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Can Labour Supply Explain the Rise in Unemployment and Inter-Group Wage Inequality in the OECD?¤

Etienne WASMER
Institute for International Economic Studies
and Center for Economic Performance, LSE
E-mail: wasmer@iies.su.se

Abstract

This paper investigates how labour supply trends might have a®ected the OECD labour markets in the last decades. It is argued that changes in supply cannot be considered as homogenous: they involve more young and more adult female workers, who are complements with skilled men and substitutes with low-wage groups (young, unskilled). Such labour supply trends since the 50's may have increased competition between women, young workers and low skilled workers in some segments of the labour force. These mechanisms are described by a model and an empirical strategy is undertaken to test its predictions. Disaggregation by gender is necessary. Endogeneity of participation levels with respect to unemployment is treated in two ways, by instrumental variables estimators, and with time series techniques. Signi¯cant causal relations between participation and unemployment cannot be rejected.

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'Ask ¯ve economists and you'll get ¯ve di®erent answers (six if one went to Harvard).' Edgar R. Fiedler

In the last twenty years, a large number of possible causes of rising European unemployment have been put forward, without any consensus. Recently, a new line of explanation has emerged[1]. Starting from the observation that wage earnings inequality has increased considerably over the past 25 years in the US and in the UK, but has remained fairly stable in the high unemployment countries, it postulates that a common cause could explain the two phenomena, unemployment and inequality. The evolution of wage inequality was studied for example in Davis (1992), Katz and Murphy (1992), Katz, Loveman and Blanch°ower (1993), Juhn, Murphy and Pierce (1993), Card, Kramarz and Lemieux (1995), Goux and Maurin (1995). The forces involved in the increase in inequality (mainly in the literature biased technical progress, or international trade with less success), could well be the same across countries, but act di®erently due to the country-speci¯c institutions. Any institutional factor leading to wage rigidity at the bottom of distribution might explain the di®erences between the US and Europe (minimum wage, unions, non-wage income or unemployment bene¯ts causing increasing reservation wages).

In this paper, I will follow this appealing line of explanation, which seems to rule out the usual distinction between the factors of increase in unemployment on the one hand, and the factors of persistence of unemployment on the other hand[2]. However, being not entirely convinced by theories which only rely on technological changes a®ecting the demand for labour (after all, these changes come often as residuals, i.e. what has not been explained by other factors), I will rather focus on the changes in labour supply which, in contrast, have the advantage that they can be observed and quanti¯ed. In this paper, both the increase and the persistence in unemployment will be interpreted as the consequence of a positive link with labour supply, which itself shows a huge degree of persistence.

It should be recalled, however, that any attempt to link labour supply and unemployment will face an immediate and strong objection; all evidence suggests that, in a constant return to scale world, a homogeneous increase in the level of the labour

[1] from Harvard and around.

[2] This distinction has been a key ingredient of other explanations (e.g. see Bean 1994, Blanchard and Summers 1986, Bruno and Sachs 1985).

force should be neutral on labour markets in the long-run. From an empirical perspective, it is usually claimed that over a period of one century, the population has constantly grown but without creating a trend in unemployment (Layard et al., 1991). This is due to the fact that the capital stock increases so that the capital per unit of labour is constant and maintains real wages constant ceteris paribus, i.e. in absence of technological progress. This is the conventional Solowian view which is also applied to labour markets with equilibrium unemployment in representative agents' frameworks, in Nickell (1991).

Departing from this homogeneity of labour supply and allowing for generation effects as in Pissarides (1989) or in Welch (1979), labour supply is no longer neutral. My starting point here will be that the increase in the level of the labour force of the postwar period is absolutely unique in history because it involves more married women and in the 70's, more young workers of the baby-boom cohorts, thus increasing the share of unattached and inexperienced workers in the labour markets of almost all OECD countries. Then, in accordance with the first point, my second point is that the aggregate level of participation is not the correct variable to explaining unemployment, one should rather consider the composition of the labour force[3].

Section 1 presents eight stylized facts on the labour market with a focus on gender and age. The main point is that women and young are similar in many dimensions (unemployment, participation, substitutability in production). Their wage evolutions however diverge: the relative wages of women tend to slowly increase, whereas the relative wages of young workers have declined in the last decades. Section 2 introduces a model of demand and supply of labour which accounts for all these facts. The labour market is modelled with two segments, a primary and a secondary segment, which also represent two different occupations, a high wage and a low wage occupation. Wages are competitive in the primary segment and rigid in the secondary segment. Workers in the primary segment are considered to be those with high ex-

[3] This is a new explanation for the trends in labour markets: the systematic study of the role of supply factors seems absent from the literature, despite a seemingly strong explanatory power. For instance, Katz and Murphy (1992) find that 83% of the increased return to experience for male workers observed in the US, was due to the relative supply component. But they attribute this to the supply of young workers, and do not control for the relative female labour supply, the evolution of which is comparable to the supply of young workers in the 70's. In other papers, the role of supply is only mentioned, never developed (Malinvaud 1986, Murphy and Topel 1987).

perience and labour force attachment, while the workers in the secondary segments are considered to be those with low experience and a higher propensity to quit or leave the labour force. For simplicity, labour supply of adult men and young workers is inelastic, in the primary and the secondary segments respectively, and adult women's participation is driven by a neoclassical supply function of the expected wages in each occupation and of the return to domestic activity. Thus the choice of occupation for women is endogeneous. The model predicts two-ways links between the composition of the labour force and unemployment. Section 3 derives an empirical strategy to test those links in cross-section. Time series evidence is provided in section 4. In both approaches, I attempt to underline a causality from participation to unemployment but also from unemployment to participation. In the concluding section, after discussing positive objections, I answer a potential normative misinterpretation about the implications of links between labour supply and unemployment: in this paper, the positive link between female participation and unemployment is simply a negative consequence of women's participation in low wage segments (Topel 1994a remarks that in the US, the median wage of women corresponds to the 25th percentile of male wage distribution), which pleads in favour of less gender inequality, not of lower female participation.

1 Female and young workers: similarities and differences

1.1 Cross-country correlations of unemployment by group

One point not emphasized earlier is that the countries with high female unemployment are also countries with high unemployment among the young. This can be shown with the correlation coefficients in 1992 across the OECD countries between the prime-age (over 25) men unemployment rates, prime-age women unemployment rates and youths' (under 25) unemployment rates (U_{MO}, U_{FO} and U_Y):

	U_{MO}	U_{FO}	U_Y
U_{MO}	1	0.57	0.57
U_{FO}		1	0.78
U_Y			1

Taking the average over the 1980-94 period to get rid of the transitory shocks

yields the following higher correlation coe±cients:

	U_{MO}	U_{FO}	U_Y
U_{MO}	1	0.69	0.56
U_{FO}		1	0.84
U_Y			1

At least, theories of unemployment should account for these correlations, to which there is no straightforward answer. The goal of this paper is to provide an explanation and to test it.

Fact 1: The correlation coe±cients between prime-age women and youth unemployment are very strong (about 0.8 or more), and higher than the other correlations between groups of the labour force.

1.2 Time-series evolution of unemployment by gender and age

The time series evolution of unemployment also reveals interesting features. It is shown here that in the 80's unemployment in Europe is higher than in the US mainly due to female unemployment[4]. The two top charts of ¯gure 1 display the rate of unemployment by gender in the four Scandinavian countries (SCA), in the USA, in Japan, and in 11 European countries (EU11) (excluding Greece). One can easily recognize a regular and smooth pattern of European unemployment for both series, as well as the strongly cyclical pattern of American unemployment rates and the very low level of Japanese and Scandinavian (before 1991) rates. The striking feature is the strong di®erence between US and European female unemployment rates, which are a contrast to the relatively small di®erence in the corresponding rates for men. In 1990, the gap is about 6 points for women, and about 2 points for men. The same pattern is valid for ¯ve selected European countries (EU5): Spain, Italy, France, Belgium and Germany. The gap between the USA and Europe is still 2 points for men, but 9 points for women. This is also valid workers aged over 25: the two

[4]Since the di®erence between "unemployed" and "not in the labour force" might be narrow for women, all rates here will correspond to the ILO de¯nition (the unemployed are those available for a job and actively looking for one). See also Sorrentino (1993 and 1995) for a broader de¯nition of unemployment including part-time workers looking for full-time jobs and discouraged workers; the ranking of OECD countries for female unemployment remains unchanged with a notable exception: Japan.

bottom charts of ¯gure 1 plots the unemployment rates of the workers over 25, thus excluding the young workers for whom the unemployment rate is higher in Europe. Unemployment rates for prime-age men are similar in Europe and in the USA around a 6% average, with fewer high frequency °uctuations in Europe . For this category of workers, the unemployment problem does not exist more than in America - at least considering the stocks. In contrast, unemployment rates for women are much higher in Europe after 1983, with a 5% to 7% di®erence, compared to the USA.

Finally, European and the US unemployment rates also di®er due to workers aged under 25. As can be seen in ¯gure 2, the only country in Europe in the 80's with a lower unemployment rate than the US is Germany, whereas young workers in Spain, Italy, France, Belgium, and the Netherlands (HOL on the graph during most of the 80's) face extremely high unemployment rates. See Blanch°ower (1996) for a comprehensive discussion of the position of young workers in 23 countries.

Fact 2: Adult male unemployment rates are similar in Europe and in the US.

Fact 3: The unemployment rates of young and adult female workers are much higher in Europe than in the US.

1.3 Substitutability in production

Another similarity between young workers and women is their substitutability in production. Grant and Hamermesh (1979, 1982) estimated the elasticity of complementarity from a translog production function between physical capital, adult (aged over 25) men, adult women and young workers. They found capital to be q-complements with all workers, men to be q-complements with women and young workers whereas women and young workers are q-substitutes. At given input prices, it means that an increase in the number of women in the labour force should lead to a decrease of the equilibrium wage of young workers. The change in relative wages of young workers will be even more important as they are substitutes for women and this can even lead in some cases to a decrease in real wages. Indeed, the cross wage elasticity of one group to the supply of another group is the share of this group in total costs times the elasticity of complementarity, if we assume a constant supply of the other factors (see Hamermesh 1986). Grant and Hamermesh estimated this elasticity to be -0.15 between young and old white women. Berger (1983), estimating the same translog function for the inputs capital, females workers and male workers disaggre-

gated into four categories (skilled i.e. college and experienced, unskilled i.e. high school and experienced, skilled and inexperienced and unskilled and inexperienced), found female workers to be q-substitutes with low-experience (young) male workers, slightly more with high-school than with college and also q-substitutes though to a lesser extent with experienced male workers. Young educated workers are found to be complements with older educated workers. Finally, Topel (1994b) compared the e®ects on regional labour markets' wage inequalities of the increased participation of women with alternative explanations such as technical changes and changes in the industrial composition of labour demand. Estimating a demand-factors function, he again found low-skilled women to be very q-substitutes with low-skilled men. His conclusion is that \there is no evidence that di®erent regional evolutions of wages are demand-driven; the whole story is on the supply side.\ In another paper, he even wrote that \if women's participation had not changed, there would have been no decline in the relative wages of less skilled men.\ (Topel, 1994a)

Fact 4: Women and young workers, more generally low-wage groups, are substitutes for each other.

1.4 Shares in the labour force

Both groups (young and female workers) have represented an increasing share in the labour force. This is obvious for women looking at ¯gure 3. Women participate to a greater extent in every country. Despite some cross-country di®erences in the participation rates, not reported here, the evolution of the share of women in the labour force is very similar within the OECD, since countries with relatively lower female participation also have lower male participation (due to country speci¯c early retirement, schooling and training schemes).

The fact is less known when it comes to the young workers. Figure 4 top chart reports the share of 25-34 years old in the labour force for the US and three groups of European countries (Northern, Western and Southern Europe). Everywhere, the share of young workers in the labour force is higher in the 80's than in the 60's, with the strongest increase taking place in the 70's, i.e. the waves of the baby boom-cohorts. Two misunderstandings must be avoided here. First, even though the average age of the total population is higher, the labour force becomes younger: older workers leave the labour market earlier, as indicated in ¯gure 4, bottom chart.

Second, the size of the cohorts in the US peaked in 1977 and then decreased (see Welch 1979), but the share of young workers reported here is a "stock", not a °ow.

Fact 5: Female participation has increased in all OECD countries, with some di®erences in the levels of participation across countries. The labour force is also younger in the 80's than in the 60's.

1.5 Wages

Figure 5 illustrates the evolution of unconditional relative wages between the di®erent categories of workers in the USA from 1967 to 1988[5]: $w_f=w_m$ is the ratio of female to male median weekly earnings of US full-time workers, $w_y=w_o$ is the ratio of young people (under 25) to old (over 25). Finally, $w_f=w_m(y)$ denotes the female to male ratio for young workers, and $w_y=w_o(m)$ denotes the ratio of young to old for male workers, etc... It clearly appears, as reported in Katz and Murphy (1992) for instance, that the gender earning gap decreased[6], but mainly after 1977 and especially for young workers. Before 1977, the relative wages appear to be fairly constant. In contrast with women, the wages of young workers relative to older workers dropped, from 0.95 to 0.75 for women and from 0.75 to 0.55 for men which needs not to be explained.

Fact 6: In the US, the relative wages of women remained stable until 1977 and have increased since then.

Fact 7: In the US, the relative wages of young workers have fallen since 1969.

However, if the wages of young and female workers evolves di®erently, the groups still have a very similar position in the wage distribution. As already discussed in introduction, Topel (1994a) reports that the median wage of women is equal to the wage of the 25th percentile of male workers. The relative positions of young, of adult men and adult women in the wage distribution present the same characteristics in a country with a di®erent wage structure, such as France for example. For instance, if one considers the share of employees paid the minimum wage, as reported in table 1, this share is much higher for adult women and young workers (17.7% and 17.5% are paid the minimum wage) than for adult men (6.8%).

[5] Source: CPS, published data.

[6] This increase in relative wages is also valid before controlling for observable factors (see O'Neill 1985, for instance). Since the main topic of this paper is not wages but rather unemployment, I give no further details.

1.6 Occupational choices for women

Finally, it is worth emphasizing that the increasing quality of female participation might explain part of the increase in female relative wages[7]. The number of women in "low" occupations increased in absolute terms in the last decades, however. These two points are illustrated in table 2. In the USA, the number of women in the labour force increased strongly, millions switched from inactivity to employment. Their share in the total labour force grew from 32.5% in 1960 to 45.4% in 1991. Now taking the occupations 1+2 as a proxy for the good jobs, it appears that the average quality of occupations held by women improved. In 1960, the share of women in these good occupations relative to their total participation was 17.5%, thus less than the total share of these jobs in employment (20.2%). This is one face of gender inequality between occupations. In 1991, the entire di®erence had disappeared: these occupations constituted 29.2% of the occupations in the economy, while 29.6% of active women were working in these occupations. But if the share of women in good occupations increased, the supply of labour of women in the other (lower) occupations also increased strongly, from 22.2 millions to 39.5 millions between 1970 and 1991, which possibly increased the competition for these low skill jobs. A comparison with all other European countries would be fastidious, but the same ¯gures (not reported here) indicate that the extent of the gender catch-up in occupations is lower, especially in Southern Europe.

Fact 8: Women participate in better jobs/segments of the labour force.

2 A model

2.1 Workers

Understanding these facts requires a model in which labour supply is heterogeneous. A simple model of a dual labour market will give the intuitions of the impact of a compositional change of the labour force. Hereafter, I will use the words segments, occupations and jobs without distinctions. The experienced, more productive and stable workers are in the primary segment, and the inexperienced and less stable ones are in the other segment, as in Doeringer and Piore (1971). To simplify, prime-age

[7] As is also suggested in Abowd et al. (1998), where the change in the distribution of workers' unobserved skills accounts for the decrease of the gender gap in France.

men (over 25) are all assumed to be in the primary segment[8], women are assumed to be work in one segment or another in proportion determined in equilibrium, and the young workers are in the secondary segment[9]. In addition, it is assumed that there is no unemployment in the primary segment and that there may be some "classical" unemployment in the secondary segment, if the marginal productivity of secondary workers is too low.

The following production function has the properties described in section 1.3, in the simple case where the elasticity of complementarity is constant:

$$Y(G;B) = Y(L_M; L_{F_1}; L_{F_2}; L_Y) = A:[(L_M + L_{F_1})^{1} + \mu:(L_{F_2} + L_Y)^{1}]^{1=1} \qquad (1)$$

where L_M, L_{F_1}, L_{F_2} and L_Y are the equilibrium employment levels of men, women in good (1) and bad (2) jobs and young workers. Factors μ and A are productivity parameters and $^{1} \cdot 1$ characterizes the substitutability between the two types of jobs, with $1 ¡ ^{1}$ the elasticity of complementarity.

2.2 Labour demand and wage determination

Assuming: fully °exible wages; that the number of adult of both genders is the same; that all men participate in the labour force; that a fraction p of adult women participate with p equal to $L_F=L_M$ ($L_F = L_{F_1} + L_{F_2}$); that q is the (endogeneous) share of women willing to work in primary jobs, equal to $L_{F_1}=L_F$; and that j the (exogeneous) ratio of young to adult male workers equals $L_Y=L_M$; then the ¯rst order conditions on employment yields:

$$\frac{w_1}{w_2} = \frac{1}{\mu}: \left(\frac{L_M + L_{F_1}}{L_{F_2} + L_Y}\right)^{¶^{1} ¡ 1} = \frac{1}{\mu}: \left(\frac{1 + q:p}{(1 ¡ q):p + j}\right)^{¶^{1} ¡ 1} \qquad (2)$$

The ratio $\frac{w_1}{w_2}$ depends on the relative quantity of primary and secondary workers. It is clearly increasing in the share of young workers j, since $^{1} ¡ 1 < 0$: The changes of relative wages can be divided into four parts :

$$d:\ln(w_1=w_2) = ¡\,d\mu=\mu + \frac{1 ¡ ^{1}}{(1+p:q):[p:(1 ¡ q)+j]}: f[1 ¡ q(1 + j)]:dp ¡ (1 + j + p):p:dq + (1 + q:p)dj g \qquad (3)$$

[8] The assumption that all men are in the primary jobs is not at all essential. One could easily extend the model to skilled and unskilled workers, the former working in the segment with rigid wages, but that would be at the cost of obscuring the main message.

[9] See Blanchard and Diamond (1990a) for such a view of primary and secondary markets.

Then $\frac{w_1}{w_2}$ is decreasing with μ, q, and increasing with j and the participation rate p if, and only if, q is smaller than $1=(1+j)$. Higher inequality measured by the relative evolution of primary over secondary worker's wages may be the result of a demand shift (the first term of the right hand side), or an increase in female participation p not compensated by a sufficient increase in the quality of jobs dq. The average wage of adult women is $w_f = q:w_1 + (1 - q):w_2$ and the gender wage gap is equal to $w_f=w_m = w_f=w_1 = q + (1 - q):w_2=w_1$. The variations in the relative wages of female workers is:

$$d[w_f=w_m] = dq(1 - w_2=w_1) + (1 - q)d(w_2=w_1) \qquad (4)$$

The first part, with $dq > 0$, is positive, the second will be negative if the adverse impact of higher p dominates in equation (3). This means that one can observe both an increase in female relative wages, an increase in female participation and a decrease in $w_2=w_1$: when $dq > 0$ and $d(w_2=w_1) < 0$, at least if dq dominates in equation (4) i.e. when q is sufficiently close to 1.

Assume now a floor on wages $\underline{w}$ which is indexed on the wage of primary workers and let ω be the indexation rate, i.e. $\underline{w} = \omega:w_1 = w_2$.[10] The equilibrium is determined in the following way. Employment in the good occupation is determined by the labour supply of primary workers and w_1 adjusts. Denoting the labour supply of secondary workers by P_2 (as participants) and the employment level by L_2, if $MPL(P_2) > \underline{w}$ then $w = MPL(P_2)$ and $L_2 = P_2$ and if $MPL(P_2) < \underline{w}$ then the level of employment is such that $MPL(L_2) = \underline{w}$. The uniqueness comes from the decreasing return on each type of labour. Denoting the elasticity of substitution between primary and secondary workers by $\sigma = 1=(1 - \varepsilon)$, the following employment equation for secondary workers comes out:

$$L_2 = L_{F_2} + L_Y = (\mu=\omega)^{\sigma}:(L_M + L_{F_1})$$

Higher productivity of secondary workers, lower indexation rate and higher participation of primary workers all increase the level of employment of secondary workers.

[10] This does not necessarily correspond to a minimum wage: unemployment benefits, non-wage income, the value of leisure linked to the marginal utility of consumption or efficiency wage can generate a floor on wages depending on the average wage of the economy. The assumption of relative wage rigidity is appealing, for when the constraint is binding, the wage distribution is constant, which is a feature of most of Western European economies (Davis 1992 or Blanchflower et al. 1993).

To solve for the unemployment rates, I make the assumption that young workers and women in secondary jobs have equal employment probabilities. This is equivalent to: $\frac{P_{F_2}}{P_Y} = \frac{L_{F_2}}{L_Y}$, and therefore the di®erent unemployment rates are:

$$u_M = u_{F_1} = 0 \tag{5}$$

and

$$u_{F_2} = u_Y = 1 - (\mu/\theta)^{3/4} \cdot \frac{1 + q \cdot p}{j + (1 - q) \cdot p} \tag{6}$$

The unemployment rate of young workers is a decreasing function of the productivity of secondary workers, increasing in the indexation coe±cient of minimum wage θ, increasing in the share j of young workers in population, decreasing in the share of adult women in primary jobs q and increasing in the participation rate of women p if q is lower than $1/(1 + j)$. If the share of women in the labour force increases too quickly relative to their share in good jobs, they will compete with young workers and the unemployment will increase. Note that the unemployment rates of women and young workers only di®er by the factor $1 - q$; which may be a rationale for fact 1, i.e. the high correlation of these unemployment rates across countries. The unemployment rates of all males and females workers (including the young workers) are : $u_M^t = \frac{j}{1+j} \cdot u_Y$ and $u_F^t = \frac{(1-q)p+j}{p+j} \cdot u_Y$ and the unemployment rate of old workers is $u_o = \frac{p}{1+p} \cdot (1 - q) \cdot u_Y$: Finally, the total unemployment rate can be written:

$$u = \frac{p \cdot (1 - q) + 2 \cdot j}{1 + p + 2 \cdot j} \cdot u_Y \tag{7}$$

and it is easy to check that these unemployment rates are always increasing in $(1 - q)$, j and in p when q is small enough[11].

Finally, there is also a link between the growth rate of the labour force and unemployment, through the share of young workers. If the cohorts of young workers are growing at rate n_t, i.e. $L_Y = (1 + n_t) \cdot (2 \cdot L_M)$, then j the ratio of young to old male workers is equal to:

$$j_t = 2/(1 + n_t) \tag{8}$$

[11] To prove the last point, note that in u_M^t, u_F^t and u, the derivative with of the constant before u_Y respect to p is 0, $-j \cdot q$ and $-2j \cdot q + (1 - q)$ respectively, i.e. its contribution to lower total unemployment becomes negligible with lower q whereas u_Y is increasing in p as proved in the text.

2.3 Endogeneity of labour supply

From a macroeconomic perspective, the increase in the level of female labour supply is usually considered as exogeneous, or at least not so dependent on the rise in real wages (the income e®ect and the price e®ect tend to compensate each other, especially given the husband's wage)[12]. However, a fairly strong endogeneity of participation with respect to unemployment will be found in the empirical sections 3 and 4. This is easy to understand why; in some age-education cells of the labour force, female unemployment can reach 40 to 50%, clearly a®ecting the arbitrage between activity and inactivity through discouragement e®ects. The choice of occupations also depends on labour market conditions.

For these reasons, participation in the labour force is modelled as follows. The participation of adult men is inelastic and in the primary segment. For young workers, it is inelastic and in the secondary segment. For prime-age women, there is a random disutility of work in the secondary segment $¸_i$ which is distributed in the population with cumulative distribution function $F(:)$. The disutility of work in the primary segment is larger (stronger commitment, overtime), and to simplify, I assume that it is $¸_i=±$ with $±$ smaller than 1. With these assumptions, there are two cut-o® levels of disutility: $±:w_1$ and $(1 ¡ u_{F_2}):w_2$ which is higher than $±:w_1$ for a small enough $±$: Women with a smaller disutility than $±:w_1$ participate in the primary segment, women with disutility larger than $(1 ¡ u_{F_2}):w_2$ do not participate, the remaining women participate in the secondary segment. It follows that participation $p = F[(1 ¡ u_{F_2}):w_2]$ and the share of women in the good segment is $q = F(±:w_1)=F[(1 ¡ u_{F_2}):w_2]$. Since the increase in participation can be seen as supply driven, it will be modelled as a decrease in the average disutility of participation. To simplify, I assume that the disutility is uniformly distributed between 0 and $\bar{¸} > (1 ¡ u_{F_2}):w_2$: Then

$$q = \frac{±:w_1}{(1 ¡ u_{F_2}):w_2} \tag{9}$$

and

$$p = \frac{1}{\bar{¸}}(1 ¡ u_{F_2}):w_2 \tag{10}$$

Equation (9) indicates that the "quality" of female participation will begin to increase when the inequality between the two segments increases. Equation (10) indicates that

[12] See Layard et al. (1979), Mincer (1962, 1966, 1985), or Shultz (1981) for instance.

the level of participation increases both on the rise in real wages and on the inverse of the disutility of leisure: a decrease in $\bar{\lambda}$ will increase p. It will leave q unchanged at constant relative wages and unemployment. However, when p rises, so does the ratio $\frac{w_1}{(1-u_{F_2}):w_2}$, both in the flexible and in the non-flexible economy, and so does q.[13]

2.4 Conclusion of the model

A simulation of the model is reported in appendix C. Some of its predictions will be tested. First, in time-series, there should be a long-run relationship between participation and unemployment. Second, in the cross-section of OECD countries, the relationship between participation and unemployment involves differences across countries -first in the degree of equality between gender (how far from 1 is q), second in the degree of downward wage rigidity preventing the equilibrium in this simple framework, and third, in the participation rate of men. Third, there is a also relationship between the growth rate of the labour force and unemployment.

3 A cross-sectional analysis

3.1 The empirical strategy

Three preliminary remarks are required before testing the link between labour supply and unemployment in a cross-section of countries. First, as stated in the model, the correct participation indicator is not the level but rather the composition of the labour force. The share of young workers or of women in the labour force will be a better conditioning variable than levels of participation, since it reflects the share of workers in the secondary segment. Second, given that countries with high female participation are countries with a large number of women in part-time employment, a control for part-time work is necessary to analyse the effect of the hours supplied. As explanatory variables, I will use the share of hours supplied by women in the

[13] Equation (9) can easily be extended to gender discrimination; if women are discriminated against men and receive lower wages, they will participate less in good occupations, since q is proportional to the wage received. Note that $\pm$ can be interpreted either as the fraction of male wages paid to women, or as any disutility exerted by colleagues. Similarly, in the secondary segment, if women are discriminated (they face higher unemployment or a lower wage w_2), they participate less, according to (10).

labour force. [14]

Third, the endogeneity of female participation to unemployment possibly leads to a downwards bias in the estimation of the coe±cient of the impact of participation on unemployment. The same is true for young workers. The problem of simultaneity of participation to unemployment can be described by the following equations:

$$u = C + \bar{}:(\text{Female Share}) + ¸:(\text{Youth Share}) + °:X + ²_1 \quad (11)$$

$$\text{Female Share} = C^0 + \bar{}^0:u + °^0:Z_1 + ²_2 \quad (12)$$

$$\text{Youth Share} = C^{00} + \bar{}^{00}:u + °^{00}:Z_2 + ²_3 \quad (13)$$

where X, Z_1 and Z_2 are a set of national variables described below, and u is unemployment. Since $\bar{}^0$ is likely to be negative and $\bar{}$ to be positive, the variable representing female participation will be correlated with $²_1$ and the estimation of $\bar{}$ by the ordinary least square will be biased downwards. [15].

Finally, some of the variables involved in equation (7) are di±cult to observe. This is particularly the case with gender inequality in occupations as re°ected by $1 ¡ q$ or in participation as re°ected by $\bar{¸}$. The relative wage rigidity ° is also di±cult to observe. Lacking good control variables, I have chosen to concentrate on the links between labour supply and unemployment with a control for aggregate real wages when possible, here the Calmfors and Dri±ll's (1988) index of centralization of bargaining. Other tests using the Jackman et al. dataset with more structural variables provide the same kind of results.

3.2 The centralization of wage-bargaining as control variables

The variables used by Calmfors and Dri±ll (1988) are described in appendix B. The endogeneous variables, unemployment rates, are expressed in % of the labour force and averaged over 1980-94. The ¯rst task is to ¯nd appropriate instruments for female participation among the following: net pre-schooling enrolment of the six year

[14] It was not possible to ¯nd data on the average number of hours worked by full-time and part-time workers in all countries. The available data indicated, however, that assuming aggregate half-time to be part-time was a fairly accurate assumption. So I used the the formula: Female Share(corr) = $\frac{L_F(1 ¡ part\_time_{F=2})}{L_{F+M}(1 ¡ part\_time_{F+M=2})}$ where L is the labour force and part_time represents the share of part-time workers (assumed to be half-time) of total employment.

[15] To improve the estimation, I replace (12) by : Female Share= $C^0 + \bar{}^{10}:u_M + \bar{}^{20}:u_F + °^0:Z_1 + ²_2$ but without any very signi¯cant di®erence.

old children, schooling expectancy of ¯ve year old children (source Education at a Glance, OECD), an index of human development corrected by gender inequality, an index of gender empowerment measures, the share of women in the population enroled in tertiary education (sources Report on Human Development, United Nations 1996), birth rates, divorce rates (source UN Demographic Yearbook, 1992), and the fraction of women in national parliaments (see table A in the appendix).[16] The ¯rst four instruments are eliminated by lack of signi¯cance through a recursive method (rotations of the variables four by four in a regression of female participation also including unemployment).[17] For the share of young workers, I use the projections of the 1990 ¯gures made in 1980 by the International Labour O±ce (ILO 1980), which are based on participation and demographic projections, but not on unemployment changes, and take the average of the 1980 and 1990 ¯gures. This method should remove much of the endogeneity problem associated with this variable.[18]

Tables 3, 4a and b summarize the results. In table 3, I ¯rst perform the simple OLS estimation with the share of women in the labour force corrected by part-time (columns 1 and 5). The impact of the share of women is slightly negative but not signi¯cant, but it becomes positive when the share of young workers is added to the speci¯cation (column 5). Accounting for endogeneity leads to signi¯cant changes in the estimates. Columns 2 and 6 are the result of the estimation with a partial-information method (2-stage least square). I then proceed to full-information methods (3SLS) which are usually considered as more powerful (columns 3 and 7) and to GMM methods (columns 4 and 8) where the moment condition is $EZ'\varepsilon = 0$; i.e. the exogeneity of the instruments: After controlling for endogeneity, the coe±cient of

[16] Instruments based on policies a®ecting female participation (nurseries, taxation) were not considered due to endogeneity; it is highly plausible that the government's attitude towards female participation is in°uenced by the labour market variables.

[17] Table 5 reports the regressions of the share of women on instruments and on unemployment. The coe±cients have the expected signs: male unemployment increases female participation while female unemployment decreases it, higher birth rates, smaller enrolment rates in tertiary education and smaller divorce rates are also associated with lower participation. The only counter-intuitive coe±cient is the one of the share of women in parliament. When running the same regression with the share of women not-corrected by part-time (second column in table 5), the coe±cent is no longer positive. It might be that the share of women in parliaments has some impact on legislations about part-time work, which would explain the di®erence.

[18] The same results were obtained using the predicted share of young workers for 1985.

female participation becomes signi¯cant at the 10% level in most of the cases, and at the 5% level with the GMM method. This coe±cient, about 0.5 should be interpreted as follows. Everything else controlled for, an increase of 8% in the share of hours supplied by women (approximately the increase faced by the OECD countries since the mid-70's), is associated in cross-country with an increase of total unemployment rate of 4% of the labour force. Finally, in all estimates, the share of young workers is positive and rather signi¯cant, although it reduces the coe±cient of women's share once introduced.

The same methodology (2SLS, 3SLS and GMM) is then applied to female and male unemployment rates, as illustrated in tables 4a and 4b. The elasticity is found to be lower for men (0.43 on average for men, 0.62 on average for women), which is what the model predicts. These elasticities imply that a 8% increase in the share of women in the labour force increases unemployment for men by about 3% of the labour force, and for women by about 5% of the labour force. The impact of the relative supply of young workers is also stronger for female workers, which is once more consistent with the model. It should also be observed that the coe±cients of CORP and CORPSQ are fairly stable, which ex-post justi¯es their use, although the results do not depend on their inclusion. These regressions must be interpreted carefully, since the choice of instruments is always di±cult and arbitrary. However, usual tests of their validity do not reject their exogeneity.[19] A Sargan-test for testing over-identifying restrictions in the non-weighted 2SLS gives 0.974, whereas $\hat{A}^2[3]$ critical's value at 5% is 7.82[20].

Unemployment bene¯ts which have been so far ignored, could jointly a®ect the level of female participation (by increasing the value of participation), and of unemployment (by reducing search intensity). The previous 3SLS and GMM estimates were thus re-estimated by adding the replacement ratio (unemployment bene¯ts over wages) (source Layard et al. 1991, pp51-53). The coe±cients of the share of female hours in the labour force in total, male and female unemployment with (resp. without) the share of young workers are reported in table 7a (resp. 7b). In addition, all speci¯cations contain the variables CORP and CORPSQ. It can be observed that the size of the coe±cients is not a®ected by the introduction of bene¯ts variables, but the signi¯cance of the coe±cient decreases for women. Overall, it can be concluded

[19] See the table 6 for these tests.

[20] e.g. see Greene (1993) pp617-620.

that unemployment bene¯ts only change the results marginally. [21]

The female participation variables can also be interacted with the CORP and CORPSQ variables: some regressions of this kind indicate an inverted-U dependence of the coe±cient ¯ in equation (11), with lower signi¯cance levels. These regressions are not reported here however, since in the model, the coe±cient ¯ varies with the index of relative wage rigidity, whereas the Calmfors-Dri±ll's index represents a control for absolute wage rigidity. Another reason is that estimating this more complex model decreases the number of degrees of freedom.[22]

The results of this section do not only rely on the instruments. In fact, I will next report simpler OLS regressions of unemployment on growth rates of the labour force. However, this is no longer a test of the long-run impact of labour supply, but instead a test of the short term impact of labour supply. The rationale for this speci¯cation comes from the combination of equations (8) and (7). The model of aggregate unemployment is once again estimated with the variables CORP and CORPSQ and with the growth rate of the labour force over the period 1980-94. As is shown in table 8, the labour force growth does not account for higher cross-country unemployment, since the correlation is negative. When a disaggregation by gender is introduced, the situation changes drastically. As predicted in the model, the coe±cient on the growth rate of female labour force is positive and signi¯cant, while the growth rate of the male labour force becomes signi¯cant but comes with a negative sign. The same remains true when the growth rate of the young workers in the labour force is added (either the 16-29 or the 16-34 years old, the former although not being reported here giving similar results). Disaggregation of unemployment by gender leads to similar conclusions. It is, however, disappointing to see that the e®ect of the growth of the labour force of younger workers is stronger for male than for female unemployment, contrary to the regressions in level shown in tables 3-4.

There is of course a question of endogeneity with those growth rates. Concerning the growth rate of the labour supply of younger workers, the criticism does not apply since the ¯gures in 1990 are the projection data from the ILO (1980), based on changes in the population structure and on trends in participation, but not on unemployment trends. The growth rate of the labour supply of male workers arguably

[21] Similar conclusion is also reached when controlling for the duration of unemployment bene¯ts.

[22] These regressions are available upon request.

depends on education and retirement decisions, which are certainly highly dependent on aggregate unemployment and the negative coe±cient in the regression is probably due to endogeneity. However, it is very di±cult to ¯nd good instruments for the male labour force[23]. Finally, the endogeneity of the growth rate of female labour supply is certainly important, but tends to downwards bias the estimates: these regressions underestimate the extent to which female participation growth a®ected unemployment.

This is suggestive evidence. One would like to carry out several more cross-sectional regressions, for instance extend the analysis to other periods. Regressions of the average unemployment over the period 1970-80 were less successful: some countries had to be removed from the sample because of data availability. Moreover, the series are not always consistent between the 70's and the 80's, as explained in appendix A. Extending the analysis to more cross-sectional units, like the regions of the countries, would have created new problems, since the labour force is mobile between regions. Thus the problem of endogeneity of regional participation would have been extremely di±cult to overcome. Finally, time-series of instruments such as the one used above were not available.

4 Some time-series evidence

There is, however, another empirical strategy for overcoming endogeneity problems with time-series methods. I investigate co-integration and non-Granger causality. It allows me to measure the permanent e®ect on unemployment of an increase in labour supply . Longer time series are required, and I use quarterly data of the labour force from di®erent sources (see appendix A for a description) for France, Germany, the USA and the UK, since 1967 (1972 for the UK). The number of observations is 82 for the UK, 103 for France and the US and 100 for Germany. Seasonality is removed by projection on quarterly intercepts. No disaggregation by gender is available for these countries with quarterly data, and therefore I test the model in a rather unfavourable case. Since the changes in the level of the labour supply over the period 1970-1995

[23] The most obvious one, the growth rate of the male working age population, was found to be almost non-correlated in both cross-country and time-series with the growth rate of the male labour force (a correlation coe±cient of merely 0.12). This is because in some countries like the US, both growth rates are very high, whereas in most European countries, the working age population is increasing quickly, while the male labour force is constant or even declining.

are purely re°ecting its compositional changes, the coe±cients linking the level of participation and unemployment should be interpreted as a reduced form of the coe±cients implying the composition of participation and unemployment.

4.1 Co-integration

First, I investigate the existence of a co-integration relationship between unemployment and the labour force. In the following, the variables (the unemployment rate and the participation rate) are in logarithm. With usual unit root tests[24], the non-stationarity of participation cannot be rejected in most of the cases (table 9). The non-stationarity of unemployment is sometimes rejected for the UK, but evidence rather suggests non-stationarity, especially for France (see table 10).

The non-stationarity of participation and unemployment implies that these cannot be linked by more than one co-integration relation. Computing the ADF test of the residuals of the regression:

$$Log(U) = C + a{:}Log(PART) + \varepsilon \qquad (14)$$

and testing for stationarity (which implies co-integration), it appears that in three of the four countries, one cannot reject the null hypothesis that the series unemployment and participation are not co-integrated at 5% or 10% at least in one of the speci¯cations (table 11). In table 12, I also provide the results of alternative tests of co-integration, known as the Johansen tests[25]. Except for France, the Johansen test rejects the null hypothesis of no co-integration less often than with the previous two-stages procedure. However, the likelihood ratio associated with the highest eigenvalue is often close to the critical value of the 5% con¯dence level (equal to 15.4), except for the USA. More generally, it seems that the existence of a high minimum wage in France implies a strong relation between the two series which is consistent with the model.

[24] Augmented Dickey-Fuller tests, or the signi¯cance of the coe±cient δ in $\Delta X_t = C + \sum_{s=1}^{k-1} \Phi{:}\Delta X_{t-s} + \delta{:}X_{t-k} + \varepsilon_t + \pm{:}\text{trend}$ with or without a trend

[25] The test uses the autoregressive decomposition of $X = (Log(U); Log(PART))$: $\Delta X_t = \sum_{i=1}^{k-1} D_i{:}\Delta X_{t-i} + \Pi{:}X_{t-k} + \varepsilon_t$ where ε_t is stationary, D_i is the coe±cients of the polynomial matrix of the lag operator and a matrix. The Johansen test consists of ¯nding the rank of the matrix Π which directly gives the order of co-integration. In the bivariate case, this is a test of the null hypothesis fthe highest eigenvalue of Π is equal to 0g, equivalent to absence of co-integration relation.

Given the coe±cients of the long-run relation between the series (reported in table 13), one can calculate the estimated e®ect of the increase in the labour force between 1971 and 1991 (table 14). The rise of unemployment observed in these four countries is therefore well explained by the model: the ¯tted rise in unemployment (the elasticity times the rise in participation) is between 50% and 200% of the actual value.[26]

4.2 Causality

From Granger (1986), reported in Hendry (1995, p289,d), when two series are co-integrated, at least one must Granger-cause the other. I investigate the direction of causality and perform causality tests of the null hypothesis: X does not Granger-cause Y. In table 15, the non-causality from unemployment to participation is rejected for the USA, France and Germany (with a six-month lag in Germany). The non-causality from participation to unemployment is rejected at good levels of con¯dence for France, evidence is mixed for Germany, and the non-causality cannot be rejected for the UK and the USA.

4.3 Interpretation of co-integration

The interpretation of co-integration in France is that both series are linked by a long-run relation, or equivalently that participation has an impact on unemployment. A second interpretation, though more controversial, is that the source of non-stationarity in unemployment arises from labour supply shocks and not from any other shocks. One may be tempted to interpret the robustness of co-integration in France in this light: the unemployment series are found to be very persistent in this country. This property is interpreted as a hysteresis phenomenon generated by insiders bargaining over wages, at a constant labour supply (Blanchard and Summers 1986). The view here is totally di®erent: the non-stationarity of unemployment comes from changes in the labour supply. In the same vein, the signi¯cance of trends in many empirical macroeconomic works (Bean 1993 for instance found in panel data of OECD countries that the shocks on unemployment were explained as well both by the world GDP °uctuations and by a trend) could be interpreted as simply proxying

[26] The dynamic aspects of the link can be explored with structural VARs (see my IIES seminar paper 629) but no new information is added.

for the increase in labour force participation.

5 Concluding comments and future research

These evidence suggest the existence of a positive link between the composition of the labour force and unemployment. This faces an objection: the adverse e®ects of rising female participation on unemployment might not exist because the female-male wage gap has decreased and that the increased participation of women would thus rather be demand driven. However, Mincer's procedure (predicting changes in participation with changes in wages given estimated elasticities of labour supply to wages) does not support this conclusion (see Layard et al. 1979, or Mincer 1985). Consistently, the model proposes a mechanism through which women more often participate due to changes in the opportunity cost of participation, and in the same time work in better occupations because of the relative attractiveness of the primary jobs when the share of female and young workers in the labour force rises. It is also highly plausible that employers have substituted men for women in some sectors to get around unions: this is a pure competition story between di®erent factors of production, i.e. men and women. As an illustration of this, some authors have studied the evolution of employment by gender in speci¯c sectors like the Printing and Publishing sector and the replacement of male typesetters by more productive female workers in the 70's (see for instance Borzeix and Maruani 1988 and the subsequent references of the work by Maruani). This substitution should obviously weaken the relative position of unskilled men.

A related objection is that men and women work in di®erent occupations, so that substitutability (implying competition) between them is unlikely. Once more, one can argue that there might be a low short-run substitutability, but a higher substitutability in the long-run (10 to 15 years). In any case, results in Grant and Hamermesh (1982) on substitutability of production functions cannot be explained without gender competition. There is also a theoretical answer: even a narrow sector in which women and men, or more consistently with the model of section 2, women and young workers are employed in the same occupation, like cashiers in supermarkets is su±cient for an increasing female labour supply to imply a decline in the equilibrium wage of young workers. This is the case when there is some mobility across sectors.

In conclusion, this work pleads in favour of the inclusion of controls for supply of labour in any unemployment regressions contrary to what is usually done. It also suggests that a combination of quickly rising female participation and high gender inequality may have adverse effects. Therefore, the policy implication if one wants to draw some, should be to reduce gender inequality, and not to reduce female participation. More generally, future work should attempt to investigate the role of gender discrimination in high European unemployment.

Appendix A. Definitions and data sources, series names.

Yearly Data: OECD Labour Force Statistics, 1962-82, 1970-90, 1973-93, OECD Quarterly Labour Force Statistics, 1994-95. Many data breaks are by less than 1%, due to random errors in labour force surveys. The remaining part is due to profound changes in the measurement concepts, especially during the 70's, a period during which most countries adapted the ILO definition to unemployment statistics. Generally, the data are self-consistent in the 80's. In the OECD-CEP database, the series are generally chained. Another method to estimate the amplitude of the break, less ad hoc, is to regress the series on their lagged values, with a constant, a trend and a dummy for the break (ex: break in 77, the dummy D1=(time>77) was included) so that the cyclical component, the trend and the average value of the series are consistent before and after the break. In practice, the difference is very small with the chaining method.

Quarterly Data: USA: Employment and Earnings, UK: Employment Gazette, Germany: Amtliche Nachrichten der Bundesanstalt für Arbeit, Arbeitsstatistik Jahreszahlen, and OECD, France: OECD (Civilian Employment on Payrolls and Bulletin Mensuel des Statistiques du Travail. The quarterly data of the 15-64 years old population are interpolated from the yearly data published in the OECD Labour Force Statistics.

Appendix B.

Corporatism variables.

Calmfors and Driffill (1988) constructed a rank ordering of countries according to the degree of centralization (1988, p19, table 1), for 17 OECD countries which aims at representing the effect of labour market institutions on (aggregate) wage determination. Rank 1 is for Austria, the most corporatist country and rank 17 for Canada, the most decentralized economy. Evidence suggests that economic performance is linked to this rank according to an inverted U-shaped curve. The theoretical argument is that in decentralized economies, wages (almost) fully adjust to the labour supply, whereas in very centralized economies, unions take account of the externality of wage bargaining on employment, which is not true in the "intermediate" economies. The advantage of this approach is that two variables, the rank ordering and its square, proxy the 6 structural explanatory variables that can be found in structural models like Layard et al. (1991). It is therefore possible to add new explanatory variables. The loss obviously lies in the lack of structure of the U-curve, however, the results will be shown to be robust and reveals the differences between men, women and young workers. I extend the classification to four other countries: Spain, Portugal, Luxembourg and Ireland, which were not included in the initial ranking[27]. To allow for the

[27] In Layard, Nickell and Jackman (1991, p 52), these countries are characterized according

possibility of a U-shaped relationship, we construct the variable CORP, which is directly the rank ordering of the 17+4=21 countries, and CORPSQ = CORP ¤ CORP its square.

Instruments
See table A.

² Appendix C. Simulation of the model in Section 2

This is a simulation[28] of a non-°exible economy where the changes are all driven by the supply factor ¯¸ (the upper bound of the distribution of disutility of work).

¯¸ (upper bound of disutility)	6.0	5.0	4.0	3.0	2.5	1.5	1.0
Female Participation Rate p	0.30	0.35	0.42	0.54	0.64	0.77	0.99
Female Share in Primary Jobs q	0.36	0.37	0.38	0.39	0.40	0.41	0.43
Total Unemployment Rate (%)	7.3	8.3	9.7	11.3	12.3	13.5	14.9
Male Unemployment Rate (%)	4.7	5.4	6.2	7.2	7.8	8.6	9.4
Female Unemployment Rate (%)	10.8	12.2	13.9	16.0	17.2	18.6	20.2
Youth Unemployment Rate (%)	14.1	16.1	18.5	21.6	23.5	25.7	28.3
Female To Male Wage $w_f = w_m$	0.775	0.778	0.782	0.787	0.790	0.795	0.800

When ¯¸ decreases from 6.0 to 1.5, female participation increases from 30% to 77%. There are more workers in the secondary segment, leading to a higher unemployment rate for secondary workers (identical to the youth unemployment rate by construction). The primary sector becomes more attractive to women, whose share q in this sector increases from 36 to 41%. The unemployment rates of all categories rise twofold. Due to the compositional change of labour supply, women's relative wages increase during the same period.

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to union coverage, union coordination and employer coordination. To be consistent I gave rank 11 to Portugal (between Australia and France), rank 14 to Spain (between UK and Italy), and 17 to Ireland (between Japan and Switzerland). Luxemburg, as we believe, is also decentralized, and was given rank 19, between Switzerland and the USA. Greece is excluded because for it is not ranked according to the degree of wage setting centralization.

[28] Parameter values: j = 0:5; ¹ = ¡2, µ = 0:1, ° = 0:65, ± = 0:2

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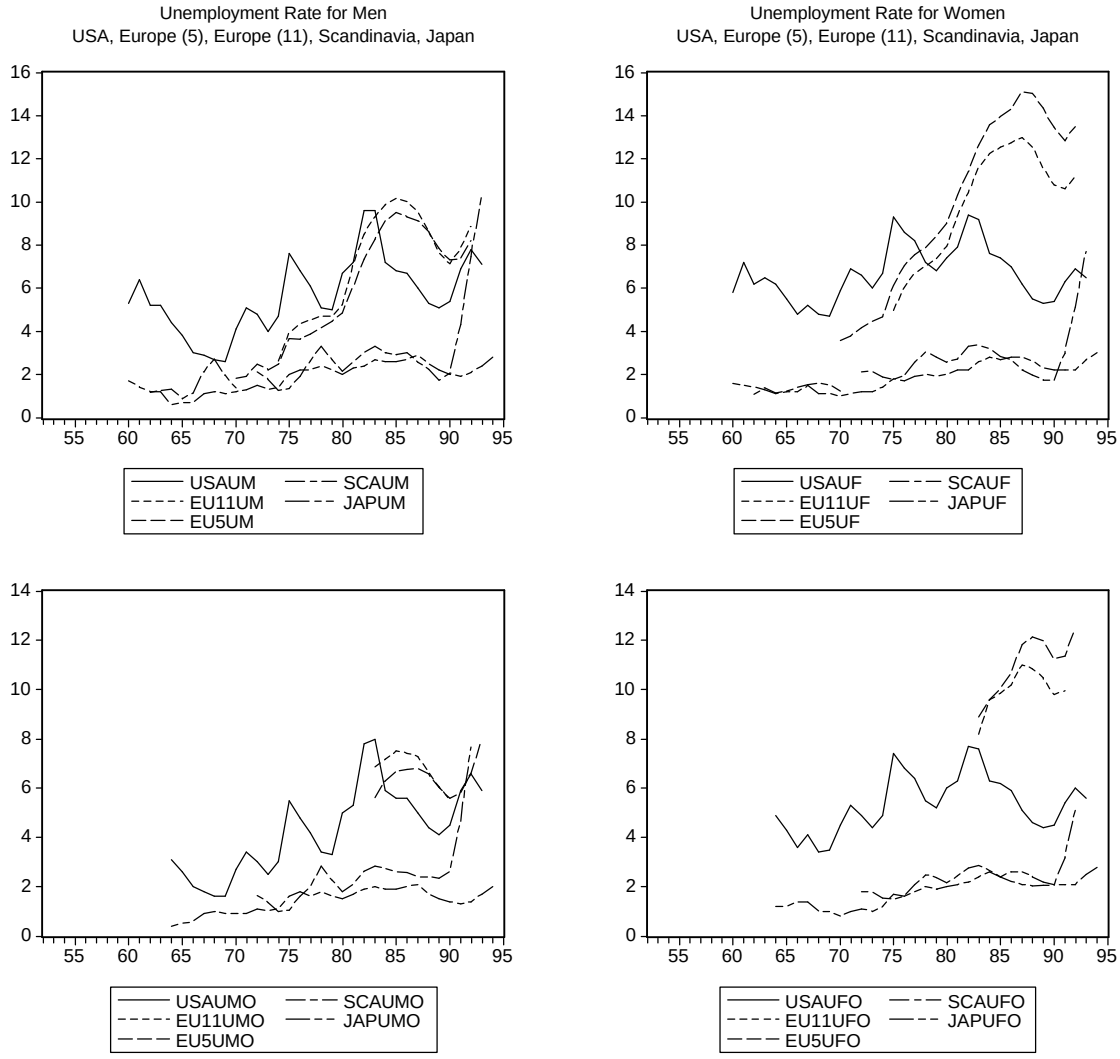


Figure 1: Unemployment rates by gender and age. UM= Male Unemployment, UF= Female Unemployment, UMO=Adult Male Unemployment, UFO=Adult Female Unemployment

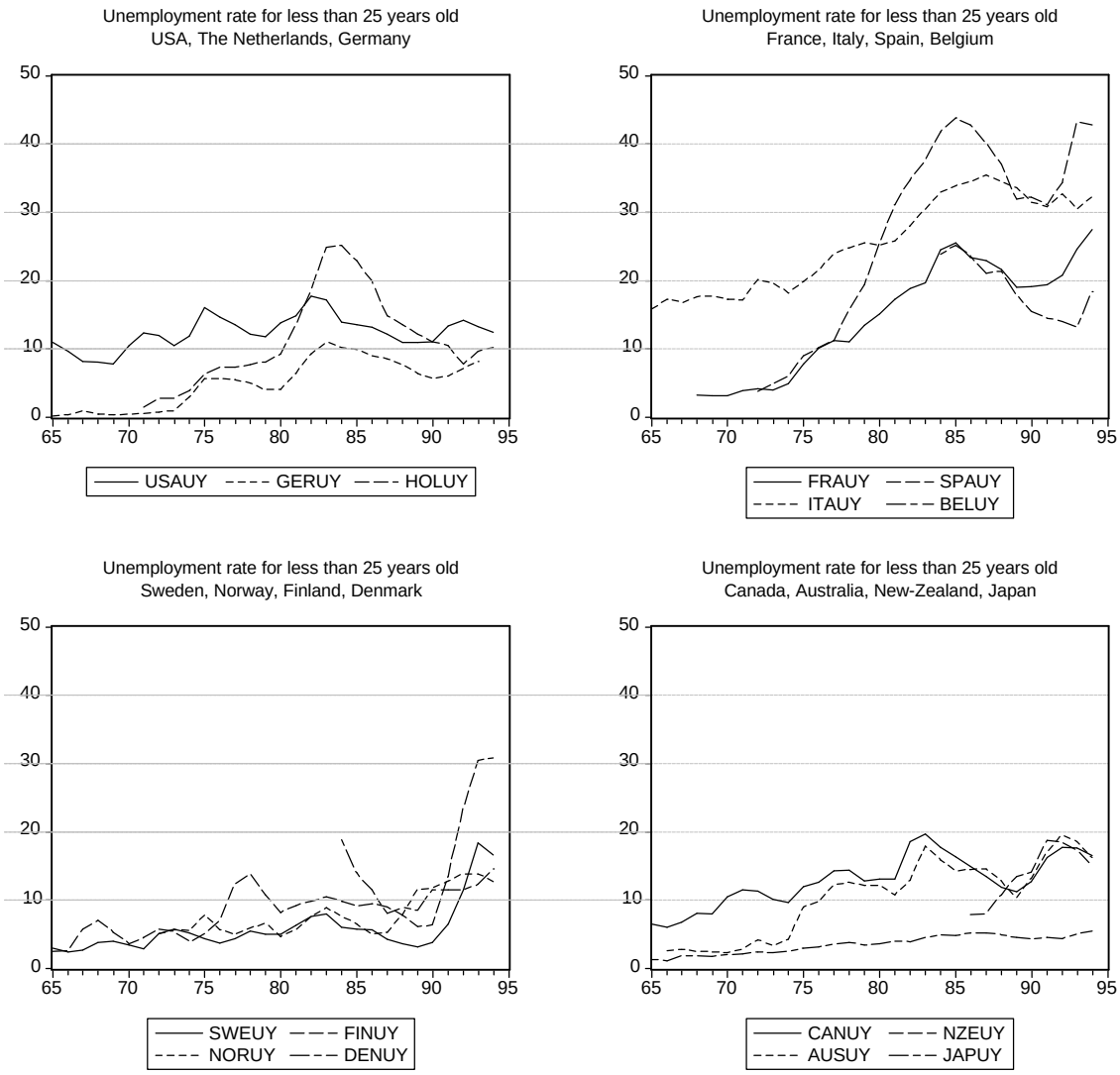


Figure 2: UY = Unemployment rate of young (less than 25 year old) workers.

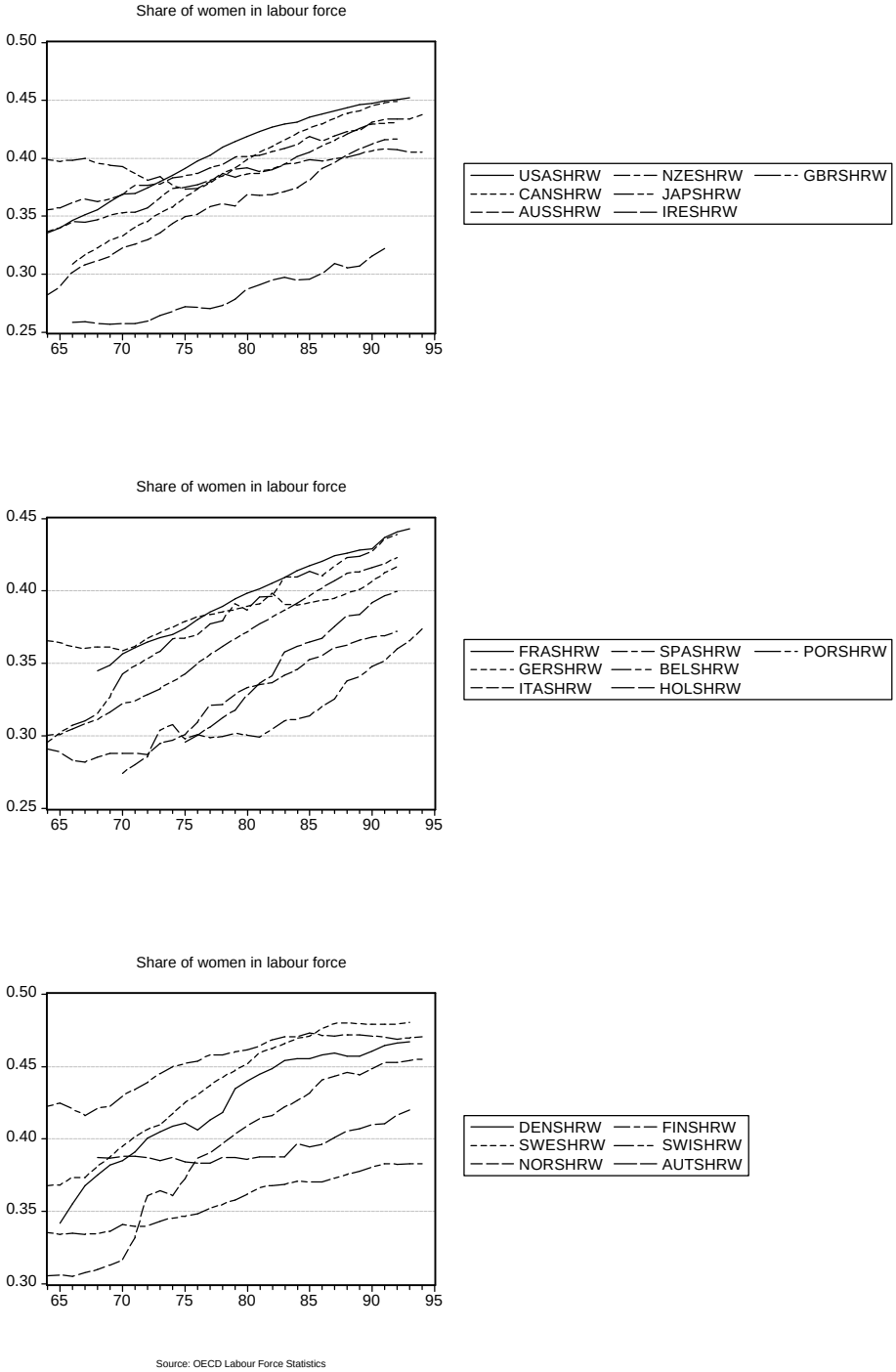
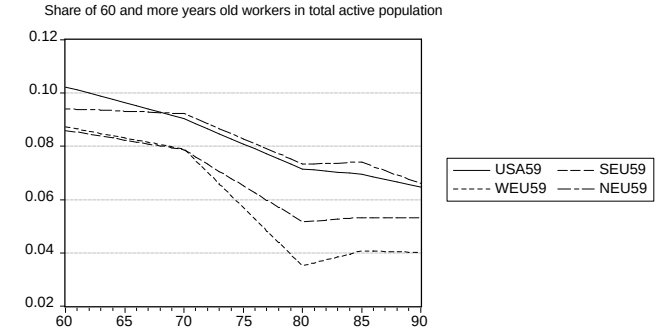
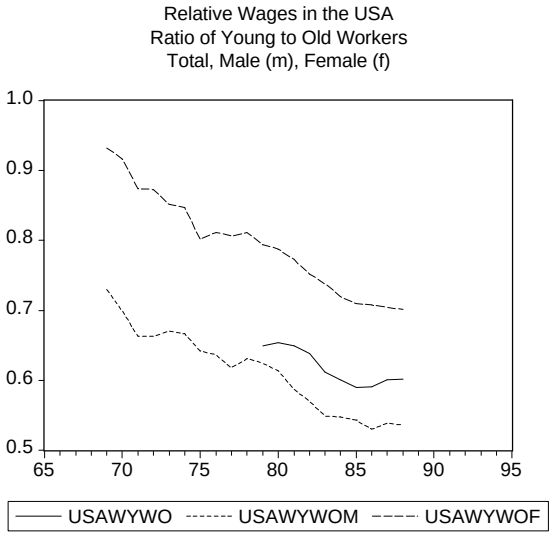


Figure 3: SHWR = Share of women in the labour force, OECD countries



Source: ILO projections on economically active population (1990=proj. figures)
WEU: Western Europe (France, Germany, Netherlands, Switzerland, Belgium, Austria, Luxemburg)
SEU: Southern Europe (Spain, Italy, Portugal, Greece, Albania, Yougoslavia)
NEU: Northern Europe (Denmark, Iceland, Norway, Ireland, Sweden, United Kingdom, Finland)

Figure 4: Age composition of the labour force, USA vs Europe



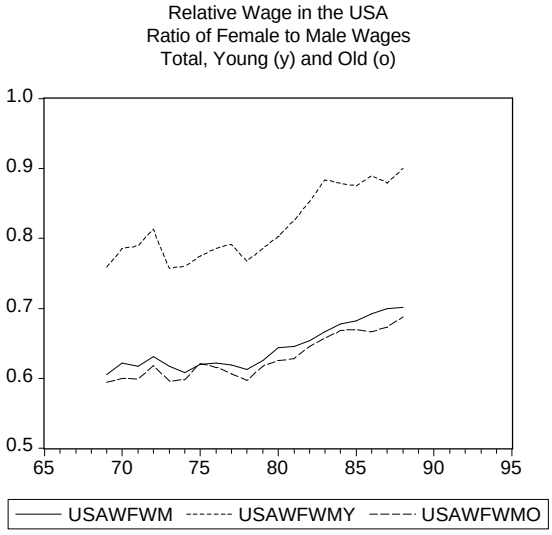


Figure 5: Relative wages in the US (median wage of the groups). WYWO = ratio of young workers (under 25) wages to older workers (over 25) wages; WYWOF (resp. M) = WYWO ratio for female (resp. male) workers. WFWM = ratio of female workers wages to male workers wages. WFWMO (resp. Y) = WFWM ratio for older workers (resp. young workers).