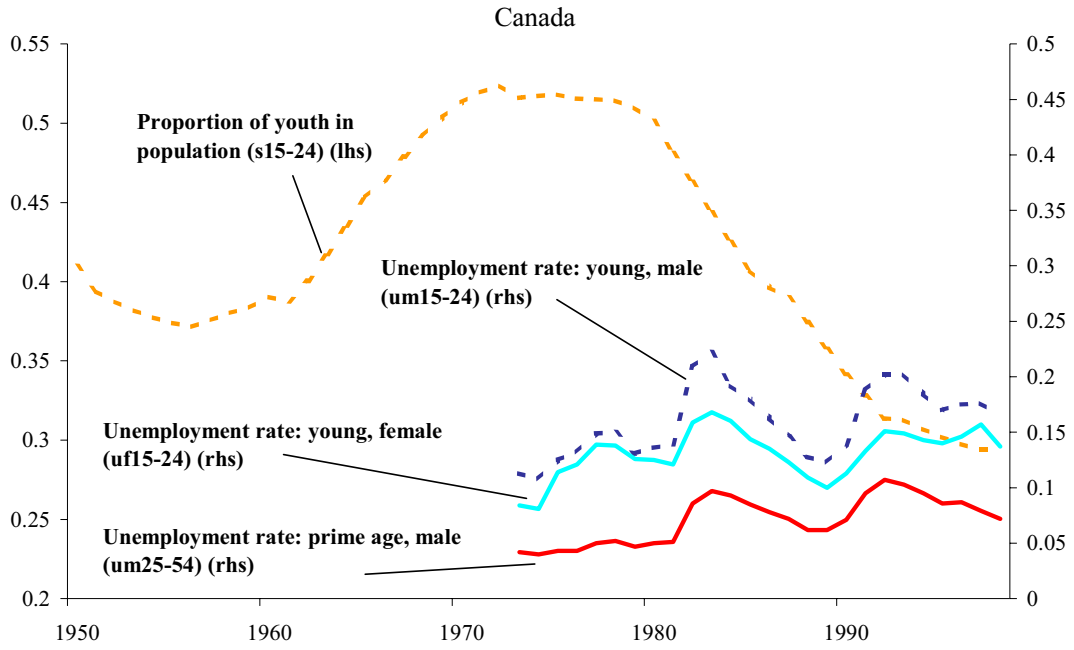
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 6:


Canada
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Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 7:

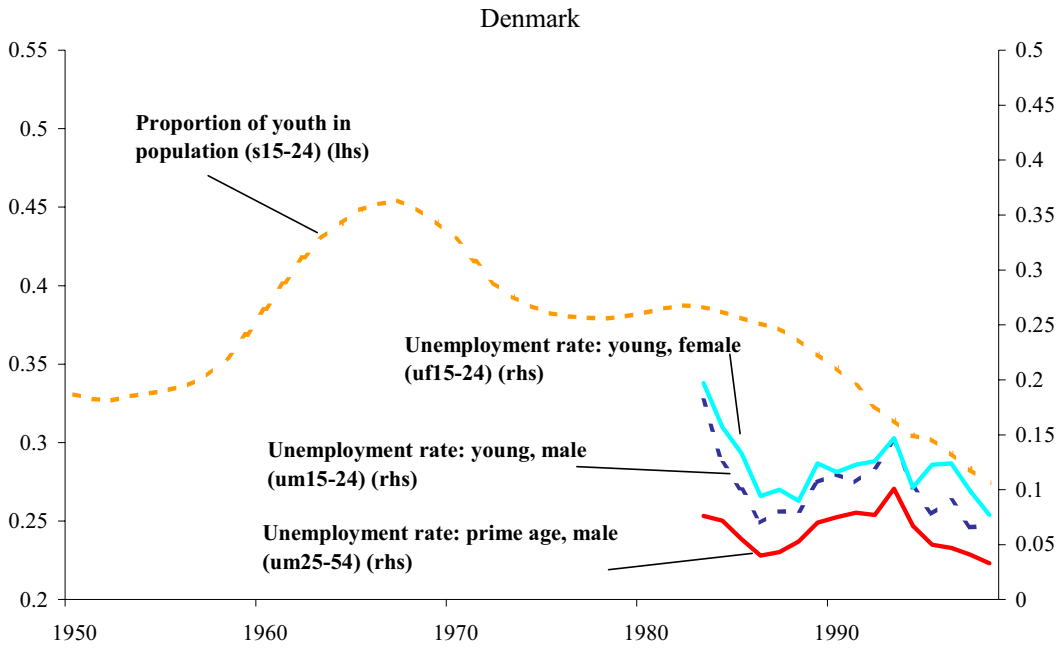
Denmark
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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Figure 8:

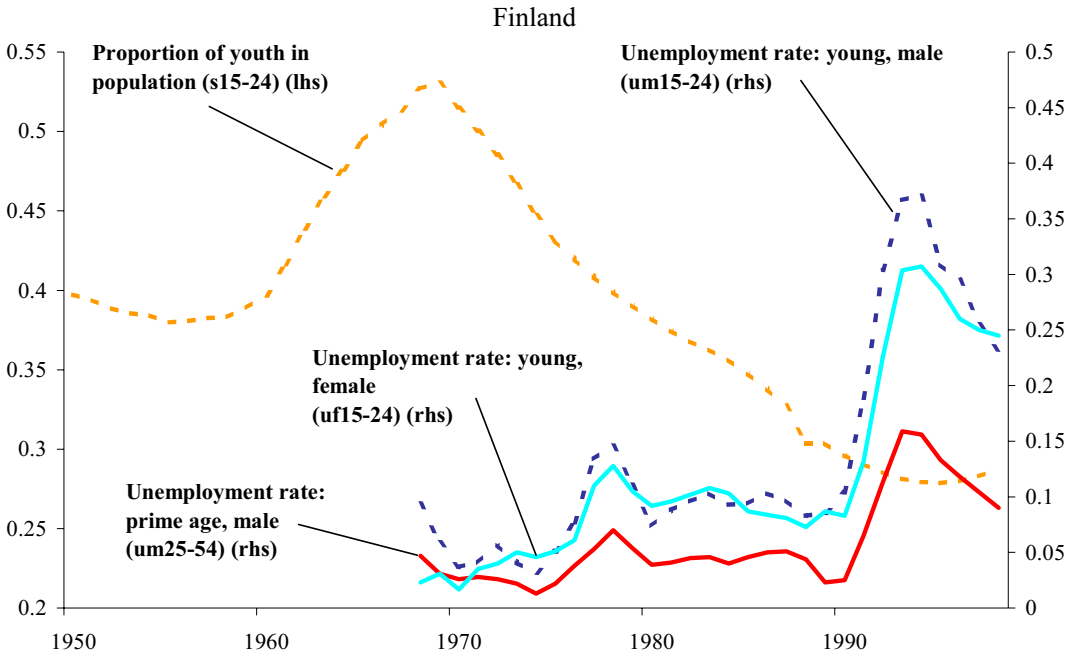
Finland
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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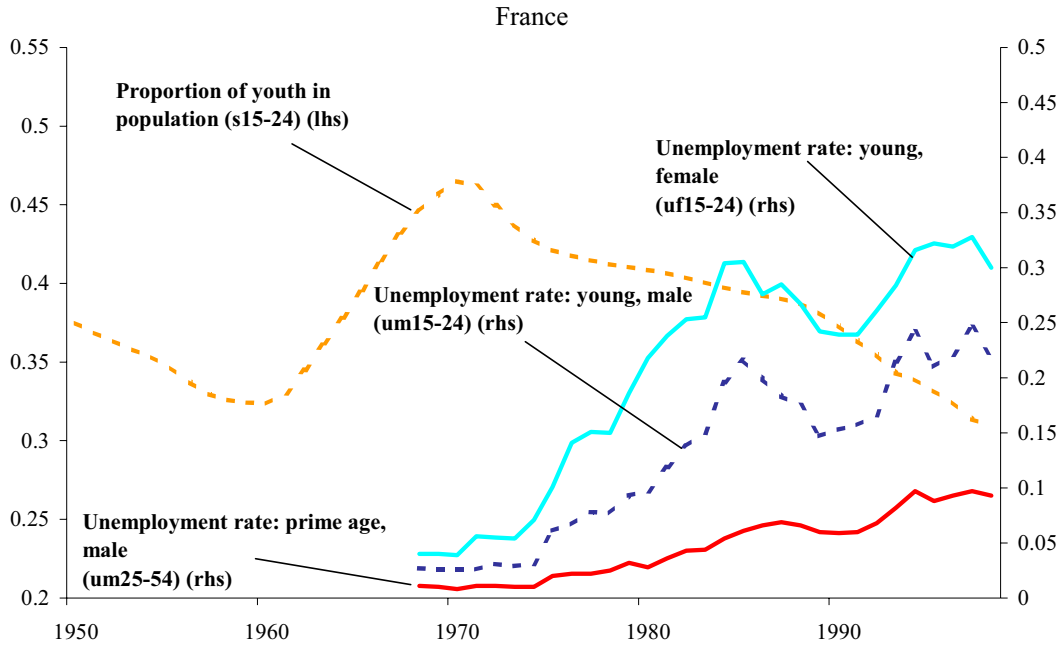
Figure 9: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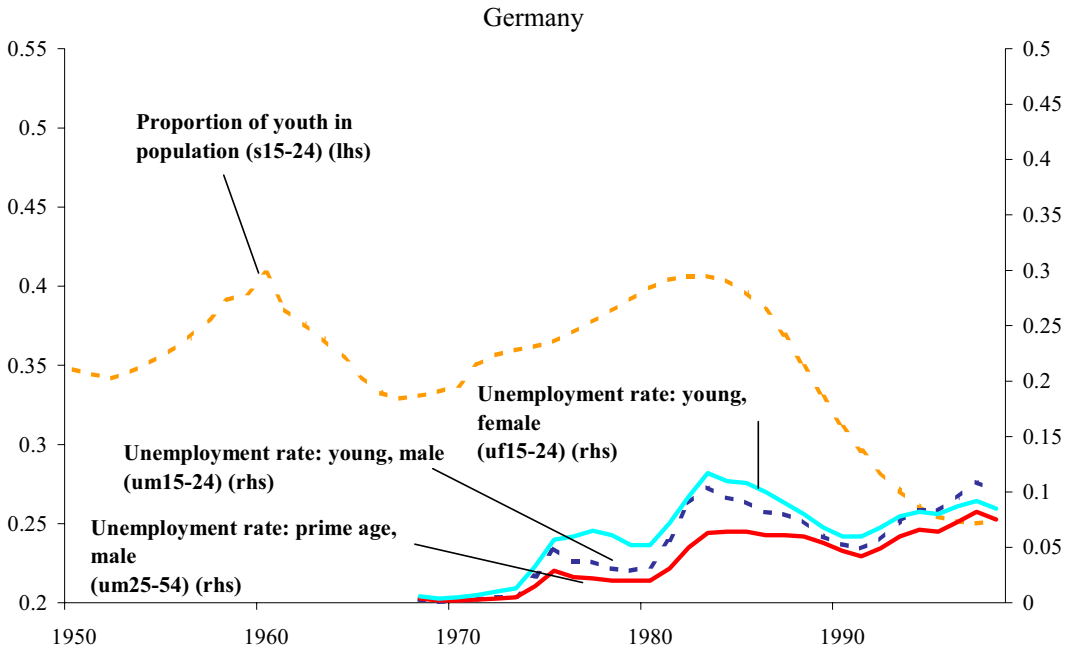
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 10:


Germany
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1950
1960
1970
1980
1990
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 11:

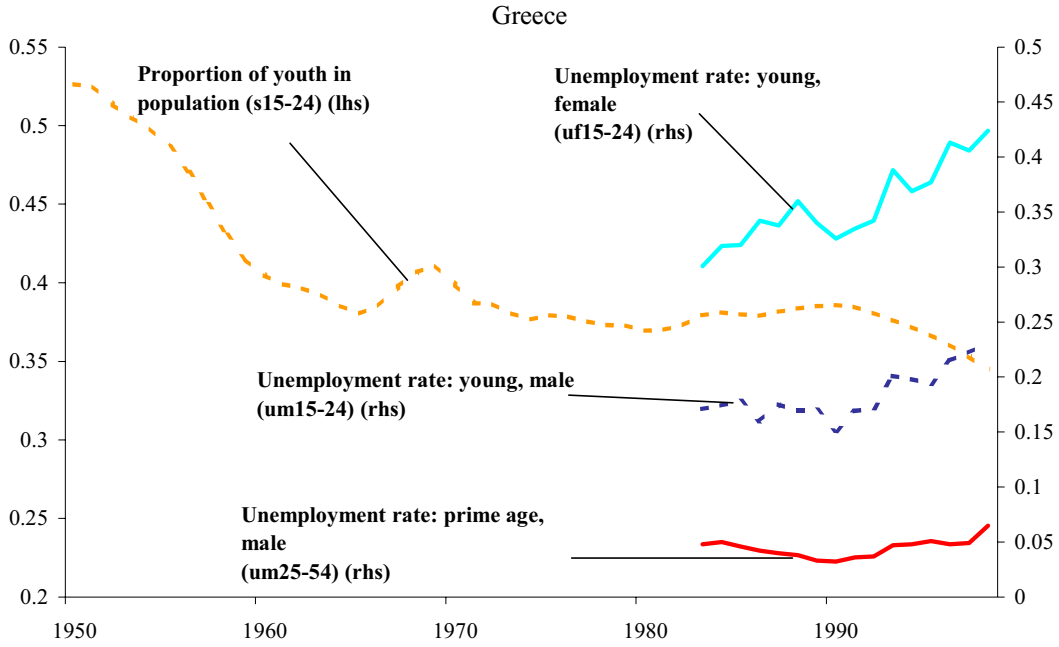
Greece
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
0.55
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Figure 12:

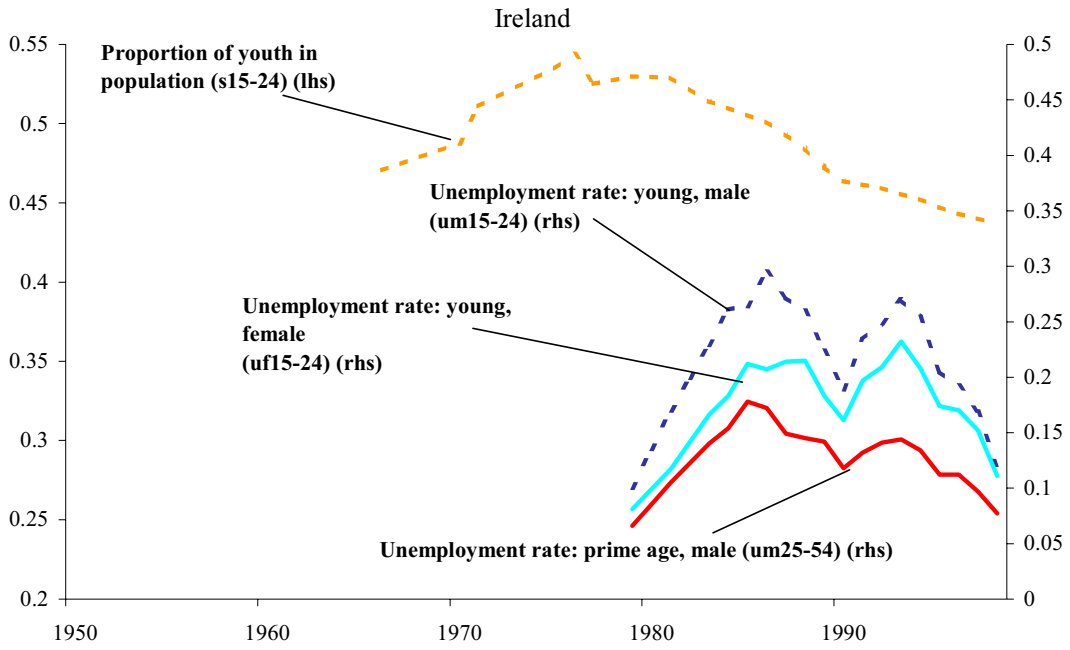
Ireland
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
0.55
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Figure 13:

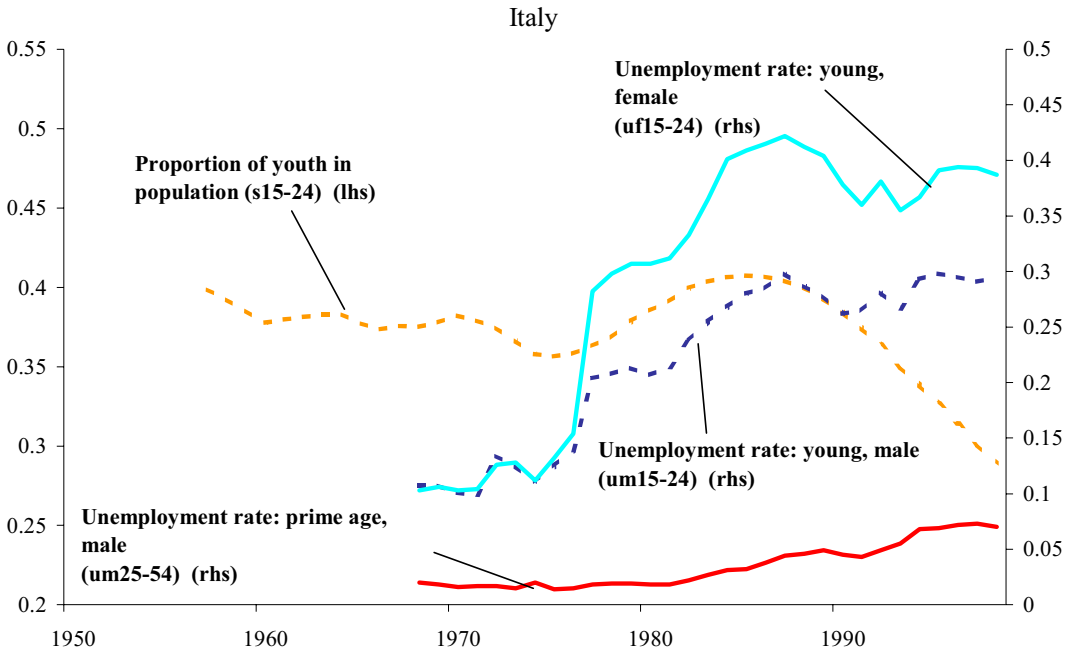
Italy
Unemployment rate: young, female (uf15-24) (rhs)
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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Figure 14:

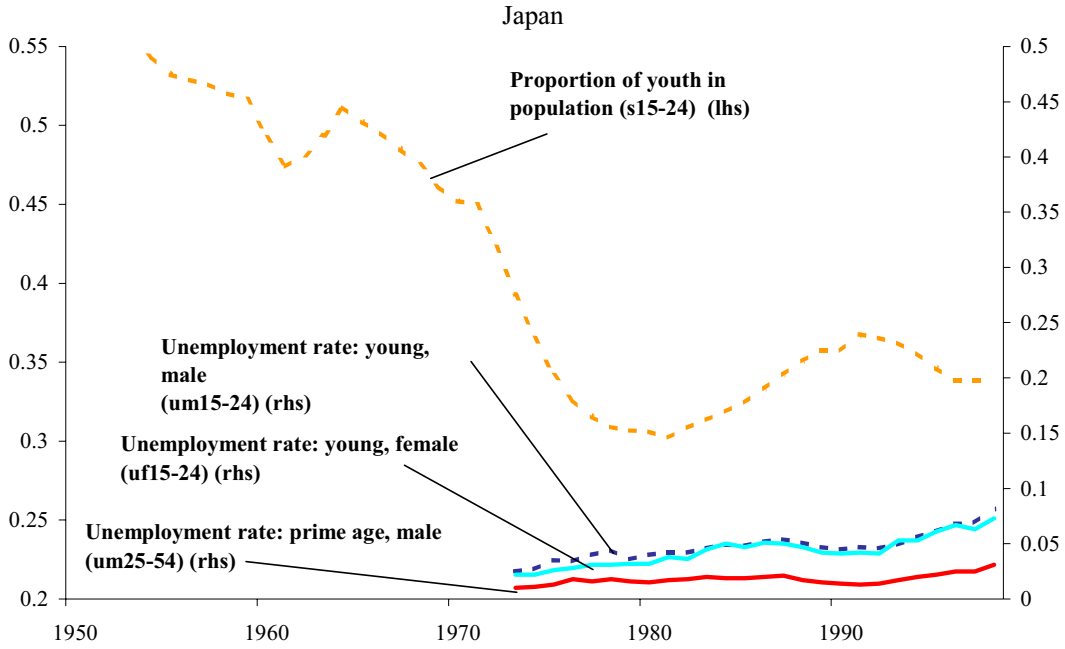
Japan
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
0.55
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Figure 15:

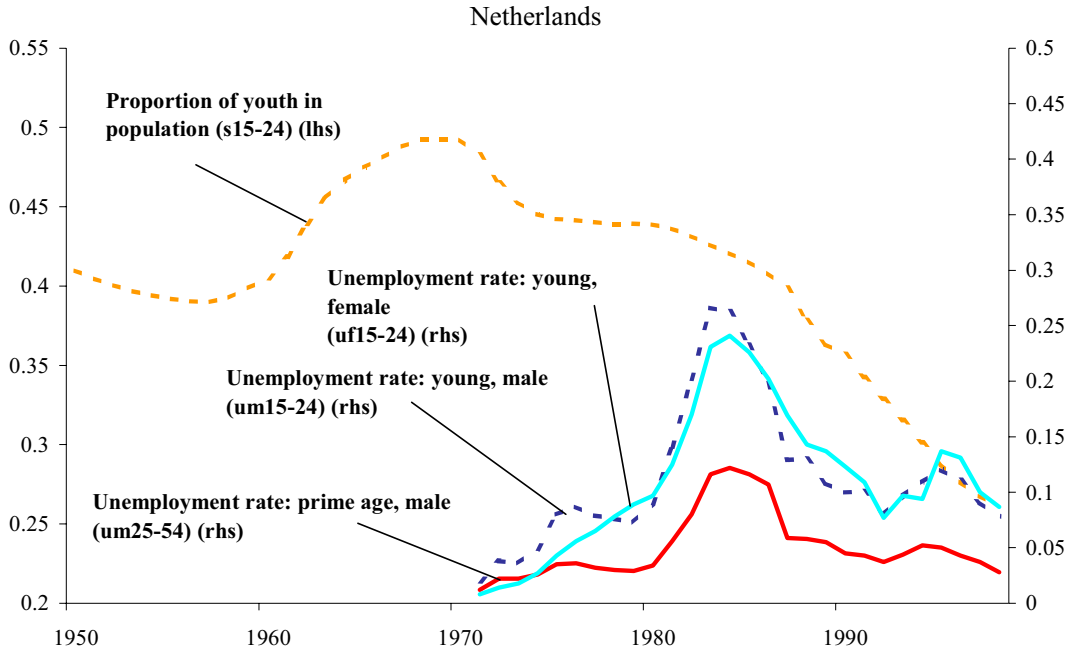
Netherlands
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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Figure 16:

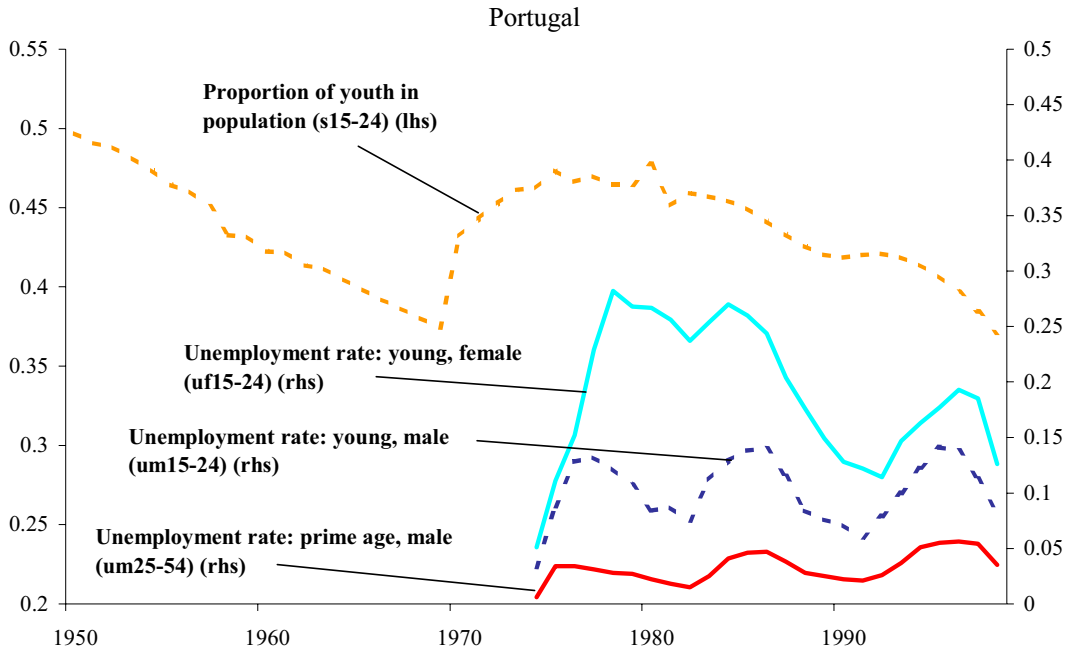
Portugal
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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Figure 17:

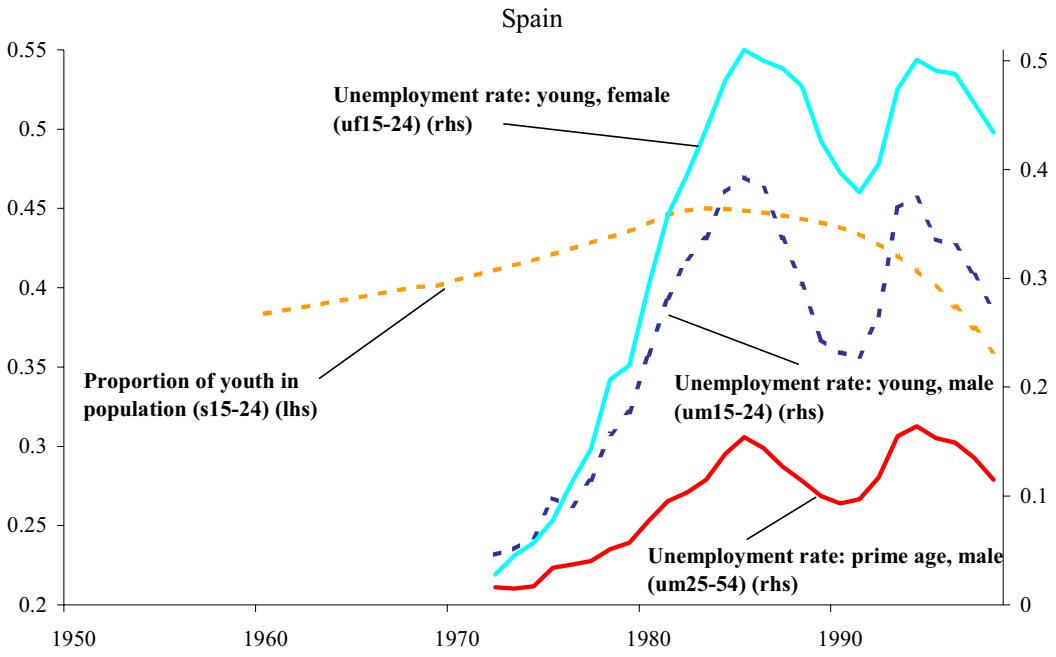
Spain
Unemployment rate: young, female (uf15-24) (rhs)
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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Figure 18:

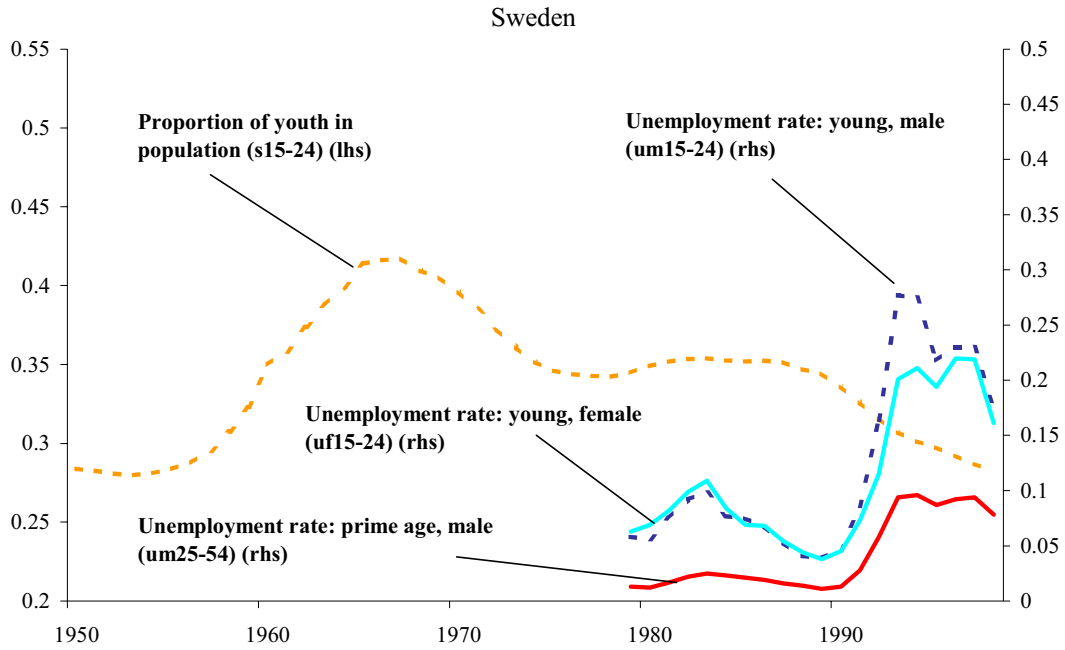
Sweden
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)
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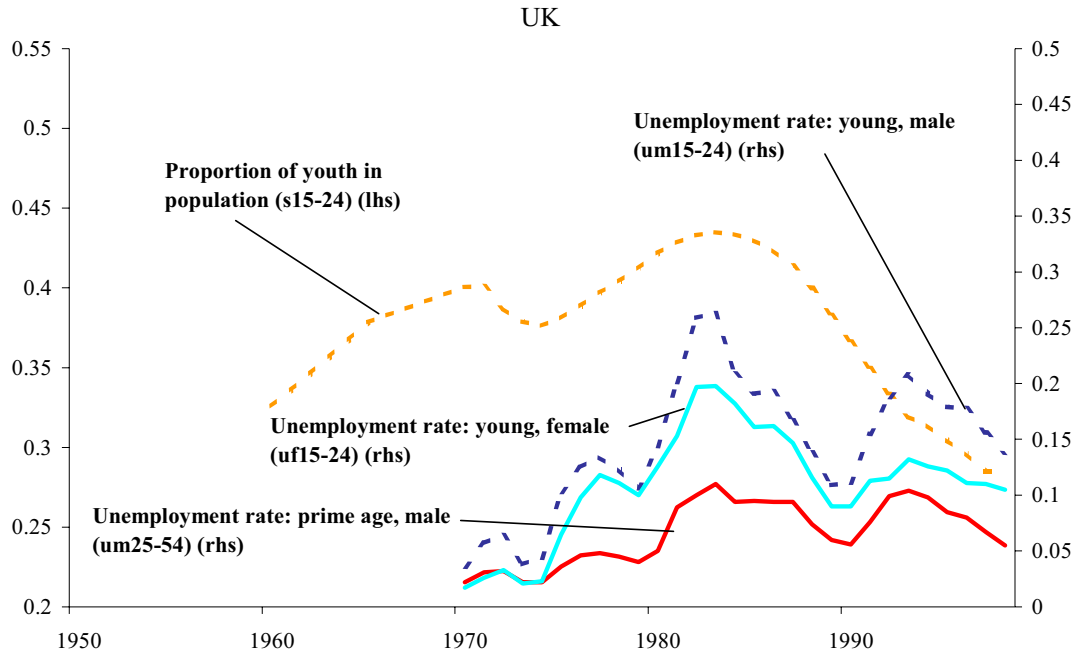
Figure 19: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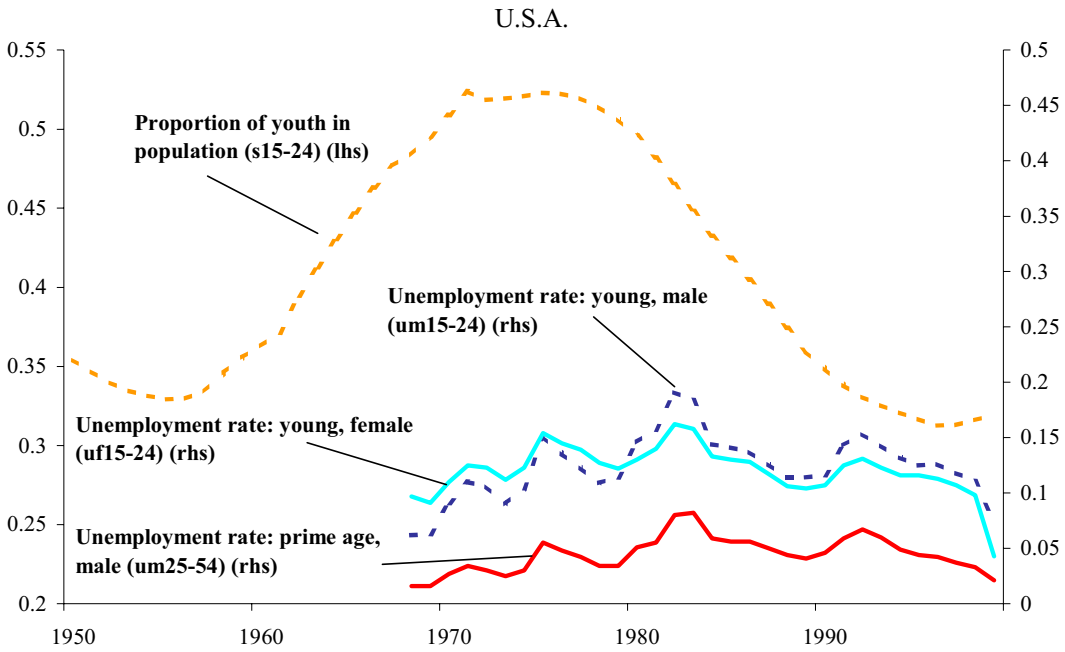
Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

Figure 20: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Proportion of youth in population (s15-24) (lhs)
Unemployment rate: young, male (um15-24) (rhs)
Unemployment rate: young, female (uf15-24) (rhs)
Unemployment rate: prime age, male (um25-54) (rhs)

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