Changes in the Composition of Labour Supply
Implications for Wages and Unemployment

Thesis submitted for the degree
of Doctor of Philosophy (PhD) by
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Changes in the Composition of Labour Supply. Implications for Wages and Unemployment

by

Etienne WASMER

Submitted to the Department of Economics, London School of Economics
on September 1997, in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy (PhD)

Abstract

This thesis aims to show that usually neglected compositional changes of the labour force over the last 30 years (more young workers, more women, more workers with low attachment to the labour market, less experienced workers, more educated workers), can explain important stylized facts.

First, about unemployment: the countries with high female unemployment are also countries with high young unemployment (the correlation across OECD countries between the two rates is positive and quite high at about 0.84). This can be explained by a shift towards more competition among young / women in a secondary labour market due to increased labour supply of the two groups. About 4 points of total unemployment are associated with observed changes in labour supply, if endogeneity of participation variables with respect to unemployment is properly accounted for. Second, about wage inequality: the most important trend in wage inequality in the US is the rising return to experience, or equivalently the deterioration of the relative position of younger workers. The second fact can be explained by a historical change in the skill composition of the labour force - workers though more educated are yet less experienced. This substitution of skills can also explain a significant part of the unexplained rise in the return to education, depending on the substitutability between education and experience in human capital: more inexperienced workers in the labour force generate a relative scarcity of human capital that increases the demand for education.

In the theoretical part of the thesis, two trends of the OECD labour markets are explored within matching models. First, it is shown that more short-term employment can be explained by higher active population growth and lower productivity growth. Second, stronger urban unemployment gradients and higher aggregate unemployment can be shown to reinforce each other when location choices within agglomerations are endogenous.

Thesis Supervisor: Christopher A. Pissarides
Title: Professor, Department of Economics, London School of Economics

Modifications to the PhD dissertation
"Changes in the Composition of Labour Supply.
Implications for Wages and Unemployment"
by Etienne Wasmer

p21, second paragraph: "twice the" , instead of "twofold"

p27, last line: replace "attack" by "address"

p28, last paragraph: "The matching function even allows us to" instead of "The matching function allows us to even"

p29, last paragraph: "monotonically" instead of "monotonously"

p30, first paragraph: "arises" instead of "come back"

p46, first paragraph: "has become much less common" instead of "has become very less frequent"

p54, first paragraph: "continuously increasing" instead of "continuously augmenting"

p60, appendix C: "in the last sentence" instead of "in the above equation"

p63, third line: "substantial" instead of "substantive"

p63, first paragraph: "wage rigidity should not persist for that a long time"

p65, first paragraph: "...participation from being conclusive" instead of "participation to be conclusive

p66, second paragraph: replace "more than 25 years old workers" by "adult workers"

p66, second paragraph: replace "who are more unemployed" by "who have higher unemployment rates"

p75, last line: replace "be thought without" by "be usefully analysed without incorporating"

p 89, third line: replace "we are safe of the criticism" by "the problem is not serious"

p91, last paragraph: "over the period 1970-1995, changes in the level of labour supply reflect its compositional changes"

p100, first column first table: "683 (3.3%)" instead of "(3.3%)"

p110, second paragraph: "advanced" instead of "imposed" and "inequality-increasing" instead of "dispersing"

p111, first line: "and" instead of "whereas"

p131, "Figure 3-9: Comparison of the price of skills and the quantities supplied (in efficiency units)"

p169, second paragraph: "appearance" instead of "apparition"

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0.1 Introduction: why an interest in labour supply?

This thesis is about the role of labour supply in the rise in unemployment in the OECD countries, and in the rise of wage inequality in Anglo-Saxon countries. It argues that some stylised facts about female and youth unemployment and about the changes in relative wages have no (convincing) explanation and that looking at labour supply properly focusing on all its components (age, education, experience, gender) significantly improves our understanding of these stylized facts. The changes in labour supply are first a change in the level and in the growth rate of the labour force due to an increase in population and second a change in the composition of the labour force. Macroeconomists have usually considered that changes in the level of labour force are neutral in their effect on the equilibrium unemployment rate in the long run, though a change in the growth rate has some effects that are perceived as weak. The compositional changes have not been seriously addressed so far, or have not been approached in all their varied dimensions. The first section presents the motivation of the thesis, summarizes some stylized facts addressed in the thesis and the mechanisms that explain them. The next sections (sections 2 and 3) explain why the thesis will be restricted to the study of compositional changes. Section 4 describes the organization of the thesis. Section 5 discusses the problems linked to the endogeneity of participation, which come back in the different chapters and section 6 concludes in suggesting directions for future research.

0.1.1 Motivation, objections and answers

This first section is devoted to the motivation of the thesis. The main reason for the interest in labour supply is the lack of existing work on the question. In the most influential works on the subject, the Chelwood Gate conferences I and II, edited in Bean et al (1987) and Dreze and Bean (1990), and in Layard et al. (1991), Bean (1994), Snower and de la Dehesa (1997), the possible impact of labour supply is not addressed or not central. The lack of work *per se* is a justification for the study. The reasons for the absence of serious analysis on the question are numerous. Some are serious, some other not so. For instance, there are some good reasons to think that unemployment is not connected to the *level* of labour supply. In the very long run, unemployment is not trended, whereas the size of active population is. This is why the

focus of the thesis will rather be on the composition of the labour force. It happens that in the past decades, the increase in the level of the labour force (at least in countries like the US, the UK, France) is associated with changes in its composition. In all the OECD countries, the size of cohorts of new entrants into the labour market increased, especially in the 70's, with the post-war demographic shock. In the United States, the peak in the size of cohorts occurred in 1977. The share of women on the labour market has drastically increased, on an average from 30% to 45% of the labour force in less than 30 years. This is an enormous change, which has not been addressed with a macroeconomic perspective.

However, in many works, the question of labour supply is dismissed in three lines. In the case of France for instance (see Malinvaud 1986, Lambert and al. 1990), a question of timing is often involved: there is a positive inflexion in the growth of female labour force in the end 60's, more precisely in 1967, whereas the rise in unemployment occurred mainly after 1974. This is however a too simple view of the problem: I would like to argue that, in order to properly consider the links between unemployment and labour supply, there is the need to disentangle the cyclical component from the trend of unemployment. The figure 0-1 displays the residuals of a simple OLS estimate of yearly French unemployment on the index of capacity utilization. It appears more clearly that, once the cyclical demand factors, approximated by the cycle indicator are removed, the trend in higher unemployment does not start in 1974, but rather earlier since the mid 60's. Moreover, between 1967 and 1968, the residual goes up faster than its trend. This can be related to the analysis of the chapter 2: using quarterly data, it is found that a co-integration relationship exists between participation and unemployment in France, with a positive coefficient.

Another commonly made objection to an important role of labour supply is that in the US, despite their rising share in the labour force, women's wages have caught up men's wages, which seems to indicate the dominance of labour demand rather than labour supply side phenomenons. To answer this objection, I will argue that the average "quality" of participating women has strongly increased: the relative rise in their wages is in fact a manifestation of a compositional effect rather than of a demand side effect. Moreover, most of the studies (Mincer 1985, Layard et al. 1980) show that the historical progression of real wages cannot explain much of the rising female participation. This supports the view that rising participation is supply driven.

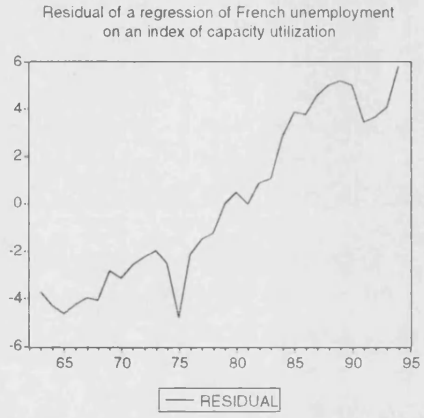

Figure 0-1: Trend in unemployment in France

In Layard (1997, p344), a strong positive correlation between the growth of the labour force and the growth of employment is shown across the OECD countries. This kind of analysis is helpful in showing that the number of jobs is not an exogenous given constant as in the simplest Keynesian models and that there are obviously positive comovements of labour force and employment. However, these graphs don't deal with possible endogeneity issues: the labour force obviously depends on the economic conditions, relative wages and employment prospects, as shown in Gregg and Wadsworth (1995). The causality in Layard's scatter diagrams is an open question. This question of causality is thus addressed to in chapter 2.

In addition, there are neglected facts about labour supply that can be usefully reminded. For instance, in Germany, fluctuations of the labour force are very strong: in Entorf et al. (1990), the graph 7.2. p 243 tells us that between 1974 and 1976, the labour force was reduced by 800 000 workers (mostly foreigners), which should explain at least in the short run part of the decline in unemployment after the 1974 peak. This simple fact is not commented upon in the text, however. The VAR and co-integration analysis undertaken in the chapter 2 of the thesis give a statistical interpretation: in Germany, causality runs from unemployment to labour supply after a few quarters and the long run relation between participation and unemployment implies a negative coefficient. Another interesting feature concerns the supply of hours of worked by women: in some countries the share of women working part-time (the UK, 50%; the

Netherlands, 63%; Switzerland 54%; Sweden 44%) is much higher than in others (Spain 15%; France 26%; Italy 11%) and so comparative studies of labour market performance should be able to integrate this fact. There are many aspects of female labour supply (cyclicality, hours supplied, opportunity cost i.e. incentives of participation) that could frequently be used, in order to more accurately compare the countries.

0.1.2 Some selected stylised facts about unemployment and wage inequality

How can the supply trends be considered? The starting point of this work is a simple observation: since the second oil shock in 1979, unemployment in Europe has been permanently higher than in the US, but both rates are actually quite similar when only adult men are considered. In contrast, when adult female and young (less than 25) workers are considered, the difference between the two sides of Atlantic becomes extremely important. See the figure 0-2 for the gender differences[1], and Blanchflower (1996) for the youth labour markets. If one wishes to explain European unemployment, these facts of inter-group unemployment disparities cannot be neglected. To some extent, European unemployment is specific to female and youth. At the national level, the stylized facts can be summarized as follows: in a cross-section of OECD countries, the correlation coefficient between unemployment rates of adult women and young workers is 0.84 over the 80-94 period, while it is 0.69 between adult men and adult women and 0.56 between men and young (chapter 2). Unemployment rates of each category, female and young, should be explained jointly.

The claim of the thesis is that a key to understanding these facts is labour supply. The intuition can be described starting from the micro-econometric literature on production functions. Different production factors enter in production with different elasticity of substitution. There is a fair degree of convergence of these studies (Grant et Hamermesh 1982, Berger 1983, Topel 1994): adult men and adult women are complementary factors, young and adult men are complementary factors, young and adult women are substitute factors, as well as women and low-skills men. For instance, an increase in the labour supply of one of these groups has a negative effect on equilibrium wages of the q-substitutes group. Of course the impact of the size

[1] EU11: unemployment rate in Europe excluding Greece, EU5 (Spain, Italy, France, Germany, Belgium), Sca Scandinavian countries. See figure figures 1 and 2 in chapter 2 for more details on this graph.

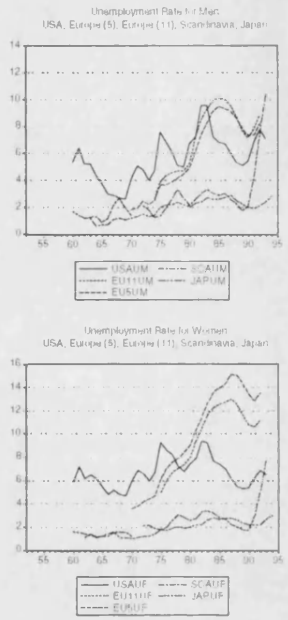

Figure 0-2: Unemployment rate by gender

of the cohorts of young was studied in the previous literature. It was shown that this affected the relative position of young with respect to older workers in the US: bigger cohorts have lower wages, lower growth of wages (see Welch 1979). These negative effects of the labour supply were also considered in other OECD countries by Bloom, Freeman and Korenman (1987). They lead to unemployment and lower wages for young workers. The originality of the thesis is to consider explicitly the substitutability between young and women. When this is done, a natural cause of deterioration of the relative position of female and young workers on the labour markets lies in the evolution of labour supply described below: more young and more women. A part of this change should have generated either unemployment or inter-group wage inequality. These last two points, *the compositional change in labour supply* and *the substitutability between young and women in production*, have not been addressed to in the macroeconomic literature so far. The mechanism highlighted in the thesis (chapter 2) is basically the following one. Consider a dual labour market. In segments of this labour market, groups that are substitutes are assumed to be working in the same segment. As in Doeringer and Piore (1971), the primary jobs require stable workers (like men and educated women) and the secondary jobs can be filled by

high turnover workers (young, low educated women). The change in the composition of the labour force can be viewed as a relative increase in the workers of the secondary segment, at least in some stage of the last decades, and even a *saturation* of this segment[2]. In chapter 2, estimates of unemployment in cross-section of countries show that differences in participation alone explain about 4 percent of total unemployment, 3 percent of male unemployment and 6 percent of female unemployment after institutional factors have been controlled for.

Another stylised fact quite relevant here, concerns wage inequality which has strongly increased since the 70's, especially in the US and in other "flexible" economies like the UK. A key fact that the thesis addresses is the most important trend in the rise in the return to skills described by Juhn, Murphy and Pierce (1993): a rise in the return to experience of male workers, by 70% between 1963 and 1988. In other words, there has been a strong decline in the relative wages of young workers. The literature is rather silent on this aspect: there is little evidence that biased technological progress like intense computerization can easily explain the worsening relative position of younger workers. Similarly, the impact of competition with developing countries through international trade should be more important in sectors intensive in younger workers to explain anything, what has not been shown so far. It is also important to notice that the size of the cohorts of new entrants in the labour market is not able to explain the trend, since this size peaked in 1977 and then declined. The last part of the rise in the return to experience, since the mid 70's, has no convincing explanation, as acknowledged by Katz and Murphy (1992, p75). There is a missing piece in the puzzle that the thesis proposes to solve. This is the second mechanism. After having shown that women have lower employment experience and lower return to true employment experience, I argue that the rising share of young and women in the labour force can be interpreted as a *cumulative increase in the share of "low experience" workers.* This can easily explain the rising return to experience of men described by Juhn, Murphy and Pierce, as illustrated in figure 0-3 (source: chapter 3). This decrease in the share of experienced workers decrease the aggregate quantity of skills which is supplied. This relative scarcity of skills (a mix of experience and education) can explain the rising demand for education, just by substitutability between education and experience.

[2] By saturation it is meant that the wage necessary to insure full employment is so low that there is either high unemployment in this segment or people are overwhelmingly leaving the labour force.

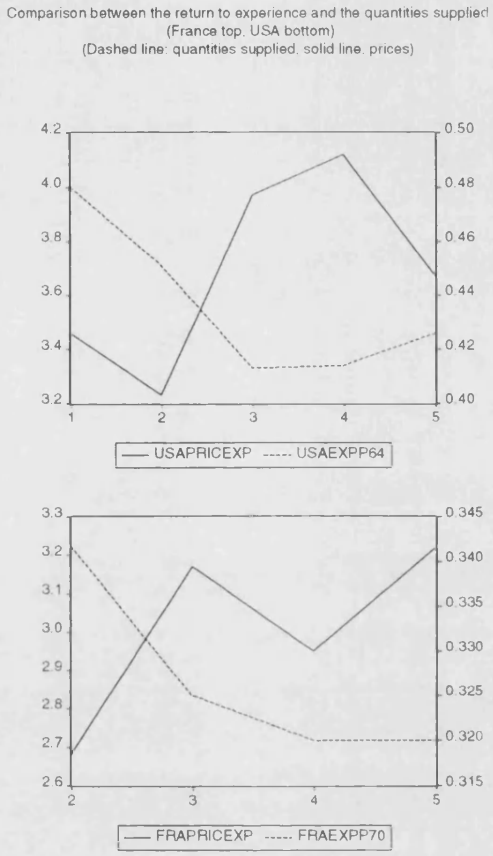

Figure 0-3: Returns to Experience and Quantities of Experience Supplied. Comparison between France and the USA

From my calculations, a significant part (say 10 to 25%, depending on the assumption about the elasticity of substitution between experience and education in human capital formation) of the unexplained rise in the college premium can be explained by the inflows of inexperienced workers.

One may be tempted to underestimate the importance of the inter-group increase in inequality, arguing that the rise in wage inequality, to the extent of about 60%, is due to the rise in inequality within narrowly defined groups of education, age and gender at least in the US. My answer is that over the last decades, the change in inter-group inequality is quantitatively more important than usually thought. An accurate reading of Juhn, Murphy and Pierce (1993,

table 4, p 430) reveals that 60% for the within-group component is the figure for the whole period 1963-88. However, it is worth emphasizing that the first part of this period faced only a slight change in the dispersion of wages. The share of the rise in wage inequality explained by the within-group component is actually about 40% during the quite interesting period of the strong rise in inequality, i.e. since the late 70's. The change in inequality due to the change in observed prices is always more important than the change due to the unobserved prices and quantities. It follows that the inter-group inequality is more relevant than usually attributed to in the explanation of rising wage inequality.

0.2 Labour Supply with Homogenous workers

0.2.1 Level of the labour force

The impact of the level of the labour force on equilibrium unemployment is usually considered as null in the long run. There are both empirical evidence and strong theoretical arguments in support of this. From the empirical point of view, it can be observed than in all countries an increase in the size of the labour force due to population growth in the very long run, say two centuries, is not associated with an increase in the unemployment rate (defined as the ratio of the number of unemployed to the labour force) is associated. For this view, see Layard et al. (1991). It follows that any regression of unemployment rates on the level of labour force will provide statistically insignificant coefficients if the sample size has sufficiently long time series dimension. In the long run, the observed correlation between labour supply and unemployment rates will be a very small number. On the theoretical side, in both market clearing models and models with imperfect wage adjustment (wage setting models, or WS models hereafter), a change in the level of labour supply only implies short run effects on wages or on equilibrium unemployment. For instance, in a WS model, if an increase in the labour force raises the number of unemployed, this leads to a decrease in wage pressure, and a decrease in real wages. Whenever labour is cheaper, capital is going to be more profitable and after capital stock adjustment, the equilibrium level of wages and of unemployment will be the same as before the change in the labour force. If there are effects of the changes in the level of the labour force on unemployment and wages, these effects are likely to be only short run effects. This is illustrated in Nickell

(1989) in a wage-setting price-setting framework (WS-PS). Since these effects are well known, the thesis will not revert to these issues.

0.2.2 Growth rate of the labour force

In contrast, there is no reason for compositional changes of the labour force to be neutral on equilibrium unemployment. The first of the compositional changes is a change in the growth rate of the labour force. If the growth rate of the labour force increases, this can be the result of either larger flows of workers from inactivity to activity, or smaller flows from activity to inactivity. Assume, for instance, that the inflows from inactivity to activity are the young new entrants and that they are previously unemployed. It follows that an increase in the growth rate of the labour force is associated with more young workers and with higher unemployment, even if the workers can be considered as ex-ante identical. This case was made for instance in Pissarides (1990, chapter 2). However, it is generally considered that the magnitude of a change in the growth rate of the labour force on unemployment is weak and can be neglected. Simulations of Pissarides model for instance (not reported here, but with the values of the parameters in the simulations described in the chapter 5) suggest that a 1% increase in the growth rate of the labour force (which is large, about twofold in average growth rate) has a very small impact on equilibrium unemployment, of +0.15%. Since it was anticipated that no important effect would come from the change in the growth rate of the labour force, this aspect was also skipped in the thesis.

0.3 Labour Supply with Heterogeneous workers

0.3.1 The simplest compositional effect

There are other compositional changes that one can introduce in models of equilibrium unemployment. However, in contrast to the former ones, one needs to go beyond the representative agents framework: one can no longer consider ex-ante identical workers. Assume, for instance, that there are N classes of agents indexed by i, each of them being a fraction α_i of the labour force. Each of these class of agents has a different "*natural unemployment rate*" u_i. This concept of natural unemployment rate could be generated in many different models. In static

WS-PS models, differences in the u_i would come from differences in the labour demand or from the outside options of the agents. In flow models incorporating hiring rates determination and separation rates (exit rates from employment), differences between the u_i would, in addition, come from differences in the separation rates. At this stage, it is not necessary to choose just one type of model of natural rate of unemployment to make the following points. The average unemployment rate of the labour force is given by the weighted average of the rates of each group,

$$u = \sum \alpha_i . u_i \tag{0.1}$$

and any change over time in the average unemployment rate can be decomposed into the sum of a compositional change and a change in the unemployment rate within each group:

$$\Delta u = \sum \Delta\alpha_i . u_i + \sum \alpha_i . \Delta u_i \tag{0.2}$$

where Δ is a difference operator between two dates. This formula can be applied to the rise in unemployment in some OECD countries over the 1970-95 period. It reveals that much, if not all, of the rise in unemployment can be attributed to the rise in the group-specific unemployment rates u_i: in each groups of age, gender and education, the unemployment rate has been increasing sometimes in huge proportion. See the following tables:

USA[3]	1964	1970	1977	1985	1991
u (%)	4.6	3.6	6.2	5.8	5.4

USA	1964-70	1970-77	1977-85	1985-91	1964-91
$\sum \alpha_i . \Delta u_i$	-1.2	+3.0	+0.3	+0.2	+2.3
$\sum \Delta\alpha_i . u_i$	+0.2	-0.4	-0.7	-0.6	-1.5

France	1970	1977	1985	1993
u (%)	2.5	4.8	10.9	11.8

[3]The groups are defined according to the gender, 4 experience categories and 4 education categories (resp. 5 for the USA), i.e. 32 groups for France, 40 groups for the USA.

France	1970-77	1977-85	1985-93	1970-93
$\sum \alpha_i.\Delta u_i$	+2.1	+5.9	+1.6	+9.6
$\sum \Delta\alpha_i.u_i$	+0.2	+0.2	-0.7	-0.3

Does this necessarily imply that the compositional changes of the labour force have no impact on the average unemployment rate? The answer is no. Two arguments are outlined in the next two sub-sections. The first relies on the fact that the relative size of some groups has an impact on the relative demand for all the groups. For instance, when the share of adult women in the labour force increases, given their significant substitutability with the young workers, the relative position of young workers is affected. The above decomposition does not preclude any impact of the composition of the labour force on unemployment: it may well be that the increase Δu_i , in for instance young unemployment, is caused by the supply of some other group. This argument is the core of chapters 2 and 3.

The second argument relies on the fact that the above analysis based on the decomposition of equation (2) is valid only as long as there are no changes in the structure of the population *within* groups, in other words as long as the division of the labour force into arbitrary groups is valid. Unobserved heterogeneity for instance could have changed within groups.

0.3.2 Competition among groups

The first argument is the following. Coming back to the equation (0.1), it can be stated that the group-specific unemployment rates u_i are affected not only by their share in the labour force, but also by the share of some of the others. To simplify the presentation of the argument, let us consider a full-employment model in which wages are fully flexible, and consider how these wages respond to the share of the different groups. Any transposition to the study of unemployment would come from relative wage rigidity, as developed in chapters 2 and 3. Consider a multi-factor production function with constant return to scale, $Y = F(X_1, X_2, ..., X_n)$. Consider the case where the X_i are labour inputs only. The constant return to scale assumption implies that the marginal product of a category j of workers is a function of the ratios X_1/X_j, ..., X_n/X_j, or a function of the share α_i of group i in total labour inputs. It follows that

$$w_j = w_j(\alpha_1, ...\alpha_i, ...\alpha_n)$$

if the wage equals the marginal product. It is well known that the impact of an increase in the share of one group on the wage of another group will depend on the partial cross-derivative in the production function. When the Hicks elasticities of complementarity are negative (i.e. when the cross-derivative of the production function are negative), the groups are said to be q-substitute whereas they are termed q-complement when the converse is true.

In the empirical literature of the early 80's, it was often found that some low wage groups are q-substitutes. This is the case of young workers, low-skilled women, low skilled men, and even medium and high skilled women (see Grant and Hamermesh 1982, Berger 1983). It follows that a change in the composition of the labour force that would jointly increase the fraction of young workers and of women would adversely affect the bottom end of the wage distribution. The picture is however not as clear as it could be: in particular, other labour supply changes have taken place over the last twenty years, like the strong improvement of educational levels. Nevertheless, it is surprising that usual explanations of the rising wage inequality and of the rise in unemployment have neglected the substitutability between groups of the labour force. In particular, men and women are often considered as working on separate islands, which is not necessarily the case. An exception is Topel (1994) who investigates the elasticities of substitution between various demographic groups and concludes that "*there is no evidence that different regional evolution of wages are demand-driven; the whole story is on the supply side.*"

0.3.3 Are the groups appropriately defined?

Equation (2) is helpful only when the groups considered faced no change in the composition of their population. However, since data limitations are often very strong, missing variables could make the division in the different groups inappropriate. Two simple examples can illustrate this point. Consider first the group of young men with a given education level, say 12 years of schooling: the equivalent of a US. high school degree. In 1964 in the US, these workers were in fairly high quantiles of the education distribution in the labour force. In 1991, these workers were in much lower quantiles of the distribution of education. In 1964, 50% of the population had strictly less than 12 years of education in the USA, in 1991 this fraction was only 22%. If one believes that education serves as sorting individuals (sorting is either signalling

and screening, for the distinction see the survey by A. Weiss 1995) as well as it provides human capital to workers, certainly part of the decline of the relative position of the low education groups comes from the fact that when most of population has a higher education level, those who remain at lower education level are less attractive to employers.

Another example which will be very important in some of the chapters of the thesis, is the group of women of intermediate age, say 30-45 years old. Over time, their attachment to the labour market is very likely to have increased. If in addition, it is believed that employers expectations about the attachment of a given female worker to the labour force is crucial in explaining reciprocal investment in human capital, like training, then this can explain why the relative position of this group has been improving over time. Again, this is a supply side effect, rather than a demand side effect. A similar argument can be advanced about the use of potential experience (i.e. a proxy for real experience, equal to age minus education) as a way to define the different groups of the labour force. In the same group of women, the difference between potential experience and real experience is likely to have declined over time and, if real experience is an important determinant of wages or unemployment, there should be no surprise in observing an improvement in the position of the group, due to a supply effect.

In other words, in these two examples, there is a problem of unobserved heterogeneity. In the first example, the unobserved heterogeneity is correlated to the determinants of the groups i, and may bias the conclusion on the impact of compositional changes. In the second case, this heterogeneity is changing over time and there is a hidden or unobserved supply change. This argument can be used in many situation where usual indicators lead to seemingly unambiguous conclusion. For instance, Katz and Murphy (1992) provide a necessary condition for the existence of labour demand shifts: if the inner product across cells of changes in relative employment and relative wages is positive, necessarily there is a demand shift. However, this holds only when the decomposition of the groups is appropriate. There is a lack of empirical work on that point and the thesis does not fill this gap, but this is certainly a direction for future research.

0.4 Organisation of the thesis

We start from the observation that the increase in labour supply in all OECD countries in the last thirty years leads to specific change in the composition of the labour force, an increase in the share of young workers and of female workers. It will be useful to determine what relevant characteristics of these workers differ from that of the average labour force. The first of these characteristics is about attachment to the labour force or to the average turnover rate: the young and some adult women are perceived by employers as less stable in their job as compared to men, because their outside options (out of activity) are greater than that of adult men. Chapter 1 investigates the differences in the turnover rates among different groups and over time, in France. Building on the empirical results of chapter 1, the second chapter proposes a model of the consequences of the compositional changes and how they may affect the macroeconomic variables. This is tested on OECD macroeconomic data. A second characteristic which differs among the different categories of workers is that female and younger workers have generally lower wages than the average. However, these lower wages are the sum of two opposite effects of skills: on average, the recent cohorts of young workers and of active women are more educated, but they are less experienced than men. Chapter 3 investigates these trends with the micro-data of French and US labour force surveys. This chapter deals with possible wage discrimination problems. The dynamic implications of these trends are explored in the model of chapter 4.

0.4.1 Turnover (chapter 1)

In the first chapter, the 6 rates of transition among employment, unemployment and inactivity in the French labour market are decomposed into trends and cycles. Contrary to other countries like the UK, almost all rates have a significant trend between 1968 and 1993. A striking result, is that a growing fraction of the workers leaving employment choose unemployment rather than inactivity (20% in 1968, up to 60% in 1993). This evolution is shown to be a result of women's rising participation and their stronger attachment to the labour market. The consequences are important changes in the ergodic distribution of workers in the three states, which can be associated with a rise in unemployment by about 4% of the labour force in the 80's. A comparison with the UK suggests that this evolution is specific to France: in the UK, the trend

is rather a withdrawal from activity (see Gregg and Wadsworth 1995).

0.4.2 Macroeconomic impact of labour supply (chapter 2)

The second chapter investigates the consequences of labour supply changes on the labour markets in the OECD countries during the last decades. It is argued that changes in supply cannot be thought of as homogenous: these changes involve more young and more adult female workers, that are complements to skilled men and substitutes for low-wage groups (young, unskilled). Logically, these labour supply trends since the 50's increased competition between female workers, young workers and low skilled workers in some segments of the labour force. Using the result of chapter 1, where it appears that men have much lower employment-inactivity transitions rates than women, but the difference is narrowing over time, I introduce a model of dual labour market, where the primary segment is the segment of low turnover workers, the secondary segment is the segment of high turnover workers. The model provides testable predictions of the links between unemployment and participation indicators.

An empirical strategy to test these links is undertaken. Disaggregation by gender is necessary and gives positive relation between female participation growth and unemployment. Endogeneity of participation levels with respect to unemployment is treated in two ways, by instrumental variables' estimations and with vectorial auto-regression techniques. Causal relations between participation and unemployment cannot be rejected.

0.4.3 Skills: empirics (chapter 3)

Macroeconomic data are no longer sufficient to conclude whether or not labour supply has adverse effects on the labour market. An approach using microeconomic data is necessary and can address connex issues. Specifically, since the thesis is to some extent on the debate of rise in inequality in Anglo-Saxon countries, therefore taking into account the educational levels of workers is unavoidable. The rise in inequality in the US is explained for instance by Juhn, Murphy and Pierce (1993) or Katz et Murphy (1992) as a result of structural changes in the labour demand toward more skilled workers. In this chapter, French data from INSEE (Enquête Actifs Financiers 1992, Formation et Qualification Professionnelle 1970, 77, 85 et 93) and the US data from the March Current Population Survey (1964, 70, 77, 85, 91) are used to attack

the question of labour supply changes.

Using French and US data, the paper assesses the substitution in the composition of skills of the labour supply: low education / high experience workers have been replaced by low experience / high education workers. In aggregate, these changes can have a positive or a negative impact to the skill level of the active population. Using French and US data, the paper establishes the substitution in the composition of skills of the labour supply. In France covariations of price and supply of skills are consistent with pure labour supply stories. In the US, changes in labour demand seem important, even if labour supply changes could lead to the same predictions depending on the substituability between experience and education.

0.4.4 Skills: a model (chapter 4)

In the earlier chapters (2 and 3), it was shown that an increase in female participation can have a negative impact on the prospects for young workers. Since unemployment for young workers can prevent them from accumulating human capital (employment experience), the supply trends can generate adverse dynamic effects, and can lead to multiple equilibria. In addition, more education can be an endogenous response of the labour force to these shocks. A model with explicit dynamics of labour supply by skill and age is constructed, to disentangle the effects of labour supply trends and the rising demand for skill. The model predicts that supply can have the same effects as demand, provided that supply changes are associated to more inexperienced workers in the economy.

0.4.5 Competition for Jobs in a Growing Economy and the Emergence of Dualism (chapter 5)

In the two last chapters, we present two extensions of matching models. An interesting characteristic of matching models is that they are equilibrium unemployment models. This equilibrium comes from a stochastic rationing process, the allocation of resources (job seekers and jobs) is not instantaneous, but is time-consuming. The matching function allows us to even endogeneise this time dimension. This kind of model is therefore extremely useful to complement the empirical analysis of the previous chapters. They are applied to the analysis of two trends of the OECD labour markets, the (re-)emergence of dualism and peripherisation/ghettoisation of the

unemployed.

Pushing the logic of the thesis to the extreme, chapter 5 aims to provide a theoretical explanation of the rising share of short-term employment in Europe with (partly) supply trends in using a matching model with growth. In the model, higher population growth increases the share of temporary jobs and unemployment. In addition, we find that a slowdown in growth of labour productivity leads to the emergence of temporary (i.e. short-term) jobs and explains their increasing share in total employment. Lower growth rates also shift the "Beveridge curve" to the right and weaken the bargaining position of workers. These effects generate a relation between growth and unemployment, which can be negative when the adverse effect of growth on wage setting dominates its positive effect on labour demand. Finally, the often blamed firing costs are found to be neutral when there is no floor on wages.

0.4.6 Equilibrium Urban Unemployment (chapter 6)

In this paper written jointly with Yves Zénou (CORE and Hermes, Paris II), we focus on an original aspect of labour supply, the location of workers. The model is about search equilibrium unemployment when a spatial dimension is introduced. By assuming that workers' search efficiency decreases with the distance to the employment-centre located at the city-centre, two urban equilibrium configurations emerge: either the unemployed reside at the vicinity of the employment-centre or locate at the outskirts of the city. The latter case happens when the surplus of the employed and labour market tightness are low. When the wage is exogenously set, we show that the first urban equilibrium is better because aggregate matching is more efficient and the unemployment level is lower. Unemployment does not depend monotonously on the exogenous wage. If the wage is endogenously determined through bargaining, some externalities linked to distance arise in wage determination: unemployment differences between urban configurations can be reduced. In conclusion, the model shows that introducing endogenous location choice in search equilibrium leads to the amplification of the effect of small aggregate changes on unemployment.

0.5 More on participation decisions

This section summarizes some of the problems faced with the endogeneity of participation decision. No chapter specifically addresses this question, but since it comes back in three chapters, the introduction of the thesis is the opportunity for explaining how they were considered.

0.5.1 Endogeneity of participation with macroeconomic data

Contrary to microeconomists, macroeconomists like to think of labour supply as exogenous, or weakly affected by wages. Indeed, in the case of rising female participation for instance, it has been argued that the secular rise in real wages has little explanatory power for rising female participation, given the measured elasticity to real wages. This is partly because there are price effect and an income effect that may compensate each other, and partly because wage growth affects both the wage of potential participants and the other incomes of the family. The latter fact should decrease participation probability. Aggregate elasticity of participation with respect to aggregate wages tends to be very small.

In contrast, participation may react more to unemployment. One of the findings in chapter 2 is that participation rates in cross-section of countries depends quite strongly on unemployment rates and that instrumental variable estimators are necessary to estimate unemployment equations.

0.5.2 Endogeneity of participation with microeconomic data

Since the thesis also investigates the links between labour supply and unemployment using micro-data, a question arises about the necessity to control for endogenous choices of participation in running wage or employment equations. The Heckman procedure is easy to apply: an equation for participation is estimated, the residual is used to calculate the mean of the residual of the wage equation conditional on participation, which leads to unbiased estimators of the wage earning return to skills.

This procedure is however not always useful in our context. Wage equations are estimated to investigate the employability / productivity of workers, conditional on the fact that they effectively participate. In other words, what wage equations estimated with a simple OLS/GLS

estimator provide is the return to skill of those who are actively looking for a job. This is exactly what the thesis is interested in. A Heckman estimator would in contrast provide the unconditional return to skills, for all participants and non-participants, and the coefficient could not, *stricto sensu*, be used to derive the same welfare implications. Crudely, I do not care about non-participants, i.e. those who are not looking for a job nor employed.

There is, however, a justification for the use of the Heckman procedure, which relies on a specific view about the structural model of participation. The logic is as follows. Workers, employed and non-employed, have different reservation values. They receive wage offers, that they accept or reject by comparing these against the reservation value. Therefore, when one observes the wage distribution, one actually only considers the *accepted* wage offers, while the distribution of the employability of workers (assumed to be relevant to the welfare analysis) would more accurately be measured by the distribution of all wage offers. For this reason, chapter 3 provides both types of estimates, without alteration of the conclusions.

0.6 Conclusion

A major conclusion emerging from the thesis is that the supply effects were hitherto wrongly neglected. They help explain some trends of the rise in wage inequality and they also help predict cross-country or time series unemployment. It was however a very ambitious task to consider the macroeconomic problem of unemployment under the perspective of the changes in participation, usually considered as a microeconomic field. So far I can say that more work can be done on the subject . I suggest the following directions.

First, a rough description of the data lead me to consider that during the 60's-70's, the labour markets faced a substitution in their skill composition, from high experience / low educated workers to low experience / high education workers. There may be differences across countries in the amplitude of the substitution, which may be helpful to investigate. More precisely, some countries which are cited for their good macroeconomic performances may have bounded their labour supply to low levels, by developing various disincentives to female full-time work. One disincentive is for instance lack of enough nurseries, another is a schooling system in which children have too many hours free. Both situations make female participation much more

difficult.

Second, the low experience groups are those which are less attached to the labour market. In an insider/outsider type of approach, it may be interesting to address the political economy of this situation. Is it possible to consider that unions care more about, say male employment than female and youth employment? Some of these issues were investigated by Pissarides (1989).

Third, there is a lack of theory about participation decisions when there is unemployment. I sometimes uses the static expected wage (employment rate times the received wage) as the determinant of participation, but a more dynamic approach would certainly be required. A basis for this could be the work by Burdett and al. (1984).

Chapter 1

Trends in worker flows on the labour market and some consequences for unemployment: France 1968-93

Abstract: The 6 rates of transition among employment, unemployment and inactivity in the French labour market are decomposed into trends and cycles. Contrary to other countries like the UK, almost all rates have a significant trend between 1968 and 1993. A striking result is that a growing fraction of the workers leaving employment choose unemployment rather than inactivity. This evolution is shown to be an outcome women's rising participation and their stronger attachment to the labour market. Its consequences are important changes in the ergodic distribution of workers in the three states, which can be associated with a rise in unemployment by about 4% of the labour force during the 80's.

1.1 Introduction

Since the 1960's, unemployment across OECD countries has increased, depending on the countries, twofold to tenfold. Inequality in wage earning in the US and other Anglo-Saxon economies has risen, as also the share of temporary contracts in Europe, which can be seen as another type of inequality among workers. Common view on these evolutions is that, as firms face an increasing international competition and operate in a high technology environment, the rela-

tive position of unskilled workers has deteriorated (Katz and Murphy 1992, Juhn, Murphy and Pierce 1993). Institutional factors may have further translated these changes in labour demand into a rise in unemployment in Europe, as a counterpart of the US inequalities (Krugman 1994, Bertola and Ichino 1995).

We argue here that in addition to technological changes and international trade, labour supply evolutions may also have some important explanatory power, and illustrate this point using French data: labour supply has been increasing in a non-neutral way in France, with more women and more educated workers[1]. These facts concerning labour stocks are well known. We try to provide additional explanation of labour supply changes by examining accurately the flows, or the numbers of workers moving among the three different states (employment, unemployment and inactivity). The merits associated with the flow' approach are elaborated by Blanchard and Diamond (1990a) and Layard et al. (1991). Firstly, as they point out that the flows are much more cyclical than the stocks, helping to capture the impact of the business cycle fluctuations on labour markets far better. Secondly, much of the secular rise in European unemployment is accounted for by a decrease in the exit rate from unemployment rather than an increase in the inflows into unemployment (Bean 1993 or Layard et al. 1991). This leads one to emphasize the possible depreciation of the skill level of the labour force during unemployment as in Pissarides (1992).

Two recent papers study the flows of workers in the French labour market. One by Cohen and Lefranc (1994), that establishes a relationship between technological growth and some of the transition rates: the rise in the exit rate from employment is well explained by the slowdown in productivity growth[2]. In the other paper, Y. L'Horty (1994) uses relevant data to compute contribution of each transition rate to the rise in unemployment. One of his conclusions is that even a two-states representation, i.e. Employment-Unemployment is broadly sufficient to explain the rise in unemployment. We argue here that this is not so obvious in the 80's and that

[1] See Acemoglu (1996) for the effect of a rise of skilled labour supply leading to a change in demand for skilled overshooting the supply and generating inequality.

[2] In France, the exit rate from employment also increases because of the rising share of temporary contracts in total employment: there are more short duration jobs with higher turnover. However, Cohen and Lefranc's conclusion holds when one considers the rise in temporary contracts in total employment as the outcome of a transition to low producitivity growth rates. This is argued in the chapter of the thesis: high growth rate implies higher future profits. In a matching framework, it is important for firms to retain workers with long-term contracts, whereas the contrary holds in low growth regimes.

the interaction between activity and inactivity rather explains a fairly substantial fraction of unemployment changes. Our first result is that the destination of workers leaving employment is more frequently unemployment rather than inactivity. Consequently, our second result is that a higher turnover through unemployment has an adverse effect on unemployment stock itself, by a mechanical effect.

The chapter investigates the flows of workers between the three mutually exclusive and collectively exhaustive states employment, unemployment and inactivity, in France between 1968 and 1993. In section 2, we use data from the labour force survey (Enquête Emploi) and computing the fraction of workers in a given state who were in another state one year before, we build up a yearly transition matrix, defining implicitly a Markovian model of the labour market transitions. This matrix is then transformed to have an estimate of the transition probabilities. In section 3, we decompose the time series of the six transition probabilities into trends and cycles. We find that all rates have statistically significant cyclical components. Some of the rates have unexpected cyclical signs, implying increased labour force participation during downturns (income effect dominating price effect). All rates are also found to exhibit strong trends. This differs from the result of Gregg and Wadsworth (1995) for the UK, where almost all the variations of the transition rates are cyclical ones.

Section 4 covers one of the most important trends: workers - in fact women - leaving activity are less and less likely to indicate inactivity and rather more and more likely to declare themselves as unemployed in the labour force surveys. We show that labour force composition such as changes in the size of cohorts of retiring workers cannot account for it, and instead it is really a change in individual's (females) labour supply which is clearly implied. This is one of the numerous dimensions of increased female participation and their stronger attachment to the labour markets. In section 5, we define the ergodic distribution (the limit of the stocks given the actual transition rates) and the associated concept of the stationary rate of unemployment (like in L'Horty 1994). The changes in behaviour of labour force participants described in section 3 is associated with a 4% increase in stationary unemployment rate. In section 6, we undertake a brief comparison with the flows in the UK, to emphasize as to how the trend described above is specific to France. In section 7 we suggest that secondary workers effects are a good factor for explaining the trend of more workers choosing unemployment rather than

inactivity. We then conclude that first, the changes in the transition rates are closely linked to the changes in participation characteristics and second, it is reasonable to conclude that the level of unemployment is dependent on labour supply, through these transition rates.

1.2 Transformation of the data

1.2.1 The data

The French labour force survey, "Enquêtes Emploi", is computed every year by the French administration (INSEE), and aggregate data are available since 1968 in " INSEE Séries Longues". Individuals in the sample are asked their labour force status: employed or unemployed according to ILO's definition or not in the labour force. They are also asked their status a year before. If we represent the transitions of the labour market as a Markovian process of all identical individuals, we can use the information in the Enquêtes Emploi to estimate the instantaneous transition probabilities, or alternatively the monthly transition probabilities[3]. However, data require some prior rectification. For instance, the fraction of people having moved from unemployment to employment in one year, calculated from the surveys as the number of movers from one state to the other divided by the unemployment stock the previous year, is not a proper measure of the transition probability. Since there are, among the movers, people having moved more than once, such a mechanical calculation is not appropriate. This is especially true when the annual rates are large, like the exit rate from unemployment, in France being about 50% a year. We have thus to correct for multiple transitions within a year (hereafter intra-year transitions).

1.2.2 Correction for the multiple transitions.

We correct the data in the following way. Let $Q(dt)$ be the Markov transition matrix associated to the states E, U and N (Employment, Unemployment and Not in labour force respectively), during the period t and $t + dt$. In our case,

[3] Of course, the dependence of transitions rates of individuals to their past history is quite strong. Then, a Markovian process (in which the transition probabilities depend only on current state) may be insufficient. This is however enough for this description of the trends of the French labour market and what we want to highlight.

$$Q(dt) = \begin{pmatrix} 1-ue-ne & ue & ne \\ eu & 1-eu-nu & nu \\ en & un & 1-en-un \end{pmatrix} (dt)$$

where xy denotes the transition rate from state X to Y during time dt. For a vector of the stocks $X(t) = (E, U, N)(t)$ representing the number of persons in each state at time t, we have therefore: $X(t+dt) = Q(dt).X(t)$. Assuming a constant transition matrix Q, clearly $Q(2)$ is given by $Q(1) * Q(1)$. From the Enquêtes Emploi, we build the yearly matrix $P = Q(dt = 12$ months) and P is equal to the monthly transition matrix to the power 12. Thus, dividing the non-diagonal coefficients of P by twelve would provide a more appropriate monthly Markovian matrix, because of the multiple transitions (intra-year). The proper monthly transition matrix is the unique real 12th root of the yearly transition matrix. One could question the uniqueness of this 12th root in the set of real 3x3 matrices. In fact, the uniqueness comes from the fact that each year, all the matrices are found to be diagonalizable and to have three positive eigenvalues, one equal to 1 and rest two strictly between 0 and 1[4]. We thus assume that the Markovian matrix (expressed in months) is not far from the instantaneous transition matrix expressed in month: the error term being of the order of the difference between $(1-\lambda)$ and $-log(\lambda)$, where λ are the eigenvalues of the transition matrices. In the yearly case, the error could reach 50%, fortunately partially compensated. For the monthly rates, the error is around 4% for the exit rates from unemployment, and by less than 0.5% for the other transition rates. We then compute[5] for each year the 12th root of the yearly transition matrix, for men, women and all workers: this is the matrix of the monthly transitions rates, provided that there are no intra-monthly multiple transitions, which we assume hereafter.

[4] See also Fougeres and Kamionka (1992) for a formal exposition of the transition matrices and of their properties.

[5] With Mathematica for Windows.

1.3 Decomposition in trends and cycles

1.3.1 Trends in the transformed data

Number of workers in transition

Having estimated the monthly transitions probabilities, we can calculate the monthly flows of workers year by year (XY is the number of movers between states X and Y). The following table displays the yearly growth rates for the period of study, plus additional statistics on the stocks. These growth rates are very large, either positively or negatively, which means that the time trends of these flows are persistent, and significant. The flows between E and N have clearly decreased over the period, the flows between N and U have risen, the flows between U and E have a clear upward trend. This reveals deep changes in the French labour market, that we analyse in details while considering the transition rates, in the next sub-sections.

Table 1.1. Average yearly growth rates, 1968-92

Series	Growth rate (%)	Series	Growth rate (%)
EU	+7.22	Entry in E	0.58
UE	+5.25	Entry in U	6.47
EN	-2.05	Entry in N	-0.75
NE	-1.95	Employment E	+0.45
UN	+5.83	Unemployment U	+6.90
NU	+4.91	Unemployment rate u	+6.01
Exit from E	+1.66	Labour Force $U+E$	+0.80
Exit from U	+5.38	15-64 years old $E+U+N$	+0.82
Exit from N	-0.44		

Transition rates

The transition rates are defined by $xy = XY/X$: for example, $eu = EU/E$, $en = EN/E$ and $exit\_e = eu + en$. They are displayed in figures 1-1 to 1-3.

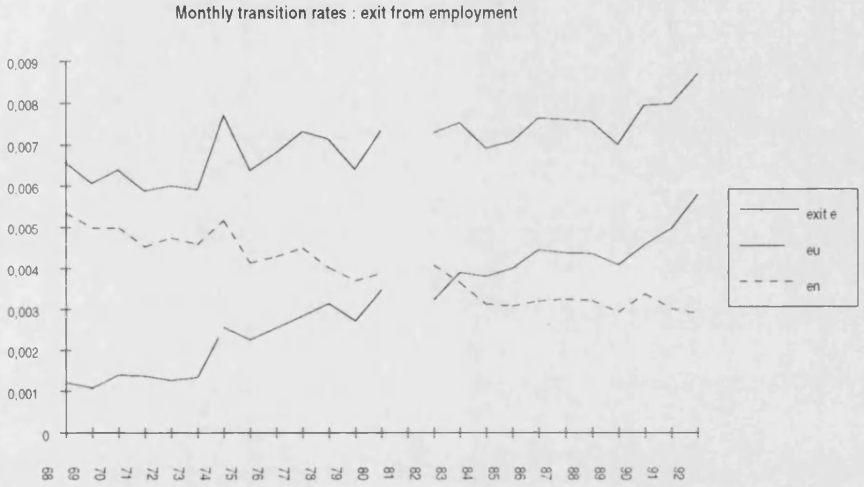

Figure 1-1: Transition Rates From Employment, France

From employment Considering the outflows from employment, a *a priori* unexpected result is that the separation rate (on the figure 1-1 $exit\_e = s\_e = en + eu$) has not been really increasing over the period, compared to the rise in French unemployment. This last point is nevertheless the result of two different evolutions: a fall in en and a rise in eu. This is where this paper differs from Y. L'Horty's: he finds that 6.4 points of the rise in unemployment are explained (in an accounting sense) by the changes in the rate Employment-Unemployment, and attributes this change to more job destruction. Here we don't intend to imply job destruction in the explanation of rising eu rate, since the exit rate from employment is more or less constant. Consistently, we prefer to focus on the propensity to remain on the labour market after a job separation. We see that this propensity is larger than what it was twenty years back. This may be due to a change of arbitrage between unemployment and inactivity, or the composition of people exiting from employment, voluntarily or otherwise, which could be different from earlier period. This is investigated in details in section 4.

From unemployment From figure 1-2, it appears that the probability of unemployed persons to leave this state has been strongly decreasing over the period. As the un rate has only slightly decreased, the higher decrease in the accession rate from unemployment ue is the main cause of

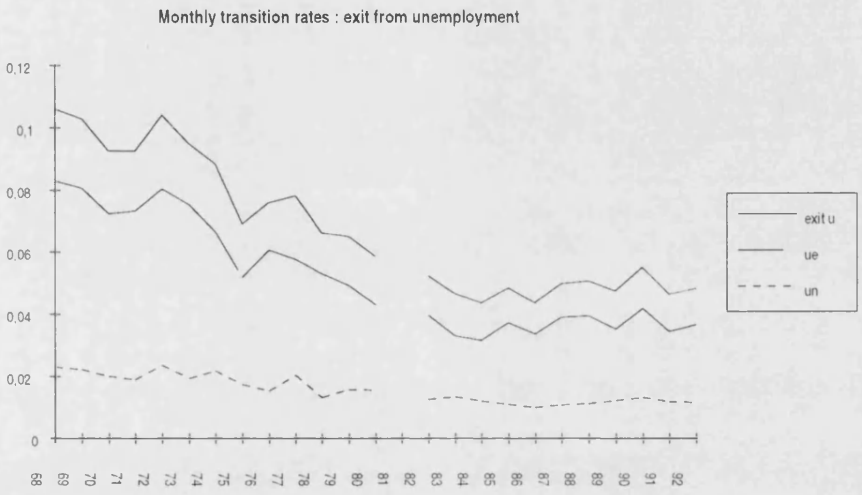

Figure 1-2: Transition Rates From Unemployment, France.

the decrease in the exit rate from unemployment i.e. $ue + un$. The decrease occurred mainly in the 70's, and not in the 80's. One important implication of this is that the theory of persistence of unemployment due to a loss of skill of the unemployed or of ranking by employers of the unemployed according to duration, at least at a first glance does not fit well far with the French labour market: the decrease in the exit rates from unemployment should arise when long term unemployment rates increase, which was the case in the 80's. Other explanations of the French evolutions are still to be provided.

From inactivity into the labour force The outflows from inactivity are shown in figure 1-3[6]. The fraction of inactive people coming on the labour market has not strongly decreased. The accession to employment from inactivity is in decline, but less than the accession to employment from unemployment. The nu rate has increased over the period, but to have decreased during the boom in 1988-89, when more directly found a job.

[6]The definitions of the three states have changed in 1974 and 1982. Before 1974, the working age population was defined as persons aged more than 15. After 1974, people more than 65 (retired) are removed from our sample. After 1982, people older than 60 are also removed, because of the change in legal age of retirement. However, this is not a big problem, as it does not concern workers moving between the three states, but only the stayers.

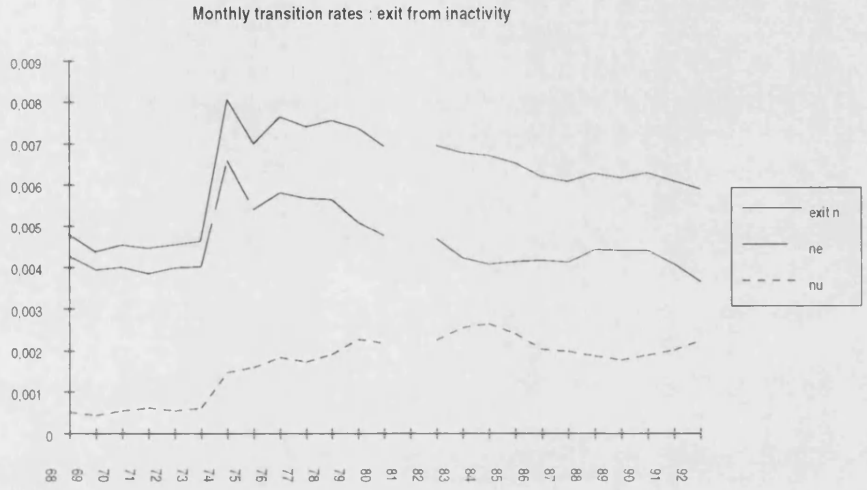

Figure 1-3: Transition Rates From Inactivity, France.

1.3.2 Cycles

Apart from the trends, the flows and the transition rates have a clear cyclical behaviour, as also remarked in many recent works[7]. It is interesting to separate trends and cycles, to avoid any confusion between transitory recessions and long run evolutions of the labour market. We want to focus on the latter. In addition, the cyclical component is strong in the flows and contains some interesting information on the determinants of labour supply. Moreover, this section is motivated by the difference with the UK: in Gregg and Wadsworth (1995), it appears clearly that all variations of the rates of transition for this country rates are cyclical ones, except the rate *un* which is upwards trending.

A way to separate the trends and the cycles is to use the Hodrick-Prescott filter. This filter removes the high frequency component and the result can be interpreted as a long run trend, while the residuals can be termed as the cyclical component. Another way to proceed, though somewhat less sophisticated yet sufficient, is to run the following regressions in annual time series:

[7]See for these six flows, Blanchard and Diamond (1990), Burda and Wyplosz (1993), for the job-to job flows, see Hartog and Van Ophem (1994) and Burgess (1994); for job flows, see Leonard (1987), Davis and Haltiwanger (1990) and for a more theoretical approach Mortensen and Pissarides (1994).

$$xy = C + a.trend + \epsilon_t \qquad \text{(reg 1)}$$

$$xy = C + a.trend + b.Cycl + \epsilon_t \qquad \text{(reg 2)}$$

$$xy = C + a.trend + b_1.Cycl_1 + b_2.Cycl_2 + \epsilon_t \qquad \text{(reg 3)}$$

ϵ_t being an error term with mean $E(\epsilon_t) = 0$, $E(\epsilon_t, \epsilon_{t-1}) = 0$ (Hypothesis Ho), and $Cycl$ a cycle indicator. This give us a decomposition of the series into transitory cyclical changes, and long term evolutions which are the main focus after this section. For the cycle indicator, we take either the capacity utilization rate in manufacturing and an index of output gap (gross domestic product filtered by Hodrick-Prescott filter, parameter value $\lambda = 1600$), without huge differences. We report here the results with the capacity utilization rate, the other results are in appendix B, but are qualitatively identical. We allow for two different coefficients b_1 from 1968 to 1981, and b_2 from 1982 to 1993, by defining $Cycl_1 = Cycl$ if $t < 1982$ and 0 if $t \geq 1982$. $Cycl_2$ is defined as $1 - Cycl_2$ (reg 3)[8]. The results are the following:

Table 1.2. Dependent variable: rate xy.

Rate	eu	ue	en	ne^*	un	nu^*
C (reg1)	0.0038(2.4)	-0.054(-2.0)	0.0035(2.5)	0.2e-4(0.01)	-0.003(-0.3)	0.43e-2(2.7)
a (reg1)	0.002(21.0)	-0.0021(-15)	-0.001(-13)	-1.4e-3(-11)	-0.0005(-10)	0.3e-4(2.3)
$a.\Delta T(\%)$ (reg1)	+0.44	-5.35	-0.24	-0.35	-1.30	+0.07
b (reg2)	-0.36(-1.9)	16.5(4.99)	0.21(1.23)	0.87(4.08)	3.12(2.68)	-0.34(-1.59)
b_1(reg3)	-0.40(-2.1)	16.7(4.89)	0.22(1.24)	0.85(3.25_	3.05(2.55)	-0.24(-0.96)
b_2 (reg3)	-0.45(-2.3)	16.8(4.76)	0.22(1.24)	0.84(2.96)	2.95(2.39)	-0.22(-0.79)
R^2	0.97	0.92	0.89	0.82	0.81	0.89
DW	1.83	1.13	1.91	0.99	2.53	0.68

In brackets: t-Student. $a.\Delta T(\%)$ is the variation of the monthly rate xy over the period without the cyclical component. The sign * means that a dummy variable is added to the independent variables

[8]The choice of the year of the dummy variable is not done according to some efficiency criterion, but because of the missing point in 1981 and its median position in the sample.

to take into account the change of definition of inactivity.

Table 1.3. Dependent variable: rate xy.

Rate	$en + eu = s\_e$	$un + ue = s\_u$
C (reg1)	0.007(2.98)	-0.057(-1.8)
a (reg1)	0.00007(6.1)	-0.0026(-16)
$a.\Delta T(\%)$ (reg1)	+0.20	-6.50
b (reg2)	-0.15(-0.5)	19.6(4.98)
b_1(reg3)	-0.18(-0.6)	19.7(4.84)
b_2 (reg3)	-0.22(-0.7)	19.8(4.68)
R^2	0.62	0.94
DW	2.30	1.10

In brackets: t-Student. $a.\Delta T(\%)$ is the absolute variation of the monthly rate xy over the period.

The sign and size of the trends appear in rows 2 and 3, the signs of the cyclicality in rows 4 to 6, and the R^2 and Durbin-Watson statistics in the last two rows[9]. The findings are also summarized in figure 1-4 and 1-5, displaying the transition rates at the beginning and the end of the period (1968 and 1992), when the cycle indicator is taken at its average, or the average plus (or minus) two times its standard deviation (upturns or downturns).

The rates are simulated from regression 3, with $cycl_1$ and $cycl_2$ as regressors. The table 1.4 offers another summary of the results. The flows ue, eu and ne have expected behaviour: eu is countercyclical, being bigger in recession, whereas ue is procyclical, like ne. It is easier to find a job in expansion, from either unemployment and inactivity and there are more job separations towards unemployment in downturns.

Table 1.4. Cyclical behaviour of different rates.[10]:

[9] Standard test reject the null Ho of no autocorrelation of the residuals. However, given missing data in 1981, AR(1) procedure cannot be performed efficiently. Since the purpose here is mainly descriptive, we have not improved the estimation. In addition F-tests on the equality of b_1 and b_2 generally do not reject the null.

[10] (+) means a high level of significativity, (-) a low level.

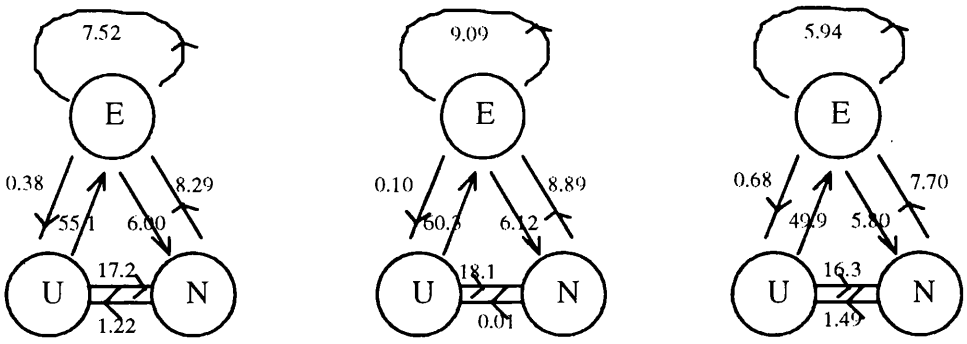

Figure 1-4: Predicted Transition Rates in 1968 with Cycl = 80.9% (left) Cycl = 87.3% (middle) Cycl = 74.5% (right)

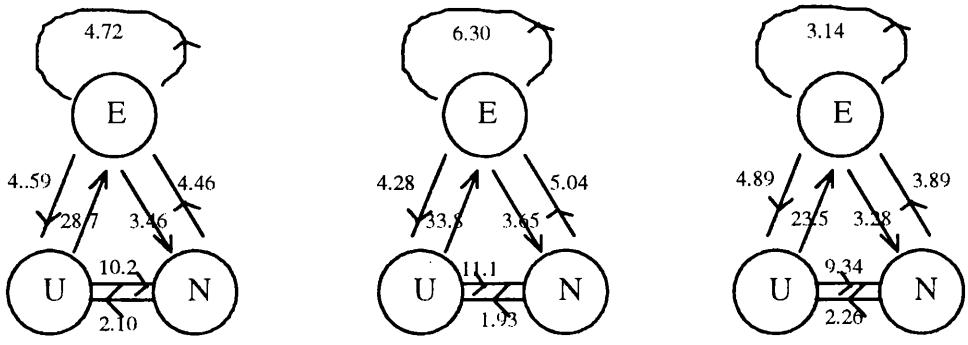

Figure 1-5: Predicted Transition Rates in 1992 with Cycl = 80.9% (left) Cycl = 87.3% (middle) Cycl = 74.5% (right)

From\To	E	U	N
E	-	Counter	Pro (-)
U	Pro (+)	-	Pro
N	Pro	Counter (-)	-

The behaviour of the three other rates is paradoxical: en and un are procyclical, nu is countercyclical. Thus, in recessions, more people come to the labour markets and fewer leave the labour market to return to inactivity. This can be explained by secondary or added workers effects (see Appendix C for a short theoretical framework): in period of recession, households are more likely to loose the primary income and to compensate with additional workers going to the labour market. This added worker effect should primarily concern women. To test this, we undertake the same analysis with male and female transition rates. The tables are reported in appendix B. The main finding is summarized here: the exit rate from employment is countercyclical for men, as expected but is procyclical for women. This is due to the fact that the transition rate from employment to inactivity is a-cyclical for men, but strongly procyclical for women. This is a result that we interpret in section 7 as a renewal of added workers effect in France due to high unemployment.

1.4 The rise in the fraction of job movers going to unemployment.

As pointed out in Bean (1993), the exit rate of unemployment has decreased and it is one of the most important "cause" of French rise of unemployment. However, this decrease occurred mainly in the 70's whereas the probability to find a job has roughly remained constant in the 80's. This decrease cannot explain why unemployment almost doubled during these years. The separation rate (transition from employment) is almost constant, which is also a well-known feature (see Layard et al., 1991). What is less known and that we show here is that the destination of workers leaving a job has markedly changed. We interpret this in section 7 as a consequence of the fact that during the same period, the arbitrage between unemployment and inactivity has largely changed since the end of 60's. In France, workers leaving a job decide to search for another job. In 1968, eu/s, the fraction of job movers going to unemployment instead of inactivity, was only

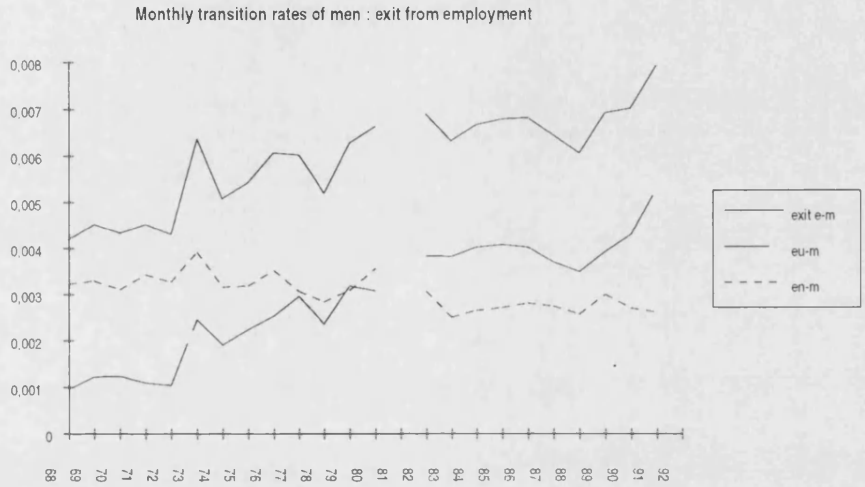

Figure 1-6: Transition Rates From Employment, male workers, France.

13%. By 1992, it jumped up to 59%. For workers leaving a job, it has become very less frequent to return to inactivity, and rather more frequent to register in unemployment agencies. This section is devoted to this trend.

1.4.1 Men and women.

To go further, it will be useful to consider disaggregated data by gender. The separation rate of men ($eu + en$, figure 1-6) has increased since 1968. This is only due to the transitions to unemployment (eu) that have been multiplied by a factor of 5. This rise has not occurred slowly, on the contrary each recession was followed by a seemingly permanent increase of the separation rate, in 1973, 79, and 82. But the en rate is roughly constant and male workers flows cannot account for the aggregate decrease of the transition Employment-Inactivity.

By contrast, for women this separation rate $eu+en$ has slightly decreased (figure 1-7), even if it remains higher than the corresponding rate for men. The disaggregation in the destinations reveals that again this is essentially due to an inverse shift of both transitions rates eu and en. The eu rate of women has increased by a factor of 5 (like for men) whereas the en rate in 1992 is 40% only of its 1968 value.

Figure 1-7: Transition Rates From Employment, female workers, France.

It follows that the fact observed and described above, the change in the arbitrage between activity and inactivity is mainly a change in women's participation to the labour market. From these two graphics, it also appears that women have progressively got jobs with longer tenures, compared to those of men: the average duration of a job, in steady-state being the inverse of the separation rate. Two explanations are possible: the quality of the jobs proposed is better; and alternatively, the willingness of women to stay on the labour market, i.e. their attachment to the labour force has increased for different reasons on which we come back in section 7.

Finally, the yearly transitions[11] of the 25-49 years old (so without retirements) for men and women confirm the view that there is a shift in the arbitrage between unemployment and inactivity and that this is due to women only (see figures 1-8 and 1-9).

1.4.2 Demography

We could object that these changes are due to changes in the size of cohorts of workers as the number of retiring workers could have decreased over the period. The test of this hypothesis is provided in the following table.

[11] These latter transitions rates are not corrected for intra-year transitions, because all the six rates disaggregated by age were not available, so the 12th root of the transition matrices couldn't be computed.

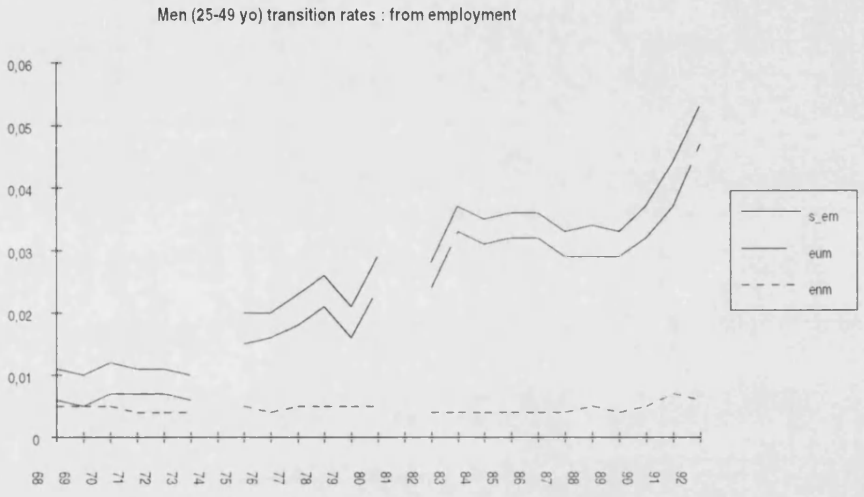

Figure 1-8: Transition Rates From Employment, 25-49 year male workers, France.

Figure 1-9: Transition Rates From Employment, 25-49 year female workers, France.

Table 1.5. Cohort sizes in different years in France.

Age category	1968	1975	1982	1990
65 years	503 361	501 645	611 361*	590 594*
(65-69 years) / 5	456 579	477 542	441 027*	578 414*
18 years	864 732	843 538	879 676	894176
(15-19 years) / 5	853 008	846 473	872 150	866178

The symbol * in a column means that the corresponding column reports individuals of 60 years old in the first row and 60-64 years old in the second row, to take into account the change in the retirement age in 1982, from 65 to 60 years old. Numbers taken the first day of the year.

As there is no downward trend in the number of retiring people (this number even increased between 1968 and 1990), the hypothesis that a fall in the size of cohorts can explain the trend is rejected.

1.5 Ergodic Distribution of Unemployment Under Different Assumptions.

Given that in France, the flows between activity and inactivity have significant cyclical and secular variations, a three states representation of the labour market is necessary. We now study here how the transition rates between the three states have an impact on the long run distribution of the workers in each of these three states and define the concept of ergodic distribution.

Definition 1. *The ergodic distribution of the Markovian system is the limit of the stocks when the transition rates are held constant.*

Denoting by E, U and N the *stocks* of workers, we have the following dynamic equations, equal to 0 for the ergodic distribution:

$$dU/dt = E.eu + N.nu - U.(ue + un) = 0 \tag{1.1}$$

$$dE/dt = N.ne + U.ue - E.(eu + en) = 0 \tag{1.2}$$

$$dN/dt = E.en + U.un - N.(ne + nu) = 0 \tag{1.3}$$

so we can also define, like in L'Horty (1994) a stationary rate of unemployment when E, N and U are constant, which is the rate of unemployment corresponding to the ergodic distribution of workers in the three states.

Definition 2. *The ergodic rate of unemployment is given by:*

$$u^* = \frac{eu.ne + eu.nu + en.nu}{eu.ne + eu.nu + en.nu + ue.ne + ue.nu + ne.un} \tag{1.4}$$

The speed of convergence to this stationary rate is difficult to write explicitly[12]. It should also be remarked that u^* has no real interpretation but is the limit to which u converges if all the transition rates remain constant. Now if we suppose that in each year the workers losing a job have the same preferences that they had in the 1960's, i.e. if $en = 81/100.s$ and $eu = 19/100.s$ as in 1968, where $s = eu + en$ we can build a second stationary rate u^{**}, defined by:

$$u^{**} = \frac{0.19s.ne + 0.19s.nu + 0.81s.nu}{0.19s.ne + 0.19s.nu + 0.81s.nu + ue.ne + ue.nu + ne.un} \tag{1.5}$$

The figure 1-10 represents the actual rate of unemployment (solid line), u^* and u^{**}[13].

There are two observations to be made.

- If the rise of u is smooth, the rise of u^* arises more suddenly and unevenly. The slowness of the rise of u is often seen as a hysteresis effect, but an interpretation in terms of structural changes affecting the transition rates is possible.

- The hypothesis made on eu/s and en/s has a large impact on the stationary rate of unemployment, especially after 1981. In fact, 4 points of the unemployment rate of the ergodic distribution of workers can be linked to the change of preferences. In other words, unemployment at the end of 1960's could have been more important, if preferences had

[12] It depends on the eigenvalues of the matrix A defined by $X_{t+1} = A.X_t$ where X_t is the vector (E, U, N). There are three eigenvalues: 0 and the two negative solutions of the equation $X^2 + (eu + en + nu + ne + un + ue)X + \{eu(un + ne + nu) + en(ue + un + nu) + ue(ne + nu) + un.ne)\} = 0$

[13] Note the homogeneity of degree 0 in the flows from inactivity insuring that u^* and u^{**} are not affected by the break on the inactive population in 1975 .

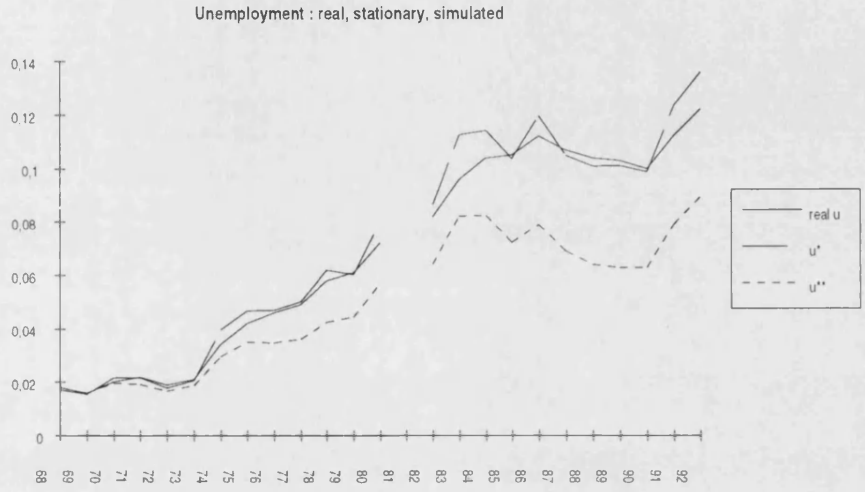

Figure 1-10: Comparison of different simulated unemployment rates, France.

been the same as in the 1980's[14].

One could object that keeping constant the proportion of two of the six transitions rates at its 1968 value would affect the other rates. This weakens the interpretation of u^{**}. However, the effect of this assumption on the other rates is ambiguous, as is their impact on the ergodic unemployment[15].

Another way to quantify the consequence of the change in the exit rates from employment is to evaluate the gross flow EN in level if it had grown since 1968 only at the demographic rate. In 1968, each month, 105 852 workers were moving from employment to inactivity. In 1992, it should represent 128 771 persons, instead of the actual value: 64 292 persons. The monthly difference is then 64 479 monthly, or 773 748 yearly who now transit through unemployment. With an average duration of unemployment of 1.3 years, it means 1, 005, 872 unemployed people, or again 4.0% of the labour force. Independent of the method used to estimate the

[14] More detailed studies can be found in Cohen and Lefranc (1994) for the respective contributions of demography, hiring and firing rates, and in L'Horty (1994) for the analysis of contribution of each of the six rates.

[15] Assuming $eu/en(t) = eu/en(68)$ means that we have each year less active people than in reality: therefore, labour supply should decrease, equilibrium wage should increase, therefore hirings $ue + ne$ should decrease and resultantly u^{**} is underestimated. But, if more people are exiting from activity, the average search intensity with respect to reality should increase, therefore ue and ne should increase, and u^{**} would be overestimated.

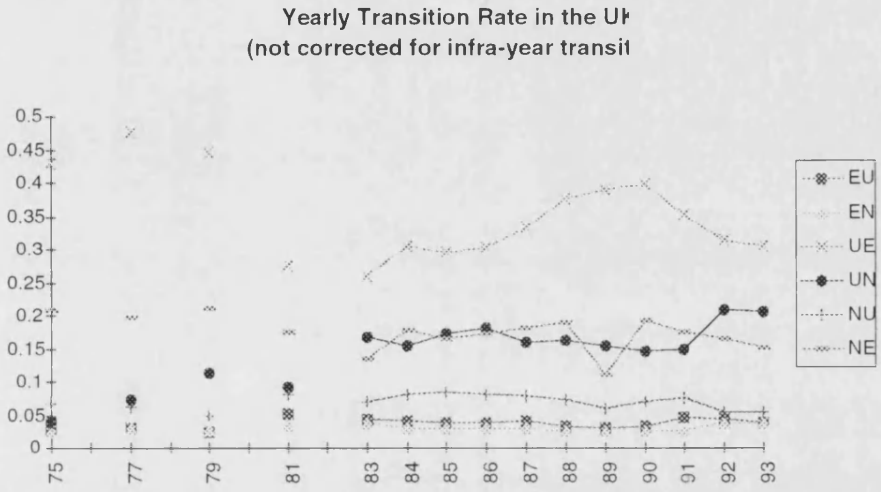

Figure 1-11: Transition Rates, UK.

effect of the shift in preferences observed in the data, it clearly represents a significant fraction of unemployment.

1.6 A comparison with the UK.

Before discussing the reasons for the main trend in French data, it is interesting to compare the transition rates with Gregg and Wadsworth's data. As stated before, it can be seen in figure 1-11 that there are almost no trends in the British transition rates, and most of the variations are only cyclical ones. In 1975, the share of workers leaving employment to unemployment was 55% of total job movers ($EU + EN$) and in 1993 it was only 50.3%. In figure 1-12, we repeat the exercise of last section: for this we compute the stationary rate of unemployment u^* and we compare it with the actual rate u (from OECD data), and with the stationary rate u^{**} simulated with $eu/(eu+en)$ and $en/(eu+en)$ at their levels of 1975.

The comparison with France is quite clear: the hypothesis made on u^{**} has no impact in the UK as compared with u^*. The difference between the actual and stationary rates can be seen, as in France, as a transition to the stationary state, and yields no additional information here.

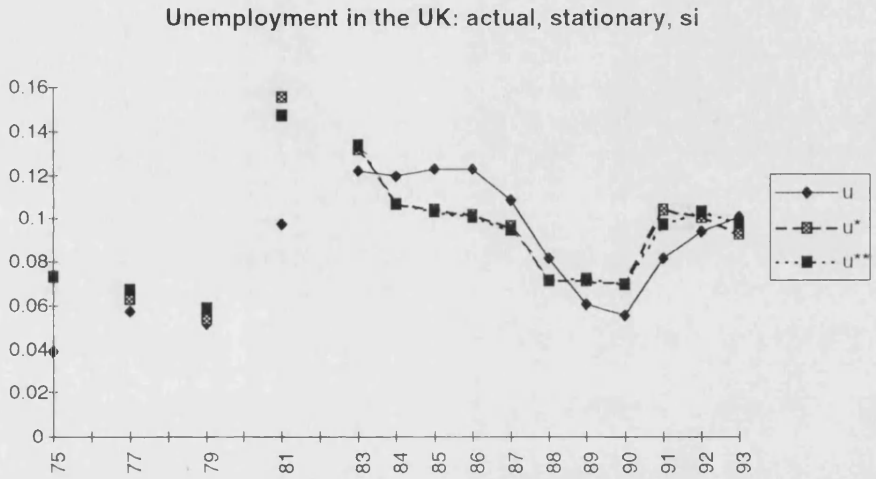

Figure 1-12: Comparison of different simulated unemployment rates, UK.

1.7 Secondary workers effects in France?

It is difficult to conclude without offering a few explanations for the shift in the destination of women leaving jobs in France. We propose five mechanisms and then show evidence that secondary workers' effects are plausible in the 80's in France.

- First, a change in attitudes with respect to the labour market: women have become more than a only a " reservoir " of labour. They are more attached to the labour markets, whatever the cyclical fluctuations of the economy[16].
- Second, a rise of real wages w, which is an incentive to undertake job search.
- Third, a rise of unemployment compensation $z = \alpha.w$, either by a rise of w and of α, also by an increase of the coverage.
- Fourth, informational reasons, if one believes that finding a job from inactivity is more difficult, and that the intermediary role of employment agencies has become necessary.

[16] For instance, the rise in the divorce rates is certainly linked with the propensity of women to work, as a cause but perhaps also as a consequence.

- Fifth, secondary worker effects, affecting poor households: as noted in Dolado et al. (1996), the primary cause of poverty in Europe is unemployment, and in a world where unemployment has strongly risen, the risk for primary workers to become unemployed has been continuously augmenting. This can explain why secondary workers prefer to stay in the labour force.

Only a study with micro-data would allow to disentangle the different explanations. However, we are going to argue that the last explanation, secondary workers' effects is very likely. It already received some support in section 3.2, where the cyclicality of some of the transition rates (en, un, nu) could be explained by added workers' effects.

Indeed, in the 80's, French unemployment has been constantly at very high level. Furthermore, this level has certainly been perceived by agents as permanent in the medium run, while this was not necessarily the case in the mid 70's. The view of a change in the perception of unemployment was developed in Cohen (1988). He argues that the shift towards more conservatism in the late 70's-early 80's is due to the progressive understanding of the nature of unemployment, resulting from permanent supply shocks, and not from transitory demand factors. It is possible to transpose this analysis to the participation decisions of households: they expect a long period of high structural unemployment in the 80's, rather than a temporary fluctuation, and higher participation of women is acting as an insurance in case of unemployment of the other family members. See also in the figure 1-6 how the separation rate of men has increased over the period, leading to more uncertainty in household's incomes. Other elements in favour of this explanation can be found in figures 1-13 and 1-14:

The number of women in the labour force has constantly increased at a rate of 2.5% a year (figure 1-13), much faster than the growth of population (0.8%). This is well explained by the rise of real wages during the first part of the period (figure 1-14). After 1980, the deceleration in the rise of real wages should have lead to an inflexion in the trend in participation, which is not the case in figure 1-13. Moreover, it appears that the female labour force participation has a different behaviour in the late 80's than in the 70's: the 1974's recession is followed by an inflexion (a decrease if we remove the trend, solid line in figure 1-13) in labour force of women. On the contrary, women's active population declines at the beginning of the economic expansion, in 1987. Furthermore, it is under the secular trend during this entire period. At the

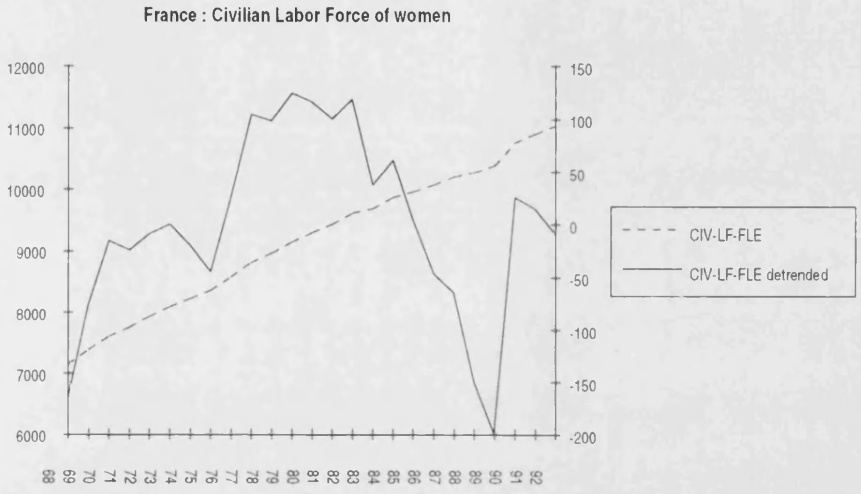

Figure 1-13: Female Labor Force, France. Thousands of workers.

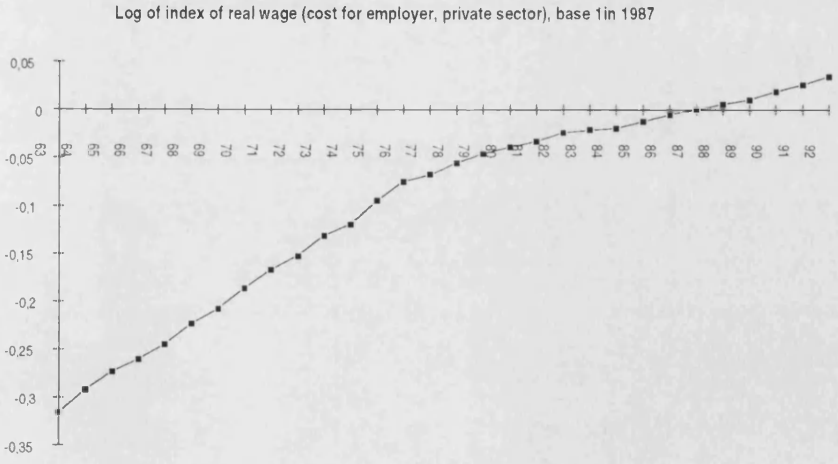

Figure 1-14: Evolution of real wages, France.

beginning of the large recession of the early 90's, it increases, and only declines in 1993. We have here many signs that labour force participation of women has become less procyclical in the 80's. This is consistent with a renewal of secondary effects due to high levels of unemployment.

In the UK, by contrast the indicators of the labour market are much less trended. The figures 1-11 and 1-12 have more cyclical variations than trends. It can be argued that the perception of a rising and long-lasting unemployment is stronger in France than in the UK. This would explain the difference in the behaviour of workers leaving unemployment in the two countries.

1.8 Conclusion

This worker flows analysis aims to show that in the 80's in France, the decline in the exit rate from unemployment is not sufficient to explain the rise in unemployment. Another relevant aspect that must not be forgotten is that due to a stronger labour force attachment of women, arbitrage between unemployment and inactivity has changed. This single fact account for more than 4 points of unemployment in the ergodic distribution of all workers between the different states of the labour force. With a different perspective, unemployment in France in the 60's could have been partly hidden, because women losing or leaving jobs were very likely to return to inactivity, which is no longer the case now. A possible explanation for this evolution is that secondary workers' effects are more important in the context of high unemployment equilibrium, and may be at least partly responsible for this shift in preferences between unemployment and inactivity.

The central idea underlying this paper is that labour supply changes (shocks, trends and composition) are non-neutral on the labour markets, especially on unemployment rates. Therefore the consequences of increasing labour force participation should be investigated in other OECD countries, since this is for sure one of the strongest common change affecting the labour markets.

- **Appendix A: sources of data**

Figures 1-1 to 1-3 and 1-6 to 1-9: INSEE, enquêtes Emploi, annual survey, after the transformation described in section 2. Figures 1-4, 1-5 and 1-10: author's calculations. Table 5: INSEE Démographie,

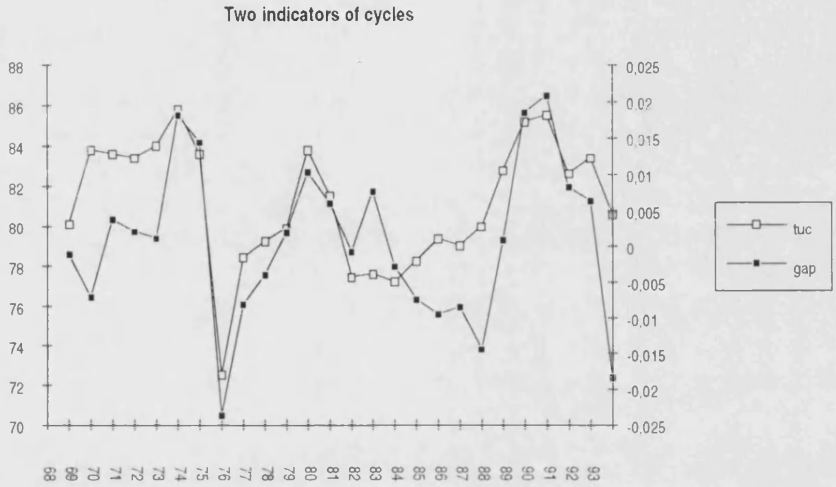

Figure 1-15: Comparison of different cycle indicators, France.

various years. Figures 1-11 and 1-12 British LFS, provided by J. Wadsworth. Figure 1-13: OECD Labour Force Statistics. Figure 1-14: OECD National Data, variable WRSE. Figure 1-15: Direction de la Prevision, Ministere des Finances et OECD National Accounts.

- **Appendix B**

Tuc is an index of utilization of capacity in industry (source OECD) and is the cycle indicator used in the text and called *Cycl*. *gap* is the high frequency component of *GDP* filtered by the Hodrick-Prescott filter. The following tables provide the results of the regression analysis of the text with the cycle indicator *gap* (see regressions 1 to 3 for the notations)

Table B1. Dependent variable: rate **xy**. Cycle indicator: output gap filtered by H-P filter, $\lambda = \mathbf{1600}$.

Rate	eu	ue	en	ne^*	un	nu^*
b_{gap} (reg2)	-0.12(-2.33)	1.60(2.34)	0.13(2.41)	0.232(3.96)	0.50(2.13)	-0.065(-1.2)
b_{1gap} (reg3)	-0.05(-0.76)	1.06(1.11)	0.09(1.16)	0.189(2.34)	0.21(0.66)	0.03(0.45)
b_{2gap} (reg3)	-0.19(-2.64)	2.19(2.19)	0.17(2.24)	0.280(3.35)	0.82(2.46)	-0.17(-2.32)

In brackets: t-Student.

Rate	$en + eu = s\_e$	$un + ue = s\_u$
b_{gap} (reg2)	0.01(0.13)	2.11(2.73)
b_{1gap} (reg3)	0.03(0.29)	-0.90(-0.43)
b_{2gap} (reg3)	-0.01(-0.12)	2.70(1.24)

In brackets: t-Student.

The results are similar with this indicator of the cycle.

Table B2. Dependent variable: rate **xy** for men only Cycle indicator: output gap filtered by H-P filter, $\boldsymbol{\lambda = 1600}$.

Rate	eu	ue	en	ne^*	un	nu^*
b_{gap} (reg2)	-0.16(-2.36)	1.44(2.10)	0.09(1.77)	0.33(4.25)	0.59(2.85)	-0.13(-1.44)
b_{1gap} (reg3)	-0.04(-0.50)	0.87(0.91)	0.07(0.98)	0.35(3.25)	0.73(2.50)	0.01(0.09)
b_{2gap} (reg3)	-0.28(-3.10)	2.06(2.07)	0.11(1.47)	0.30(2.75)	0.45(1.46)	-0.28(-2.33)

In brackets: t-Student.

Rate	$en + eu = s\_e$	$un + ue = s\_u$
b_{gap} (reg2)	-0.06(-0.70)	2.03(2.93)
b_{1gap} (reg3)	0.03(0.24)	1.60(1.64)
b_{2gap} (reg3)	-0.17(-1.27)	2.51(2.47)

In brackets: t-Student.

Table B3. Dependent variable: rate **xy** for women only Cycle indicator: output gap filtered by H-P filter, $\boldsymbol{\lambda = 1600}$.

Rate	eu	ue	en	ne^*	un	nu^*
b_{gap} (reg2)	-0.06(-1.21)	1.90(2.37)	0.20(2.06)	0.19(2.87)	0.32(0.86)	-0.03(-0.67)
b_{1gap} (reg3)	-0.06(-0.86)	1.41(1.25)	0.11(0.81)	0.11(1.22)	-0.43(-0.90)	0.04(0.84)
b_{2gap} (reg3)	-0.06(-0.80)	2.43(2.07)	0.30(2.14)	0.28(3.06)	1.13(2.29)	-0.10(-1.95)

In brackets: t-Student.

Rate	$en + eu = s\_e$	$un + ue = s\_u$
b_{gap} (reg2)	0.14(1.10)	2.22(2.18)
b_{1gap} (reg3)	0.04(0.25)	0.98(0.71)
b_{2gap} (reg3)	0.23(1.32)	3.57(2.47)

In brackets: t-Student.

We also run the regressions 1 to 3 for men and women. The results are displayed in tables B4 and B5 with the cycle indicator of the section 3, or in Tables B2 and B3 with the alternative cycle indicator. Consider the table B5, for women only. The eu rate is countercyclical, but not really in the beginning of the period (until 1981) and as much as for the total flows in the second period. This certainly reflects the fact that female workers have progressively got better jobs. The ue rate is procyclical, as the ne rate. This is explained classically by the flexion or discouraged workers effect. The three other rates also have a paradoxical behaviour: en and un are procyclical, and nu is countercylical. Moreover, for en, the coefficient of the exogenous variable $Cycl$ is +0.64 to compare to +0.22 (3 times less, and not significant) for men. We can also remark that the aggregate (men+women) separation rate is a-cyclical (table 3). The cyclicality of the separation rate of men and women are of opposite signs. Men leave employment in recession. By contrast, the job separation rate of women is lower in downturns, due to the strong procyclicality of the en rate i.e. less frequent returns to inactivity.

Table B4. Dependent variable: rate xy for men only.

Rate	eu	ue	en	ne^*	un	nu^*
b (reg2)	-0.40(-1.52)	7.29(1.68)	0.22(1.33)	0.96(1.03)	2.41(2.07)	-0.52(-1.26)
b_1 (reg3)	-0.41(-1.53)	7.08(1.59)	0.19(1.20)	0.02(0.02)	2.32(1.95)	-0.43(-0.86)
b_2 (reg3)	-0.43(-1.53)	6.75(1.47)	0.14(0.83)	-0.24(-0.21)	2.17(1.77)	-0.41(-0.73)

In brackets: t-Student. The sign * means that a dummy variable is added to the independent variables to take into account the change of definition of inactivity.

Table B5. Dependent variable: rate xy for women only.

Rate	eu	ue	en	ne^*	un	nu^*
b (reg2)	-0.08(-0.3)	17.84(3.78)	0.64(2.25)	0.70(2.97)	3.73(1.96)	-0.11(-0.67)
b_1 (reg3)	-0.16(-0.90)	18.66(3.99)	0.68(2.44)	0.72(2.49)	3.94(2.04)	-0.14(-0.73)
b_2 (reg3)	-0.28(-1.47)	19.73(4.07)	0.75(2.57)	0.73(2.30)	4.23(2.11)	-0.15(-0.71)

In brackets: t-Student. The sign * means that a dummy variable is added to the independent variables to take into account the change of definition of inactivity.

Table B6. Dependent variable: rate xy for men only.

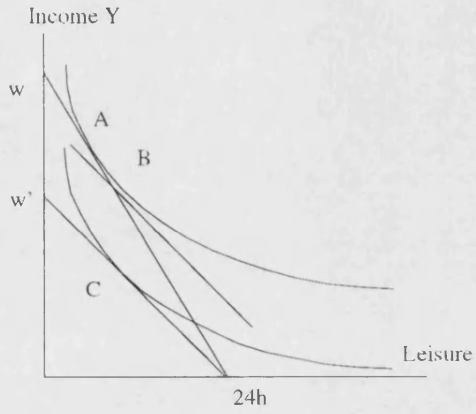

Figure 1-16: Income and Price Effect

Rate	$en + eu = s\_e$	$un + ue = s\_u$
b (reg2)	-0.18(-0.51)	9.70(2.00)
b_1 (reg3)	-0.22(-0.64)	9.40(1.90)
b_2 (reg3)	-0.29(-0.81)	8.92(1.74)

Table B7. Dependent variable: rate xy for women only.

Rate	$en + eu = s\_e$	$un + ue = s\_u$
b (reg2)	0.56(1.30)	21.6(3.54)
b_1 (reg3)	0.52(1.19)	22.6(3.73)
b_2 (reg3)	0.47(1.04)	23.96(3.82)

- **Appendix C**

In a static model, from Slutsky decomposition, with $H(w, Y)$ the supply of hours, w the wage, Y the income: $dH/dw = dH/dW(utility = constant) + H.dH/dY$. The first term on the right handside is positive, the second one is negative.

Under the assumption that leisure is a normal good, the signs in the Slutsky equation are as written in the above equation. Thus, the cyclical behaviour of labour force participation can be written as the sum of two effects (see also the figure 1-16):

- The price-effect. During an expansion leading to a higher wage and/or a higher probability to

find a job, i.e. a higher present-discounted value of having a job, labour force participation should increase. The same holds for recessions, where labour force should decrease. This is known as the flexion effect or discouraged workers' effect, which leads to procyclicality of labour force. Primary workers' participation is not very cyclical and generally women's participation obeys this law better. On the graph, the substitution effect is represented by the path from A to B.

- The income-effect. This is the opposite cyclical effect. A loss of wage due to adjustment during a recession, or due to lower probability to have a job, leads to an increase of hours supplied in households with more than one working age person. This is the secondary worker effect. On the graph, this is the path from B to C. Mincer (1962) made the following remarks:"While the parameters estimates predict no clear-cut cyclical patterns of labour force participation of married women in the aggregate, they point to differential patterns of subgroups depending on employment experience of husbands. In families whose heads have become unemployed, the relative decline in family income is much stronger than the relative decline in the "expected" wage rate of the wife. In such families therefore, labour force rates of wives are likely to increase in recessions. In all other families, incomes are relatively stable but wage-rate expectations decline somewhat. The likely result in these families is a slight decrease in labour force rates of wives." This phenomenon should be stronger in poor households or in poor countries. The studies on women labour force participation (Mincer 1962, 1966, Layard et al. 1980, Killingsworth and Heckman, 1986) have concluded that this effect, relevant in the 40's and 50's, has progressively vanished in the 60's and the 70's due to the rise in real wage due to the growth of technical progress in OECD countries. When poverty in Europe is due mainly to long term unemployment, one cannot rule out a renewal of secondary worker's effect.

Chapter 2

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

Abstract: This paper investigates the consequences of labour supply changes in the OECD countries in the last decades. It is argued that changes in supply cannot be thought as homogenous: these changes involve more young and more adult female workers, that are complement with skilled men and substitute with low-wage groups (young, unskilled). These labour supply trends since the 50's increased competition between women, the young workers and the low skilled workers in some segments of the labour force. An empirical strategy to test these hypothesis is undertaken. Disaggregation by gender is necessary and gives positive relations between female participation growth and unemployment. Endogeneity of participation levels with respect to unemployment is treated in two ways, by instrumental variables estimations, and with vectorial autoregression techniques. Causal relations between participation and unemployment cannot be rejected. The estimated elasticity implies that the observed changes in labour supply account for a significant part of the increase in unemployment.

The rise of unemployment, observed in every developed country over the past 30 years, has been especially strong in Europe, where it reached a level of 11.4% of active population in 1994, compared to just 6.1% in the United States. Yet there was a time, not so long ago, when the

average unemployment rate in Europe was only about 2%, and it was the US. economy that seemed to be performing badly, with an unemployment rate of 5.3% in 1960. In fact, the rise of unemployment in Europe was substantive after each oil shock, i.e. 1974 and 1979. Having observed a return to the pre-74 equilibrium in the US, but not in Europe, it was natural to consider the possible causes of persistence in Europe. A first type of explanation was related to the real wage gap. The wage setters were able to maintain high wages after a bad shock, without being cooperative enough to care about total employment (Bruno and Sachs, 1985). But 15 years after the oil shocks, this explanation has become less popular since wage rigidity should not persist that a long period and a second type of explanation was explored, implying the existence of multiple equilibria, with high or low employment. For instance, a low equilibrium could be due to a loss of skills of unemployed workers during the spells of unemployment, making the labour force less attractive (Pissarides 1992, Layard and al. 1991). This explanation, or the alternative one - a ranking by employers of the unemployed according to the time spent in unemployment (Blanchard and Diamond 1990) - seems to fit well with the European case where the share of long-term unemployed is extremely high compared to the US.

A third line of explanation, ruling out the issues of persistence in contrast to the two previous ones, came from the observation that wage inequality had strongly risen over the past 25 years in the US and in UK, but had remained fairly stable in the high unemployment countries, and that a common cause could explain both phenomenon. The evolution of wage inequalities was studied in Davis (1992), Katz and Murphy (1992), Katz, Loveman and Blanchflower (1993), Juhn, Murphy and Pierce (1993), Card, Kramarz and Lemieux (1995), Goux and Maurin (1995) amongst others. The forces involved in the rise of inequality (mainly in the literature international trade, biased technical progress or institutional changes like the decline in unionization), could well be the same across countries, but act differently according to the wage setting institutions. In particular, the levels of minimum wages in Europe, associated with high employment payroll taxes, could make the unskilled extremely unattractive to employers. Any other institutional factor leading to wage rigidity in the bottom of the distribution could also explain the differences between the US and Europe.

Here we follow the third line of explanation. Since we are not convinced by theories relying only on technological changes affecting the demand for labour (after all, this is always the

residual of what has not been explained), we rather focus on the changes in labour supply which, in contrast, have the advantage of being observed and quantified. Indeed, a major change in the labour markets during the postwar period was the massive increase of the labour force, both by the rise in the size of the cohorts of the baby-boom and by higher female participation. Of course, a homogeneous increase of the labour force should be neutral on labour markets: over a period of a century, creating no trend in unemployment: what happens is that the capital stock increases such that capital per labour is constant and maintains real wages constant *ceteris paribus,* i.e. in absence of technological progress. This is the conventional Solowian view, also applied to labour markets with equilibrium unemployment in Nickell (1991), or Malinvaud (1986), in representative agents frameworks. When one departs from this homogeneity of labour supply, allowing for generation effects as in Pissarides (1989) or in Welch (1979), labour supply is no longer neutral. This is the first point here: the rise in labour force of the postwar period is absolutely unique in history, and involves more married women and in the 70's, more young workers of the baby-boom cohorts, increasing the share of unattached and inexperienced workers in the labour markets of almost all OECD countries. Then, consistently with the first point, the second point in this paper is that the aggregate level of participation is not the proper variable to explain unemployment. It is better to consider the composition of the labour force[1].

The paper is about the links between labour supply and unemployment. The study of the changes in the wage structure is explored in next chapter. In section 1, we give 8 stylized facts about labour supply and unemployment by gender. In section 2, we introduce a model where the heterogeneity of the increase of labour supply is approximated with two segments of the labour market, a primary and a secondary segment. Wages are competitive in the primary segment and not always competitive in the secondary segment. Workers in the primary segment are thought as those with high experience and labour force attachment, while the workers in the secondary segments are thought as the low experienced, with higher than average propensity to leave the

[1] This explanation for the trends in labour markets is new: the role of supply factors seems to be avoided in 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. However they attribute it to the supply of young workers, and do not control for the relative female labour supply, the evolution of which is comparable in the 70's to the supply of young workers. In other papers, the role of supply is only mentioned, never developed (Malinvaud 1986, Murphy and Topel 1987). A notable exception is Topel (1994a) who is lead to conclude that the decrease in the relative wage of unskilled in the US is almost accounted for by increased female participation.

labour market. Labour supply shocks are represented by the evolution of three parameters: the share of young workers in the labour force, the participation rate of adult women and the share of adult women in the primary segment of the labour force. In section 3 we derive an empirical strategy. We investigate the cross-country determinants of unemployment in section 4 and the time-series evidence in section 5 and show simultaneity issues between participation and unemployment. In section 6, we argue to conclude that these simultaneity issues, which prevent simple correlations between unemployment and participation to be conclusive, are one of the explanations to the lack of interest of macroeconomists in the impact of labour supply on the labour market. We take the risk to re-examine this controversial question in this paper.

2.1 Some facts

2.1.1 Cross-country correlations of unemployment by group

An interesting point not emphasized earlier is that the countries with high female unemployment are also countries with high youth unemployment: we report here the correlations in 1992 across the OECD countries between the prime-age (more than 25) men unemployment rates, prime-age women unemployment rates and youth's (less than 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 correlations:

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

The correlation coefficients between prime-age women and youth are very strong (0.78 and 0.84), and stronger than the other correlations. At least, theories of unemployment should account for these correlations, for which there is no straightforward answer. The goal of this paper is to provide an explanation and test it.

2.1.2 Unemployment by gender and age

The time series evolution of unemployment also reveals interesting features. It is shown here that unemployment in Europe is different from the US in the 80's, mainly because of female unemployment. The two charts of figure 2-1 display the rate of unemployment by gender in the four Scandinavian countries (SCA), in the USA, in Japan, and in 11 European countries (excluding Greece) . We recognize easily 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. Its striking feature is that the strong difference between the US and European female unemployment rates, which contrasts with the relatively narrow difference of the corresponding rates for males. In 1990, according to our measure of the unemployment rates, the gap is about 6 points for women, and about 2 points for men. The same pattern remains true for five selected European countries: Spain, Italy, France, Belgium and Germany. The gap between the USA and Europe is still 2 points for men, but is now 9 points for women. The same also remains true for more than 25 years old workers: we plot in figure 2-2 the unemployment rates of the 25-54 year old workers (or 25-59 year old workers in some countries), thus excluding the young workers, who are more unemployed in Europe. Unemployment rates for prime-age men are similar in Europe and in the USA, with more stability in Europe around a 6% average. For this category of workers, there is no problem of unemployment (or no more than in America). Unemployment rates for women are much higher in Europe after 1983, with again a 5% to 7% difference compared to the USA.

These results could be affected by a possible bias due to discouragement effects emphasized by Sorrentino (1993, 1995): discouragement could occur more in the US than in Europe, and affect women more frequently than men. However, to show that this is not the case, we plot in figure 2-3 the employment rates (the ratio of employment for the 15-64 year old population).

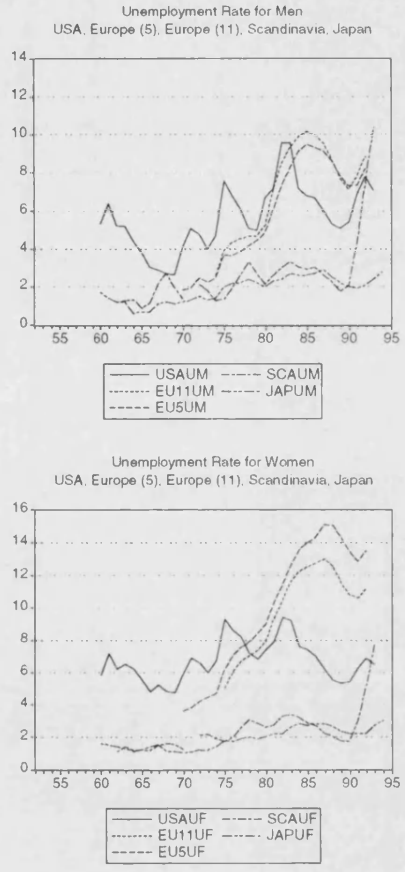

Figure 2-1: Unemployment Rate by Gender

Again the picture is the same, most of the cross-country differences are accounted for by women: the gap between Europe and the USA is 10 points for men, while it is about 20 points for women. For the five European countries, this is again more spectacular: the difference with the USA is 8% for men, 23% for women.

2.1.3 Size and composition of labour supply and of female labour supply

Can the labour supply trends have some explanatory power? Since they are common to all OECD countries, this possibility needs to be explored. A graphical view of these trends can be seen in figure 2-4. $PARTM$ and $PARTF$ are the male and female participation rates (Labour Force over 15-64 Population), for the USA, Japan, Scandinavian countries and Europe

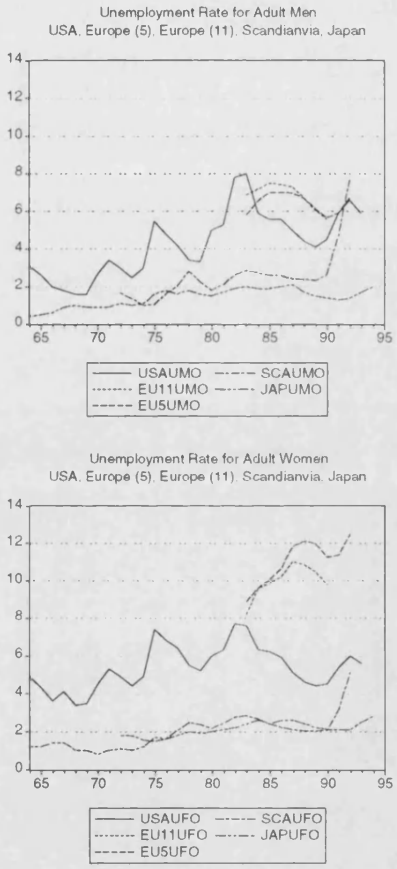

Figure 2-2: Unemployment by Gender, Adult Workers

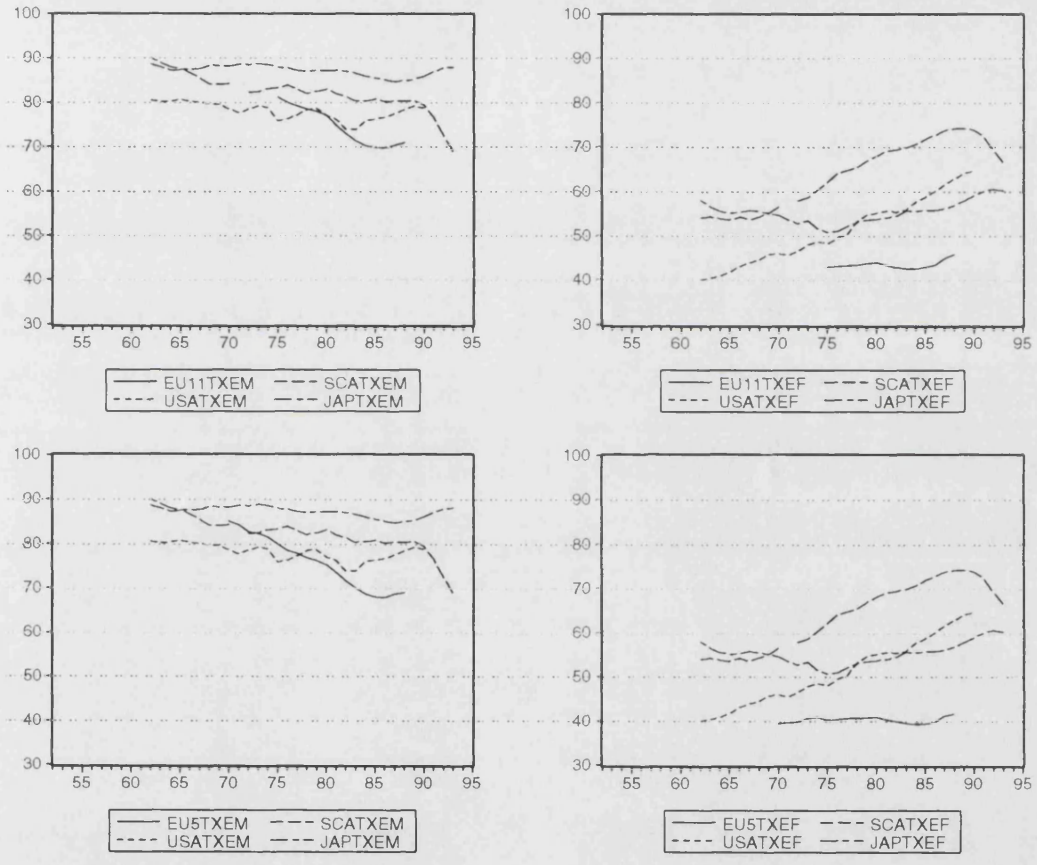

Figure 2-3: Employment Rates by Gender (Men Left, Women Right) Europe, USA, Scandinavia, Japan

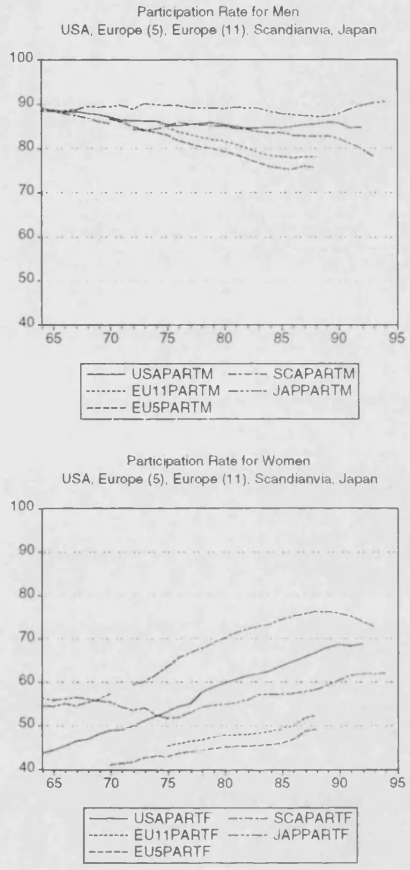

Figure 2-4: Participation by Gender

(EUR11 being the twelve minus Greece, EUR5 being Germany, France, Belgium, Italy and Spain). It appears that over time, men are participating less (or leave activity sooner), and less in Europe than in the USA. Women are participating more and more in every country, with the same upward trend. If women are participating more in the US than in Europe, it does not necessarily mean that their share in the labour force is higher, because of lower participation of men in Europe. On the contrary, the evolution of the share of women in the labour force is very similar across countries. This can be seen in figure 2-5, which displays the ratios of female active population in total active population. This ratio has increased everywhere.

A look at the composition of female participation reveals two facts. First, the average "quality" of the participation, as measured for instance by occupations, has increased. Second,

Figure 2-5: Gender Composition of the labour force

in the 60's, the total number of women in "low quality" jobs increased a lot. The two tables 2.1 and 2.2 illustrate these points. In the USA, the number of women in the labour force increased strongly, millions of them switched from inactivity to employment. Their share in total labour force grew from 32.5% in 1960 to 45.4% in 1991. Now if we consider the jobs 1+2 as a proxy for the good jobs, it appears that the average quality of jobs held by women improved. In 1960, the share of women in these good jobs relative to their total participation was 17.5%, so thus less than the share of these jobs in the economy (20.2%). This is one face of gender inequality between occupations. In 1991, all the difference had disappeared: against 29.2% of these jobs in the economy, 29.6% of active women are working in these jobs. But if the share of women in good jobs increased, the supply of labour of women in the other jobs also increased strongly, from 22.2 millions to 39.5 millions between 1970 and 1991, certainly increasing the competition for these low skill jobs. As a comparison with all other European countries would be fastidious we restrict it that to the French case (similar results can be shown for other European countries like Spain, Italy or Germany). There is an increasing participation in the labour force, but still some gender inequality, more than in the United States. In table 2.2, it appears that the share of women in the labour force grew from 34.4% to 44.4%. It is interesting to note that despite a lower aggregate female participation rate than in the US, the share of women in the work force is the same in France as in the US, due to lower participation rates of men in France. Women's share in the good jobs increased from 13.1% to 23.8%. This evolution is close to the increase in the total (men+women) share of these jobs in the economy, from 15.8% to 27.0%. However, contrary to the USA, there is still a substantial degree of gender inequality in the occupational structure.

2.1.4 Wages

Given that the "quality" of participating women has increased, one should observe an increase in their relative wages[2]. Figures 2-6a and 2-6b illustrate the evolution of unconditional relative wages between the different categories of workers in the USA between 1967 and 1988[3]: 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

[2]This increase in realtive wages should be true before controlling for observable factors, but also after, since much is not measured in usual wage equations. This is not central for the paper, and we don't detail this further.

[3]Source: CPS, published data.

ratio of youth (less than 25) to old (more than 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 appears clearly, as reported in Katz and Murphy (1992) for instance, that the gender earning gap decreased, but only after 1977 and especially for young workers (the increasing relative education levels of young women). Before 1977, the relative wages appear to be rather constant. We also observe that 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 is an important fact to be explained, and which has no convincing explanation after 1977, when the size of the cohorts of young workers decreased (see Welch 1979)[4]. Competition with women could be part of the story.

There are few doubts that these changes in relative wages would have occurred during the same period in Europe, if the labour markets' institutions had been the same. If not, then this should generate unemployment. In Blanchflower et al.(1993) or Davis (1992), the main conclusion is that continental Europe has experienced very little changes in the distribution of wages. The French case is perhaps an extreme example of this wage distribution stability (see Goux and Maurin 1995 or Kramarz et al. 1996). We take the minimum wage as a proxy for downwards wage rigidity. Two facts will emerge here. More and more workers are paid the minimum wage level and that minimum wage is mainly affecting women and young workers. First consider in figure 2-6c the share of wage earners paid the SMIC (French Minimum Wage, or Salaire Minimum Interprofessionel de Croissance, variable $FRAWMSH$), which is indexed on inflation and on a measure of the average wage in industry. There is a clear trend: more and more people are paid this level, from about 2% in 1967, to 10.9% in 1990. One could thus argue that the minimum wage has been increasing too much compared to the other wages. But this explanation is not consistent with the evolution of the ratio of the average wage over the minimum wage (the solid line, variable $FRAW/WMIN$): we observe almost no change in the last 25 years. In contrast, the trend in workers paid the minimum wage is consistent with the explanation implying an increasing dispersion of the marginal productivity of the different categories of workers. More disaggregated data by age and gender are provided in the table 2.3. The toughness of the minimum wage is measured by the share of employees paid this level.

[4] I thank Richard Freeman for making this empirical observation clear to me.

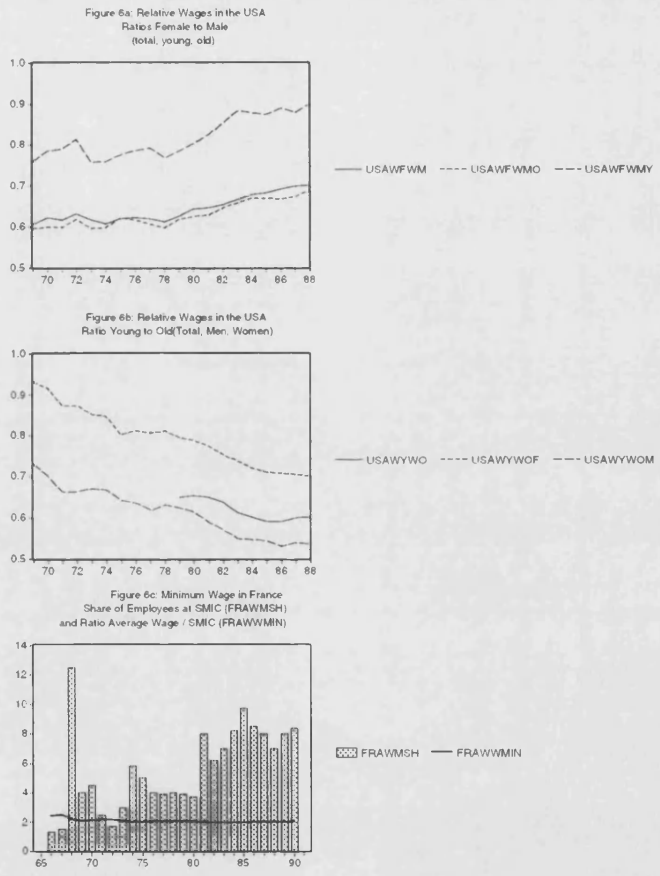

Figure 2-6: Relative Wage Adjustment the USA and France

This toughness of the minimum wage appears to be more important for women and youth (17%) than for men (7%). More generally, the minimum wage affects more what we will call the secondary labour market.

2.1.5 Summary

The model of next section is built in order to fit the stylized facts described in this section, which can be summarized here.

- Fact 1: Adult male unemployment rates are similar in Europe and in the US.
- Fact 2: Young and adult women unemployment rates are much higher in Europe than in the US.
- Fact 3: The cross-OECD correlation of female and young unemployment rates is much higher than any other correlation by demographic group.
- Fact 4: Female participation has increased in all OECD countries, with some differences in the levels of participation across countries.
- Fact 5: Women have participated in better jobs/segments of the labour force.
- Fact 6: In the US, relative wages of women have remained stable until 1977 and have increased afterwards.
- Fact 7: In the US, relative wages of young workers have fallen since 1969.
- Fact 8: In continental Europe, wage distribution has remained stable, but at least in France, the share of workers paid the minimum wage has constantly increased in the last 25 years and such workers are generally the young and women.

2.2 A model

2.2.1 Labour supply

A simple model with labour supply will easily account for these facts. The key point is that changes of labour supply cannot be thought without some kind of heterogeneity. For instance,

young workers and women have (with respect to adult men), on an average less labour force experience[5] but a higher turnover rate. In both cases, the difference between men and women is decreasing over time. See O'Neill (1985) and on the turnover, the previous empirical chapter based on the workers flows in France. Concerning the difference between young and older workers, there is little evidence of dramatic changes in turnover or experience differences in the last decades.

For these reasons, we model the changes in the labour supply as compositional change in a dual labour market. In the primary segment, we have the experienced, more productive and stable workers, and on the other side, the inexperienced and less stable ones, as in Doeringer and Piore (1971). To simplify, prime-age men (the older than 25) are all assumed to be in the primary segment[6], women are assumed to be shared between the two segments (the skilled in the primary segment, the unskilled in the secondary segment), and the young in the secondary segment. See Blanchard and Diamond (1990a) for such a view of primary and secondary markets. 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 is too low in a sense detailed below[7]. Issues of endogeneity of participation are addressed to in the next sub-sections.

2.2.2 Elasticity of complementarity and cross-elasticity of demand for labour

The model is based on the empirical literature on production functions. Grant and Hamermesh (1979, 1982) estimated elasticity of complementarity from a translog production function between capital, old (more than 25) men, old women and youth. They found capital to be q-

[5] In addition to the differences in the quantity of experience accumulated between workers, there are also subtle distinctions in the quality of this experience. For instance, a possible explanation for lower returns to labour force experience for women is that employers invest in match specific human capital only if they expect a long job tenure from the employee. Indeed, for women, a return to inactivity is more likely to occur. The same is true for young workers, a possible interpretation being that the separation rate is higher for this category of workers because the quality of the match is stochastic and older workers are more likely to be in good jobs/matchs. This higher propensity to quit is also due to higher outside options (especially for women), or longer time horizons (for young). The result is that in the wage equations, the valuation of human capital accumulated proxied by experience will be lower for the secondary workers.

[6] There is nothing essential here in assuming that all men are in the primary jobs.

[7] It may be thought that the jobs held by young and women do not really have the same characteristics as those described above. For the model, the low productivity is the only essential feature that we want to highlight, since we do not model here the process of human capital accumulation.

complement with all workers, men to be q-complement with women and youth whereas women and youth are q-substitute. This last point has very strong implications. At given input prices, it means that an increase in the quantity of women in the labour force should lead to a decrease of the equilibrium wage of both young and women workers. The change in relative wages of young workers will be all the more important as they are substitutes for women. Absolute wages in some cases can even decrease. *This is all the more important than explanations implying biased technological changes always face difficulties in explaining why real wages of male workers in the first five deciles of the wage distribution have declined in the US.* 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 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 disaggregated into four categories (skilled (college) and experienced, unskilled (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-substitute though to a lesser extent with experienced male workers. The young educated workers are found to be complements with older educated workers. Finally, Topel (1994b) compared the effects of increased participation of women on regional labour markets' wage inequalities with alternative explanations like 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-substitute to low-skilled men. His conclusion is that "*there is no evidence that different regional evolutions of wages are demand-driven; the whole story is on the supply side.*" In another paper (Topel, 1994a) 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.*"

The following production function has these properties and those described in 2.1, in the simple case where the elasticity of complementarity are constant:

$$Y(L_M, L_{F_1}, L_{F_2}, L_Y) = A.[(L_M\rho + L_{F_1}\rho)^{\mu/\rho} + \theta.(L_{F_2}^{\rho'} + L_Y^{\rho'})^{\mu/\rho'}]^{1/\mu} \qquad (2.1)$$

where L_M, L_{F_1}, L_{F_2} and L_Y are the equilibrium employment levels of men, women in

primary and secondary jobs and youth. The factors θ and A are productivity parameters and ρ, ρ'and μ are parameters characterising the substitutability of these categories of workers. The elasticity of complementarity is $1-\rho$ between men and women in primary jobs, is $1-\rho'$ between women in secondary jobs and young workers and is $1-\mu$ between primary workers and secondary workers. Given our assumptions, μ is negative and ρ and ρ' are close to 1. With this double CES function, it is not possible to generate a negative cross-elasticity of demand between two groups. For that a translog production function would be needed. Here we take the most favourable case, where $\rho = 1$ and the elasticity of complementarity is equal to 0.

2.2.3 Labour demand

A flexible labour market

We would have in equilibrium, if wages were flexible enough to equate the marginal product at full employment:

$$\frac{w_1}{w_2} = \frac{1}{\theta}.\left(\frac{L_M + L_{F_1}}{L_{F_2} + L_Y}\right)^{\mu-1} = \frac{1}{\theta}.\left(\frac{1+q.p}{\lambda+(1-q).p}\right)^{\mu-1} \tag{2.2}$$

with p the participation rate of prime-age women, equal to L_F/L_M (since all men participate and the number of adult of both genders is the same), with q the share of women willing to work in primary jobs, equal to L_{F_1}/L_F, and λ the ratio of young to old workers, equal to $2L_Y/L_M$. The ratio w_1/w_2 depends on the relative quantity of primary and secondary workers. It is clearly increasing in the share of young workers λ, since $\mu - 1 < 0$. The changes of relative wages can be decomposed into three parts :

$$d.\ln\frac{w_1}{w_2} = -d\theta/\theta + \frac{1-\mu}{(1+p.q).(p.(1-q)+\lambda)}.\left([1-q(1+\lambda)].dp - [(1+\lambda).p+p^2].dq\right) \tag{2.3}$$

Calculating the derivative, this is decreasing in the share of women in primary labour force q, and decreasing with the participation rate when q is smaller than $1/(1+\lambda)$, otherwise increasing with p. *So the relative evolution of primary over secondary worker's wages may be the result of a demand shift (the first term of the right handside), or an increase in female participation that is not compensated by a sufficient increase in the quality of jobs dq, which*

is likely when participation is low, or also when the quality of jobs is low. The average wage of adult women is $w_f = q.w_1 + (1-q).w_2$ and the gender earning gap is equal to $w_f/w_m = w_f/w_1 = q + (1-q).w_1/w_2$. Consider now the variations in the relative wages of female workers: $d[w_f/w_m] = dq(1 - w_1/w_2) + (1-q)d(w_1/w_2)$. The first part, with $dq > 0$, is positive, the second, according to (2.3), should be negative. Then, both an increase in primary workers' relative wages, and an increase in women average wages would be observed if the positive term associated with dp in (2.3) dominates. This rise of female relative wages will be stronger when q is close to 1, and smaller when q is close to 0.

With a floor on wages indexed on primary wages

Now assume that there exists a floor on wages $\underline{w}$ which is indexed on the marginal product of labour (MPL) of primary workers. This does not need to be a minimum wage: either unemployment benefits, non-wage incomes, the value of leisure linked to the marginal utility of consumption or efficiency wage can generate a floor on wages depending on the average wealth of the economy. We assume that $\underline{w} = \gamma.w_1 = w_2$ where γ is an indexation rate. This assumption is appealing since when the constraint is binding, the wage distribution is constant, which is a feature of most of the Western European economies, see Davis (1992) or Blanchflower et al. (1993). Then the wages are determined in the following way: denoting by L the labour supply and by N the employment level, if $MPL(L) > \underline{w}$ then $w = MPL(L)$ and $N = L$ and if $MPL(L) < \underline{w}$ then the level of employment is such that $MPL(N) = \underline{w}$. The uniqueness comes from the decreasing return on each type of labour. In the case of our production function, we have, denoting by $\sigma = 1/(1-\mu)$ the elasticity of substitution between primary and secondary workers, the following employment equation for secondary workers: $N_{F_2} + N_Y = (\theta/\gamma)^\sigma.(L_M + L_{F_1})$

Higher productivity of secondary workers, lower indexation rate, higher substitutability and higher participation of primary workers, all increase the level of employment of secondary workers. To solve for the unemployment rates, we make the assumption that young workers and women in secondary jobs have the same opportunities. This is equivalent to: $\frac{N_{F_2}}{N_Y} = \frac{L_{F_2}}{L_Y}$,

therefore we can write the different unemployment rates: $u_M = u_{F_1} = 0$ and

$$u_{F_2} = u_Y = 1 - (\theta/\gamma)^{\sigma}.\frac{1+q.p}{\lambda+(1-q).p} \tag{2.4}$$

The unemployment rate of young workers is a decreasing function of the productivity of secondary workers, increasing in the indexation coefficient of minimum wage γ, decreasing in the share of youth in total population λ, 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 $1/(1+\lambda)$. *If the share of women in labour force rises too fast compared to their share in good jobs, they will be in competition with young workers and unemployment will rise.* Now we can write the other rates as a function of u_Y only: $u_F = (1-q).u_Y$. The unemployment rates of all males and females (adding the young workers) are: $u_M^t = \frac{\lambda}{1+\lambda}.u_Y$ and $u_F^t = \frac{1-q+\lambda}{1+\lambda}.u_Y$ and the unemployment rate of old workers: $u_o = \frac{p}{1+p}.(1-q).u_Y$

Finally, the total unemployment rate can be written:

$$u = \frac{p.(1-q)+2.\lambda}{1+p+2.\lambda}.u_Y \tag{2.5}$$

It is easy to check that these unemployment rates are increasing function of p, λ and $(1-q)$. Finally, there is also a link between growth rates of the labour force and unemployment, through the share of young workers. If the cohorts of young workers are growing at rate n, then λ the ratio of young to old workers is equal to:

$$\lambda_t = (1+n_t).\frac{2+n_t}{2+n_{t-1}}.\frac{1+p_{t-1}}{1+p_t} = 1 + n_t + \Delta n_t/2 - \Delta p_t \tag{2.6}$$

with Δ the difference operator. In steady-state, this ratio is simply equal to $(1+n_t)$. Observe that the active population is also growing at rate n.

2.2.4 Endogeneity of participation

Endogeneity of participation is not the focal point here. On a macroeconomic perspective, the level of labour supply is usually considered as exogenous, at least independent of wages. For instance, Layard et al. (1979) found that given the micro-estimates of labour supply,

increasing wages accounted for about 30% only of the increasing female participation in the UK. Increasing female participation could happen due to sociological reasons, or because of decreasing opportunity cost of participation. The issues are summarized in Mincer (1962, 1966, 1974, 1985), Layard et al. (1979), Becker (1965) and Shultz (1981) for instance. In these views, it is interesting to note that increased participation is no longer demand-driven.

However, in the empirical sections, it will be found a rather strong endogeneity of participation with respect to unemployment. A likely reason is that those female workers who are indifferent between activity and inactivity are rather unskilled, therefore face rather high unemployment rates. The unemployment of these groups is much higher than (and very correlated with) the aggregate unemployment rate, which may explain why participation depends that much on aggregate unemployment. Similarly, one can also argue that the choice of the occupation is not independent of the labour market conditions. We chose to model participation as follows. Prime-age men's participation is inelastic and in the primary segment. For young, it is inelastic and in the secondary segment. For prime-age women, there is a random disutility to work in the primary segment λ_i which is distributed in the population with cumulative distribution function $F(.)$. The disutility of work in the secondary segment is smaller, and to simplify, we assume that it is perfectly correlated in the population with the first disutility: $\delta.\lambda_i$ with δ much smaller than 1. With these assumptions, we have two cut-off levels of disutility: w_1 and $(1-u_{F_2}).w_2/\delta > w_1$ for a small enough δ. Women with disutility smaller than w_1 participate in the primary segment, women with disutility larger than $(1-u_{F_2}).w_2/\delta$ do not participate, the remaining participate in the secondary segment. It follows that $q = F(w_1)/F[(1-u_{F_2}).w_2/\delta]$ and $p = F[(1-u_{F_2}).w_2/\delta]$. Since the increase of participation can be seen as supply driven, it will be modelled as a decrease in the average disutility of participation. Assume to simplify to the extreme that the disutility is uniformly distributed between 0 and $\overline{\lambda} > (1-u_{F_2}).w_2/\delta$. Then

$$q = \delta \frac{w_1}{(1-u_{F_2}).w_2} \tag{2.7}$$

and

$$p = \frac{1}{\delta.\overline{\lambda}}(1-u_{F_2}).w_2 \tag{2.8}$$

A decrease in $\overline{\lambda}$ will increase p, but 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 the non-flexible economy. This will also drive the increased quality of female participation. We don't solve for the reduced-forms equations and just provide simulations.

2.2.5 Simulations

We report some simulations[8] of a non-flexible economy where the changes are all driven by the supply factor $\overline{\lambda}$.

$\overline{\lambda}$ (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	0.775	0.778	0.782	0.787	0.790	0.795	0.800

When $\overline{\lambda}$ decreases from 6.0 to 1.5, female participation rises from 30% to 77%. There are more workers in the secondary segment, generating more unemployment for secondary workers (equal to youth unemployment rate). The primary sector becomes more attractive to women, whose share q in this sector rises from 36 to 41%. Unemployment rates of *all* categories rise twofold. Due to the compositional change of women active population, women's relative wages increase during the same period.

2.2.6 Conclusion of the model

- Female and youth unemployment should be highly positively correlated (fact 3), or equivalently, the difference between "flexible" and "non-flexible" economies should be observed mainly on young and women's unemployment (facts 1 and 2).

[8] Parameter values: $\lambda = 0.5$, $\mu = -2$, $\theta = 0.1$, $\gamma = 0.65$, $\delta = 0.2$

- In flexible economies, the ratio of the wages of primary to the wages of secondary workers, and the ratio of the wages of old to the wages of young workers increase, all the more that at the beginning of the period, female participation is low and concentrated in secondary jobs (facts 4, 5, 7). But, the ratio of female to male workers' wages remains stable and then increases (fact 6).

- In less "flexible" economies (here, with an additional relative wage rigidity), unemployment rate of men, women and especially young increase, while the wage rigidity should be more binding in the secondary segment (facts 2, 8).

- In time-series, there is a long-run relationship between participation and unemployment. In cross-section of OECD countries, the relation between participation and unemployment involves differences across countries in the degree of equality between gender (how far from 1 is the parameter q), second in the degree of downward wage rigidity preventing the equilibrium in this simple framework, and third, in the participation rate of men, such that the share of women in the labour force can be used as a better explanatory variable.

- There is a relation between the growth rate of the labour force and unemployment.

These predictions are the basis of our empirical strategy on both time-series and cross-section.

2.3 The empirical strategy

When there is a floor on wages, the model implies a positive link between participation and unemployment. Some preliminary remarks are needed before testing this link in cross-section of countries.

First, section 1.3 showed that despite huge differences in female participation rates between the US and European countries, the share of women in the labour force was very similar between them. This arises from lower male participation in Europe. As the floor on wages in the secondary sector of the model is all the more binding when there are fewer primary workers, the share of women in the labour force will be a better conditioning variable than the

participation rate. Second, high female participation countries are countries with high part-time work of women, such that we also have to control for part-time in order to analyse the effect of the hours supplied. We will use as explanatory variables the share of hours supplied by women in the labour force, with the formula:

$$\text{Female Share (corr)} = \frac{L_F.(1 - part\_time_F/2)}{L_{F+M}.(1 - part\_time_{F+M}/2)} \tag{2.9}$$

where L is the labour force and *part_time* represents the share of part-time (assumed to be half-time) in total employment[9].

Finally, we have a problem of endogeneity of female participation: through a classical price effect, participation should decrease when unemployment is high. In some age-education cells of the labour force, female unemployment can reach 40 to 50%, clearly affecting the arbitrage between activity and inactivity, and leading to a downwards bias of the coefficient of the impact of participation on unemployment. For that reason, in cross-section of countries, we instrument female participation with variables reflecting the social attitude of the country towards female participation.

In time-series, most of the problems of endogeneity will vanish with the use of Vector Auto-Regression techniques. To have quarterly data to perform causality and co-integration tests, we have to give up the disaggregation by gender and study four of the OECD countries, Germany, France, the USA and the UK.

2.4 Cross-sectional analysis.

The empirical strategy described above is first applied to a cross-section of countries. Our approach here is to come back to macroeconomic works of Calmfors and Driffill (1988) and Layard et al. (1991) and to introduce participation variables in addition to the existing variables. The focus is not on the existing variables, but on the effect of supply factors.

[9] The correlation coefficient across OECD countries of the corrected and the non-corrected share of women in labour force is about 0.73, indicating that the correction matters.

2.4.1 First cross-sectional analysis: the centralization of wage-bargaining

We base our first cross-sectional analysis on the work by Calmfors and Driffill (1988). They construct a rank ordering of countries according to the degree of centralization (1988, p19, table 1), for 17 OECD countries. The rank 1 is for Austria, the most corporatist country and 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 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) (see section 4.2). It is therefore possible to add new explanatory variables. The loss lies obviously in the lack of structure of the U-curve, however, the results will be shown to be robust and revealing the differences between men, women and young workers[10]. We extend the classification to four other countries: Spain, Portugal, Luxembourg and Ireland, which were not in the initial ranking[11]. The unemployment rates, in %, are averaged over 1980-94.

The important problem of simultaneity of participation to unemployment can be described in the model below:

$$u = C + \beta.(\text{Female Share}) + \lambda.(\text{Youth Share}) + \gamma.X + \epsilon_1$$

$$\text{Female Share} = C' + \beta'.u + \gamma'.Z_1 + \epsilon_2 \tag{2.10}$$

$$\text{Youth Share} = C'' + \beta''.u_Y + \gamma''.Z_2 + \epsilon_3 \tag{2.11}$$

where X,Z_1 and Z_2 are a set of national variables described below, u is unemployment. Since β' is likely to be negative and β positive, then the variable representing female participation will be correlated with ϵ_1 and the estimation of β by the ordinary least square will be biased

[10] Since the U-curve in Corp will be very robust in all the specifications, the appendix B (table B1) contains variations on this theme with statistical tests.

[11] In Layard, Nickell and Jackman (1991, p 52), these countries are characterized according to union coverage, union coordination and employer coordination. To be consistent with them we give the rank 11 to Portugal (between Australia and France), the rank 14 to Spain (between UK and Italy), and 17 to Ireland (between Japan and Switzerland). Luxembourg, as we believe, is also decentralized, and was given the rank 19, between Switzerland and the USA. Greece is excluded because not ranked according to the degree of wage setting centralization.

downwards. To improve the estimation, we replace (2.10) by (2.12)

$$\text{Female Share} = C' + \beta^{1'}.u_M + \beta^{2'}.u_F + \gamma'.Z_1 + \epsilon_2 \tag{2.12}$$

without a large difference. A first task is to find appropriate instruments for female participation, in the following list: index of human development corrected by gender inequality, index of gender empowerment, net pre-schooling enrolment of the 6 year old children, schooling expectancy of 5 year old children (Source Education at a Glance, OECD), share of women in enrolment in tertiary education (sources Report on Human Development, United Nations 1996), birth rates, divorce rates (source UN Demographic Yearbook, 1992), fraction of women in national parliaments (see table B2 in appendix). The first four instruments were eliminated by lack of significance through a recursive method (rotations of the variables four by four in a regression of female participation also including unemployment). The regression of participation variables on the instruments is reported in table 2.6.

For the share of young workers, we use the projections of the 1990 figures made in 1980 by the International Labour Office (ILO 1980), which are based on participation and demographic projections, but not on unemployment changes. We then take the average of the 1980 and 1990 figures. This method should remove much of the endogeneity problem associated with this variable.

Tables 2-4 and 2-5 summarize the results. We first perform the simple OLS model with the share of women in the labour force corrected by part-time (columns 1 and 2). The impact of the share of women is not significant though slightly negative. We then show how the use of the instruments leads to significant changes in the estimates (columns 4 and 5) and test for the exogeneity and the validity of the instruments with partial-information methods, like a 2-stage least square (table 2.7). We then go to full-information methods (3SLS) which are usually seen as more powerful (table 2.4, columns 5 and 6).

After controlling for endogeneity, the coefficient of female participation becomes significant at the 10% level in most of the cases. The coefficient of about 0.5 should be interpreted as follows: everything else controlled, an increase in the share of hours supplied by women of 8%, is associated in cross-country with an increase by 4% of total unemployment. This figure of 8% is

more or less the increase that faced most of the OECD countries in since the mid-70's. Applying the same methodology (2SLS and 3SLS) to female and male unemployment rates, it is found that the elasticity is lower for men (0.43 on an average for men, 0.62 on an average for women), which is what one would have expected from the model. The impact of the relative supply of young workers is also stronger for female workers, which again could be expected from the model. Finally, it should be observed that the impressive regularity of the coefficients of $CORP$ and $CORPSQ$ is *per se* is a justification for their use. In addition, the associated coefficients are more significant for women and imply a stronger curvature (see also the appendix, table B1). Table 2.6 shows a regression of the share of women on its instruments and on unemployment. Strictly speaking, one should use instruments for the unemployment variables as well, however, the use of $CORP$ and $CORPSQ$ was not of a great help. The coefficients have the expected signs: male unemployment increases female participation, female unemployment decreases it, higher birth rates, smaller enrolment rates in tertiary education and smaller divorce rates are associated with lower participation. The only counter-intuitive coefficient is the one of the share of women in parliament[12]. These regressions should be interpreted carefully since the choice of instruments is always difficult and arbitrary. However, usual tests of their validity do not reject their exogeneity. Similarly, it is not possible to reject the exogeneity of $CORP$, $CORPSQ$ and the share of less than 29 years old predicted by the ILO. See the table 2.7.

Unemployment benefits, ignored so far though certainly correlated to the variables *corp* and *corpsq*, could affect jointly the level of female participation (by increasing the attractiveness of participation), and of unemployment (by reducing search intensity). We run the previous 3 stage least square estimates in adding the replacement ratio (benefits over wages) and the duration of the benefits (these variables are in Layard, Nickell and Jackman 1991). In the next table are reported the coefficients of the share of female hours in the labour force in total, male and female unemployment with different specifications, with the replacement ratio (I to IV), with or without benefits duration (I-III or II-IV), with our without the share of young workers in the labour force (I-II or III-IV). All specifications I-IV contain in addition the variables $CORP$ and $CORPSQ$. It can be observed that the size of the coefficients is little affected by

[12] In running the same regression with the share of women not-corrected by part-time (second column in table 4.3), it is found that the coefficent is no longer positive. Maybe the share of women in parliaments has some impact on the legislations about part-time which woud explain the difference.

the introduction of benefits variables. The significance of the coefficient is lowered for women. However, it can be observed that these variables were available for 18 countries only, such that these regressions have two less observations than previously. On the whole, it can be concluded that unemployment benefits only marginally change the results.

3LS Model for Unemployment, Impact of Benefits	Endogenous Variables		
Specifications I-IV:	u	um	uf
I. Young / Replacement Ratio	0.476	0.448	0.529
	(1.90)	(1.96)	(1.54)
II. Young / Replacement Ratio / Benefits Duration	0.404	0.417	0.435
	(1.95)	(2.57)	(1.39)
III. Replacement Ratio	0.648	0.551	0.806
	(1.95)	(1.92)	(1.76)
IV. Replacement Ratio / Benefits Duration	0.494	0.420	0.620
	(1.84)	(1.97)	(1.55)

(t-St in parentheses)

Given that the validity of instrumentations always depends on the assumption that there is at least one valid instrument, one should also provide estimates of unemployment determinants only using simple OLS estimators. The model of aggregate unemployment is again estimated with the variables $CORP$ and $CORPSQ$ and with the growth rate of labour force over the periods 1980-94: the growth rates are apparently less endogenous to unemployment than the levels. The rationale for this specification comes from the combination of equations (2.6) and (2.5). From table 2.8, it appears that aggregate participation growth is not explaining higher cross-country unemployment, since the correlation is negative. When a disaggregation by gender is introduced, things drastically change. The coefficient on the growth rate of female labour force is positive and significant, while the growth rate of male labour force becomes significant but 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 latter one though not being reported here giving similar results). Disaggregation of unemployment by genders leads to similar conclusion. It is however disappointing to see that the effect of the growth of labour force of younger workers is stronger for male than for female unemployment, contrary to the

regressions in level shown previously.

There is obviously a question of endogeneity in the regressions with the growth rates. For the growth rate of the younger workers, we are safe of the criticism, since again the figures in 1990 are the projection data from the ILO (1980), based on the change in the structure of the population and trends in participation, but not on unemployment trends. For the growth rate of male workers, data come from the OECD, and are actual numbers. It can be argued that this growth rate depends on education and retirement, which are certainly highly dependent on unemployment. However, it is very difficult to find any good instrument for the male labour force. The most obvious one, the growth rate of male working age population, was found to be almost non-correlated in both cross-country and time-series with the growth rate of male labour force (a correlation coefficient of merely 0.12): it happens that in some countries like the US, both growth rates are very high, whereas in most European countries, the working age population is increasing fast but not the male labour force. Finally, the effect of endogeneity of female participation is certainly significant, but tends to bias the estimates towards smaller values: therefore our estimates underestimate the extent to which female participation growth affected unemployment.

To conclude, disaggregation by gender yields new results. The appropriate variables related to labour supply in such a model of unemployment are compositional ones, like the share of women in the labour force. Endogeneity of participation to unemployment also appears clearly from the data. In addition, regressions of the average of unemployment over the period 1970-80 were much less significant, since countries had to be removed from the sample. Regressions of unemployment by age category (prime-age male, female and young workers) were not possible for the same reason.

2.4.2 Second cross-sectional analysis: the Jackman, Layard and Nickell's structural approach.

In Layard et al. (1991) and in Jackman et al. (1996), a regression of unemployment rates (short term and long term) is performed, with structural explanatory variables. As a supplementary test of the model, we want to apply the methodology to analyse the gender differences. The unemployment data are the average of 1983-88 and 1989-94, like in Jackman et al. (1996). We

then have a panel of 2x20 observations. Unemployment rates are in logarithm. The regressors are the variables defined in Layard et al. (1991): the replacement ratio (unemployment benefits as a fraction of the wage), the duration of these benefits in years (infinite=4), active labour market spending divided by unemployment (replaced by the instrument: active labour market spending in 1987 divided by the average unemployment rate 1977-79), union coverage (1-3), wage setting coordination (1-3), change in inflation, a dummy for the second period and random effects. To this, we add a dummy for the existence of a minimum wage in the country and the growth rate of female participation rate over the period 1972-94, for a proxy of the accumulation of inexperienced-unattached workers on the labour market. The results are in table 2.9.

The growth rate of female participation rate is significant at the 10% level for women, and positive and less significant for men. The possible endogeneity bias of participation and unemployment is not a strong problem: first the participation variable is a growth rate between 1972 to 1994, so half of the period is lagged with respect to unemployment. Second, the correlation, if it exists, should be negative (the price effect) and so the coefficient is biased downwards, which would reinforce the interpretation of the paper. The active labour market spending per unemployed, which were significant in Jackman and al. (1996) for long-term unemployment, are naturally no longer significant for the average rates. Two other results come out: first, the negative impact of union's coverage is stronger for women. An interpretation is a political economy one, where insiders (men) bargain over the labour market regulations and do not care about the consequences on unemployment of the others (women). Second, the dummy for minimum wage is significant, especially for female unemployment (see column 3). Given that this qualitative variable does not fully reflect the effects of different levels of the minimum wage, the impact of minimum wage could be even more significant if better measured.

2.5 Time-Series Evidence

Another empirical strategy to overcome endogeneity problems is to use time-series methods: co-integration, non-Granger causality, and VARs. We want to quantify the non-transitory effect of an increase in labour supply on unemployment. We use quarterly data of labour force from different sources (see the appendix A for a description) for France, Germany, the USA and the

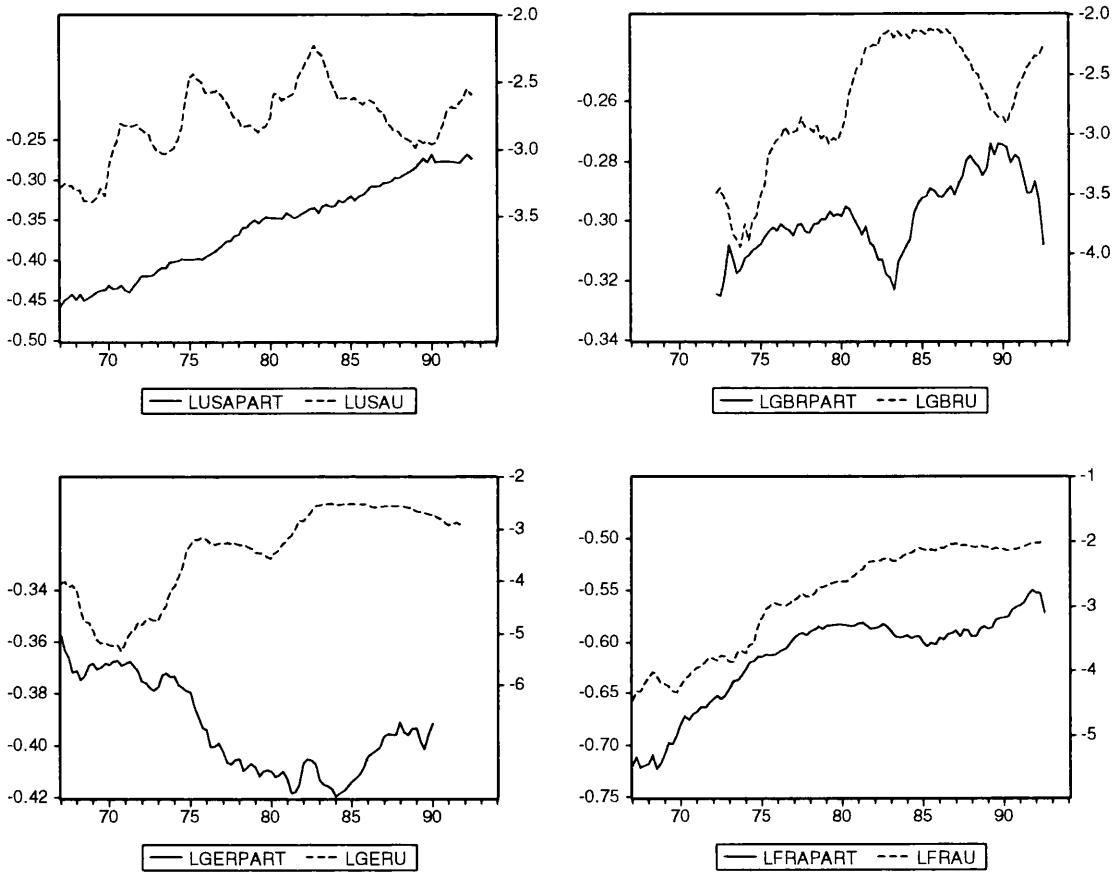

Figure 2-7: Participation (PART) and Unemployment Rates (U) Deseasonalized, Logarithms

UK, since 1967 (1972 for the UK). The figure 2-7 plots the series in logarithm $PART$ and u (the labour force divided by the 15-64 years old population, and unemployment divided by the labour force respectively[13]). No disaggregation by gender is available for these countries with quarterly data, and therefore we test the model in a rather unfavourable case. However, one can recall that over the period 1970-1995, changes in the level of the labour supply reflect its compositional changes, therefore the coefficients linking participation and unemployment should be interpreted as a reduced form of those implying the composition of the labour force and unemployment.

[13]Seasonality removed by projection on quarterly intercepts.

2.5.1 Co-integration

First we investigate the existence of a co-integration relationship between unemployment and labour force. The unit root tests (Augmented Dickey-Fuller tests, or the significance of the coefficient in:

$$\Delta X_t = C + \sum_{s=1}^{k-1} \alpha.\Delta X_{t-s} + \gamma.X_{t-k} + \epsilon_t + \delta.trend \tag{2.13}$$

with or without a trend) on the logarithm of U and $PART$) cannot reject the non-stationarity of participation in most of the cases. The non-stationarity of unemployment is sometimes rejected for the UK, but evidence rather suggests non-stationarity, especially for France (see table 2.10).

The non-stationarity of participation and unemployment implies that they cannot be linked by more than one co-integration relation. We compute the ADF test of the residual of the regression (table 2.11):

$$Log(U) = C + a.Log(PART) + \epsilon \tag{2.14}$$

In three of the four countries, one can reject the null hypothesis that the series unemployment and participation are not co-integrated at 5% or 10% at least in one of the specifications (table 2.12). We also provide in table 2.13 the results of alternative tests of co-integration, known as the Johansen tests, using the autoregressive decomposition of $X = (Log(U), Log(PART))$:

$$\Delta X_t = \sum_{i=1}^{k-1} D_i.\Delta X_{t-i} + \pi.X_{t-k} + \epsilon_t \tag{2.15}$$

where ϵ_t is stationary, D_i the coefficients of the polynomial matrix of the lag operator and a matrix. Then the Johansen test consists of finding the rank of the matrix π which directly gives the order of co-integration. Here in the bivariate case, we test the null hypothesis that the highest eigenvalue of π is equal to 0, equivalent to absence of co-integration relation. 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% confidence level (equal to 15.4). For the USA, the hypothesis of a co-integration relation is difficult to defend. More generally, it seems

that consistently with the model, the existence of a high minimum wage in France implies a strong relation between the two series.

Given the coefficients of the long-run relation between the series (reported in the table 2.14), one can calculate the estimated effect of the increase of labour force between 1971 and 1991 (table 2.15). The rise of unemployment observed in these four countries is therefore well explained by the model: the fitted rise (the elasticity times the rise in participation) is between 50% and 200% of the observed value.

2.5.2 Causality

From Granger (1986), reported in Hendry (1995, p289,d), when two series are co-integrated, at least one must Granger-cause the other. We investigate the direction of causality and perform Granger causality tests. We report the F-statistics and the confidence level of the null hypothesis: X does not Granger-cause Y.

In table 2.16, the non-causality from unemployment to participation is rejected for the USA, France and Germany (with a delay of more than six months in Germany if we look at the significance level of the regression with two lags). The non-causality from participation to unemployment is rejected at good levels of confidence for France, evidence is mixed for Germany, and the non-causality cannot be rejected for the UK and the USA.

2.5.3 VAR

After the long-run relation between participation and unemployment, we explore the dynamics of this link. We estimate with two lags the coefficients of a VAR model. We assume that the model is:

$$X = \begin{pmatrix} PART \\ U \end{pmatrix} = B(L). \begin{pmatrix} \epsilon^l \\ \epsilon^d \end{pmatrix} \tag{2.16}$$

with $B(L)$ a polynomial of matrix and L the lag operator. The shocks are structural shocks on labour supply and on labour demand. We describe in Appendix C the methodology of Blanchard and Quah (1989) to isolate the effect of the innovation of each series $PART$ and U on the bivariate system. As identification restrictions, we assume that the instantaneous

effect of an innovation of labour force on total unemployment is 0.6, a coefficient of 0.5 for the US having been taken in Blanchard and Diamond (1989). The other restriction is that a demand shock will reduce unemployment by 1 unit and will increase participation by 0.4 unit, the same value as in Blanchard and Diamond. We assume also that the matrix V is diagonal (the aggregate demand shock and the labour supply shock are not correlated). Given that the ratio of labour force over population is about 0.6 and that we consider the series in rate and not in logarithm, the 1% innovation on participation is also a 1% innovation in unemployment in the short run. Using this set of restrictions, $B(0)$ is then

$$B(0) = \begin{pmatrix} 1 & 0.24 \\ 1 & 1 \end{pmatrix} \tag{2.17}$$

and we plot the impulse response on figure 2-8. In the USA, the innovation on labour supply has a permanent effect on participation (solid line), but a transitory effect on unemployment (dashed line), half of the shock being absorbed after 3 years. After 8 years, the effect of the shock is not statistically different from 0. In the UK, participation seems much more stationary and despite a decline in participation after the rise of unemployment, the deviation in unemployment is still above 0.5 after 8 years. The same response is observed in Germany, but with a stronger decline in participation, which in turn helps reduce unemployment. Finally, participation is declining in France, but unemployment exhibits no decline after 4 years, and only a very slow decline after 8 years. One can also estimate the Vector Autoregressive model in introducing error correction. Casual observation of the results seems to indicate that the differences in the predictions varied very little from the VAR estimated in level.

2.5.4 Conclusions

Evidence for a long-run relation between participation and unemployment has been provided for France, and also for the UK. This is harder to maintain in the US or the German case. In Germany, participation has decreased and is quite counter-cyclical, as shown by the Granger (negative) causality from unemployment to participation.

A first interpretation of co-integration is that both series are linked by a long-run relation, or equivalently that participation is not neutral for unemployment. A second interpretation,

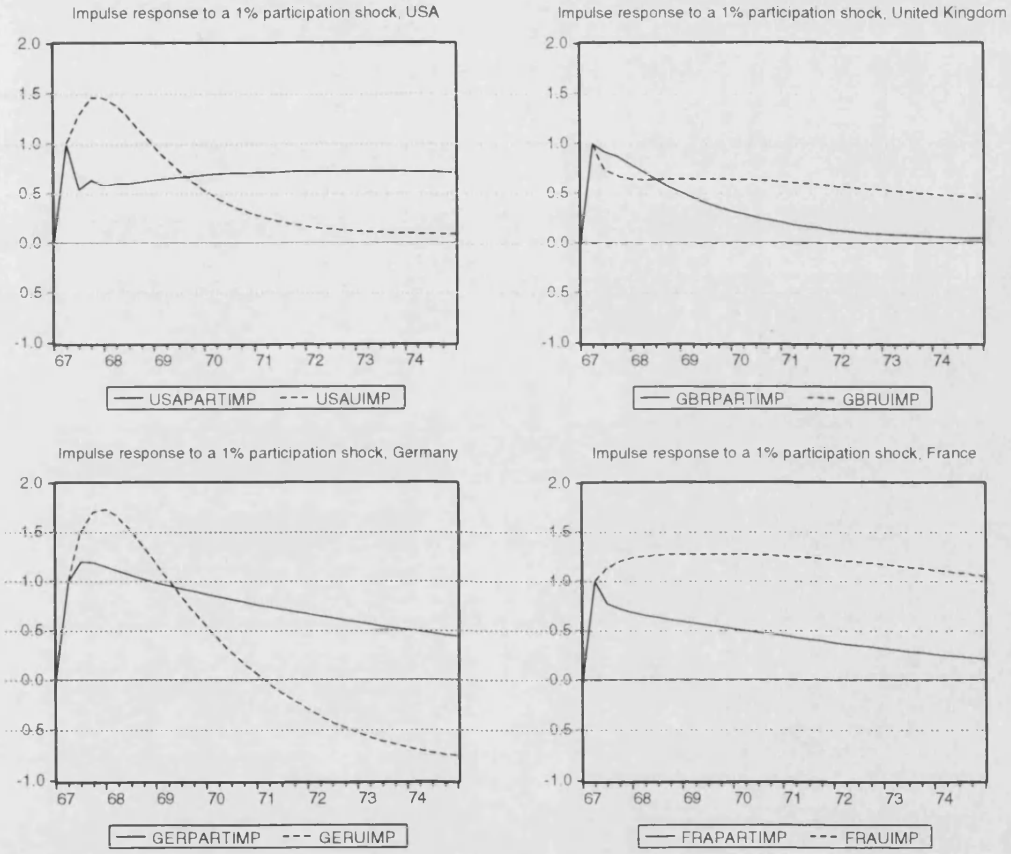

Figure 2-8: Impulse Response of a VAR estimated with 2 lags. Solid line: participation ; dashed line: unemployment

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 the co-integration in France under 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 constant labour supply (Blanchard and Summers 1986). Here we propose a totally different interpretation: the non-stationarity of unemployment as coming from the labour supply. In the same vein, the significance of trends in many empirical macroeconomic works (Bean 1993 for instance, who found in panel data of OECD countries that the shocks on unemployment were explained as well by the world GDP fluctuations as by a trend) could be interpreted as just proxying for the increase in labour force participation.

Finally, it must be accepted that it was not possible to mix the cross-sectional dimension with the time-series dimension, and to estimate as in section 4 an equation like: $U_{i,t} = D_i + \rho.U_{i,t-1} + \lambda.Cycle + \theta.$Share Women$+\epsilon_{i,t}$. It would have needed to tackle with the problem of endogeneity of the share of women in the labour force, and to find yearly time-series of instruments, which was not possible. Such an analysis needs to be carried out in another paper.

2.6 Concluding comments and future research

A common and immediate objection to theories implying adverse effects of rising female participation on unemployment is that the female-male wage gap has decreased and so the increased participation of women is rather demand driven. However, the model proposes a mechanism through which women prefer to 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 by women in some sectors to get around unions: this is a pure competition story between different factors of production, men and women; some authors have studied the evolution of employment by gender in specific 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 the unskilled men. A related objection is that men and women work in different occupations, such that competition between them is unlikely. Again, one can argue that there is, maybe a low short-run substitutability, but in the long-run (10 to 15 years) a higher substitutability. In any case, Grant and Hamermesh (1982) results on substitutability of production functions cannot be explained theoretically if there is no substitutability. There is also a theoretical answer to this point. It is sufficient to have an even narrow sector in which men and women, or more consistently with the model of section 2, women and young, are working in the same occupation, like cashier in supermarkets, to have cut in wages in all sectors due to increased labour supply. This is the case when there is free mobility across sectors.

A second objection is that a large part of the rise in inequality comes from a rise of within-group inequality, while our explanation involves inter-group inequality. We consider that the rise in inter-group inequality is well explained by the supply factor, and have to say little about the within-group component here. The model is not designed to consider that question. Anyhow, since 1979, according to Juhn et al.(1993), less than half (42% only) of the rise in inequality is due to the within-group component, and this share is less than the share explained by the changes in observed prices, i.e. the between-group component. About the rise in inequality, it should finally be said that the analysis of this paper is able to explain very naturally the decline in the absolute wages of the less skilled workers. In contrast, stories implying biased technological changes face more problems.

In the empirical sections, we showed for a cross-section of OECD countries a positive and significant correlation between female participation and unemployment, after controlling for female part-time work and endogeneity of participation with respect to unemployment. There are also positive correlations between the share of young workers in the labour force and unemployment, and also between the growth rates of young and female active population and unemployment. In time-series, a co-integration relation between unemployment and participation was found in some countries like France. Overall, the observed changes of the composition of the labour force are associated with significant increases in unemployment, about 4 to 5 points, 3 to 4 for men, 6 to 7 for women.

The thesis of the paper is that the long run evolution of labour markets can be explained partly but significantly by labour supply factors. It has to be confronted to the main alternative

explanation, the biased technological progress which lead to higher relative demand for skilled workers. This is in the agenda. Anyhow, explanations implying labour demand shifts should also consider the possibility that labour supply shocks have had an adverse effect on labour markets.

- **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 deep changes in the measurement concepts. In the OECD-CEP database, the series are generally chained. Here we regressed 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) such that both the cyclical component, the trend and the average value of the series are consistent before and after the break. Concretely, 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 15-64 years old population are interpolated from the yearly data published in the OECD Labour Force Statistics.

- **Appendix B.**

Corporatism variables.

To allow for the 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. We then analyse the impact of these variables on unemployment rates by gender and their differences. The estimation is: $X_i = C(1) + C(2).corp + C(3).corpsq + ei$. Two statistical tests will be considered here. First, are the explanatory variables *corp* and *corpsq* relevant, or equivalently does the F-test associated to the equality to 0 of their coefficients allow us to reject this hypothesis? Secondly, does the t-statistic of the coefficient of *corpsq* reject the hypothesis of a U-shaped relationship? We present the results of the tests (21 observations) in the table B1.

All the coefficients C(3) support the U-shaped pattern (column 3), with correct levels of confidence (column 4). The influence of the degree of centralization, proxied for by the rank ordering, is generally

acceptable, and more for women and youth than for men. It may be observed that the coefficient of *corpsq* is twice higher for women's unemployment and three times higher for youth's unemployment than for the male rate: given that the curvature (the second derivative) of the U-shaped curve is expressed by 2*C(3). It indicates that women are more sensitive to the degree of centralization than men. The intermediate countries are the high unemployment gender gap countries. Finally, the youth unemployment rate, predicted by the model, is low in the corporatist economies, whereas higher in the decentralized economies.

Instruments

They are described in table B2

• Appendix C. Identification of the structural shocks in the bivariate system.

We describe the methodology of Blanchard and Quah (1989) here to isolate the effect of the innovation of each series $PART$ and U on the bivariate system. This method was applied to the US labour market by Blanchard and Diamond (1989). As in Blanchard and Diamond (1989) we assume that:

$$\begin{pmatrix} \epsilon^l \\ \epsilon^d \end{pmatrix} = C(L).\begin{pmatrix} \eta^l \\ \eta^d \end{pmatrix}$$

with η^d a white noise innovation on demand and η^l a white noise innovation on labour supply, with $E(\eta^d, \eta^l) = V$ and $C(0) = Id$. Therefore, estimating $X = D(L)\xi$, with $D(0) = Id$, yields $D(L)$. ξ are the reduced form innovations on unemployment and labour supply, and $D(L)$ characterizes the reduced form relationship between the series. Given that $B(L).C(L) = D(L).B(0)$, we can go back to what Blanchard and Diamond call the "structural equation". For that, identifications assumptions are required to compute $B(0)$. They are described in the text

Table 2.1: United States: Female Labour Force by Occupations

	1960	1970	1980	1991
1. Professional,				
Technical and Related	3001 (14.2%)	4550 (16.4%)	7187 (17.3%)	10422 (18.5%)
	(11.7%)	(15.1%)	(15.4%)	(16.4%)
2. Administrative and				
Managerial Workers	(3.3%)*	1055 (3.8%)	3070 (7.4%)	6287 (11.1%)
	(8.5%)	(8.4%)	(10.4%)	(12.4%)
1.+2.	3795 (17.5%)*	**5605 (20.2%)**	**10257 (24.7%)**	**16709 (29.6%)**
	(20.2%)	**(23.5%)**	**(25.8%)**	**(29.2%)**
3. Clerical and Related	6141 (29.2%)	10104 (27.3%)	12997 (31.2%)	15413 (27.3%)
	(14.0%)	(18.2%)	(17.3%)	(15.5%)
4. Sales Workers	1746 (8.3%)	2141 (7.7%)	4671 (11.2%)	7327 (13.0%)
	(8.0%)	(7.2%)	(10.0%)	(11.9%)
5. Service Workers	4572 (21.8%)*	4789 (17.2%)	7452 (17.9%)	10291 (18.2%)
	(11.6%)	(11.4%)	(12.9%)	(13.9%)
6. Agriculture, animal,				
husbandry and related	390 (1.9%)*	225 (0.8%)	404 (1.0%)	606 (1.1%)
	(6.6%)	(3.2%)	(2.9%)	(3.0%)
7. Production and related	4006 (20.7%)*	4951 (17.8%)	5852 (14.1%)	6099 (10.8%)
	(39.5%)	(36.4%)	(31.2%)	(26.9%)
Total	**20.7M**	**27.8M**	**41.6M**	**56.2M**
Share of Women	**32.5%**	**36.9%**	**42.6%**	**45.4%**
in Labour Force				

Table2. 2: France: Female Labour Force by Occupations

	1962	1975	1982	1990
1. Professional,				
Technical and Related	717 (10.9%)	1308 (16.2%)	1600 (17.1%)	2096 (19.8%)
	(11.0%)	(16.0%)	(17.1%)	(19.8%)
2. Administrative and				
Managerial Workers	145 (2.2%)	338 (4.2%)	470 (5.0%)	524 (5.0%)
	(4.7%)	(7.2%)	(8.2%)	(7.2%)
1.+2.	**862 (13.1%)**	**1646 (20.4%)**	**2070 (22.1%)**	**2610 (23.8%)**
	(15.8%)	**(23.2%)**	**(25.3%)**	**(27.0%)**
3. Craftmen,	736 (11.2%)	578 (7.2%)	617 (6.6%)	588 (5.6%)
Shopkeepers	(10.9%)	(8.1%)	(7.9%)	(7.7%)
4. Employees	2347 (35.7%)	3616 (44.9%)	4522 (48.3%)	5378 (50.9%)
	(18.5%)	(23.5%)	(27.0%)	(29.1%)
5. Manual Workers	1468 (22.3%)	1648 (20.4%)	1604 (17.1%)	1600 (15.1%)
	(39.1%)	(37.4%)	(33.4%)	(32.1%)
6. Farmers	1169 (17.8%)	570 (7.1%)	547 (5.9%)	376 (3.6%)
	(15.9%)	(7.8%)	(6.4%)	(4.3%)
Total	**6.6M**	**8.1M**	**9.4M**	**10.6M**
Share of Women	**34.4%**	**37.1%**	**40.3%**	**44.4%**
in Labour Force				

Notes for tables 2.1 and 2.2 The first number is the number of thousands of women in the workforce by occupation, the second number is the share of women in the occupation relative to the total number of women in the workforce, the third is the share of this occupation in the total workforce (male and female workers). Source: ILO Statistics relative to the total number of women in the workforce, the third is the share of this occupation in the total workforce (male and female workers). Source: ILO Statistics. * : different definitions in 1960: 2 Administrative, executive and managerial workers, 5 Service, Sport and Recreation Workers, 6. Farmers, Fishermen, Hunter, 7. Craftmen, prod-process and labourers.

Table 2.3: Fraction of the wage earners affected by the national minimum wage, France 1990

	Nb of Salary Earners (x1000)	% of "Smicards"
Blue Collar	Men	9.5
	Women	32.2
	Total	15.0
Other Salary Earners: Men		3.6
	Women	11.4
	Total	7.3
All Salary Earners:	Men	6.8
	Women	17.7
	Youth (-26)	17.5
	Total	10.9

Source: Enquete ACEMO-SMIC, et MTEFP, in Dossiers Statistiques du Travail et de l'Emploi, Mars 1992.

Table 2.4: OLS, 2SLS and 3SLS Models for National Unemployment

	Variable: Unemployment 80-94					
	OLS	*OLS*	*2SLS*	*2SLS*	*3SLS*	*3SLS*
Cte	2.51	-7.91	-2.93	-22.0	-18.0	-21.6
	(0.46)	(-1.03)	(-1.58)	(-2.00)	(-1.59)	(-1.96)
CORP	1.25**	1.12**	1.84**	1.17**	1.22**	1.17**
	(2.60)	(2.33)	(2.40)	(2.02)	(2.25)	(2.32)
CORPSQ	-0.052**	-0.047**	-0.078**	-0.054**	-0.052**	-0.051**
	(-2.25)	(-2.03)	(-2.36)	(-2.10)	(-2.24)	(-2.32)
Corrected Share of Women in LF	-0.012	+0.012	+0.690*	0.472*	0.578*	0.476*
	(-0.08)	(0.09)	(1.73)	(1.77)	(1.88)	(1.79)
Share of Young (<29) in the LF	-	0.294**	-	0.216+		0.185
		(2.66)		(1.41)		(1.24)
R-sq	0.18	0.35	-0.21	0.09	-0.11	0.079
Adjusted R-sq	0.04	0.19	-0.44	-0.15	-0.32	-0.17
N observations	21	21	20	20	20	20

(White Heteroskedasticity-Consistent t-Statistics in parentheses,**=significant at the 5 % level, * significant at the 10% level, + at the 15% level, *CORP* = rank of ordering of centralization of wage bargaining, 1=Canada, 21=Austria, *CORPSQ=CORP*CORPSQ*, *Corrected Share of Women in LF* means the share of hours of women in total hours, Ireland is the country for which one of the instrument is missing)

Table 2.5: OLS, 2SLS and 3SLS Models for National Unemployment by Gender

	Variable							
	Male Unemployment 80-94				*Female Unemployment 80-94*			
	2SLS	*2SLS*	*3SLS*	*3SLS*	*2SLS*	*2SLS*	*3SLS*	*3SLS*
Cte	-14.1	-17.1	-14.1	-16.7	-24.3	-29.6	-24.4	-28.8
	(-1.43)	(-1.73)	(-1.43)	(-1.69)	(-1.56)	(-1.98)	(-1.56)	(-1.93)
CORP	0.94*	0.87+	0.94*	0.872+	1.84**	1.70**	1.84**	1.70**
	(1.70)	(1.67)	(1.70)	(1.67)	(2.09)	(2.15)	(2.10)	(1.57)
CORPSQ	-0.043*	-0.040*	-0.043*	-0.039+	-0.083**	-0.077**	-0.082**	-0.074**
	(-1.76)	(-1.74)	(-1.76)	(-1.69)	(-2.14)	(-2.20)	(-2.14)	(-2.13)
Corrected Share of Women in LF	0.464*	0.404+	0.464*	0.407*	0.690*	0.561+	0.691*	0.0563+
	(1.80)	(1.69)	(1.80)	(1.70)	(1.70)	(1.55)	(1.70)	(1.56)
Share of Young (<29) in the LF	-	0.160	-	0.141	-	0.314+	-	0.270
		(1.16)		(1.04)		(1.51)		(1.34)
R-sq	-0.07	0.06	-0.07	0.059	-0.09	0.13	-0.09	0.12
Adjusted R-sq	-0.28	-0.18	-0.28	-0.19	-0.29	-0.10	-0.29	-0.11
N observations	20	20	20	20	20	20	20	20

(White Heteroskedasticity-Consistent t-Statistics in parentheses,**=significant at the 5 % level, * significant at the 10% level, + at the 15% level, *CORP* = rank of ordering of centralization of wage bargaining, 1=Canada, 21=Austria, *CORPSQ=CORP*CORPSQ*, *Corrected Share of Women* means the share of hours of women in total hours, Ireland is the country for which one of the instrument is missing)

Table 2.6: Choice of Instruments for Female Participation

	Variable:	
	Share of women in the labour force corrected by part-time	*Share of women in the labour force non-corrected by part-time*
	OLS	*OLS*
Cte	*2.93*	*2.65*
	(3.53)	*(4.06)*
Male Unemployment 80-94	*0.515*	*0.606**
	(1.00)	*(1.88)*
Female Unemployment 80-94	*-0.533*	*-0.706***
	(-1.38)	*(-2.51)*
Birth Rate	*-1.794***	*-1.08*
	(-2.28)	*(-1.21)*
Female Enrollment Rate	*0.644***	*0.598***
in Tertiary Education	*(2.67)*	*(3.15)*
Divorce Rate	*2.410**	*1.147*
	(1.77)	*(0.71)*
Share of Seats for Women	*-0.198*	*-0.030*
in Parliament	*(-1.46)*	*(-0.42)*
R-sq	*0.43*	*0.54*
Adjusted R-sq	*0.18*	*0.34*
N observations	*21*	*21*

(White Heteroskedasticity-Consistent t-Statistics in parentheses,**=significant at the 5 % level, * significant at the 10% level, + at the 15% level)

Table 2.7: Validity and exogeneity tests

	Specification					
	Total Unemployment		*Male Unemployment*		*Female Unemployment*	
	Without and with Young Share		*Without and with Young Share*		*Without and with Young Share*	
Exogeneity of the exogenous variables						
t-Stat of v1 on u1	*-1.18*	*-1.04*	*-0.69*	*-0.586*	*-1.40*	*-1.25*
Confidence level	*(25%)*	*(30%)*	*(49%)*	*(56%)*	*(17%)*	*(22%)*
Validity of the Instruments: T-stat and confidence level						
Birth Rate	*-0.22*	*-0.72*	*0.15*	*-0.20*	*-0.67*	*-1.32*
	(82%)	*(48%)*	*(89%)*	*(84%)*	*(50%)*	*(20%)*
Female Enrollment Rate	*0.45*	*0.52*	*0.16*	*0.18*	*0.74*	*0.90*
in Tertiary Education	*(66%)*	*(61%)*	*(88%)*	*(86%)*	*(47%)*	*(38%)*
Divorce Rate	*-0.27*	*0.02*	*0.07*	*0.30*	*-0.63*	*-0.32*
	(79%)	*(98%)*	*(94%)*	*(77%)*	*(54%)*	*(75%)*
Share of Seats for Women	*0.54*	*0.49*	*0.59*	*0.52*	*0.42*	*0.09*
in Parliament	*(59%)*	*(65%)*	*(56%)*	*(61%)*	*(68%)*	*(0.76)*

u1 is the residual of a regression of the endogenous variables on the exogenous variables and the instruments, v1 is the residual of the 2SLS estimations. The nul of exogeneity of the exogenous variables is rejected if u1 explains significantly v1. The null of exogeneity of the instruments is rejected if they explain significantly u1

Table 2.8: OLS for National Unemployment with the growth rates of labour force

	Variable						
	Unemployment 80-94			*Unemployment 80-94*		*Unemployment 80-94*	
				Male		*Female*	
	OLS	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*
Cte	*4.31*	*2.11*	*2.50*	*2.91*	*3.40*	*0.628*	*0.868*
	(1.96)	*(0.98)*	*(1.08)*	*(1.38)*	*(-1.39)*	*(0.25)*	*(0.34)*
CORP	*1.14/***	*0.60*	*0.37*	*0.42*	*0.14*	*0.91**	*0.77*
	(2.30)	*(1.40)*	*(0.76)*	*(0.97)*	*(0.26)*	*(1.71)*	*(1.36)*
CORPSQ	*-0.044***	*-0.020*	*-0.009*	*-0.012+*	*0.002*	*-0.034+*	*-0.028*
	(-1.87)	*(-1.04)*	*(-0.41)*	*(-0.56)*	*(-0.10)*	*(-1.32)*	*(-1.19)*
Growth of Labour Force 80-94	*-2.95*	-	-	-	-	-	-
	(-1.49)						
Growth of Male Labour Force 80-94	-	*-10.6***	*-9.44***	*-8.95***	*-7.51***	*-13.3***	*-12.6***
		(-3.08)	*(-3.51)*	*(-0.11)*	*(-2.60)*	*(-3.50)*	*(-3.40)*
Growth of Female Labour Force 80-94	-	*4.40***	*3.93***	*3.41***	*2.83+*	*6.12***	*5.83***
		(2.67)	*(2.39)*	*(2.17)*	*(1.67)*	*(2.85)*	*(2.89)*
Growth of Young Labour Force 80-94	-	-	*1.81**	-	*2.25**	-	*1.11*
(<29yo)			*(1.93)*		*(2.05)*		*(0.87)*
R-sq	*0.24*	*0.52*	*0.61*	*0.39*	*0.52*	*0.55*	*0.56*
Adjusted R-sq	*0.11*	*0.41*	*0.47*	*0.23*	*0.36*	*0.44*	*0.42*
N observations	*21*	*21*	*21*	*21*	*21*	*21*	*21*

(White Heteroskedasticity-Consistent t-Statistics in parentheses,**=significant at the 5 % level, * significant at the 10% level, + at the 15% level. *corp* = rank of ordering of centralization of wage bargaining, 1=Canada, 21=Austria, *corpsq=corp*corp)*

Table 2.9: Random Effects Model for National Unemployment

	log(u)	*log(um)*	*log(uf)*
Repl. Rate (%)	0.0037 (0.6)	0.0057 (0.8)	0.0026 (0.4)
Ben. Dur. (Yrs.)	0.081 (1.2)	0.135 (1.8)	0.012 (0.2)
ALMP (%)	-0.07 (0.1)	-0.0045 (-0.39)	-0.011 (-1.2)
Union Cov. (1-3)	0.69 (3.6)	0.52 (2.3)	0.88 (4.9)
Coord. (1-3)	-4.74 (-2.1)	-0.54 (-2.1)	-0.42 (-2.0)
Δ inflation (%)	-0.16 (-1.9)	-0.19 (-1.8)	-0.11 (-1.3)
Min. Wage. (0-1)	0.40 (1.8)	0.20 (0.8)	0.59 (2.9)
Growth of female participation rate	0.54 (1.4)	0.48 (1.1)	0.56 (1.6)
Const.	0.027 (0.04)	0.36 (0.54)	-0.30 (-0.6)
Dummy 88-94	0.14 (1.9)	0.18 (1.9)	0.10 (1.4)
R sq	0.68	0.58	0.75
N	40	40	40

(t-St in Parenthesis). Periods: 83-88 and 89-94. *u*=national unemployment rate, *um*=male unemployment rate, *uf*=female unemployment rate

Table 2.10: Unit root tests for participation rates

Log(PART)	*Number of lags in the ADF regression:*					
	Arbitrary (4)			*Determined by the k-max criterion[a]*		
Specification	*C*	*C+Tr*	*Conclusion*	*C*	*C+Tr*	*Conclusion*
			t-statistics of γ			
USA	*-0.66*	*-2.59*	*I(1),Tr*	*-0.58(1)*	*-2.29(1)*	*I(1),Tr*
UK	*-2.08*	*-2.00*	*I(1)*	*-2.04(0)*	*-0.98(0)*	*I(1)*
GER	*-1.43*	*-0.83*	*I(1)*	*-1.65(1)*	*-0.63(1)*	*I(1)*
FRA	*-2.97**	*-2.16*	*I(1)*	*-2.81**(0)*	*-1.44(0)*	*I(0) or I(1)*

(significant at 5%, ** significant at 1%, [a] the principle of the k-max-criterion is to run the regression with an arbitrary large number of lags, and to remove one lag until the last coefficient α is significant -here at the 5% level. The final number of lags is in parentheses)*

Table 2.11: Unit root tests for unemployment rates

Log(U)	*Number of lags in the ADF regression:*					
	Arbitrary (4)			*Determined by the k-max criterion[a]*		
Specification	*C*	*C+Tr*	*Conclusion*	*C*	*C+Tr*	*Conclusion*
			t-statistics of γ			
USA	*-2.64*	*-2.52*	*I(1)*	*-2.28(1)*	*-2.80(2)*	*I(1)*
UK	*-3.54****	*-3.63****	*I(0)*	*-3.01(5)**	*-2.50(5)*	*I(1)*
GER	*-1.76*	*-3.14*	*I(1)+Tr*	*-1.50(3)*	*-3.01(3)*	*I(1)+Tr*
FRA	*-1.57*	*-0.89*	*I(1)*	*-1.57(1)*	*-0.89(1)*	*I(1)*

(significant at 5%, ** significant at 1%)*

Table 2.12: Cointegration Relation: Engle-Granger Two-Step Procedure

	ADF stat (without C, nor trend): t-statistics of γ for the residuals	
	Number of lags in the ADF regression	
	4 lags	*k-max*
USA	*-2.62**	*-2.98(2)***
UK	*-2.97***	*-2.97(4)***
GER	*-2.37*	*-1.89(3)*
FRA	*-2.49**	*-1.65(6)*

(significant at 10%, ** significant at 5%, *** significant at 1%, the number of lags is in parentheses in column 2, t-St in parentheses in column 3)*

Table 2.13: Johansen test on the maximal eigenvalue

	Ho : no cointegration					
	k=2		*k=3*		*k=4*	
	Likelihood Ratio	*Ho rejected*	*Likelihood Ratio*	*Ho rejected*	*Likelihood Ratio*	*Ho rejected*
USA	*10.0*	*no*	*10.2*	*no*	*10.0*	*no*
UK	*18.8**	*5%*	*8.85*	*no*	*13.0*	*no*
GER	*7.70*	*no*	*11.2*	*no*	*14.6*	*no*
FRA	*23.0**	*5%*	*29.8***	*1%*	*21.8***	*1%*

Critical values at 5%: 15.41,at 1%: 20.04

Table 2.14: Long-run Equilibrium Between Unemployment and Participation

	Long-run Relation Between Unemployment Rate and Participation Rate	
USA	*Log (U) = -2.00 (13.4) + 2.18 (5.34).Log(PART) + Res,*	*Rsq=0.22, DW=0.07*
UK	*Log (U) = 1.33(-1.03)+ 13.6 (-3.17).Log(PART) + Res,*	*Rsq=0.11, DW=0.04*
GER	*Log(U)= -20.05(16.1) - 42.1(13.3).Log(PART) + Res,*	*Rsq=0.66, DW=0.08*
FRA	*Log(U) = 7.15(-16.1) + 16.3 (-22.7).Log(PART)+Res,*	*Rsq = 0.84, DW=0.07*

(t-St in parentheses)

Table 2.15: Predictions of the long-run equilibrium relation

(%, 1971-1991):	*Actual growth of participation rate (%)*	*Actual growth of unemployment rate (%)*	*Fitted growth of unemployment rate (%)*
USA	14.7	12.9	32
UK	4.9	103	67
GER	-2.4	201	101
FRA	11.1	124	181

Table 2.16: Granger Non-Causality Tests between Unemployment and Participation Rates

		Ho: Log(PART) does not cause Log(U)		*Ho: Log(U) does not cause Log(PART)*	
	N lags	*F stat*	*Confidence Level*	*F stat*	*Confidence Level*
USA	*2*	*1.93*	*15%*	*3.50*	*3.4%***
	4	*0.66*	*62%*	*3.03*	*2.2%***
UK	*2*	*1.33*	*27%*	*0.70*	*50%*
	4	*1.96*	*11%*	*1.31*	*27%*
GER	*2*	*1.26*	*29%*	*1.36*	*26%*
	4	*3.44*	*1.2%***	*2.89*	*2.7%***
FRA	*2*	*5.18*	*0.7%****	*5.44*	*0.6%****
	4	*2.71*	*3.4%***	*3.07*	*2.0%***

(Ho rejected at 10%, ** at 5%, *** at 1%)*

Table B1: Tests of the impact of the degree of centralization of wage setting institutions

	F-test C(2)=C(3)=0	Confidence level	t-Stud C(3)	Confidence level	Rsquare	
AU2	*2.05*	*0.157*	*-1.89*	*0.074*	*0.19*	*21 obs*
AUM2	*1.28*	*0.303*	*-1.41*	*0.175*	*0.12*	*21 obs*
AUF2	*2.50*	*0.110*	*-2.17*	*0.044*	*0.22*	*21 obs*
AUY2	*2.60*	*0.074*	*-2.01*	*0.062*	*0.25*	*19 obs*
ADU2	*0.68*	*0.520*	*-1.16*	*0.263*	*0.08*	*21 obs*
ARU2	*1.085*	*0.359*	*-1.37*	*0.187*	*0.11*	*21 obs*

*AU2 = 2.06(0.69) + 1.26(2.01).corp -0.052(1.90)*corpsq* *R2=0.19*

*AUM2= 2.61(0.88) + 0.96(1.55).corp -0.039(1.41)*corpsq* *R2=0.12*

*AUF2= 1.04(0.28) + 1.76(2.24).corp -0.075(2.17)*corpsq* *R2=0.22*

*AUY2=0.27(6.93) + 3.02(1.37).corp-0.120(2.00)*corpsq* *R2=0.25*

*ADU2=-1.41(0.46) + 0.74(1.14).corp -0.034(1.16)*corpsq* *R2=0.08*

*ARU2= 0.81(2.43) + 0.10(1.46).corp -0.042(1.37)*corpsq* *R2=0.11*

(t-St in parentheses)

Table B2: Description of the variables used to instrument the unemployment equations

Country	Average unempl. rate	Rank of corpo ratism	Female partici-pation rate	Share women labour force	Share women correc part-time	Share women in part-time	Gender empow erment measure	Women in Parlia ments.	Women manager or administ	Number of births	Enroll. univer. women share)	Divorce rates	School expect. for 5 y.o.
	(%)	(rank)	(rate)					(%)	(%)	/1000p	(%)	/1000p	(%)
Year	80-94	-	81-94	81-94	81-94	1987	1996	1996	1996	1987	1992	1987	1992
USA	7	20	0.706	0.452	0.433	0.253	0.645	10.4	42	15.7	51.2	4.7	14.2
CAN	9.8	21	0.684	0.449	0.427	0.262	0.685	18	42.2	14.4	50.1	3.08	14.7
AUS	8.1	10	0.625	0.416	0.373	0.423	0.59	13.5	43.3	15	50.7	2.48	na
NZE	6.3	9	0.452	0.361	0.332	0.357	0.685	21.2	32.3	16.7	48.9	2.63	14.1
JAP	2.5	16	0.599	0.39	0.359	0.352	0.445	6.7	8.5	11	38.9	1.25	na
IRE	15	17	0.378	0.309	0.292	0.213	0.504	12.8	17.3	16.5	44.8	na	14.4
GBR	9.9	13	0.65	0.435	0.384	0.438	0.53	7.8	33	13.6	45.1	2.89	13.4
GER	6.8	6	0.556	0.398	0.361	0.32	0.654	25.5	19.2	11.2	41.6	2.09	15.9
FRA	9.4	12	0.56	0.418	0.39	0.263	0.437	5.9	9.4	13.8	52.4	1.9	15.9
SPA	18.7	14	0.447	0.374	0.358	0.148	0.49	14.6	12	10.9	49.5	0.59	15.4
ITA	10.6	15	0.468	0.372	0.361	0.11	0.593	13	37.6	9.6	46.8	0.44	na
POR	6.2	11	0.637	0.439	0.43	0.111	0.491	8.7	36.6	12.4	53.9	0.91	na
GRE	7.1	na	0.41	0.357	0.351	0.076	0.37	6	12.1	10.6	52.2	0.6	13.7
HOL	9.8	7	0.394	0.348	0.287	0.63	0.646	28.4	15	12.7	41.6	1.89	15.8
BEL	11	8	0.537	0.423	0.388	0.285	0.58	15.4	18.8	11.9	48.3	2.1	15.5
LUX	1.4	19	0.494	0.345	0.326	0.183	0.59	20	8.6	11.4	37.1	2.08	na
DAN	8.4	4	0.771	0.343	0.315	0.373	0.718	33	20	12	48	2.87	15.6
SWE	3.5	3	0.782	0.479	0.434	0.414	0.779	40.4	38.9	12.5	51.8	2.1	14.3
NOR	3.9	2	0.71	0.455	0.274	0.476	0.786	39.4	30.9	12.9	51.8	2.08	14.7
FIN	7.4	5	0.697	0.47	0.464	0.111	0.71	33.5	26.4	12.1	49.7	2.45	15.4
ICE	na	na	na	na	na	0.475	na	na	na	23	na	1.84	na
AUT	3.5	1	0.594	0.42	0.392	0.228	0.641	23.2	19.2	11.4	44.5	1.96	na
SWI	1.1	18	0.576	0.383	0.324	0.541	0.594	16.7	27.8	11.7	33.4	1.93	15

Chapter 3

The labour market consequences of demographic trends: France and USA 1964-94

Abstract: This paper examines the consequences of the changes in the composition of the labour force in the last 30 years: in many OECD countries, low education / high experience workers have been replaced by low experience / high education workers. In aggregate, these changes can have both a positive or a negative impact to the skill level of the active population. Using French and US data, the paper establishes the substitution in the composition of skills of the labour supply. In France covariations of price and supply of skills are consistent with pure labour supply stories. In the US, changes in labour demand seem important, even if labour supply changes could lead to the same predictions depending on the substituability between experience and education.

3.1 Introduction

After 20 years of high unemployment in Europe, and without a very convincing explanation of what generated the strong increase of the 70's - 80's, as acknowledged in Bean (1993), a promising area of research has emerged in the early 90's. Its originality is that trends in inequality in the US and in unemployment in Europe, could well be the result of the same forces which lead to rising dispersion of equilibrium wages of workers, by affecting adversely the

unskilled workers. See for instance Bertola and Ichino (1995), or Krugman (1994). In Europe, labour market regulations may prevent the less skilled from finding jobs. The present paper is sympathetic with this strand of research in general, but makes an attempt to challenge the origin of the forces at work.

Those are generally viewed as the impact of technological progress, leading to higher demand for educated and skilled workers and international trade. Both would increase the gaps between the low and high skilled workers. Two influential papers, by Katz and Murphy (1992), and Juhn, Murphy and Pierce (1993) have imposed the view that these dispersing forces in the US were changes in the demand for educated and more broadly for skilled workers.

In contrast, labour supply factors were always denied any important role, even if any, a role of reduction in disparities only: the 70's-80's faced an impressive increase in the share of college educated workers. Similarly, economists concerned by the rise in European unemployment have paid little attention to the rise in active population: in representative agent models, relations between labour supply and unemployment cannot persist in the long run, since capital stock will endogenously increase and so the productivity of labour. This is the view expressed in Malinvaud (1986) or Nickell (1991) for instance[1].

The present paper claims that one should take the supply changes more seriously. In the 70's-80's, the supply of educated workers increased in all OECD countries, but this is not the most preeminent change of labour supply. The most important quantitative and fast change is that, since the 60's, labour force has enormously increased with the massive arrival of women (see figure 3-1), bigger cohorts of young workers (figure 3-2a). There have also been less older workers (figure 3-2b). There is no reason to believe that this has been neutral. This is the reason why, instead of considering almost only education, like many authors (Nickell and Bell 1994, Manacorda and Petrongolo, 1996 and others), this paper considers the two other dimensions of labour supply (age and gender). In other words, it will make explicit the *continuous substitution of high experience / low education workers, by high education / low experience workers.* I argue that the implication of this substitution is to give more explanatory power to the labour supply

[1] In some models however, the size of labour force can affect equilibrium unemployment, through a composition effect. Such is the case in Pissarides (1990), where labour force growth, by increasing the share of young workers in the sense of new entrants from inactivity to unemployment, affects the equilibrium unemployment. This kind of composition effect of the labour force will be the main line of attack of this paper.

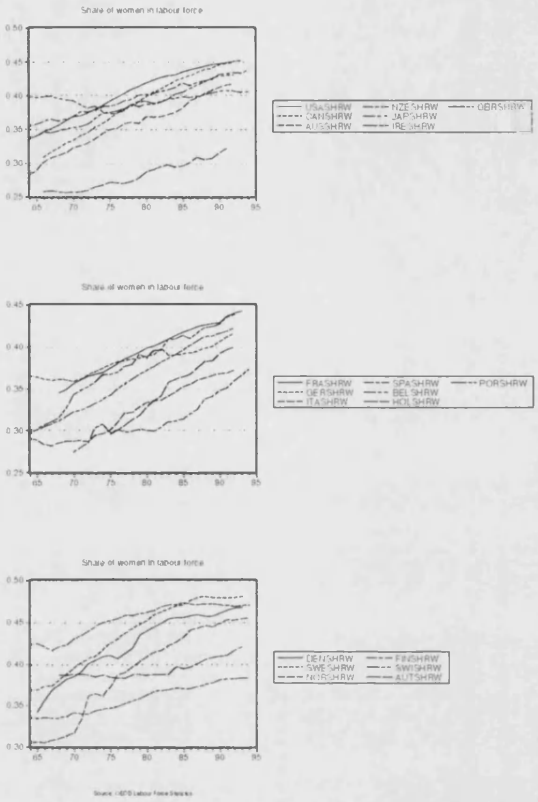

Figure 3-1: Gender Composition of the Labour Force, OECD

factors, whereas less to the labour demand factors.

The paper is organized as follows. In section 2, the relation between changes in labour supply and the productivity of the labour force is explored. Using French (Formation et Qualifications Professionelles 1970, 77, 85, 93) and US (March Current Population survey 1964, 70, 77, 85, 91) micro datasets, we divide the labour force in 32 (resp. 40 in the US) groups of age, education and gender. It is shown that between 1964 and 1981 in the US, there is no positive correlation between the change in the size of the cells and the relative wage of these cells. To a lesser extent, the same is true in France between 1970 and 1985. Identifying wage with productivity, it means that the increase in the labour supply during these periods was neither an appreciation nor a depreciation of the labour force - in average. Section 3 goes one step further and decompose wages in their two main components, experience and education. In both

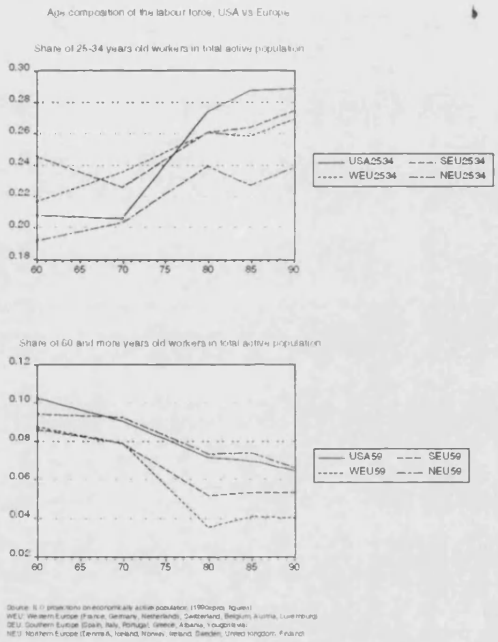

Figure 3-2: Age Composition of the Labour Force, OECD

countries, it is shown that the rise in the labour force has implied on an average a more educated, but a less experienced labour force, until the early 1980's. In other words, if the labour force has become more productive along the dimension of education, it has become less productive along the dimension of experience. This is an assessment of the *change in the skill composition of the labour force*, which is the key point of the paper. Issues of gender discrimination are then addressed, that do not affect the conclusion. In section 4, I examine the implications of these findings for the interpretation of relative wage changes. In France, the wage return to education decreased, the wage return to experience increased, changes consistent with a labour supply story, as found in Goux and Maurin (1995). In the US, the education supplied by workers increased and during the same period, the return to education increased. Changes in demand for educated labour could however be overestimated, depending on the elasticity of substitutability between education and experience. Section 5 answers potential objections and concludes.

3.2 Changes in labour supply and relative wages

This section aims to compare the changes in the quantities of labour and the relative wages. This deserves preliminary comments. First of all, similar calculations were done by Katz and Murphy (1992) and Goux and Maurin (1995): they compute the inner product of changes in relative wages and changes in relative employment. If labour demand is constant, the inner product needs to be negative. This is what Goux and Maurin (1995) found in France, which is a necessary condition for the absence of a demand shift in favour of the skilled workers. For the US, Katz and Murphy found a positive inner product over some sub-periods (those which include the mid-eighties).

Here, the focus is different: first, the study is about labour supply and therefore all the active workers will be considered, including the unemployed. Second, the interest is about the relative productivity of the workers who belong to the demographic/education groups whose share in the labour force has changed. This productivity can be approximated - certainly imperfectly - by their relative hourly wage. This is why this section focuses on the correlation between the change in labour supply and wages across cells of the labour force. The vector of changes in

labour supply by cell is denoted by $\Delta L = (L_{t=k+T} - L_{t=k})$, and w is the log of the relative wages of each cell, with an average over the period as: $Log(w) = Log[(w_{t=k} + w_{t=k+T})/2]$.

I will first estimate a regression of $\Delta L/L$ on a constant and on w . Since the size of the cells are different, the OLS estimator is weighted with the initial size of the cells. I display in the tables the t-statistics of the coefficient: a positive value implies a positive correlation, and a negative value implies a negative correlation. Second, I will calculate the correlation coefficient of ΔL and w which I then decompose in the sum of two correlation coefficients over two subperiods according to equation (3.1):

$$
\begin{aligned}
corr(x,y) &= \frac{\sum x_i.y_i}{\left(\sum x_i^2 \sum y_i^2\right)^{1/2}} = \frac{\sum\limits_{i\in A_1} x_i.y_i}{\left(\sum\limits_{i\in A_1} x_i^2 \sum\limits_{i\in A_1} y_i^2\right)^{1/2}} \left(\frac{\sum\limits_{i\in A_1} x_i^2}{\sum x_i^2} \frac{\sum\limits_{i\in A_1} y_i^2}{\sum y_i^2}\right)^{1/2} \\
&+ \frac{\sum\limits_{i\in A_2} x_i.y_i}{\left(\sum\limits_{i\in A_2} x_i^2 \sum\limits_{i\in A_2} y_i^2\right)^{1/2}} \left(\frac{\sum\limits_{i\in A_2} x_i^2}{\sum x_i^2} \frac{\sum\limits_{i\in A_2} y_i^2}{\sum y_i^2}\right)^{1/2}
\end{aligned}
\tag{3.1}
$$

where A_1 and A_2 are partitions of the sample. The subsample A_1 and A_2 will be either men and women, or young and older workers.

3.2.1 USA 1964-91

Wages and labour force data by cells come from the March Current Population Survey. The labour force is disaggregated into 40 categories: gender, 4 potential experience categories ($\leq 10, 11 \leq \exp \leq 20, 21 \leq \exp \leq 30, \geq 31$, where potential experience is defined by age - education - 5, and 5 educational categories (no diploma or at most 11 years of completed schooling, 12 years (high school), 13 to 15 years of schooling, 16 years of schooling, and more than 17). See the description of the data in the appendix.

Coefficients and t-stat of a regression of ΔL on w are displayed in table 3.1. Before 1981, the changes in the size of the cells do not appear to be correlated with the mean wage of the cell: this means that the contribution of the groups to the growing labour force in the US is neutral with respect to the position of the workers in the wage distribution, up to 1981. In

Table 3.1: USA, OLS regression of $\Delta L/\mathrm{L}$ on w across 40 cells

Time Period	Coefficient	t-Stat
1964-1967	-0.036	-0.52
1967-1970	-0.050	-0.67
1970-1973	-0.023	-0.28
1973-1977	-0.100	-1.17
1977-1981	-0.006	-0.08
1981-1985	0.192	2.95
1985-1988	0.138	4.02
1988-1991	0.101	2.46

other words, it is difficult to argue that over that period, the rise in the labour force in the US is associated with a rising quality of the workers if wages fully reflect their quality. The impact of this assumption on the conclusions is examined in the next section. It is only after 1981 that the coefficients appear to be positive and significant. Figure 3-3 summarizes these findings by plotting the changes in size of the cells with respect to the logarithm of the relative wage, averaged over each the sub-periods. The seeming outliers with very low ΔL are the older workers (men and women of experience 4) with education level 1 (0-11 years of schooling). Since the active population has been growing enormously in the US, most of the cells are above the horizontal axis.

Unweighted correlation coefficients (the weighted correlation coefficients are similar) and the contribution of each group to the correlation are in table 3.2. Again, it appears that the correlation between the changes in the size and the mean relative wage is rather small before 1980. The decomposition of equation (3-1) shows that groups contributing to decrease the correlation over this period are women and young workers. Young workers are defined as those with less than 20 years of potential experience, the older workers are the complement.

3.2.2 France 1970-93

Wages and employment data by cells come from the survey Formation et Qualifications Professionnelles on French workers. The labour force is divided into 32 categories: gender, 4 potential experience categories ($\leq 10, 11 \leq \exp \leq 20, 21 \leq \exp \leq 30, \geq 31$, where potential experience is defined by age - age of end of schooling), and 4 educational categories (no diploma, education < 12 yrs, education $=12$, and education ≥ 12). See the description of the data in the appendix.

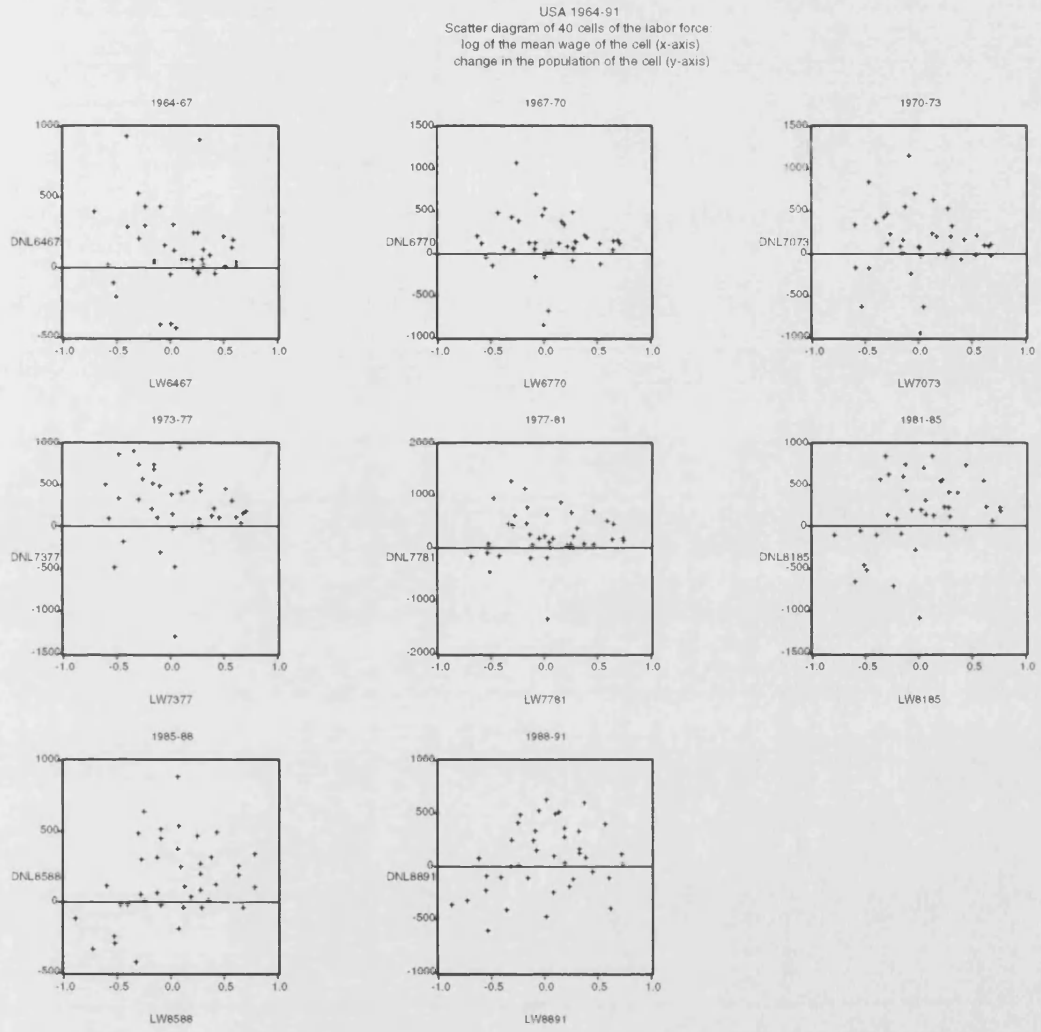

Figure 3-3: USA: Changes in Labour Supply and Relative Wages

Table 3.2: USA, Correlation of ΔL on w across 40 cells, and contribution of different groups

Time Period	All Sample	Men	Women	Young	Old
1964-1967	-0.141	+0.076	-0.333	-0.367	+0.141
1967-1970	-0.087	+0.112	-0.157	-0.236	+0.090
1970-1973	-0.062	-0.126	-0.029	-0.209	+0.319
1973-1977	-0.137	+0.013	-0.137	-0.177	+0.169
1977-1981	+0.022	+0.156	+0.073	+0.154	+0.190
1981-1985	+0.300	+0.527	+0.380	+0.524	+0.526
1985-1988	+0.319	+0.388	+0.392	+0.460	+0.179
1988-1991	+0.275	+0.271	+0.589	+0.301	+0.098

Table 3.3: France, OLS regression of $\Delta L/\mathrm{L}$ on w across 32 cells

Time Period	Coefficient	t-Stat
1970-1977	0.220	1.70
1977-1985	0.130	0.89
1985-1993	0.645	3.99

The result found with these data is that the coefficient of a regression of $\Delta L/L$ and w is not strongly significant from 0 between 1977 and 1985. It is positive though only weakly significant between 1977 and 1985. By contrast, between 1985 and 1993, there is a strong positive coefficient. See the table 3.3. In table 3.4, it appears that the correlation coefficient is slightly positive before 1985, and more strongly after. One of the main reason for the difference with the US, where the correlation was more clearly negative or close to 0, is that the contribution of both women and young workers to the total correlation is positive, indicating a slower change in the composition of labour supply in low wage groups, as compared to the US.

Figure 3-4 plots the change in size of the relative groups with respect to the logarithm of the relative wage. Between 1970 and 1977, no cell can be found in the fourth quadrant (smaller size and high wages), and 9 cells are in the second quadrant, which means larger size and low wages.

One can draw the following conclusion from the decomposition of the changes in the labour

Table 3.4: France, Correlation of ΔL on w across 32 cells, and contribution of different groups

Time Period	All Sample	Men	Women	Young	Old
1970-1977	+0.198	+0.376	+0.154	+0.114	+0.487
1977-1985	+0.154	+0.307	+0.227	+0.379	+0.212
1985-1993	+0.468	+0.534	+0.531	+0.590	+0.361

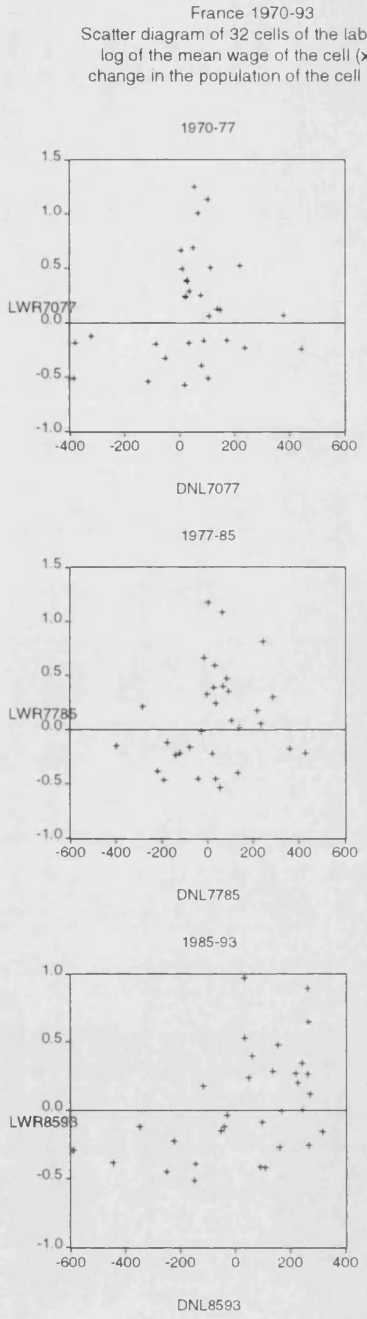

Figure 3-4: France. Labour Supply and Relative Wages

supply in France. Until 1985, despite the rise in the educational level of the workforce, the absolute increase in the workforce is not particularly concentrated in high wage groups, whereas, as in the US, after 1985 there seems to be an important upgrading of the labour force.

3.3 Education vs Experience

3.3.1 Decomposition

Taking the relative wages as a proxy for the relative productivity of workers, the exercise of last section shows that before 1985 in France, and before the early 80's in the US, the effect of a rising labour supply was neutral on the average productivity of the labour force. One would like to go one step further and provide a decomposition of the changes in productivity in the two components of wages, education and experience. For that, I estimate for each year the price of each skill (diploma and experience) in running a wage equation separately for men and women on 5 dummies for each educational level[2] and on potential experience and its square.

$$Log(w_{iT}) = C + \alpha_T.Education_i + \beta_T.Experience_i + \epsilon_i \quad (3.2)$$

$$= f(Education) + g(Experience) + \epsilon_i \quad (3.3)$$

Then the variable $\widehat{w_{iT}}$ is defined as the predicted value of wages i.e. the conditional mean wage. This can be decomposed into an intercept, the experience component $\int$ and the education component $\int$. Each component can be averaged over the whole labour force. For instance, the education component is: $\sum_{i=1970} \alpha_T.Ed_i$ for the year 1970. This provides a decomposition of the average productivity of the labour force in efficiency units of education and in efficiency units of experience. Such an exercise can be conducted at constant prices (α_{64} and β_{64} for simplicity) and at current price.

[2]The fourth and the fifth education level in France are the 14 years of schooling, and the more than 15 years of schooling respectively.

3.3.2 Potential Problems

Gender Discrimination

An issue that arises, is the extent to which gender discrimination may affect the conclusion. It may be that, the gender gap in wages or in the wage return to education or experience only reflect some discrimination and not their true productivity. First, in the wage equations described above, the gap in wages between men and women conditional to the measured skills (i.e. the difference in the intercepts) is rather important in the first years (in the US, 23% in 1964, 24% in 1970), and decreases over time: 5% in 1977, 1% in 1985, 4% in 1991). If there is gender discrimination, a significant part of it should be captured by the intercept, whereas the decomposition above only implies the wage return of observed skills. This is a reason for only focusing on how discrimination may affect the wage return of the skills: let α_M be the measured price of a given skill for men and α_F the measured price of the skill for women. Then, define the return to skill for women corrected for discrimination by:

$$\alpha_F(\lambda) = \alpha_M + (1 - \lambda).(\alpha_F - \alpha_M) \tag{3.4}$$

With $\lambda = 0$ (no discrimination), $\alpha_F(\lambda) = \alpha_F$. With $\lambda = 1$ (full discrimination), $\alpha_F(\lambda) = \alpha_M$. I will provide estimates of the decomposition of wages in two components by taking different values of λ.

Interaction terms between education and experience

It might be that the decomposition of (3.2) of wages in education and experience is arbitrary, and that there are significant interactions between experience and education. Therefore, one should add an interaction term in the econometric specification and estimate change in the skill level of the labour force according to a three dimensional space (education, experience and interaction). However, it will be shown that, in both France and the USA, the size of the interaction term and its changes are small compared to the two other dimensions. Therefore the conclusion of the two-dimensional decomposition will remain valid.

Measurement Error on Female Experience

It is well known that due to recurrent interruptions of activity, some women may have an actual experience which is much lower than what is measured by potential experience. Assume that real experience for women is determined by the following model:

$$RExp_i = \upsilon.Pot.Exp_i + \theta_i$$

where θ_i is an random error term with variance σ^2 and $\upsilon < 1$ is a systematic error. It is known that if $\sigma > 0$ there is a downwards bias to the OLS estimates of the elasticity of the coefficient on experience, by a factor $\frac{\sigma^2}{\sigma^2+\omega^2}$ where ω^2 is the variance of the residual of the wage equation for women. In addition, the coefficient is biased by a factor $1/\upsilon$. It follows that the number of efficient units of experience estimated for an individual will be biased by the factor $\frac{\sigma^2}{\sigma^2+\omega^2}$, but not by the factor $1/\upsilon$, since that systematic error cancels out in the product of the variable and its coefficient. To the extent that much of the error on experience is a systematic one, as seems to be the case from preliminary work on the issue of real experience for women (using the survey Actifs Financiers 1992, described in chapter 4), the problem of measurement error is small. However, more work on the question is needed.

3.3.3 USA

To provide an accurate comparison between the two countries, the wage equations described above will be done using the same specification on the same sample of employed workers[3]. See the tables 3.5 and 3.6. One can observe the rising return to education, especially after the mid 70's, the rising return to experience for men, and the rise in the variance of the residuals.

Using those coefficients, one can decompose wages in two different components according to education and experience, as in tables 3.7 and 3.8.

[3]The CPS allows to estimate not only the wage of those who work, but also the non-employed who worked at least one week during the year preceding the survey. This is very convenient to treat sample selection bias due to unemployment, since most of the unemployed workers in the US have worked during the last twelve months. The regressions were done on the whole sample of active workers, or on the sample of employed workers, without very significant differences. To compare with France, I have used the results on the sample of employed workers only.

Table 3.5: USA, GLS of ln (hourly wage) of male workers on potential exp. and sq., 5 education dummies and two race dummies

Men	1964	1970	1977	1985	1991
Educ 2	0.284	0.267	0.271	0.302	0.298
Educ 3	0.439	0.361	0.374	0.402	0.459
Educ 4	0.561	0.563	0.569	0.651	0.689
Educ 5	0.581	0.604	0.679	0.756	0.824
Exp	0.0496	0.0475	0.0581	0.0604	0.0531
Exp sq. (x100)	-0.075	-0.076	-0.092	-0.093	-0.082
Av. return to exp in % (20 yrs)	3.46	3.23	3.97	4.12	3.67
Residual, diff. 90/10 percentile	1.27	1.20	1.22	1.34	1.33
Residual, diff. 75/25 percentile	0.60	0.58	0.61	0.67	0.67

Table 3.6: USA, GLS of ln (hourly wage) of female workers on potential exp. and sq., 5 education dummies and two race dummies

Women	1964	1970	1977	1985	1991
Educ 2	0.320	0.260	0.230	0.228	0.291
Educ 3	0.392	0.379	0.357	0.397	0.457
Educ 4	0.544	0.590	0.536	0.590	0.722
Educ 5	0.808	0.778	0.766	0.850	0.934
Exp	0.0269	0.0233	0.0247	0.0303	0.0305
Exp sq. (x100)	-0.043	-0.039	-0.042	-0.053	-0.051
Av. return to exp in % (20 yrs)	1.83	1.55	1.63	1.97	2.03
Residual, diff. 90/10 percentile	1.49	1.32	1.23	1.32	1.32
Residual, diff. 75/25 percentile	0.69	0.61	0.60	0.64	0.66

Table 3.7: USA, decomposition of wages on education (SD in parentheses)

All Labour Force Education	T=1964	Current T	T=1991
$\sum_{i=1964} \alpha_T.Ed_i$	0.212 (0.21)	0.212 (0.21)	0.235 (0.25)
$\sum_{i=1970} \alpha_T.Ed_i$	0.246 (0.21)	0.228 (0.21)	0.272 (0.26)
$\sum_{i=1977} \alpha_T.Ed_i$	0.291 (0.21)	0.267 (0.21)	0.326 (0.26)
$\sum_{i=1985} \alpha_T.Ed_i$	0.334 (0.20)	0.338 (0.24)	0.379 (0.26)
$\sum_{i=1991} \alpha_T.Ed_i$	0.351 (0.20)	0.400 (0.26)	0.400 (0.26)

Table 3.8: USA, decomposition of wages on experience (SD in parentheses)

All Labour Force Experience	T=1964	Current T	T=1991
$\sum_{i=1964} \alpha_T.Exp_i$	0.480 (0.24)	0.480 (0.24)	0.507 (0.26)
$\sum_{i=1970} \alpha_T.Exp_i$	0.451 (0.25)	0.400 (0.23)	0.478 (0.26)
$\sum_{i=1977} \alpha_T.Exp_i$	0.413 (0.25)	0.435 (0.29)	0.439 (0.26)
$\sum_{i=1985} \alpha_T.Exp_i$	0.414 (0.24)	0.477 (0.29)	0.441 (0.25)
$\sum_{i=1991} \alpha_T.Exp_i$	0.426 (0.23)	0.455 (0.24)	0.455 (0.24)

The evolution of the skill composition of the labour force is represented on the figure 3-5. At constant 1964 price of skills, it appears that the average level of experience decreased strongly in efficiency units until 1977, and then increased slightly but never recovered the initial level. The evolution of education is exactly the opposite: it spectacularly increased over all the period. At current prices, experience levels decreased until 1970 but then the strong rise in the return to experience compensated for it and the efficiency level of experience strongly rose until 1985. Education in contrast, constantly increased at current prices. Finally, taking the price of skills in 1991 instead of the price of skills in 1964, does not change the picture: there is more education and less experience in the labour force.

One take account of the gender discrimination on the return to skills in reestimating the content of the tables 3.7 and 3.8 with various values of λ as defined in (3.4). With a value of $\lambda = 1$, the results can be interpreted in two ways. First, in assuming that 100% of the difference in the return to skills between gender is due to pure discrimination, it provide the proper measure of the efficiency units supplied by the labour in each component education and experience. Second, taking $\lambda = 1$ is equivalent to neutralize the changes in the gender composition of the labour force and to observe the pure effect of the change in the age structure. It can be observed from the table 3.9 that different values of λ have little impact on the measure of education of the labour force: much of the effect of different λ is on the measure of experience of the labour force. Higher values of λ tends to increase the estimated experience (not surprisingly since men have higher return to experience). However, the decline in the level of experience of the labour force still holds, even if its amplitude is reduced with high values of λ. The conclusion of the previous subsection is not affected by the existence of discrimination between gender.

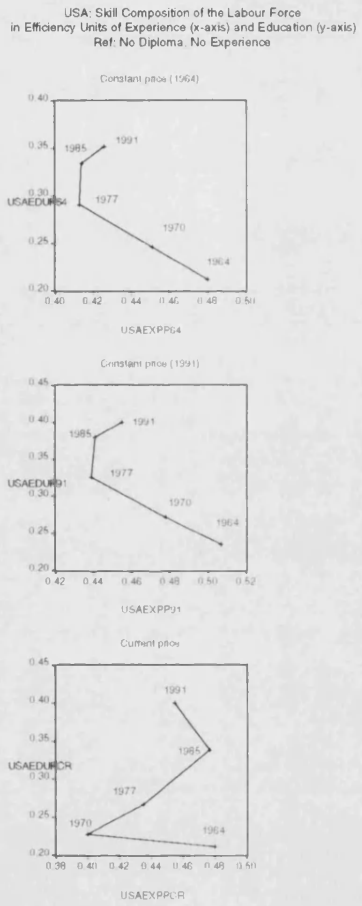

Figure 3-5: USA. Skill Composition of the Labour Force (Education, Experience)

Table 3.9: USA, decomposition of wages on experience and education with gender discrimination (SD in parentheses)

All Labour Force	T=1964				
Education	$\lambda = 0$	$\lambda = 0.25$	$\lambda = 0.5$	$\lambda = 0.75$	$\lambda = 1$
$\sum_{i=1964} \alpha_T.Ed_i$	0.212 (0.21)	0.211 (0.21)	0.209 (0.23)	0.208 (0.21)	0.206 (0.21)
$\sum_{i=1970} \alpha_T.Ed_i$	0.246 (0.21)	0.244 (0.21)	0.242 (0.21)	0.240 (0.21)	0.239 (0.20)
$\sum_{i=1977} \alpha_T.Ed_i$	0.291 (0.21)	0.289 (0.21)	0.287 (0.20)	0.285 (0.20)	0.283 (0.20)
$\sum_{i=1985} \alpha_T.Ed_i$	0.334 (0.20)	0.332 (0.20)	0.329 (0.20)	0.327 (0.20)	0.324 (0.19)
$\sum_{i=1991} \alpha_T.Ed_i$	0.351 (0.20)	0.349 (0.20)	0.346 (0.19)	0.344 (0.19)	0.341 (0.19)

All Labour Force	T=1964				
Experience	$\lambda = 0$	$\lambda = 0.25$	$\lambda = 0.50$	$\lambda = 0.75$	$\lambda = 1$
$\sum_{i=1964} \alpha_T.Exp_i$	0.480 (0.24)	0.506 (0.24)	0.532 (0.23)	0.557 (0.23)	0.583 (0.24)
$\sum_{i=1970} \alpha_T.Exp_i$	0.451 (0.25)	0.478 (0.24)	0.504 (0.24)	0.530 (0.25)	0.557 (0.26)
$\sum_{i=1977} \alpha_T.Exp_i$	0.413 (0.25)	0.439 (0.24)	0.465 (0.25)	0.491 (0.25)	0.517 (0.26)
$\sum_{i=1985} \alpha_T.Exp_i$	0.414 (0.24)	0.442 (0.23)	0.471 (0.23)	0.500 (0.23)	0.529 (0.24)
$\sum_{i=1991} \alpha_T.Exp_i$	0.426 (0.23)	0.457 (0.22)	0.488 (0.22)	0.520 (0.23)	0.551 (0.24)

Finally, I represent in figure 3-6 the decomposition of the supply of skills in three dimensions, education, experience and the interaction term (education times experience)[4]. It appears that the conclusions are not strongly affected. The interaction term is small, the supply of "pure" education increased, the supply of pure experienced decreased until 1977 and then remained stable.

3.3.4 France

The same analysis is applied to France. Since no race variables are available, the specification only includes experience and education. One can notice in tables 3.10 and 3.11 the continuous decline in the coefficients of education, the rise in the return to experience for women and to some extent of men, and the stability in the variance of the residuals except in the last part of the period, after 1985.

Using those coefficients, one can decompose wages in two different components according

[4] On the x-axis, 1,2,3,4 and 5 stand for 1964, 70, 77, 85 and 1991.

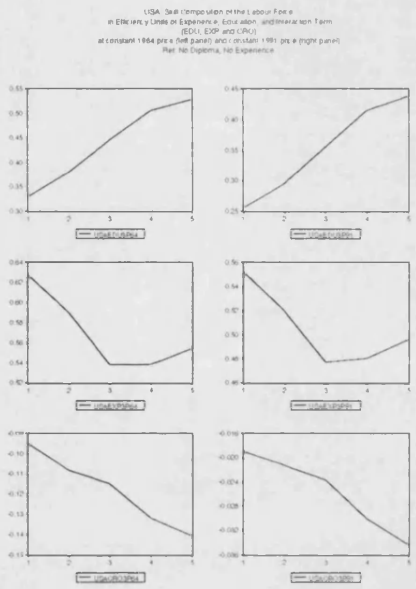

Figure 3-6: USA. Skill Composition of the Labour Force (Education, Experience, Interaction Term)

Table 3.10: France, GLS of ln (hourly wage) of male workers on potential exp. and sq., 4 education dummies

Men	1970	1977	1985	1993
Educ 2	0.323	0.283	0.250	0.173
Educ 3	0.693	0.632	0.562	0.407
Educ 4	1.192	1.044	0.884	0.789
Exp	0.0404	0.0475	0.0425	0.047
Exp sq. (x100)	-0.068	-0.079	-0.065	-0.074
Av. return to exp in % (20 yrs)	2.68	3.17	2.95	3.22
Residual, diff. 90/10 percentile	1.09	0.93	0.90	0.97
Residual, diff. 75/25 percentile	0.54	0.46	0.45	0.48

Table 3.11: France, GLS of ln (hourly wage) of female workers on potential exp. and sq., 4 education dummies

Women	1970	1977	1985	1993
Educ 2	0.306	0.274	0.235	0.176
Educ 3	0.684	0.613	0.502	0.421
Educ 4	0.864	0.817	0.704	0.687
Exp	0.0162	0.0244	0.0279	0.0360
Exp sq. (x100)	-0.033	-0.046	-0.047	-0.062
Av. return to exp in % (20 yrs)	0.96	1.52	1.85	2.36
Residual, diff. 90/10 percentile	1.04	0.86	0.87	0.95
Residual, diff. 75/25 percentile	0.52	0.41	0.41	0.44

Table 3.12: France, decomposition of wages on education (SD in parentheses)

Employed Population Education	T=1970	Current T	T=1993
$\sum_{i=1970} \alpha_T.Ed_i$	0.266 (0.26)	0.266 (0.26)	0.157 (0.17)
$\sum_{i=1977} \alpha_T.Ed_i$	0.324 (0.29)	0.286 (0.26)	0.194 (0.20)
$\sum_{i=1985} \alpha_T.Ed_i$	0.365 (0.31)	0.284 (0.24)	0.225 (0.22)
$\sum_{i=1991} \alpha_T.Ed_i$	0.422 (0.35)	0.270 (0.25)	0.270 (0.25)

to education and experience. In tables 3.12 and 3.13 the results of the decomposition of wages along the two dimensions for all the employed population are displayed. It can be observed that at constant 1970 prices, there is a strong increase in the supply of education and a decrease in the quantity of experience until 1985, which then remains more or less constant. Similar conclusion emerges when one considers the price of skills in 1993 (third columns in the tables). At current prices, the picture is different. The supply of educated workers in efficiency units increases until 1985, and then decreases significantly, from a drop in the return to education. In contrast, the efficiency units of experience constantly increase until 1993, which is mainly due to the increasing return to experience.

The evolution of the skill composition of the labour force is represented in figure 3-7. At constant price, this represents the inverse shift in the composition of the skills of the labour force, more education and less experience.

The division between an experience and an education component in the wage determination is not driving the result: when one estimates a richer specification including linear experience

Table 3.13: France, decomposition of wages on experience (SD in parentheses)

Employed Population Experience	T=1970	Current T	T=1993
$\sum_{i=1970} \alpha_T.Exp_i$	0.342 (0.20)	0.342 (0.20)	0.503 (0.19)
$\sum_{i=1977} \alpha_T.Exp_i$	0.325 (0.20)	0.408 (0.21)	0.483 (0.19)
$\sum_{i=1985} \alpha_T.Exp_i$	0.320 (0.19)	0.424 (0.18)	0.480 (0.18)
$\sum_{i=1993} \alpha_T.Exp_i$	0.320 (0.19)	0.486 (0.19)	0.486 (0.19)

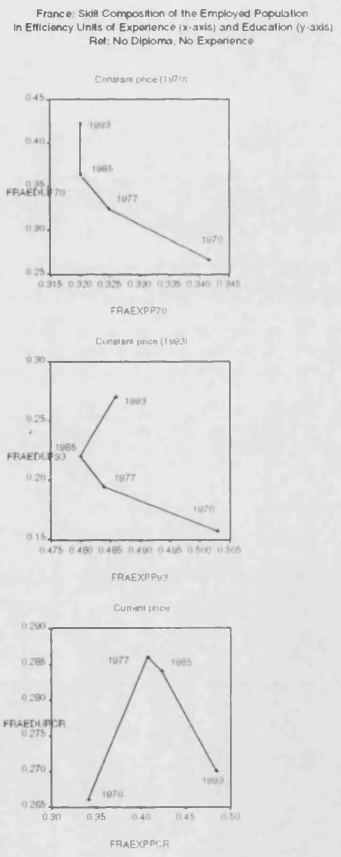

Figure 3-7: France. Skill Composition of the Employed Population (Education, Experience)

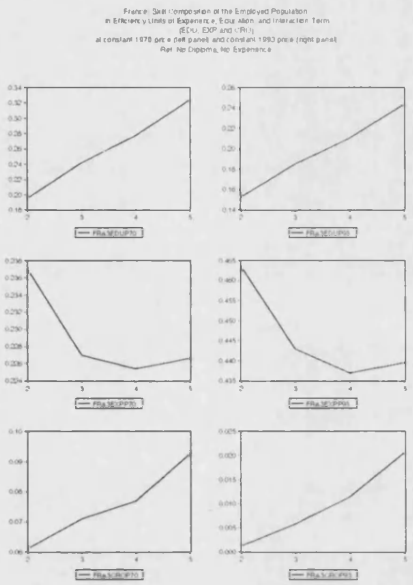

Figure 3-8: France. Skill Composition of the Employed Population (Education, Experience, Interaction Term)

terms by diploma level, like in:

$$w_{iT} = C + \alpha_T.Edu_i + \beta_T.Exp_i + \gamma_T.Edu_i * Exp_i + \epsilon_i$$

the same conclusions holds. The three-dimensional equivalent of figures 3-7, the pattern of evolution of the efficiency units of education, experience and the interaction term is represented on figure 3.8[5]. As in the US case, the interaction term is rather small compared to the others and at constant price, increases over the period. The education term increased and the experience term remained constant after the strong decrease of the 70's.

Finally, I take account of possible discrimination by taking different values of the coefficient λ as in the US case. Again the picture is not affected by the existence of possible discrimination: the quantity of education supplied increased in all the columns of table 3.14, and the quantity of experience supplied decreased between 1970 and 1977 in all cells and then remained more or less constant, except maybe in the extreme case where $\lambda = 1$, where in 1993 the term

[5] On the x-axis, 2,3,4 and 5 stand for 1970, 77, 85 and 1993.

Table 3.14: France, decomposition of wages on experience and education with gender discrimination (SD in parentheses)

Employed Population	T=1970				
Education	$\lambda = 0$	$\lambda = 0.25$	$\lambda = 0.5$	$\lambda = 0.75$	$\lambda = 1$
$\sum_{i=1970} \alpha_T.Ed_i$	0.266 (0.26)	0.268 (0.26)	0.270 (0.27)	0.271 (0.27)	0.273 (0.27)
$\sum_{i=1977} \alpha_T.Ed_i$	0.324 (0.29)	0.326 (0.30)	0.329 (0.30)	0.331 (0.30)	0.333 (0.31)
$\sum_{i=1985} \alpha_T.Ed_i$	0.365 (0.31)	0.368 (0.31)	0.372 (0.32)	0.375 (0.32)	0.379 (0.33)
$\sum_{i=1993} \alpha_T.Ed_i$	0.422 (0.35)	0.426 (0.35)	0.431 (0.37)	0.436 (0.36)	0.440 (0.37)

Employed Population	T=1970				
Experience	$\lambda = 0$	$\lambda = 0.25$	$\lambda = 0.50$	$\lambda = 0.75$	$\lambda = 1$
$\sum_{i=1970} \alpha_T.Exp_i$	0.342 (0.20)	0.370 (0.17)	0.397 (0.15)	0.426 (0.15)	0.454 (0.15)
$\sum_{i=1977} \alpha_T.Exp_i$	0.325 (0.20)	0.354 (0.17)	0.384 (0.16)	0.413 (0.15)	0.442 (0.15)
$\sum_{i=1985} \alpha_T.Exp_i$	0.320 (0.19)	0.351 (0.17)	0.381 (0.15)	0.412 (0.15)	0.443 (0.15)
$\sum_{i=1993} \alpha_T.Exp_i$	0.320 (0.19)	0.353 (0.17)	0.386 (0.15)	0.419 (0.15)	0.452 (0.15)

$\sum_{i=1993} \alpha_T.Exp_i$ recover the 1970 level.

3.4 Implications for the labour demand shift hypothesis

One can first comment on the difference between France and the USA: the experience term $\sum \alpha_T.Exp_i$ is stronger in the US at the price of 1970, but very close at the price of 1993, that for all years: the degree of wage inequality between workers along this dimension (age or experience) is actually quite similar in the two countries. In contrast, the average return to education $\sum \alpha_T.Edu_i$ is stronger in France at the price of 1970, revealing more wage dispersion along the dimension of education than in the US. In 1993 however, the picture is inverted, and France is more egalitarian in terms of education than in the US. I don't really comment any more on this issue, but this is an interesting question deserving more work.

To summarize, the pattern of the return to education and experience and the comparison with the quantity supplied is represented in the figure 3-9[6]. It reveals that 3 of the 4 panels are

[6]The price of education is an average of men and women of: in the US, the college premium with respect to high school, in France the Baccalaureat premium with respect ot CEP/BEP. The price of experience is the return to experience over the 20 first years for men. (1=1964, 2=1970, 3=1977, 4=1985, 5=1991 or 1993)

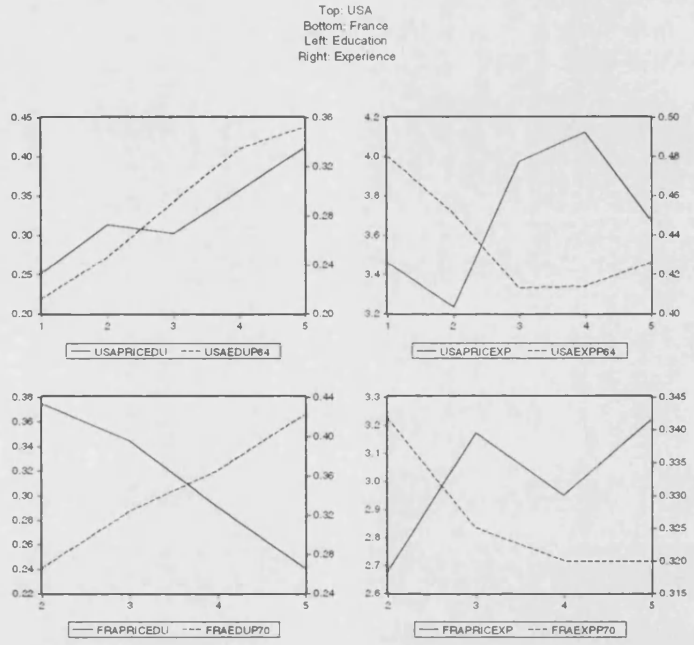

Figure 3-9: Comparison of the price of skills and the efficient quantities supplied, USA and France

consistent with pure labour supply stories. In France, there is a strong decrease in the return to education, while there is a increase in the return to experience. The skills that increased in quantity have had a declining return, whereas the skills that decreased in quantity have had an increasing return. In addition, this chapter provides an explanation for the rising return to experience, by supply factors: the increase in the supply of inexperienced workers.

The next step is to summarize the implications of the paper in the debate over the shift in the relative demand for skills. In the USA, in contrast to France, there seems to be a strong increase in both the quantity of educated workers and of the returns to education, which seems to imply a change in demand for education.

One can push the logic to the extreme and try to see if one can explain the unexplained rising return to education by supply factors. The interpretation of the findings of the previous sections can be summarized as follows: there has been a decline in the quantity of experience supplied by the labour force; this tends to reduce the average skill of the labour force, assuming

education fixed. It follows a relative scarcity of the skills. The price of the skills should increase: the price of experience, but also maybe the price of education, provided that education and experience are substitutes for each other.

Some algebra helps to detail the intuition. Assume a production function of human capital $H = F(E, X)$ where E and X are aggregate human capital linked to education and experience. These quantities X and E are actually the sum over all employed workers of their basic skills linked to their individual experience and education. Assume the $X = \sum h_X(e_i, x_i) = \sum h_X(x_i)$ the last equation implied by an assumption of separability between education and experience in the production of human capital, and similarly $E = \sum h_E(e_i, x_i) = \sum h_E(e_i)$. The return to one unit of experience is $w_X = F_X(X, E)$, whereas the return to one unit of education is $w_E = F_E(X, E)$. For instance, the return to college vs high school workers is $w_E.\frac{h_E(e=16)}{h_E(e=12)}$. Then, differentiating $\log(w_E)$ with respect to the quantities X and E, one gets:

$$\frac{dw_E}{w_E} = \frac{F_{EE}}{F_E}.dE + \frac{F.F_{EX}}{F_E.F_X}\frac{X.F_X}{F}.\frac{dX}{X} \tag{3.5}$$

In (3.5), dE is positive (more educated labour force), F_{EE} is negative (decreasing return to one factor) and dW_E is positive (higher return to education). However, it does not necessarily imply that there is a trend term missing which represents the impact of biased technological progress. It may well be that the elasticity of substitution $\sigma = \frac{F.F_{EX}}{F_E.F_X}$ is negative (the two factors are q-substitutes). Since the supply of experience has decreased, there is at least one part of the right hand side that can be positive. In such a case, this reduces the size of the trend which is involved in Katz and Murphy (implied by the sign of their inner product $\Delta w.\Delta Q$ across cells, but biased upwards if the elasticity σ is negative).

To fix ideas, consider that production associates human capital H and physical (unskilled) labour L, as follows:

$$Y = L^{1-\delta}.H^{\delta} = L^{1-\delta}.(E^{\rho} + X^{\rho})^{\delta/\rho}$$

where ρ is smaller than 1. In this CES specification, we have $\sigma = \delta(\delta - \rho)$. The higher the factor ρ with respect to δ, the more strongly negative is σ. Using the results of tables 3.5 to 3.8, one can estimate how much of the right hand side $\frac{dw_E}{w_E}$ is explained by the decrease in the quantity of experience. As a measure for $\frac{dw_E}{w_E}$, I have taken the difference in the coefficients

Table 3.15: USA, impact of the change in experience on the return to education

Time Period	$\frac{dw_E}{w_E}$	$\frac{dX}{X}(p=64)$	$\frac{dX}{X}(p=91)$	%(with $\rho=1$)	%(with $\rho=-5$)
1964-1977	+0.021	-0.067	-0.068	+53.2	-585.2
1977-1991	+0.093	+0.013	+0.016	−2.0	+25.6
1964-1991	+0.114	-0.055	-0.052	+7.89	-87.0

*dip*4 and *dip*2 (ratio college / high school). As a measure for $X.F_X/F$ (the share of experience in human capital), I have chosen 2/3. For δ, I have chosen 1/2. The results of the calibration are in table 3.15. The last two columns (%) represent the fraction of changes in the return to education explained by the changes in experience.

There are two ways of reading table 3.15 that should satisfy everyone. If one believes that education and experience are strong substitutes, then one can explain a significant part of the rising return to education over all the period (7.9%), mainly because of the first sub-period 1964-77. In the second part of the sample, there has been no decrease in the supply of experience, therefore experience cannot explain the rising return to skills. However, if one believes that experience and education are strong complement ($\rho=-5$), one cannot explain the rising return to education in the first part of the period, but one can explain 25% of it in the second part of the period. This estimates are rather sensitive to the values chosen for ρ, δ and $X.F_X/F$. With $\rho=0.75$ instead of 1, the figures are divided by two, as is the case when $X.F_X/F$ is taken to 1/3.

3.5 Conclusion

In the paper, it is argued that one should explain the evolution of inequality and unemployment in taking account of all the labour supply changes. There has been a superposition of demographic (generational and gender) changes, and of changes in educational levels in all OECD labour markets.

Both for France and for the US, it was shown that the supply shocks are the sum of two changes: more young/women i.e. more inexperienced workers, and more educated workers. Wages and labour supply data are considered together. The compositional changes of the labour force are associated with ambiguous effects on workers productivity: before 1985 in France and before the early 80's in the US, there has been a strong increase in the labour supply of low wage

groups, as important as the increase in labour supply in high wage groups. In efficiency units, the experience level has increased and the education level has overall increased, at constant skill prices.

This paper is a basis for a new investigation about the demand shift hypothesis. If there is substitutability between education and experience, one may overestimate the size of the rising demand for educated workers in the US between 1964 and 1977: if the labour force is less skilled because less experienced, rising prices of these skill, i.e. education and experience. In contrast, if there is a strong complementarity between education and experience, one may overestimate the rising demand for education over the period 1977-91. In all cases, the share explained by changes in the supply of experience are big, because the relative changes in the quantity of experience supplied are very important, especially in the US.

3.6 Appendix: Description of the datasets

3.6.1 US CPS: 1964-1991

Data

I use the March Current Population Survey provided by the NBER on the subset of the 16-75 aged population. The sample weights used are the family weights ($famwgt$). The five education groups correspond to: less than 12, 12, 13-14, 15-16 and more than 17 years of schooling. As usual, experience is actually measured as potential experience Max (age-education-5, 0). The variable $zeduc$ denotes the number of years of schooling, and was build from the variables $grdhi$ (highest grade attended) and $grdcom$ (Did ... finished this grade?). The weekly wage is given by the variable $zwklywg$ (average weekly earnings last year). It is defined as $incwage/zwkslyr$ where $incwage$ measures the income from wage and salary and $zwkslyr$ measures the imputed usual weeks worked last year. The variable $zwkslyr$ is imputed on the basis of the variable $wkslyr$ whose modalities are 0, 1-13, 14-26, 27-39 and more than 39 before 1976 and continuous after 1976). The employment status is given by the variable $zesr$ which is a recode of the variables esr and $zwkslyr$ (weekly wage) over the 1964-94 period, whose modalities are: Not in the universe, employed working, employed not working, unemployed and not in the labour force. The variable $ftpt$ describes the full-time full-year status (more than 50 weeks last year, usually more than 35 hours per week) i.e. four occurences plus a non-worker and an invalid status. The

variable *hours* gives the hours worked last week and the variables *hrs35* and *hrs35b* indicate whether or not the interviewed worked usually more are less than 35 hours last week. The hours worked per week last year are measured by *hrslyr*, but are available since 1976 only.

Hourly wage

I describe the chosen definition of the hourly wages: after 1976, I define $lhw = log(zwkslyr/hrslyr)$. Before 1976, information is only available on full-time / part-time, and the hours worked last week (bracketed, modalities 1-4, 5-14, 15-29 and 30-34). Before 1977, when the number of hours worked last week is consistent with the part-time / full-time status, the imputed number of hours is the number of hours worked last week. When it is not, we give the conditional mean of hours worked in average given the part-time full-time status (45 hours for a full-time, 20 hours for a part-time). Further work is needed to improve the imputation method.

Top-coding

As well known, the variable *incwage* is top-coded at \$99999 between 1964 and 1967, at \$50000 between 1968 and 1981, at \$75000 between 1982 and 1984, at \$99999 between 1985 and 1988 and at \$199998 between 1988B and 1994. The following table shows the number of top-coded individuals year by year in our sample.

	1964	1970	1977	1985	1991
Occurrence	0	46	293	247	0

The usual method is to impute the average value of those with income larger than the top-code value assuming an exponential distribution of the log of earnings. This is equivalent to multiplying the top-coded earnings by a coefficient estimated from a year in which earnings are almost not top-coded. This value is 1.45 (see Buchinsky 1994 for instance).

Table 3.16: USA, sample statistics (source CPS)

Summary Statistics

	1964	1970	1977	1985	1991
# All Labor Force 16-75	29 321	58 131	70 531	77 157	77 114
Educ 1	0.451	0.368	0.272	0.190	0.157
Educ 2	0.335	0.378	0.394	0.402	0.393
Educ 3	0.084	0.106	0.137	0.163	0.178
Educ 4	0.086	0.097	0.126	0.157	0.177
Educ 5	0.043	0.050	0.069	0.089	0.096
Exp	24.4	22.8	20.0	19.3	19.9
(SD Exp)	(14.9)	(15.2)	(14.8)	(13.6)	(12.9)
Sex (Men 0, Women 1)	0.35	0.39	0.42	0.45	0.46
Black	0.100	0.098	0.097	0.102	0.104
Other Non-White	0.009	0.010	0.016	0.028	0.034
Self Employed	0.117	0.085	0.076	0.080	0.110
# Labor Force Except Self Employed	25 823	53 126	64 805	70 644	68 501
Full-Time	0.791	0.817	0.784	0.779	0.795
Hourly Wage	2.38	3.30	5.16	8.90	11.3
(SD Hourly Wage)	(2.44)	(2.70)	(5.51)	(8.07)	(10.5)

3.6.2 French surveys Formation et Qualifications Professionelles: 1970, 1977, 1985, 1993

The data were provided by INSEE and by Dominique Goux. A very important work by Goux and Maurin was undertaken to match the definitions of the sample for different years. I report here the description of the data, as it appear in Goux and Maurin (1996): the survey is conducted on a sample of about 45000 individuals aged 20-65 until 1985, and 18000 in 1993. Diploma are pooled into 5 groups: No diploma, Vocational degree (CEP, CAP, BEP), Baccalaureat, DEUG and Maîtrise or more, which in order represent: 0 year of schooling, 5 to 8 years of schooling, 12 years of schooling, 14 and more than 15 years of schooling. The last two groups were pooled together given the small size of the sub-samples (experience sex). Workers declare their earnings in the year preceding the survey, the number of months of activity, and the part-time / full-time status. It is only in 1993 that the number of hours worked is available, before the part-time are treated as half-time workers in the construction of the hourly wage

Table 3.17: France, sample statisitcs (source INSEE-FQP)

data. Experience is built as the difference between current age and age at the end of schooling.

	1970	1977	1985	1993
# All Labor Force 20-64	30 645	31 815	31 361	13 517
Educ 1	0.350	0.274	0.233	0.203
Educ 2	0.548	0.570	0.564	0.500
Educ 3	0.062	0.089	0.095	0.131
Educ 4	0.018	0.024	0.055	0.083
Educ 5	0.023	0.044	0.053	0.082
Exp	23.7	22.0	20.9	20.8
(SD Exp)	(15.0)	(14.3)	(13.2)	(11.8)
Sex (Men 0, Women 1)	0.384	0.409	0.440	0.451
Yearly Wage Equivalent	63 566	84 489	89 811	104 251
(SD)	(47 559)	(59 257)	(54 368)	(78 462)

Chapter 4

Labour Supply Dynamics, Unemployment and Education

Abstract: This chapter examines the dynamics of effects of labour supply trends on: the skill composition of the labour force, its wage inequality and on the level of unemployment. Labour supply trends of low experience workers easily account for stylized facts that are usually explained by a shift in the labour demand for skilled workers. Periods of higher labour supply growth generate more unemployment among young and high turnover workers, who do not accumulate enough human capital. This reduces the supply of skilled workers and thus the demand for the unskilled workers if the unskilled are complement to the skilled. This is an intertemporal multiplication of the supply shocks. Empirical evidence using a French survey in which workers declare their true employment experience is used to justify the relevance of the model, especially the trend of more inexperienced workers.

4.1 Introduction

Economists concerned by the rise in European unemployment have paid little attention to the rise in active population. One reason of this lack of interest is that in representative agent models, relations between labour supply and unemployment cannot persist in the long run, since capital stock will endogenously increase, and so the productivity of labour. This is the view expressed in Malinvaud (1986) or Nickell (1991) for instance. In some models however, the

size of labour force can affect equilibrium unemployment, through a composition effect. Such is the case in Pissarides (1990), where labour force growth, by increasing the share of young workers in the sense of new entrants from inactivity to unemployment, affects equilibrium unemployment.

This kind of composition effect of the labour force will be the line of attack of this paper. One of the most substantive change in the OECD labour markets since the 1960's, is that labour force has increased with the massive arrival of women and with bigger cohorts of young workers. There is no reason to believe that this has been neutral. In chapter 3, it was shown that for instance workers in these two categories have fewer (efficiency) units of employment experience: the labour supply changes can not be thought of without implying some kind of heterogeneity. This paper aims to explore the dynamics aspects of heterogeneous increase in labour supply.

Section 2 introduces the notations of a model of labour markets with endogenous participation, unemployment and human capital simultaneously introduced. The key assumption is that skilled workers are either experienced or educated ones, or in other words, that the unskilled workers are those without experience or education. Section 3 shows that, when the only source of accumulation of human capital is experience, the labour market variables are very unstable: through an intertemporal transmission of the shocks by the skill composition of the labour force, higher unemployment today leads to lower quantity of skilled workers the next period and therefore reduces the demand for the unskilled[1]. It follows that labour supply trends of more low experience workers result in generational crowding which in a world without education can cause many adverse effects: rise in inequality, unemployment and hysteresis. Endogenous participation plays a stabilizing role: when unemployment is too high, the unskilled leave the labour force. Multiple equilibria are possible: a low unemployment and high participation coexisting with a high unemployment and low participation one. Section 4 shows that multiple equilibria vanish when workers have the possibility of acquiring human capital through education. Education is modelled as the result of an arbitrage between working young

[1] This is not the first work where this kind of intertemporal transmission of the shocks of the labour market is present; Pissarides (1992) and Ortega (1993) are two examples in a job matching framework. However, this paper puts the emphasis on labour supply trends as initiator of the amplification of the shocks. It also goes deeper into the analysis of the composition of the supply of skills.

or delaying the entrance into the labour market to get a higher wage rate in the future. In the logic of the model, increased education levels of workers is the consequence of adverse labour supply trends, not of increased demand for education. This prediction of the model is investigated using French data (Formation and Qualification Professionelle) in section 5. The fact that labour supply changes are changes of more inexperienced workers, is also documented in section 5 using French data from Enquête Actifs Financiers 1992, where information on real experience is available. Both types of evidence support the model.

4.2 Notations

4.2.1 Production technology

I assume that there are only two broad types of occupations in the economy: the first one that can be filled by everyone and the second one that cannot be filled by unskilled. In this latter category, skills like education (in profession like engineers) and/or experience (in managerial occupations) are necessary. The technology associates the skilled and the unskilled. The efficiency units of employment of skilled workers (with experience or education) are denoted by N_t^S, and the efficiency units of employment of the unskilled workers by N_t^U. The production of the representative firm[2] will be: $Y = F(\tau.N_t^S, N_t^U)$, where τ is a technology parameter which represents biased technological progress, which is often involved in the explanation for the rise in inequality in the US (Juhn, Murphy and Pierce 1993, Katz and Murphy 1992). Some degree of imperfect substitutability between experience and education will be introduced[3]. Capital is ruled out: at fixed interest rate, the above production function is the long-run reduced form of a more general technology with three factors, capital, skilled and unskilled labour, as illustrated in appendix.

[2] A similar production function with dynamics of skill accumulation was introduced by J. Ortega (1993) in a search / matching framework. I thank G. Saint-Paul for signalling it to me. Ortega's model has multiple equilibria like here. The focus of the model (persistence of unemployment shocks like in Pissarides 1992), is different from here, where we are interested in the consequences of labour supply shocks on unemployment.

[3] Experience can be an imperfect substitute for education for informational reasons: there is a series of papers by Jovanovic and Nyarko (1994) who study the properties of learning through experience. Basically, experience is a signal extraction on some unknown parameter, upon which a decision has to be made.

4.2.2 Workers

Cohorts of size P_t of agents enter the labour market at time t. The growth rate of the cohorts is n_t. The agents live two periods. Consistently with F. Welch (1979), who developed a model with workers of different age complements in the production, the workers here can move from the low to the high occupation. For that, they have to accumulate human capital. There are two ways to get enough human capital to access to the skilled occupation. The first one, classically, is to spend the first period of one's life in education and work only the second period. The second one is through employment experience in first period.

With these assumptions, workers in the second period of their life can be in four different situations. They can be 1. experienced, or 2. educated. They also can be 3. inexperienced and uneducated. Finally, they can be 4. out of the labour force. The skilled are in category 1 and 2, the unskilled in category 3. I will denote by Ed the educated workers, Ex the experienced ones, I the old unskilled (inexperienced uneducated), and Y the young workers. Notice that with these simplistic assumptions, one avoids to have a fifth category of workers, the educated and experienced workers, the existence of which would somewhat obscure the intuition of the model about the changes in the demand for the different skills in introducing an interaction term between education and experience.

The experienced and educated workers will be allowed to have some degree of imperfect substitutability, detailed in section 4. In contrast and to keep the model simple, the young workers and the old unskilled are perfect substitutes in the production, $N_t^U = N_t^Y + N_t^I$. This means that, whatever the reason for not having accumulated experience (unemployment or inactivity or age), the workers are not discriminated nor they have suffered any human capital loss. This is an important difference with previous works assuming that unemployment duration has a specific adverse impact on workers, as in Pissarides (1992) or Layard et al. (1991).

4.2.3 Experience

The human capital necessary to access the skilled occupation through work experience, requires to work. Assume for instance that each period is subdivided into p smaller subperiods, in which a lottery is done each time to attribute the jobs. The experience level to access to the skilled jobs

could be $q < p$ successive spells of employment[4]. Then, if e_t is the average employment rate for the young workers, the fraction of young that access to skilled jobs is a function $\Phi(e_t, p, q)$, with $\Phi_1 > 0$, $\Phi_2 > 0$ and $\Phi_3 < 0$. Without loss of generality, it will be assumed that $\Phi(e_t, p, q) = e_t$.

It follows that periods of unemployment can prevent ex-ante homogenous workers from accessing to the high occupations, therefore that the aggregate outcome at period t depends strongly on past outcomes. In some cases, there is an *intertemporal multiplier* effect of the shocks affecting the skill level of the population and leading to multiplicity of equilibria. This key point requires only agents living two periods. More realism could be introduced in modelling more than two periods, at the cost of additional complexity and without qualitative changes.

4.2.4 Unemployment

The wage of the unskilled is not perfectly flexible, because of some downwards rigidity. These can be linked to the reservation wage of the workers, which depends on an arbitrage between work and non-work. The wage rigidity can also be linked to the existence of a wage setting curve linking wages and unemployment, like in the efficiency wage model of Shapiro and Stiglitz (1984), to the existence of a Nash-Bargaining linked to search frictions (Mortensen 1982), the existence of unions setting wages given the labour demand curve of the firms, or risk-averse workers buying an insurance to risk-neutral firms. These rigidities are modelled in two different ways, to show that the results of the model don't depend on the choice of wage determination. In the first way, the wage of the unskilled is decreasing in unemployment, like in the wage curve models. This is represented by a double log functional form, of the type:

$$\log(w_t^U) = b - \phi.\log(1 - e_t) \tag{4.1}$$

where e_t is the employment rate of the unskilled. In the second way, as in Saint-Paul (1995), there is a maximum dispersion of wage, and the ratio of the lowest to the average wage is a constant: this is a stronger type of wage rigidity. In this model with two types of workers, this is equivalent to having a socio-political constant γ , i.e. an indexation rate, such that $w_U \geq \gamma.w_S$.

[4] See Pissarides (1994) for a model in which, coming from unemployment, workers start in bad jobs and access to good jobs only from employment.

A nice feature of this assumption is that, when the equality is satisfied, the wage distribution is constant, as this is more or less the case in Europe.

Unemployment only affects unskilled: wages of the skilled are perfectly flexible and it is assumed that the demand for the skilled is high enough for their wage being always higher than the wage of the unskilled, such that they do not supply their labour force in the unskilled segment.

4.2.5 Endogenous participation

Participation is modelled as a static extension of the neo-classical model of labour supply to unemployment. In first period of their life, young workers not enrolled in education all participate: empirically, participation rates of female workers not enrolled in education are higher at lower age and then decline with age. Some heterogeneity in the work force is introduced, which allows to endogeneise the participation rate in second period. Assume that workers face a shock on utility of leisure in the beginning of the second period. This leads to a distribution of reservation wages w^r in the population, with cumulative density function $F(.)$. This reservation wage is a pecuniary equivalent of utility when inactive. In second period, those with lower than *expected equilibrium wage* will participate. This means that the participation decision is made at the beginning of the period, and is irreversible. The participation rate of the unskilled in second period is thus $\rho^I = F(e_t.w_t^I)$[5] and the participation rate of the skilled is $\rho^S = F(w_t^S) > \rho^I$.

4.3 Model Without Education

The model without education is a useful benchmark, where a lot of instability arises. The only skilled workers are the experienced ones, whose labour supply is $L_t^S = L_t^{Ex}$, and the unskilled are the young workers and the old inexperienced workers, whose labour supply is $L_t^U = L_t^Y + L_t^I$.

[5] This way of modelling the effect of unemployment on particiaption is a very static one. A more dynamic formulation offers more realism at the cost of more complexity. See for instance Burdett and al. (1984).

4.3.1 Labour supply

The time structure of the model will provide the following dynamic labour supply equations:

$$L_t^Y = P_t \tag{4.2}$$

$$L_t^{Ex} = L_{t-1}^Y . e_{t-1} . \rho_t^{Ex} \tag{4.3}$$

where ρ_t^{Ex} is the participation rate of the experienced workers, and e_t is the employment rate of the unskilled workers, which is common to both young and old unskilled. Finally,

$$L_t^I = L_{t-1}^Y . (1 - e_{t-1}) . \rho_t^I \tag{4.4}$$

where ρ_t^I is the participation rate of the old unskilled workers. Replacing the participation rates with the neo-classical labour supply defined previously, the ratio of skilled to unskilled workers in the labour force is:

$$\frac{L_t^{Ex}}{L_t^Y + L_t^I} = \frac{e_{t-1} . F(w_t^S)}{(1 + n_t) + (1 - e_{t-1}) . F(e_t . w^I)} \tag{4.5}$$

and the ratio of skilled to unskilled workers in employment is simply $\frac{1}{e_t} . \frac{L_t^{Ex}}{L_t^Y + L_t^I}$.

4.3.2 The perfectly flexible economy

In this case, wages are equal to the marginal productivity of labour at full-employment, $e_t = 1$ for all t.

Proposition 1. *In a flexible economy, higher participation (a shift in the function F to the right) reduces inequality, larger cohort size increase it. Increased demand for skilled workers also increases inequality*[6].

Proof.

If wages are flexible, then the maximization of profit for the representative firm leads to equalize the marginal revenue of each type of labour to wages. This first order condition plus

[6] On this last point, the proof is made in the Cobb-Douglas case only, but the property is certainly more general.

the constant return to scale property of technology imply the existence of a function $g(.)$ linking the ratio of wages to the ratio of employment, such that $1/\tau.\frac{w_t^S}{w_t^U} = g(\frac{L_t^Y+L_t^I}{\tau.L_t^{Ex}})$ where $g' > 0$, and where τ is the relative demand for skilled in the technology. Similarly, $w_t^S/\tau = h(\frac{L_t^Y+L_t^I}{\tau.L_t^{Ex}})$, where $h(.)$ has the same property as $g(.)$. Therefore, $w_t^S = \tau.h[g^{-1}(1/\tau.\frac{w_t^S}{w_t^U})]$. Then, using (4.5) with $e_t = 1$, we have:

$$\frac{w_t^S}{w_t^U} = \tau.g\left(\frac{1+n_t}{\tau.F\{\tau.h[g^{-1}(1/\tau.\frac{w_t^S}{w_t^U})]\}}\right) \tag{4.6}$$

The second term of (4.6) is a decreasing function of the ratio $\frac{w_t^S}{w_t^U}$. Therefore, there is one and only one ratio of wages, given by the fixed point. The left hand side of (4.6) defines a curve denoted by (MPL) of the ratio of marginal product of labour of skilled to unskilled, represented on figure (4-1). This ratio is decreasing in $\frac{w_t^S}{w_t^U}$: with higher wages, more skilled workers supply their labour force, which reduces the ratio of marginal products. When this curve is higher, the equilibrium ratio $\frac{w_t^S}{w_t^U}$ is higher. Without ambiguity, the (MPL) curve is shifted upwards when n_t is increased. Higher participation of the skilled (higher F) shifts the curve upwards. The effect of τ is ambiguous. In the case of a Cobb-Douglas production function, $g(x) = x$ and $h(x) = x^{1-\alpha}$ where α is the share of efficient skilled labour. Then, equation (4.6) becomes $\frac{w_t^S}{w_t^U} = \frac{1+n_t}{F\{\tau^\alpha.(\frac{w_t^S}{w_t^U})^{1-\alpha}\}}$ and without ambiguity a higher τ shifts the (MPL) curve to the right, increasing the equilibrium ratio $\frac{w_t^S}{w_t^U}$. ■

Remark. Higher participation *per se* is not bad. However, if higher participation means more young workers, it can generate wage inequality between old and young. Similarly, if more participation means more high turnover workers, i.e. old workers leaving the labour force in second period (represented by higher n_t and a lower F), then the adverse effects (more young and less skilled) are added up.

4.3.3 A perfectly rigid economy

When there is wage rigidity, a lot of instability can arise. Shocks on employment of unskilled in period t can be amplified next period, since some workers will be prevented from acquiring enough skill in period $t+1$. Given the complementarity, the demand for the unskilled workers will be even lower, and so on.

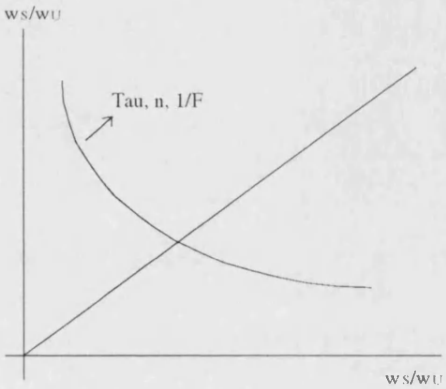

Figure 4-1: Equilibrium of the ratio of marginal productivities of skilled and unskilled workers

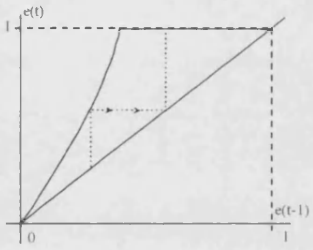

Figure 4-2: Dynamics of employment, rigid economy with high demand for the unskilled

Proposition 2. *In an economy with relative wage rigidity, the dynamics of employment is represented by one of the 5 possible cases, displayed in the figures 4-2 to 4-6. In the first one, there is one stable equilibrium,* $e_t = 1$. *In the second, there is one unstable equilibrium* $0 < e_t < 1$ *and two stable,* $e_t = 1$, *and* $e_t = 0$. *The third one has only* $e_t = 0$ *as stable equilibrium. The fourth one will have one stable equilibrium* $0 < e_t < 1$ *and* $e_t = 0$ *as unstable equilibrium. The fifth one has two equilibria between* 0 *and* 1, *the higher stable, the lower unstable, while* 0 *is also stable equilibrium.*

To prove proposition 2, consider the following lemmas.

Lemma 1. *If participation is constant,* $F = 1$, *then only the first three cases in figures 4-2 to 4-4 are possible.*

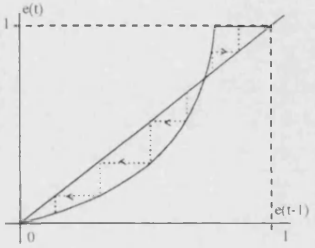

Figure 4-3: Dynamics of employment, rigid economy with intermediate demand for the unskilled

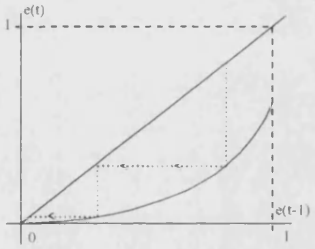

Figure 4-4: Dynamics of employment, rigid economy with low demand for the unskilled

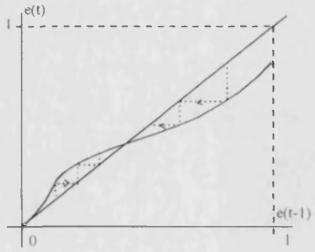

Figure 4-5: Dynamics of employment, rigid economy with endogenous participation and high demand for the unskilled

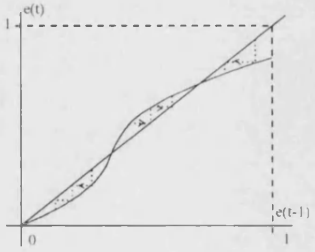

Figure 4-6: Dynamics of employment, rigid economy with endogenous participation and low demand for the unskilled

Proof. Assume that $\frac{w^U}{w^S} = \gamma$: the constraint on wages is binding. Then, equation (4.5) gives:

$$e_t = \frac{e_{t-1}F(w_t^S)}{(1+n_t)+(1-e_{t-1}).F(e_t.w_t^U)}.A_{T,\gamma} \tag{4.7}$$

where $A_{T,\gamma}$ is a constant depending only on the technology (relative demand for the skilled and elasticity of substitution). In a CES case, $A_{T,\gamma} = (\tau\gamma)^{-\sigma}$, and so decreasing in the relative demand for skills, and also in the indexation rate. With $F = 1$, equation (4.7) defines an increasing convex function $e_t(e_{t-1})$ such that $e_t(0) = 0$ and so the three possible situations of figures 4-2 to 4-4. The upper limit for e_t is 1, in which case the wage constraint in no longer binding. ■

The first three cases define situations in which the usual equilibrium mechanisms, flexibility of wages or endogeneity of participation are absent. This is why the second or the third case happen, if the demand for low skilled workers is sufficiently low: unemployment last period leads to less qualified workers next period and so less demand for the unskilled given the complementarity between skilled and unskilled and so on. This intertemporal multiplier effect of unemployment generates path dependence and hysteresis through the skill level of the active population. What happens when there is enough flexibility of participation?

Lemma 2. *The function $e_t(e_{t-1})$ is still increasing, but can be concave. The curve mapping the function is above the curve at full participation ($F = 1$) for low e_{t-1} and below for high e_{t-1}.*

Proof. First, notice that wages are independent of time: they depend on relative employment,

itself depending on the relative wage by the inverse relative demand, and so depending only on γ. Denote e_t by y, and e_{t-1} by x, and the derivatives of y with respect to x by y', y" etc...Then, $y'[(1+n)+(1-x)F(y.w^U)+(1-x).y.w^U f(y.w^U)] = F(w^S)+y.F(y.w^U)$ and clearly $y' > 0$. Then, denoting $A = (1+n)+(1-x)F(y.w^U)+(1-x).y.w^U f(y.w^U)$, this gives:

$$A.y" = y'.[2.F(y.w^U)+2.w^U.y.f(y.w^U)-2(1-x).w^U.y'.f(y.w^U)-(1-x).(w^U)^2.y.f'] \quad (4.8)$$

A necessary and sufficient condition for the concavity of the curve $e_t(e_{t-1})$ is $y" < 0$. Since $A > 0$, it is sufficient to have a high enough f or f' for having a negative y" in (4.8). The economic interpretation of high f or f' at some point x_0 is that participation is very elastic to expected wage around this point. Then, many workers will quickly leave the labour force if the expected wage decreases too much, which will increase their marginal product given the concavity of the production function. This drives the concavity of the dynamic equation (4.7), that insures that 0 is not the only stable equilibrium in figures 4-5 and 4-6. On the second part of the lemma, it is sufficient to write the sign of $\{y_{F=1}-y\}$ to get $(1+n).x.(1-F(w^S))-x(1-x).[F(w^E)-F(x.w^U)]$ which is positive for low x and negative for x close to 1. ■

This completes the proof of Proposition 2.

4.3.4 Intermediate flexibility: the wage curve

Proposition 3. *The dynamics of employment is represented on figure (4-7). There are multiple steady-state equilibria. The stability of the low one is insured by flexibility of participation. The stability of the high one is insured by the wage pressure.*

Proof. Using (4.1) into (4.5) and a marginal product for unskilled labour condition, we have a dynamic function of the type:

$$e_t.e^{-\phi'(1-e_t)} = \frac{e_{t-1}F(w_t^S)}{(1+n_t)+(1-e_{t-1}).F(e_t.w_t^U)}.A_{T,\gamma} \quad (4.9)$$

In the case with constant participation and perfect wage rigidity, the curve would be strictly increasing from 0 to 1 from proposition 2. Around $e_t = 1$, low unemployment rates lead to wage pressures, that take an extreme form since wages goes to infinity when e_t goes to 1. This means that the curve $e_t(e_{t-1})$ has a second concavity area around 1. This is represented in figure 4-7.

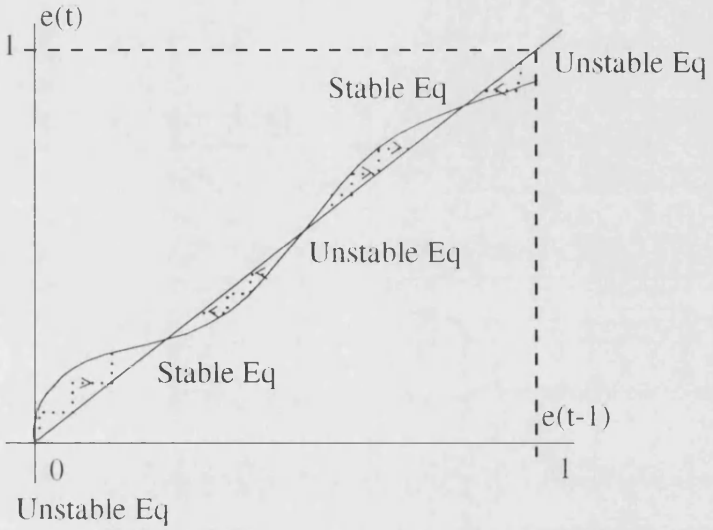

Figure 4-7: Dynamics of employment, wage curve with endogenous participation

The first concavity of the curve was demonstrated in the last sub-section and arises from the feed-back implied by low participation at low wage. The second concavity at high employment comes from wage pressure. This implies that there are now two interior stable equilibria, the two extreme intersections with the 45 degree line. The intersection between those two equilibria is an unstable equilibrium, as is 0 and 1. ■

Proposition 4. *A temporary shock on n_t can lead to a permanent change of equilibrium. Static adverse effects like a lower equilibrium employment or lower participation are driven by: larger cohorts, higher demand for skills, larger indexation rate, excess in the participation of the unskilled with respect to the skilled. Dynamic adverse effects (the existence of and the switch to a low employment equilibrium) are driven by the irreversibility of skill loss because of unemployment, and are reinforced by the same four factors.*

Proof. All comes from the fact that n_t, τ, γ and an increase in $F(e_t.w_t^U)$ relative to $F(w_t^S)$ tends to lower the curve linking e_t and e_{t-1}. ■

Among these results, there are two that deserve further comments.

- Participation and unemployment rates are negatively linked, because participation deci-

sions are endogenous. High unemployment levels may slowdown participation growth, as it is likely the case in countries with high female unemployment. This result is very close from what appears in chapter 2: cross-country regressions of unemployment on participation show a clear endogeneity of participation. Once participation is instrumented, a negative correlation can be found between unemployment and participation.

- Active population growth, equal to the growth rate of the cohorts in a steady growth, is positively correlated with unemployment, as also appeared in chapter 2.

4.3.5 Conclusions

In this section, the dynamic multiplier effect of shocks, on the average skill of active population has been highlighted. It has been shown that the key mechanism, the persistence and amplification of unemployment, is not dependent on any particular wage setting mechanism, and that different wage setting institutions produce the same dynamics. In this model, contrary to most of the theoretical constructions, increased labour force can have adverse effects, not only in the short run but also in the long run. *This is basically because, if there is an excess of low skill labour supply, the young are prevented from accumulating experience and this can be amplified next period.* Competition between demographic groups, as argued in chapter 2, can reinforce the phenomenon, if there are other demographic groups substitutes with the young workers. Here the adverse effects clearly have a dynamic nature.

4.4 Education

The debate on unemployment and inequality has focused on the demand and supply of education, therefore this section is extended to education. In Becker's theory of human capital, education is an investment according to an arbitrage between the cost of education (postponed activity, direct cost of education) and the benefits, mainly higher productivity and wages. There are other positive private returns to education: unemployment probabilities or duration are lower for educated workers. In the European case, it is very likely that the fear of unemployment is a strong incentive for young workers to acquire education, given the strong differentials of unemployment between skill categories. A similar argument was given in Saint-Paul (1993).

The supply of education will be the answer to disequilibrium situations: when wage inequality or unemployment will rise, the incentive for the young workers to differ their entrance on the labour market will increase. Agents can, either go to university and work only the second period of their life, directly as skilled worker, or choose to work in their first period as unskilled and if lucky enough to acquire enough job experience, work as skilled in second period. For simplicity, it is assumed that education is a binary choice: there are only two levels of education, 0 and 1. Participation to the labour market is now assumed for all workers in second period. The young workers only arbitrate between education and activity. The expected life-time income of those with education is then:

$$I_t(ed = 1) = 0 + \beta.w_{t+1}^{Ed} \tag{4.10}$$

with β a discount factor, and the expected life-time income of those without education is:

$$I_t(ed = 0) = e_t.w_{t+1}^{I} + \beta[e_t.w_{t+1}^{Ex} + (1 - e_t).e_{t+1}w_{t+1}^{I}] \tag{4.11}$$

Denote by s_t the share of a cohort that get educated. The dynamic labour supply equations are now:

$$L_t^{Ex} = P_{t-1}.e_{t-1}.(1 - s_{t-1}) \tag{4.12}$$

$$L_t^{Ed} = s_{t-1}.P_{t-1}$$

$$L_t^{U} = (1 - s_t).P_t + P_{t-1}.(1 - e_{t-1})(1 - s_{t-1}) \tag{4.13}$$

In (4.13), the unskilled are those without education nor experience.

4.4.1 Supply of education in steady-state equilibria

I solve the model in a steady-state, numerical simulations are offered out of steady-state in appendix. There are three possible steady-state equilibria. The first equilibrium is such that $I_t(1) < I_t(0)$: there are no educated workers in this economy: $s_t = 0$. The second equilibrium is such that $I_t(1) = I_t(0)$: there is a fraction $0 < s_t < 1$ of workers that is educated, this fraction being determined by the condition above. The third equilibrium is such that $I_t(1) > I_t(0)$:

there are only educated workers in this economy: $s_t = 1$. The selection of the equilibrium depends both on the labour market conditions and on complementarity between skill groups.

Proposition 5. *In the flexible economy, if skilled and unskilled are complement, then equilibrium 3 (without unskilled) is impossible. In both the rigid and the flexible economies, if experienced and educated are complement, the equilibrium 1 (without educated workers) is impossible.*

Proof. The complementarity insures an Inada condition, which makes that in all cases, if one factor of production is not supplied, there is an infinite demand for it, such that an equilibrium without this factor is not possible. ■

Here the question is how the level of education endogenously evolves in response to the different shocks on technology and population growth. In order to have an interior solution such that $I_t(1) = I_t(0)$, it will be assumed that the three inputs (unskilled, experienced and educated workers) are complement in the production. In what follows, I consider only the steady-state equilibrium. Assume the condition for the interior solution $I(1) = I(0)$. This is a free-entry condition into education, or a supply curve of education:

$$\beta.(w^{Ed} - e.w^{Ex}) = e.w^{U}[1 + \beta(1 - e)] \tag{4.14}$$

A more flexible representation of supply of education is represented in appendix, when lags are introduced in the response of workers to changes in the returns to education.

4.4.2 Demand for Education

It appears that the degree of substitutability between education and experience is not especially relevant as long as the Inada conditions described in the previous proposition are satisfied. Then, I have chosen the following Cobb-Douglas production function, which simplifies the equations:

$$Y = (N_t^U)^{1-\alpha-\delta}(N_t^{Ed})^{\alpha}(N_t^{Ex})^{\delta}$$

where α is thought as a demand shift parameter on education, and δ as a demand shift parameter on experience. Marginal product of labour conditions will provide the equation of demand for education.

4.4.3 The rigid economy

Assume as before a relative wage rigidity, of the type: $\frac{w^{Ed}}{w^U} = \frac{1}{\gamma}$. It can be rewritten as:

$$\frac{1-\alpha-\delta}{\alpha}\frac{s}{1-s} = \gamma.e.[(1+n)+(1-e)] \tag{4.15}$$

This equation states that the ratio of the marginal product of the skilled to the unskilled must be equal to the indexation rate. It can be interpreted as a demand for education condition: the higher the level of education, the lower their relative productivity with respect to the unskilled and so the higher the demand for them, so the higher their employment. Replacing the wage constraint in the supply condition on education now yields:

$$\beta\frac{\delta}{\alpha}\frac{s}{1-s} + e.\gamma(1+\beta(1-e)) = \beta \tag{4.16}$$

which defines a negative relation between education and employment: the higher unemployment, the higher the incentives for young workers to acquire education. It can be observed that α and δ have opposite effects: a rise in the demand for education makes education more attractive, but an increase in the demand for experience makes activity in first period more attractive, so education less attractive. The equilibrium can be mapped in plane (e, s) as illustrated in figure 4-8.

Proposition 6. *In this steady-state equilibrium, we have:* $\frac{\partial s}{\partial \alpha} > 0$, $\frac{\partial e}{\partial \alpha} \gtrless 0$, $\frac{\partial s}{\partial n} > 0$, $\frac{\partial e}{\partial n} < 0$ *and* $\frac{\partial s}{\partial \delta} \gtrless 0$, $\frac{\partial e}{\partial \delta} < 0$.

Proof. See figure 4-8. ■.

The demographic shock (increased n) explains higher unemployment for the unskilled and higher education. In contrast, each of the technological parameters explains only one stylized fact, whereas their effect is ambiguous for one of the two equilibrium quantities s and e (represented by the symbol $\gtrless$).

4.5 Empirical Evidence

The model shows that labour supply trends of more inexperienced workers produce adverse effects on labour markets that can be interpreted as a shift in demand for labour in favour of

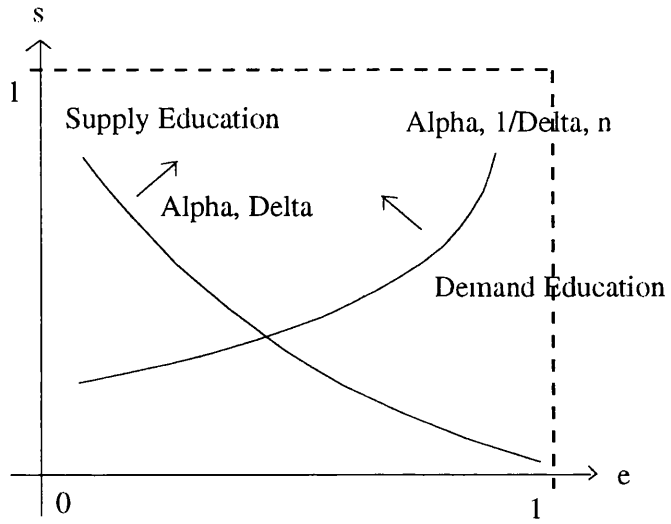

Figure 4-8: Steady-state demand and supply of education

the skilled. This empirical section has two objectives. First, it is to complement chapter 3 in documenting the trends in labour supply. The first subsection shows how the share of young and female workers evolved in the OECD during the last 30 years. The second subsection aims to show that the average number of efficiency units of employment experience of these groups are lower than the average.

The second objective is to show that one important prediction of the model is consistent with observed time-series evolution of the labour force. This prediction is that higher education is indirectly caused by the labour supply trends. The labour supply trends generate crowding out and therefore unemployment in the first period of workers' life, preventing them from accumulating skills. Young workers have stronger incentives to acquire education. In the third subsection, I borrow from the previous chapter to decompose the changes in labour supply in a high unemployment economy, France, with a historical perspective over the last 30 years: more inexperienced workers in the labour force followed, as implied by the model, by an increase in the supply of education in the mid 1970's.

Table 4.1: Share of women in the labour force, source: OECD

	USA	Europe (12)	Europe (11)	France
1962	0.327	-	-	-
1968	0.355	-	-	0.345
1975	0.391	-	0.350	0.374
1982	0.427	0.373	0.374	0.405
1992	0.451	0.401	0.410	0.440

Table 4.2: Share of 25-34 y.o. in the labour force, source ILO (1990 figure = projection

	USA	Northern Europe	Southern Europe	Western Europe
1960	0.207	0.197	0.245	0.216
1970	0.206	0.203	0.226	0.235
1980	0.274	0.239	0.260	0.260
1990	0.289	0.238	0.274	0.269

4.5.1 Labour supply composition of the labour force

The tables 4.1 and 4.2 document the changes in the age and gender composition of the labour force. It appears clearly that there are more women and to some extent, more young workers defined as the 25-34 years old [7]. Europe (12) refers to the 12 members of the European Union, Europe (11) excludes Greece for which no data were available before 1977. For more details on the composition of the countries in table (4.2), see the figure 3.2 of chapter 3.

4.5.2 Real experience

The data of the French survey Actifs Financiers 1992 were made available by INSEE. This is a unique dataset in which individuals declared the number of years they worked in part-time and full time employment since the start of their working life. Daniel Verger (INSEE-CREST) provided me with an updated dataset including a correction for some misreported variables (spells of employment due to complicated trajectories, correction for domestic employees). The description of the variables and the instruments is reported in appendix. The goal here is to show the difference between real and potential experience (potential experience is age minus age of end of schooling, the usual proxy in 90% of the studies), and accordingly, to understand to what extent women can be considered as "young" in the sense of low experienced.

[7] The choice of those older than 25 was to avoid any interference with the rising enrolment in higher education.

Table 4.3: France 1992, cell averages, men in the labour force

Men	**Real Exp.**	**Pot. Exp.**	**%Gap**	**FT+1/2PT**
All	20.7 yrs	22.9 yrs	0.096	20.3 yrs
$exp \leq 10$	5.9 yrs	6.6 yrs	0.106	5.6 yrs
$11 \leq exp \leq 20$	14.0 yrs	15.5 yrs	0.097	13.7 yrs
$21 \leq exp \leq 30$	23.3 yrs	25.2 yrs	0.075	22.8 yrs
$exp \geq 31$	33.2 yrs	34.4 yrs	0.035	32.8 yrs
Quartile 1	17.9 yrs	20.7 yrs	0.135	17.2 yrs
Quartile 2	19.5 yrs	21.5 yrs	0.093	19.0 yrs
Quartile 3	22.2 yrs	23.8 yrs	0.067	21.9 yrs
Quartile 4	23.1 yrs	24.2 yrs	0.045	22.8 yrs

The tables 4.3 and 4.4 report real experience, potential experience and their relative difference (% Gap) in different cells of the active population. The first row represents the average (potential or real) experience of all active men (or women), the rows 2 to 5 sort individuals according to potential experience and the last 4 rows sort them according to the quartile of hourly wage (in this case, the sample is restricted to the active employed). The third column is the relative difference between potential and real experience. The last column reports the real experience corrected for non-full time work (= years in full-time + 1/2 years in part-time). It appears quite clearly from the tables that even in 1992, the average real experience of women is lower than their potential experience, by 16%. When compared to men, it appears that the high skill women have actually similar experience levels as men have: the relative gap between real and potential experience is 10%, close to the men's average. Finally, young workers of both gender have difficulties with their first job: the gap is 10.6% for men, and 17% for women. These averages in the different cells do not only reflect the participation behaviour of the workers in 1992, but the past of the workers. It appears that the oldest women ($exp > 30$) have much larger differences between actual and potential experience, about 22%, while the corresponding figure is 3.5% for men. Another point is that controlling for the number of years in part-time activities (assumed to count as half of full-time years), the difference in experience between men and women and between low wage and high wage workers is even more important (fourth column).

Next, the goal is to compare the return of real experience. This will allow to get an estimate of the number of efficiency units of experience supplied by different groups. Consider the

Table 4.4: France 1992, cell averages, women in the labour force

Women	**Real Exp.**	**Pot. Exp.**	**%Gap**	**FT+1/2PT**
All	17.8 yrs	21.4 yrs	0.168	15.9 yrs
$exp \leq 10$	5.3 yrs	6.4 yrs	0.172	4.8 yrs
$11 \leq exp \leq 20$	13.4 yrs	15.6 yrs	0.141	12.1 yrs
$21 \leq exp \leq 30$	21.9 yrs	25.3 yrs	0.134	19.9 yrs
$exp \geq 31$	29.7 yrs	37.9 yrs	0.216	26.2 yrs
Quartile 1	17.2 yrs	21.4 yrs	0.196	13.3 yrs
Quartile 2	17.2 yrs	20.5 yrs	0.161	15.5 yrs
Quartile 3	17.9 yrs	18.0 yrs	0.006	17.0 yrs
Quartile 4	20.8 yrs	23.4 yrs	0.111	19.9 yrs

following econometric model of wage determination.

$$w_i = C + \alpha.Education_i + \beta.Experience_i + \epsilon_i$$

omitting the higher order terms (quadratic experience, or in table 4.8 an interaction terms) for simplicity - of course they are included in the regressors. The results are reported in tables 4.5 and 4.6. It would be necessary to correct for the selection bias due to unemployment. However, instruments correlated with the probability of unemployment but not with wages will be rather difficult to find. Endogeneity of real experience is controlled for by instrumental variables (column labelled **IV**)[8].

These tables can be used to calculate how many years of work experience are necessary to an unskilled (no diploma) to reach the initial wage of a worker of the highest diploma category. The answer is summarized in the table 4.7. The last row represent the average return to experience on the 20 first years of employment, taking account of the concavity in the return to experience. Even when comparing the return to true experience instead of potential experience, it appears

[8]Since the interest is about the price of skill with respect to the active population (i.e. the conditional mean of wages for participants to the labour force), there should be no need to control for selection bias to participation. This point is not commonly accepted, and some may think of a structural model of wage offers, such that participants are those whose offer in the wage offers distribution is higher than their reservation wage. By this logic, the interesting concept to be measured is the conditional mean of wage offers given the level of education and of experience. Therefore, since the distribution of wage offers and of accepted wage offers do not coincide, selection of participation should be accounted for. The results of estimation using simple estimators or Heckman two-step method to correct for self-selection of women will be jointly presented in the paper (columns GLS or Heckman). The instruments are: (Age - Age of First Paid Activity) and its square, a dummy variable for married. In addition for women, the number of children of less than 3, 6 and 18 years old and a dummy for the participation of mother.

Table 4.5: France 1992, variable: Log Hourly Wage

Men	**GLS**	**IV**
Experience	0.049 (0.002)	0.050 (0.002)
Exp. Sq. (x100)	-0.078 (0.005)	-0.081 (0.005)
Educ=5	0.049 (0.026)	0.050 (0.025)
Educ=8, Non Voc.	0.309 (0.024)	0.307 (0.024)
Educ=12, Non Voc.	0.491 (0.032)	0.491 (0.032)
Educ=8, Voc.	0.184 (0.020)	0.183 (0.021)
Educ=12, Voc.	0.448 (0.035)	0.447 (0.035)
Educ=14	0.654 (0.029)	0.652 (0.029)
Educ$\geq$15	0.939 (0.027)	0.938 (0.027)
R^2	0.356	0.356
N obs	3 641	3 641

Table 4.6: France 1992, variable: Log Hourly Wage

Women	**GLS**	**IV**	**Heckman**
Experience	0.030 (0.004)	0.031 (0.003)	0.029 (0.005)
Exp. Sq. (x100)	-0.042 (0.010)	-0.044 (0.007)	-0.038 (0.011)
Educ=5	0.028 (0.060)	0.030 (0.037)	0.032 (0.058)
Educ=8, Non Voc.	0.367 (0.048)	0.367 (0.033)	0.332 (0.046)
Educ=12, Non Voc.	0.482 (0.058)	0.481 (0.041)	0.439 (0.057)
Educ=8, Voc.	0.216 (0.051)	0.216 (0.033)	0.182 (0.050)
Educ=12, Voc.	0.499 (0.055)	0.498 (0.049)	0.446 (0.055)
Educ=14	0.739 (0.047)	0.738 (0.036)	0.685 (0.046)
Educ$\geq$15	0.903 (0.055)	0.902 (0.042)	0.844 (0.055)
Mills ratio			-0.223 (0.066)
R^2	0.239	0.239	0.251
N obs	3 108	3 108	2 984

Table 4.7: France 1992, Comparaison Experience / Education

Simulation: number of years of experience equivalent to:	**Men**	**Women**
Educ=12, Vocational	13 years	23 years
Educ=14	20 years	Never
Educ≥15	Never	Never
Educ≥15 - Educ=12, Non Voc.	12 years	20 years
Average return to exp in % (20 yrs)	3.34	2.16

Table 4.8: France 1992, estimated interaction terms between education and experience

GLS	Men	Women
All coef. x100	Real Exp	Real Exp
Educ=5	0.64 (0.41)	1.22 (0.59)
Educ=8, Non Voc	1.12 (0.32)	0.96 (0.45)
Educ=8, Voc	0.51 (0.49)	1.38 (0.50)
Educ=12, Non Voc	0.60 (0.28)	0.39 (0.46)
Educ=12, Voc	0.97 (0.48)	1.56 (0.52)
Educ=14	0.32 (0.42)	0.34 (0.45)
Educ≥15	0.52 (0.46)	-0.06 (0.56)

that the average return of men is higher by 45%: it is 3.34% for men whereas it is 2.16% for women. It can be seen that the average return to education is compensated in 13 to 23 years, but that the wage gap between workers with no diploma and workers with the highest level of education can never be totally covered.

For completeness, the table 4.8 reports the coefficients of an interaction term between diplomas and experience when it is added to the specification in the wage equation. These interaction terms are never very significant, contrary to what is usually found when real experienced is proxied by potential experience. When in addition a quadratic interaction term is added, none of the interaction coefficients are significant at the 5% level. The conclusion of tables 4.5 to 4.7 are not altered by the interaction terms.

4.5.3 Timing of the changes in the composition of the labour force

The figure 4-9 summarizes an exercise made in the previous chapter. The idea is to decompose the fitted hourly wage from a wage equation of all individuals in the labour force into two components, experience (on the x-axis) and education (on the y-axis). The points represent the average of the efficiency units of the labour force in each of these two dimensions for each year

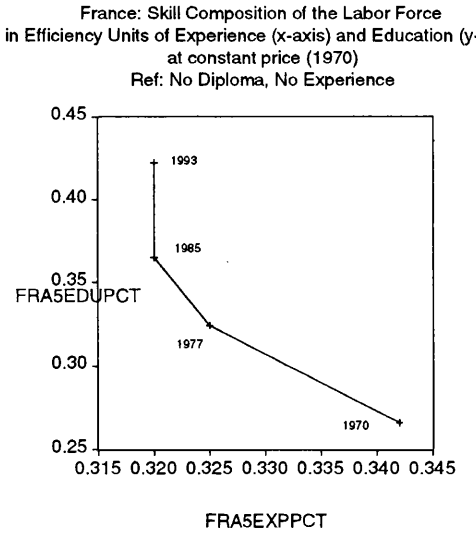

Figure 4-9: Timing of the changes in the composition of the labour force. Source FQP and chapter 3

1970, 77, 85 and 93. The return to education and the return to experience are chosen in a given year, 1970, but the result do not depend on the choice of the reference year. The wage equations allow for female-male wage differences in the intercept, the return to education and experience. It appears from the graph that the first large shift in the skill composition of the labour force is a decline during the period 1970-77 in the experience level, for reasons investigated in chapter 3 (namely, women and young). Over the same period, there is an increase in the efficiency level of education. In a second step, after 1977, the decrease in the average efficiency units of experience of the labour force decelerates, and there is a strong rise in supply of education. As predicted by the model, the rise in the education level of the labour force is following the decline in experience.

4.6 Conclusion

In the paper, it is argued that one should explain the evolution of inequality and unemployment taking in account all the labour supply changes. Demographic changes (age and gender) were important in all OECD labour markets and they have to be considered.

The model explores the dynamic implication of these changes (age and gender, i.e. less experienced workers). It allows to disentangle the effects of labour demand and labour supply shocks. When the labour supply shocks are shocks of more inexperienced workers, their effects are exactly the same as the effects of labour demand to more skilled workers: decrease in the wage of the unskilled, increase in unemployment, hysteresis in unemployment, and increased supply of educated workers.

In the last section, I present a summary of empirical findings about experience that justify the model. First, there are age and gender differences in the quantities of experience supplied, and gender differences in the return to experience. Therefore, the increasing share of young and women in the labour force can be seen as an increase in the supply of workers supplying few efficiency units of experience. Second, timing of the changes in the skill composition of the labour force is consistent with the model in a high unemployment economy, France: higher education follows the changes in the age and gender composition of the labour force.

- **Appendix: reduced form of the production technology**

Assume that $Y = F(K, N^S, N^U) = K^{\alpha}.(N^S)^{\beta}.(N^U)^{\gamma}$ for instance. The marginal product of capital must in the long run be equal to the interest rate r (assumed exogenous). It follows that $K = r/\alpha.[(N^S)^{\beta}.(N^U)^{\gamma}]^{1/(1-\alpha)}$. Replacing in the production function, $Y = (N^S)^{\beta/(1-\alpha)}.(N^U)^{\gamma/(1-\alpha)}$ (times an uninteresting constant). With a further assumption of constant return to scale of production $\alpha + \beta + \gamma = 1$, one can write Y as a CRS function of N^S and N^U.

- **Appendix: dynamics with education**

In the flexible case, it is possible to study the dynamics of adjustment. Assume for instance that supply of education adjusts with lags to demand. For instance, assume the following dynamics:

$$s_t = s_{t-1} + \lambda.\frac{I_t(1) - I_t(0)}{I_t(1)} \tag{4.17}$$

where λ characterizes the speed of adjustment. Then, in replacing the relative wages in (4.17), the following dynamics holds :

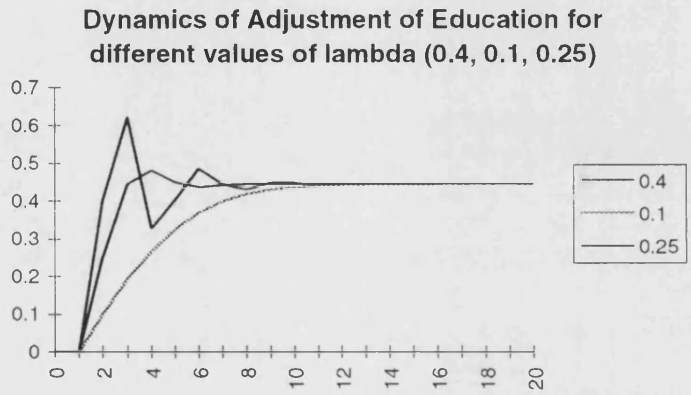

Figure 4-10: Dynamics of Adjustment of Education With different Speeds of Adjustment

$$s_t = s_{t-1} + \lambda \left[1 - \frac{1-\alpha-\delta}{\alpha\beta} . G. \left(\frac{s_{t-2}}{1-s_{t-2}} \right) \alpha \left(\frac{s_{t-1}}{1-s_{t-1}} \right)^{1-\alpha} - \frac{\delta}{\alpha} . \frac{s_{t-1}}{1-s_{t-1}} \right] \tag{4.18}$$

with $G = (1+n_{t-1})^{\alpha+\delta} (1+n_t)^{-\alpha-\delta-1}$.

The dynamics is easy to simulate. What happens is that, when s_{t-1} is close to 1, the demand for unskilled is so high that there is a sharp decline in supply of education next period. There is a dynamics of overshooting convergence in education is realized in cycles of decreasing size, which happens when the speed of adjustment is sufficiently high. Figure 4-10 shows three paths of convergence towards the same limit. The curves are uniformly shifted upwards when n_t and α increase. The effect of a rise in δ is ambiguous: it decreases the demand for unskilled, so makes education less costly, but increase the return to work experience, so the opportunity cost of education is higher.

- **Appendix : Survey Actifs Financiers 1992. Source INSEE.**

In the survey Actifs Financiers 1992, individuals are asked a series of questions on their past, including the age of end of schooling (variables $JER201$ or $JEC201$ for the person of reference of the household and his/her partner), the age of first paid job (variables $AR201$ or $AC201$), the number of periods of employment interruptions ($AR63$ or $AC63$), the reason for it (unemployment, inactivity or disease, in $AR64$ or $AC64$), and finally, real employment experience as measured by the number of years in

employment (defined as paid activity excluding "Petits boulots") (variables $AR65$ and $AC65$) and the number of years in full-time employment ($AR66$ and $AC66$). This is quite unique in micro-surveys, since usually employment experience is approximated by the potential experience or Mincer's proxy (age - education - 5 or 6).

Education is defined by the highest diploma obtained in general or vocational classes, and if there is no diploma, the level reached (variables $DIEG$, $DIEP$, $DIES$ and $NIVSAN$). It is defined by eight dummy variables (No Diploma, CEP, CAP or BEP, BEPC, Bac Technique, Bac General, Deug-Licence, Maîtrise and higher) which correspond in order to: 5 years of schooling, 8 years vocational, 8 years general, 12 years vocational, 12 years general, 14 years and more than 15 years. This gives a balanced partition of the sample.

Annual wage earnings for 1990 includes premia and wages from temporary employment and secondary activities (variable $RE01b1$and 2 for the person of reference of the household and his/her partner). Individuals declare the number of months corresponding ($RE01b1$ and 2), as well as the percentage with respect to a full-time job ($RE01d1$ and 2). There is no problem of top-coding here. Then the log of hourly wage is defined as $Log(RE01b1/RE01c1 * RE01d1/(39 * 4))$ where 39 is the legal weekly number of hours.

The sample is restricted to the 15-65 years old, not retired. About 10% of the sample whose current or last activity was self-employment are excluded, since the return to experience in this type of activity may differ from the return to paid activity.

Standard data are used as instruments for endogeneity of participation of women: the number of children of age 3, 6 and 18, the number of individuals in the household, the marital status, the status of head of household (1 if yes), the activity of individual's mother, the existence of an activity in the past, the year of constitution of household. To instrument real experience in wage equations, the same kind of variables were used.

Chapter 5

Competition for Jobs in a Growing Economy and the Emergence of Dualism

Abstract: We aim to explain the rising share of short-term employment in Europe using a matching model with growth. We find that a slowdown in growth of labour productivity leads to the emergence of temporary (short-term) jobs that explains their increasing share in total employment. Lower growth rates also shift the "Beveridge curve" to the right and weaken the bargaining position of workers. These effects generate a relation between growth and unemployment, which can be negative when the adverse effect of growth on wage setting dominates over its positive effect on labour demand. In addition, higher population growth increases the share of temporary jobs and unemployment. Finally, the often blamed firing costs are found to be neutral when there is no floor on wages.

5.1 Introduction

5.1.1 Dualism and the emergence of dualism

Dualism generally characterizes a situation where there are two sectors with different technologies, with possible migration of inputs from one sector to another. In the labour economics

context, dualism can mean both two types of firms or workers. Manning (1993) argues that it was initially thought as a good description of the way labour markets work, especially in reaction to competitive modelizations. In Doeringer and Piore (1971), the primary labour market is thought of as non competitive and viewed as an internal labour market. Firms, generally large ones, offer employment stability, training, career prospects and high wages. Workers are skilled, do not quit often. In contrast, the secondary sector is more competitive, firms are smaller, offer temporary employment at lower wages, while workers leave more often, are likely to be (in the US at that time) black and living in the centre of the cities. These conditions reflects an extreme heterogeneity, and obviously lead to an extreme polarization of jobs. Manning (1993), in Burdett and Mortensen's (1989) framework, develops one of the few models where dualism emerges endogenously and with ex-ante identical workers. Using a job-search framework, he shows that, when there is uncertainty on the location of the good jobs and search frictions, labour segmentation is possible with little deviation from the competitive model, .

This paper shows the possibility of *emergence* and of *stability* of dualism of jobs in a model with ex-ante identical workers, with one representative firm and with perfect substitutability of the two jobs in the production process. This is a different and unconventional notion of dualism in which the firm can choose to advertise for two types of jobs. The first type that we call primary or long-term jobs, have long duration and high turnover costs, characteristics of the less competitive jobs of Doeringer and Piore. The alternative jobs have shorter duration and low or no turnover costs, and will be called secondary or short-term (temporary) jobs. In equilibrium, since workers cannot move freely from one job to another because of search frictions, long-term jobs can have for workers strictly higher present-discounted values than short-term ones. We characterize this equilibrium in a job search model with exogenous growth. We study how and when dualism consisting of inequality among ex-ante identical workers arises, i.e. we study the process of emergence of dualism.

5.1.2 More temporary contracts: need for flexibility or other factors?

Beyond the tradition of dual labour markets in economics, we are motivated by macroeconomic considerations. In the past decade, we have observed an increasing share of temporary work in total employment in Europe (from 4% to 10% between 1983 and 1991) and most strongly in

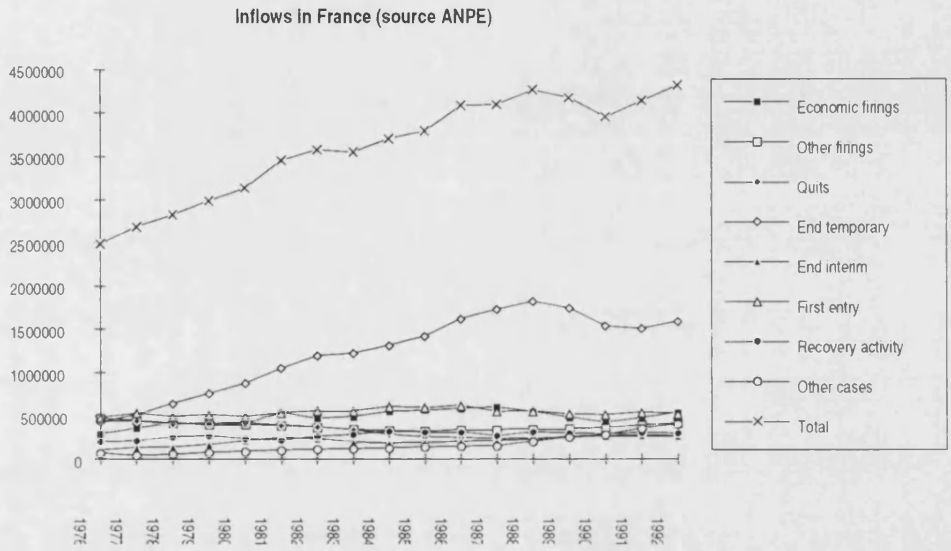

Figure 5-1: Inflows into Unemployment per year, by cause

Spain and France where these shares tripled (see Bentolila and Dolado 1994). In France, this phenomenon has substantially changed the inflows into unemployment[1]. We consider data from the National Employment Agency (ANPE). The agency collects information from its 8000 local branches about each new unemployed person, along with the cause of his or her registration. These causes are one of the following: firing because of the economic conditions of the firm, other firing, end of a temporary contract, end of an interim contract[2], first entry, come back to the labour market and other cases. The sum of all the new entrants in a year is defined as the inflows into unemployment. These flows are depicted in figure 5-1.

It appears that much, if not all, of the increase of the inflows into unemployment is due to the temporary contracts (63% of the increase) and completion of interim work (9%). Firing for economic reason represents merely 14% of the increase. Other data, from INSEE DMMO not

[1] A lot of useful information on the labour market is revealed by data on flows of workers between the different states, as was argued in Burda and Wyplosz (1993) or Blanchard and Diamond (1990). See Abowd et al. (1996) for an analysis on French establishments.

[2] The distinction between the two kind of contracts, interim and temporary, is only that the interim contract is between a firm and the interim agency. For this reason and because the two concepts are close in the anglo-saxon countries, we will call "temporary work" for all the jobs with defined duration.

reported here, show that the rise of the exits from employment because of the end of temporary contracts is a general feature of men, women and 25-49 years old workers of both gender.

This rise in the share of temporary contracts is interpreted as a need for flexibility of workers, and as a way for firms to get round rigid employer/employees relationship for the existing jobs. The lack of flexibility of the existing jobs is linked to the existence of wage rigidities, or of high firing costs (see for instance Saint-Paul 1993). By contrast, frequent renewals of temporary jobs are a convenient way for firms to set wages at the marginal productivity of workers, and their higher proportion in firms' employment makes down-sizing easier by simply not replacing the temporary contracts. Then, in that logic, countries where the share of temporary contracts has increased are those where there is a lack, and therefore a need of flexibility.

It is difficult to deny that new environment faced by firms, including more volatility or uncertainty in the economy, higher degree of competition within and among countries and many other factors can explain why more flexibility is needed from workers is needed. However, we argue here that there are two other changes having affected economies in the long run, that can contribute to the rising share of temporary contracts.

First, there is the slowdown in productivity growth: in the first 30 years following the end of Second World War, France like other European countries experienced a large productivity growth of around 5% a year. During the period 1965-74, this rate was still around 4%. However, between 1975 and 1979 it was 2.5% and has further fallen to 1.7% between 1980 and 1994. It can be argued that Western economies faced a changes in the regime of growth between the 1950- 60's and the end 1970's-80's (see Cohen 1994). What are the consequences of a change of the growth regime on the labour markets? As discussed in introduction of the recent CEPR Report (1994), lower growth has been associated to higher unemployment in Europe and higher inequality in the US. In Manning (1992) for instance, it is argued that no convincing story of OECD unemployment can avoid to imply the slowdown in productivity growth[3]. Similarly, we will argue that a slowdown in growth has an effect on the share of temporary contracts in the economy.

The second factor is the rise in labour force by the increased participation of women to the

[3] In this model, technological growth leads to wage growth, so higher " rents" of being employed. Thus higher growth induces wage moderation and so less unemployment.

labour market and due to bigger cohorts of young (with a peak in the USA in 1977, see Welch 1979), both trends implying more " young" in the sense of new entrants on the labour market. Because most of these entrants are first unemployed, this can be proxied by more flows from inactivity to unemployment like in the case of higher population growth. The rise in labour force participation leads to decrease the congestion process of the labour markets. Congestion is thought here in the sense of a negative externality between firms in the matching technology associating the unemployed and the vacant positions. This decrease in congestion may have affected the relative position of unemployed with respect to employers and their propensity to accept temporary contracts.

5.1.3 A job-search model with growth

In this paper, we consider the implications of lower productivity growth and higher population growth (higher share of new entrants in the labour force) for the labour markets, using the framework of equilibrium unemployment theory by Pissarides (1990), that we extend to the case of two kinds of jobs. We show that both the apparition and the increasing quantity of short-term jobs arise endogenously as response of firms to these two factors taken exogenously. The two basic intuitions are simple:

- In Pissarides' model, the tightness of labour markets is increased by the capitalization effect of growth: higher expected profits tomorrow induce more hiring today. Hiring, which is costly, is therefore an investment. In periods of high sustained growth, first the lost profit (the opportunity cost) of replacing workers is high and second, if there is high labour tightness, it is difficult for employers to fill the vacancies. Therefore, it is important for firms to retain workers by offering them long-duration contracts. By contrast, in a low growth regime, firms have stronger incentives to use short duration contracts, particularly if these contracts have other advantages, like weak bargaining power of the employees, low firing costs and low search costs. The result of the analysis of this paper is to show that, above a limit of growth rate, depending on the search costs and exogenous reallocation rates, there are only long-term jobs in the economy. Below this growth rate, the two types of jobs coexist, up to a point where the marginal income generated by a job (the marginal product of labour minus wage, which is positive because of the monopsonistic position of

the firm) is the same across jobs.

- Population growth does not affect the limit growth rate above which there is no coexistence of the jobs, but increases the share of temporary jobs when they exist. Indeed, more entrants into unemployment from inactivity make it less time consuming for firms to find new workers. This is the thick market externality of the matching process: more unemployed are good *ceteris paribus* by firms because search for firms is shorter. Therefore, the demand for all workers increases and more for short duration contracts: the relative advantage of long-term jobs for firms is their duration, because of the profit lost during replacement. If replacement is easy, then the relative advantage decreases, and firm prefer workers in short-term jobs.

This is the core of the paper, but the model also addresses other theoretical issues. A consequence of the rising share of temporary contracts is that the entries into unemployment are rising by more job terminations. Then, the Beveridge curve (in the model, the diagram of unemployment rates and vacancy rates in steady-state), is shifted to the right: more vacancies are needed to maintain the same level of employment, or equivalently, at constant rate of vacancies, there are more unemployed. This is an alternative explanation to the shift of the Beveridge curve observed in the OECD countries[4]. Another theoretical consequence of the model is a new relation between growth and unemployment. Indeed, there are classically two effects of growth on unemployment: the first one, the capitalization effect, implies that higher growth rates are associated with higher values of jobs and thus with increased labour demand. The other one, the destructive creation effect, implies that high growth rates make the existing jobs more quickly unproductive, because of obsolescence of old technologies[5]. Then there are more inflows into unemployment and new jobs have lower values. We find in our model a third effect of growth: higher growth increases the average turnover costs, which increases the wage pressure and partially or even totally offsets the capitalization effect of growth, such that the relation between growth and unemployment can be negative.

[4] This shift of the Beveridge curve is also in Pissarides (Chapter 5) when stochastic job matching is introduced. An increase of the dispersion of match productivities shifts the curve to the right. We have the same result with an increase in the inequality between workers, i.e. when the share of short-term employment increases.

[5] The capitalization effect is in the model, but we avoid the issues of creative destruction of Schumpeterian growth as modelled in Aghion-Howitt (1990), Cohen-Saint-Paul (1994) or Mortensen and Pissarides (1994, 1995).

We then try to provide empirical evidence for the mechanisms of the model. It is shown that the rise of the transition probability between employment and unemployment in France is fully explained by the rising share of temporary contracts, ending more frequently than the average jobs. We test in a cross-section of 15 OECD countries the basic predictions of the model: the share of temporary contracts is an increasing function of the growth of labour force, and a decreasing function of the technological growth. Such a relationship seems to emerge from the data.

5.2 The model

We start from the classical model of growth in Pissarides (1990, §2), extended to the case of two inputs of labour.

5.2.1 Firms

There is an infinite number of atomistic firms, whose output is aggregated in a production function which associates capital K and efficiency units of labour N, augmented with technical progress $exp(gt)$: $Y = F(K, N.exp(gt))$ where g is the growth rate of labour productivity and $N = L(1-u)$, with L the labour force assumed constant, and $(1-u)$ the employment rate. The efficient units of labour are specified as follows. There are two different contracts: the long-term ones, with long duration and high turnover costs, i.e. with low exogenous Poisson separation (destruction) rate s_l, and firing costs that are a fraction f_l of the wage w_l; and the short-term ones, with lower tenure and lower turnover costs, i.e. high exogenous separation rate s_s, but without firing costs. This is the legislation that distinguishes the two kinds of jobs[6]. We have to assume that there is no renewal of the temporary contracts[7]. To keep the symmetry, we define $f_s = 0$ such that $f_i.w_i$ is the firing cost of job $i, i = l, s$[8]. The two types of jobs are perfect

[6] We can think the long-term jobs as undefined duration contracts, and in that case, $s_l = s_{\text{shock}}$ is an exogenous reallocation rate due to technical changes. The short-term jobs are defined duration contracts, and end either by destruction with probability s_{shock}, or because of their normal duration, which we proxy (imperfectly) as another Poisson process with arrival rate $s_{\text{end contract}}$, then $s_l = s_{\text{end contract}} + s_{\text{shock}}$.

[7] This is a realistic feature in most European countries - except UK, Ireland and Denmark, the nine other countries have such a legislative system. The duration of the temporary contracts is also limited in eight countries (the same nine minus Holland); see Grubb and Wells (1994) and appendix 5.

[8] Exactly the same results are found if we suppose that firing costs are a fixed amount, and not indexed on wages.

substitutes in the production function, $Y = F(K, (N_l + N_s)exp(gt))$. Thus, the coexistence of two types of jobs relies only on an arbitrage between endogenous hiring costs and the expected profit of the job, depending positively on the duration of the contract. This is in contrast with most of the models studying temporary contracts, where the coexistence is purely the result of an imperfect substitutability between the jobs.

5.2.2 Search and matching

Firms post vacancies in order to hire workers. This process is costly and the flow cost of search is γ_{0i}, higher for long-term jobs. Unemployed workers are in number $U = u.L$. L is the labour force, assumed constant. There is a matching technology associating vacancies and the unemployed, which is slightly more complicated than usually. In Pissarides, the number of match between U unemployed and V vacancies is $h(U, V)$ per unit of time, where h is increasing in each of argument and concave. As there are two types of job, we have to modify the matching process (see figure 5-2):

Definition 1. *The matching technology with two types of jobs is specified as follows: the total number of contacts is $h(U, V_l + V_s)$, workers, ranking the jobs l and s, choose the first kind of job*[9]*, such that there are $h(U, V_l)$ hiring in l, and $h(U, V_l + V_s) - h(U, V_l)$ hiring in s.*

The implicit assumption is that the unemployed are ex-ante identical, but some are lucky enough to get an undefined duration contract, some other are less lucky and get a temporary contract, and some other remain unemployed[10]. The job offers are assumed to be accepted by the workers. We shall call $y_V = V_s/(V_l + V_s)$ the share of the short-term vacancies. We denote by $\theta_i = V_i/U$, the ratio of vacancies of type i to the number of unemployed. Then, the probability for a firm of filling a vacancy l is the number of hiring in l divided by the number of vacancies l,

[9] *This definition of an equilibrium (the workers prefer jobs l to jobs s) implies that the present discounted value of job l is always higher than of job s. This is a necessary condition, which as we show, is always true in equilibrium.*

[10] Another way to model this job dualization would be to have simply $h(U, V_l)$ hiring in l, and $h(U, V_s)$ hiring in s. In that case, the results concerning the effect of a slowdown of growth on dualization are very similar to those obtained here. I show in a note (Wasmer 1997) that the most important result in the paper, the existence of a threshold technological growth rate leading to the apparition of two jobs, is shown to be true for a larger class of matching functions.

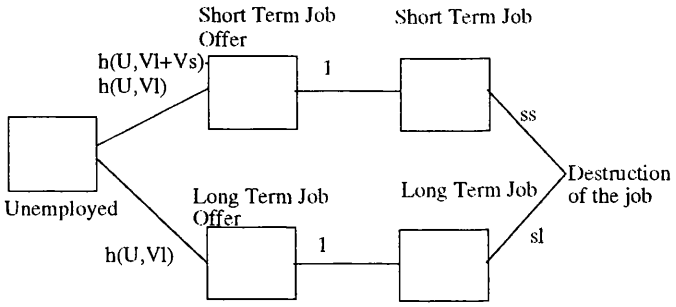

Figure 5-2: Matching technology with two types of jobs

$$q_l = h_l/V_l = x(\theta_l) \tag{5.1}$$

where $x(V/U) = h(U,V)/V$. Thus, $x(.)$ is decreasing, with elasticity $y_V.x'/x = -\eta$. This property reflects an externality in the matching process: if there are more other firms looking for workers for a job l, it is more difficult for a given firm to find a worker for a job l. The probability for a firm of filling a vacancy s is thus:

$$q_s = h_s/V_s = \frac{x(\theta_l + \theta_s)}{y_V} - \frac{1 - y_V}{y_V} x(\theta_l) \tag{5.2}$$

Here q_s is not equal to the function $x(\theta_s)$ which means additional complications in the resolution. It can be proved (see the appendix 1) that the hires in long-term jobs and total hires follow constant return to scale (respectively in (U, V_l) and in (U, V)), while hires in short-term jobs follow increasing returns to scale in (U, V_s). This property may reflect the fact that when short-term employment is more common, the unemployed are less likely to have any choice between long and short term jobs.

5.2.3 Profit Maximization

The firms are small such that they have no market power and take the stock of vacancies and of unemployment as exogenous. The firm i posts V_{ij} vacancies for the contract of type j. Hereafter we forget the subscript i. The matching function provides the following constraint on employment evolution:

$$\partial N_j/\partial t = q_j.V_j - s_j.N_j \tag{5.3}$$

The program of the representative firm is to maximize the present-discounted value (PDV) of profit:

$$\begin{aligned}\Pi = \int_0^{+\infty} & exp(-rt)[F(K,(N_l+N_s)exp(gt))+ \\ & \sum_{j=l,s}(-w_j.N_j - \gamma_{0j}.V_j - w_j.N_j f_j.s_j) - \partial K/\partial t - \delta K]dt\end{aligned} \tag{5.4}$$

with r the discount rate, γ_{0j} the search cost (depending on the type of the job), K the firm's stock of capital depreciated at a uniform rate δ. Prices of output and of new capital are normalized to 1.

Replacing V_j by N_j and $\partial N_j/\partial t$ with (5.3), we obtain:

$$\begin{aligned}\Pi = \int_0^{+\infty} & exp(-rt)[F(K,(N_l+N_s)exp(gt))+ \\ & \sum_{j=l,s}(-w_j.N_j - \gamma_{0j}.(\partial N_j/\partial t + s_j.N_j)/q_j - w_j.N_j f_j.s_j) - \partial K/\partial t - \delta K]dt\end{aligned} \tag{5.5}$$

The first order condition of $Max \int G(x, dx/dt, t)dt$ where G is a differentiable function is given by: $G_l - \partial(G_s)/\partial t = 0$ where G_j is the derivative with respect to the j^{th} argument of G.

Definition 2. *The steady state is defined by: constant stocks* $\partial V_j/\partial t = 0$, $\partial N_j/\partial t = 0$, $\partial \theta_j/\partial t = 0$ *and wages, benefits and costs growing at the rate* g.

Therefore, we have in steady-state:

$$V_j/N_j = s_j/q_j \tag{5.6}$$

for $j = l, s$.

Furthermore we assume that the flow cost of search paid by firms, which is growing at rate g, is indexed on the marginal productivity of labour: $\gamma_{0j} = \gamma_j.MPL(k).exp(gt)$, with γ_j a constant. Applying the first order conditions for K, N_l and N_s, we get, in steady-state and in defining $k = K/N.expg(t)$ and $f(k) = Y/N.exp(gt)$ respectively the capital and output per efficiency unit of labour:

$$f'(k) - r = 0 \tag{5.7}$$

$$\exp(gt)[f(k) - k.f'(k)] - (1 + s_j.f_j).w_j - \{r + s_j - g\}\gamma_{0j}/q_j = 0 \tag{5.8}$$

for $j = l, s$

The sum of all hires is equal, in steady-state, to the job destruction.. Therefore, with $V_j = \theta_j.u.L$, we get a relation between θ_l, θ_s and U or between V_l, V_s and U, which is the equivalent of the (UV) condition in Pissarides, defining the Beveridge Curve:

$$V_l.q_l + V_s.q_s = (1 - u)L[s_l.(1 - y_N) + s_s.y_N] \tag{5.9}$$

or

$$\sum \theta_j.q_j = \overline{s}.(1 - u)/u \tag{5.10}$$

where $\overline{s}$ is the average separation rate in this economy. The position of the Beveridge curve is therefore indexed by $\overline{s}$, and is therefore endogenous. Here y_N is the fraction of temporary jobs.

5.2.4 Workers' Maximization

The intertemporal valuation of employment and of unemployment for workers is quite complex to derive: there are two different jobs, with different wages, firing rates, turnover costs and hiring probability. Moreover, if offered a temporary contract, the unemployed could find it optimal to wait on an average $1/(\theta_l q_l)$ period to get a long-term job. We must check ex-post that the present-discounted value (PDV) of being unemployed U is always smaller than $Min(E_l, E_s)$ with E_j the expected PDV of being employed in a job of type j. This defines a double inequality that needs to be satisfied in equilibrium. We also assume no on-the-job

search.

When unemployed, a worker has a utility z which is equal to a share λ of the marginal product of labour: $z = \lambda.\exp(gt).MPL(k)$ where $MPL(k) = f(k) - k.f'(k)$. We index z on MPL and not on the previous wage or the average wage to avoid any further complications: if U depended on the past wage, then different hired workers would have different outside options, and could bargain different wages even if they were in the same kind of job. This obviously complicates the analysis.

The asset values of U and E_j are:

$$(r-g)U = z + \theta_j.q_j(E_j - U) \tag{5.11}$$

$$(r-g)E_j = w_j(1+s_j.f_j) + s_j(U - E_j) \tag{5.12}$$

for $j = l, s$

$f_j.w_j$ being the layoff premium. We have therefore from (5.11) and (5.12) (see the appendix 2 for the proof):

$$(r-g+s_i)(E_i - U) = w_i(1+s_i.f_i) - \frac{z + \sum\limits_{j=l,s} \frac{\theta_j q_j w_j (1+s_j.f_j)}{r-g+s_j}}{1 + \sum\limits_{j=l,s} \frac{\theta_j q_j}{r-g+s_j}} \tag{5.13}$$

Remark 1 *Our definition of the steady-state implies that we must have in equilibrium:*

$$E_i - U \geq 0 \tag{5.14}$$

for $i = l, s$ and the matching technology implies that, in equilibrium:

$$E_l \geq E_s \tag{5.15}$$

5.2.5 Wage bargaining

When an unemployed person is offered a job of type i, the firm and the worker are engaged in a bargaining process over wage. The wage rate (recall that it is growing at rate g) maximizes

each period:

$$(E_i - U)\beta(J_i - V_i)^{1-\beta} \tag{5.16}$$

with β representing the bargaining power of the worker, J_i (resp. V_i) the marginal value of a filled (resp. empty) position, and V_i is equal to 0 when all job opportunities are exploited. The sufficient conditions for an equilibrium with two jobs coexisting are reported in next section. A necessary condition for this equilibrium is given by the following proposition.

Proposition 1. *The wage plus the firing premium, (the sum being called the equivalent wage), is the same for each job.*

Proof. It is easy to show (see the appendix 3) that as in Pissarides (1990), the wage is the weighted average of the unemployment benefit and of the marginal productivity of labour plus the search cost, minus the firing cost. Then, with w_i the wage of job i and $w_{ie} = wi(1 + s_i.f_i)$ called hereafter the equivalent wage, we have:

$$w_{ie} = w_i(1 + s_i.f_i) = (1 - \beta).z + \beta[exp(gt).MPL + \sum_{j=l,s} \theta_j \gamma_{0j}] \tag{5.17}$$

for $i = l, s$

From this equation, we see that the equivalent wages $w_{ie} = w_i(1 + s_i.f_i)$ are the same in both jobs.

■.

This means that wages internalize the differences between the two kinds of jobs. We can wonder why it would be so, when the jobs have different separation rates: *a priori*, the value of the filled position should depend on the duration of the match, which is decreasing with s_i. But at the same time, the value for the worker of being employed also depends upon the duration of the match. As the wage is fixed in order to share the surplus of the match between both sides, by a property of homogeneity, the wage is independent of the separation rate. In the way we modelled the production, the jobs l and s are perfect substitutes and have the same productivity. If we relax this assumption, we loose the result. For instance, when we assume that the productivity of long-term jobs is higher by a factor α than the productivity of short-term jobs, this prevents from finding a simple symmetric solution for w_{el}/α and w_{es}.

This is shown in appendix 3.

We have from (5.17):

$$w_{ei} = w_i(1 + s_i.f_i) = [\lambda(1-\beta) + \beta(1 + \sum_{j=l,s} \theta_j \gamma_j)].MPL(k)exp(gt) \tag{5.18}$$

for $i = l, s$

It follows that $E_l > E_s$ and also that $J_l > J_s$ which is an equilibrium condition (see the appendix 3).

5.3 Solution

5.3.1 The system of equations

We are now able to eliminate the wage with (5.13) and (5.8) which leads to

$$(1-\beta)(1-\lambda) - \beta \sum_{j=l,s} \theta_j \gamma_j = (r + s_i - g).\gamma_i/q_i \tag{5.19}$$

for $i = l, s$

We have of course $y_N = N_s/(N_l + N_s)$ and $y_V = V_s/(V_l + V_s)$. (5.7) determines the stock of capital per efficiency units. (5.18) provides the equivalent wage w_{ei} which is the same for both jobs. With (5.8) we get the ratio q_l/q_s and thus with (5.6), y_N and y_V, the fraction of short-term jobs and of short-term vacancies. Then we have θ from (5.19). Finally, (5.6) and (5.10) determine V_i, N_i and u.

5.3.2 Endogenous emergence of job dualism

In this section, we derive the necessary and sufficient conditions for having an equilibrium with two types of jobs coexisting. Consider the equation (5.8), which is the marginal condition on labour. Rewriting it as:

$$\frac{\pi_i}{r + s_j - g} = \frac{\exp(gt)[f(k) - k.f'(k)] - (1 + s_j.f_j).w_j]}{r + s_j - g} = \gamma_{0j}/q_j[f(k) - k.f'(k)] = 0 \tag{5.20}$$

for $j = 1, 2$. The present discounted value of the expected return to the firm of one marginal job, is equal to the flow cost times the average search duration for the firm. The flow of income to the firm generated by the marginal job i, called π_i is the same for each job, when the two types of job coexist. Given different s_i, this implies that jobs l with longer duration (smaller s_l) are preferred to jobs s by the firms. We are going to show that the condition (5.20) cannot always be true. When it is not true, no interior solution exists with two types of jobs, and so coexistence is impossible.

Proposition 2. *There exist a limit growth rate* $g_0 = r + [s_l.\gamma_l.(1-\eta) - s_s.\gamma_s]/[\gamma_l.(1-\eta) - \gamma_s]$ *such that, if* $g > g_0$, *the marginal profit of the firm for jobs* l *is always higher than for jobs* s, *whatever the fraction of vacancies* s *and* l *the firm posts. In this case, only long term jobs exist.*

Proof. Consider π_l and π_s as functions of y_V, the share of short-term vacancies. We have:

$$\pi_l = \frac{(r + s_l - g)\gamma_l}{x[\theta(1 - y_V)]} MPL(k) \tag{5.21}$$

decreasing in y_V, and which tends to $(r + s_l - g).\gamma_l/x(\theta)$ when y_V tends to 0 and tends to 0 in y_V tends to 1. We also have:

$$\pi_s = \frac{(r + s_s - g)\gamma_s}{x(\theta)/y_V - (1 - y_V)/y_V.x[\theta(1 - y_V)]} MPL(k) \tag{5.22}$$

and π_s is decreasing in y_V, with limit in 0: $(r + s_s - g).\gamma_s/(x(\theta)(1-\eta)$ and limit in 1: $(r + s_s - g).\gamma_s/x(\theta)$

So, if $\pi_l(0) > \pi_s(0)$, then $\pi_l > \pi_s$ for every y_V: the firm chooses to post long-term vacancies only, and therefore in steady state, only long-term jobs exist. The existence of the equilibrium with only one type of job is proved in Pissarides (1990). Then, the limit growth rate g_0 is the g on solving $\pi_l(0) = \pi_s(0)$. It is straightforward to show that g_0 has the value given in the proposition 2.

■

High search cost for long-term jobs, high separation rate s_l, high discount rates increase g_0, and therefore the likelihood of coexistence. This property of endogenous emergence of dualism may appear mysterious. Actually, all is driven by the matching technology. In some cases, it is

so difficult (so long and so costly) for firms to get hires in short-term jobs that they can never satisfy the first order conditions on jobs 1 and 2.

Assume now that $g < g_0$.

Proposition 3. *With a growth rate below the growth rate g_0, both jobs coexist and the share of short-term vacancies posted by the firm is decreasing with g.*

Proof. When there is coexistence, the equilibrium y_V is given by the relation:

$$\frac{\pi_l}{\pi_s} = 1 = \frac{(r + s_l - g)\gamma_l}{(r + s_s - g)\gamma_s}\left[\frac{x(\theta)/x[\theta(1 - y_V)] - 1}{y_V} + 1\right] \tag{5.23}$$

In the Cobb-Douglas case, in the RHS of (5.23), we can eliminate θ. Then, the LHS is the product of a decreasing function of g (the first ratio) and of decreasing function of y_V. Since the product is equal to 1,y_V is decreasing in g.[11]

■

The intuition of Proposition (3), the dependence of the share of short-term vacancies in all job offers with the technological growth rate, is the following: high growth implies high values of future jobs, through the capitalization effect. Firms prefer low separation rate jobs even with higher turnover costs. The investment realized in hiring in long-term jobs has a relatively higher return, because workers in short-term jobs would have to be replaced sooner. On the contrary, when growth is low, discounted profits lost during the replacement of the successive workers are less important.

Proposition 4. The share of short-term jobs y_N, is an increasing function of the share of short-term vacancies, y_V.

Proof. From (5.6) we also have: $V_l/V_s N_s/N_l = \theta_l/\theta_s . y_N/(1 - y_N) = s_l/s_s . q_s/q_l$. Therefore, we get a relation between the fraction of short-term vacancies y_V and the fraction of short-term jobs.

$$\frac{y_N}{1 - y_N} = \frac{s_l}{s_s}\left[\frac{1}{1 - y_V}\frac{x(\theta)}{x(\theta_l)} - 1\right] = \frac{s_l}{s_s}\left[\frac{1}{1 - y_V}\frac{x(\theta)}{x[\theta(1 - y_V)]} - 1\right] \tag{5.24}$$

The right hand side (RHS) of (5.24) is an increasing function of y_V: x has an elasticity less than 1 in absolute value, so the product $(1 - y_V)x(1 - y_V)$ has a positive elasticity, thus the denominator is decreasing in y_V, so the RHS is increasing in y_V. Therefore, y_N is an increasing

[11] In non Cobb-Douglas cases, the property is rather difficult to show for all values of the parameters.

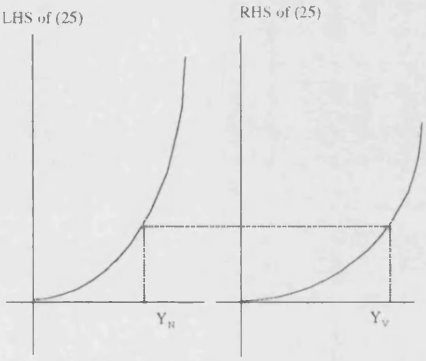

Figure 5-3: Correspondence between the share of secondary jobs and the share of secondary jobs

function of y_V. The figure 5-3 shows the correspondence between y_N and y_V, for a Cobb-Douglas matching function.

■

The propositions 2 to 4 establish that without ambiguity, a lower growth rate increases the share of short-term jobs in the economy: the profit lost during the replacement of workers is lower, and so is the relative advantage of workers in long-term jobs.

5.3.3 Aggregate Effects

We now turn to the aggregate effects of technological growth. We are interested in the effects of growth on wages, on the total number of vacancies, on unemployment and employment. For that, it is convenient to represent the equilibrium in the plane (w, θ), where θ is the sum of θ_l and θ_s. We define two curves (LD) and (WS) (like Labour Demand and Wage Setting).

From (5.18) we have:

$$\begin{aligned} &exp(-gt).w_{ie}/MPL = exp(-gt).w_e/MPL \\ &= (1-\beta)\lambda + \beta(1 + \theta_l.\gamma_l + \theta_s.\gamma_s) \\ &= (1-\beta)\lambda + \beta\{1 + \theta.[\gamma_l + (1-y_V)(\gamma_s - \gamma_l)]\} \end{aligned} \tag{5.25}$$

This is a positive relationship between wages and the supply of vacancies, represented by

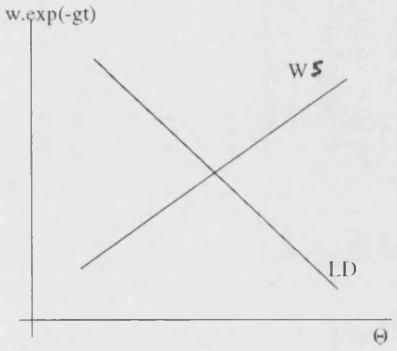

Figure 5-4: Wage Setting and Labour Market Tightness

(WS) in figure 5-4. This can be interpreted as a wage setting curve: higher values of β, the workers' share in the surplus generated by a match, and higher recruitment cost for firms, increase the rent to the workers, and shift this curve up. Given $\gamma_s - \gamma_l \leq 0$, the effect of growth is not neutral with respect to the wage setting curve, contrary to the case with only one kind of job in Pissarides. Because y_V is decreased by higher growth, the slope of the curve increases by $(\gamma_s - \gamma_l)dy/dg$: remember that the average turnover costs (equal to $\gamma_l.(1 - y_V) + \gamma_s.y_V$) are here endogenous. In a period of low growth, without the capitalization effect, the bargaining power of workers is lowered, because of smaller average turnover costs.

From (5.19) and (5.18), we get, on eliminating $(\theta_l.\gamma_l + \theta_s.\gamma_s)$,

$$exp(-gt).w_e/MPL = 1 - (r + s_l - g).1/x[\theta(1 - y_V)] \tag{5.26}$$

which is a negative relation between w and θ, represented on figure 5-4 by (LD), or labour demand, since it is coming from a first order condition in employment. A rise in g has two effects. First, there is the capitalization effect, equivalent to a decrease in the interest rate, which shifts the curve up. Secondly, there is a decrease in y_V, the share of short-term vacancies, or an increase in $(1 - y_V)$, so at constant θ, a decrease in y_N so the curve shifts down. The smaller the elasticity of the matching function, the smaller the latter effect. For a reasonable set of parameters, the capitalization effect is more important (see the simulations in section 5).

Proposition 5. *Higher growth shifts up the labour demand curves, but also the wage setting*

curve. Workers get higher wages (expressed as a fraction of the marginal product of labour). The effect on the tightness of labour market is ambiguous.

Proof. Assume that on balance, the labour demand shifts up with higher growth. Given that the wage setting curve also necessary shifts up, the result is an increase in the wage rate to the marginal product of labour w_e/MPL. By contrast, there is an ambiguous effect on the tightness of labour market. We can nevertheless get some results: if the bargaining power of workers β is low enough, then θ is likely to increase with growth, since the shift in the wage setting curve is small. On the contrary, high values of β are likely to reinforce the effect of the wage setting curve and will decrease with growth.

■

Higher growth means higher average search cost, such that the wage pressure of the workers is stronger. We call this the wage setting effect of growth.

Proposition 6. *The transition rate from unemployment to long-term jobs $\theta_l.q_l$ is without ambiguity increasing in g. This is not the case for the transition rate from unemployment to short-term jobs $\theta_s.q_s$. The sum of the two, which is the exit rate from unemployment is higher when growth is higher only when the capitalization effect dominates the wage setting effect described above.*

Proof. In the appendix 1, we show that, as θ_l is increasing in g, $\theta_l.q_l$ is increasing in g due to the properties of the matching function. This is not the case for the hires into the s-jobs. In effect, we have $\theta_s.q_s$ different from $\theta_s.q(\theta_s)$. This is the result of the difficulty to hire in the s-jobs when there are sufficiently l-jobs. We can however get a result for the sum of the two hiring rates, $p = \sum \theta_j.q_j$ because, by definition,

$p = \theta.x(\theta) = p = (\theta_l + \theta_s).x(\theta_l + \theta_s)$

If β is low, then θ is increasing with growth because the wage setting effect is not strong enough to offset the shift of labour demand. On the contrary, high values of β imply that θ is a decreasing function of g.

■

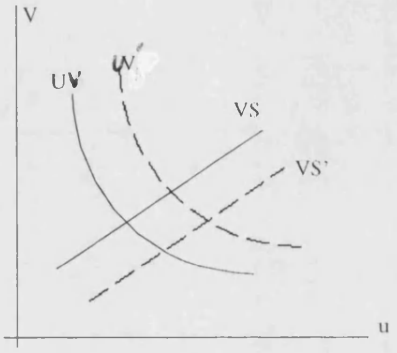

Figure 5-5: The Beveridge Curve and the (u,v) equilibrium

5.3.4 The shift of the Beveridge Curve

In the (u, V) plane, three effects are at work. When g increases, the capitalization effect and the wage setting effect shift the (VS) curve in opposite directions. When the capitalization effect dominates, the (VS) curve shifts up. The Beveridge curve also shifts to the left when growth is higher, because the average turnover is lower. See the figure 5-5.

The first and second effects are demonstrated by propositions 5 and 6. The third part comes from equation (5.10): if g increases, y_N decreases, therefore $\overline{s} = s_l.(1 - y_N) + s_s.y_N$ increases. So, $u = \overline{s}/(\overline{s} + \sum \theta_j.q_j)$ increases because of an increase of $\overline{s}$ and a decrease of $\sum \theta_j.q_j$. In other words, a slowdown in growth, by modifying the composition of employment, increases the separation rate and therefore shifts the Beveridge curve to the right. Therefore, the rise in unemployment caused by a lower productivity growth is *amplified* through this effect.

5.4 Labour force growth

If the rise in the recourse to temporary contracts is a general feature in Europe, it is much more prevalent in France and Spain. What is the reason for this? We could think of the role of firing costs, which are known to be especially strong in Spain (see Bentolila and Dolado, 1994). However, in section 2, we have shown that wages internalize the effect of firing costs: the effect of higher firing premiums is to reduce wages by the same amount times the separation rate.

The parameter f_i, the share of wage which is paid for a layoff, has no aggregate effect, only an intertemporal redistributive effect: a higher premium tomorrow implies a lower wage today.

There is however a potential explanation for the French and Spanish characteristic in demographic developments. In fact, we are going to show that the effect of population growth is to increase the stock of unemployment. Because of the increasing return to scale in the hiring technology into short-term jobs, as demonstrated in appendix 1, higher population growth increases the efficiency for firms of the hiring in short-term jobs. As a result, employers can make use of this supplementary labour force to replace long-term jobs by short-term jobs, other things being equal.

The analysis is straightforward: call n the growth rate of population or equivalently hereafter labour force growth. How does labour force growth affect the previous equations? The answer is: not much. Labour force growth has the same effect as a slowdown in technological growth on the distribution of jobs. Assume that L, the labour force, is growing at rate n, and that all the new entrants, in number $n.L$, begin by being unemployed. Thus,

$$dU/dt = n.L - \sum_{j=l}^{s} q_j.V_j + (1-u)L.\overline{s} \tag{5.27}$$

We define the new steady-state as $du/dt = 0$, $dU/dt = nU$. Condition (5.10) is now:

$$\sum \theta_j.q_j = (\overline{s} + n).(1-u)/u \tag{5.28}$$

The stock of employed workers is also growing at rate n. Therefore, equation (5.6), which is given by $dN_j/dt = n.N_j$ becomes:

$$V_j/N_j = (s_j + n)/q_j \tag{5.29}$$

The first order conditions (with respect to K, N_l and N_s) are unchanged introducing a growing population.

Now re-consider the 5 first propositions. Proposition 1, implying an equality between the equivalent wages, still holds. Propositions 2 and 3 are the same: the limit growth rate above which there are only long-term jobs is independent of the population growth. The link between

the equilibrium share of short-term vacancies when there is coexistence is also independent of population growth. There are however differences with the case of constant population (in propositions 4 and 5) which can be summarized with proposition 7.

Proposition 7. *The threshold value of growth below which there is coexistence is not changed by population growth. In contrast, the relation between the share of short-term vacancies and the share of short-term jobs is changed by population growth: at same share of short-term vacancies, there are more short-term jobs.*

Proof. Proposition 4 is changed in the following way: (5.24) is implied by (5.6), which is not invariant to population growth. Thus, (5.24) is now (5.30):

$$\frac{y_N}{1-y_N} = \frac{s_l+n}{s_s+n}[\frac{1}{1-y_V}\frac{x(\theta)}{x(\theta_l)} - 1] = \frac{s_l+n}{s_s+n}[\frac{1}{1-y_V}\frac{x(\theta)}{x[\theta(1-y_V)]} - 1] \tag{5.30}$$

Since, without ambiguity,$(s_l+n)/(s_s+n) > s_l/s_s$ if $s_l < s_s$, it means that in (5.24) the LHS curve is unchanged and the RHS curve is shifted up. This means that, for the same ratio of short-term vacancies posted by the firms, there is now a higher share of short-term jobs. The reason here is clear: higher growth of population increases the stock of unemployed. Labour market tightness decreases and the derivative of $q_l - q_s$ with respect to θ, at constant y_V, is negative. We have sign $\{\partial(q_l - q_s)/\partial\theta\}$ =sign $\{x(\theta) - x(\theta(1-y_V))\} < 0$

■

As corollary of the proposition, when g is lower than g_0, there are more short-term jobs in the period of high population growth. The wage-setting schedule is unchanged, as well as the demand curve. Finally, in the (u, v) plane, the (VS) curve is unchanged, and the (UV) curve is clearly shifted up and left, because of the increased in the inflows into unemployment. In conclusion of this extension, higher growth of population is associated with more unemployment, more job offers, the same ratio v/u, and more short-term jobs.

5.5 Simulations

Some simulations provide additional understanding of the model, especially to evaluate the relative importance of the distributive and the aggregate effects of growth. The parameters are chosen to produce equilibrium unemployment between 8 and 12 percent of labour force:

Table 5.1. Parameters Values

Parameters	Symbol	Value	
Interest Rate	r	0.075	
Separation rate l	s_l	0.1	Duration 10 years
Separation rate s	s_s	0.3	Duration 3 years
Scale parameter in $h(U,V)$	A	0.3	
Elasticity in U in $h(U,V)$	η	0.5	
Search Cost l	γ_l	0.25	
Search Cost s	γ_s	0.05	
Replacement Ratio	λ	0.5	
Share of Workers in Bargaining	β	0.1	
Limit Growth Rate with Coexistence	g_0	0.042	

The parameters r , s_l, s_s and are set to commonly admitted values. η is chosen as an average of Pissarides, Blanchard-Diamond and Burda-Wyplosz estimates. The search cost is a quarter of the marginal product of labour for the long-term jobs, and 1/20 for the short-term jobs. The other parameters are such that unemployment and hiring rates are roughly at the European levels. With these values, the limit growth rate below which dualism arises is 4.16% a year. We get the following results (table 5.2):

Table 5.2: Benchmark Simulation

Productivity growth g	0	0.01	0.02	0.03	0.04
$\theta_l = V_l/U$	4.67	5.04	5.47	5.93	6.49
$\theta_s = V_s/U$	3.63	2.97	2.19	1.27	0.201
$\theta = \theta_l + \theta_s$	8.30	8.01	7.66	7.22	6.69
$\theta_s/\theta = y_V$	0.437	0.370	0.286	0.176	0.029
q_l	0.139	0.134	0.128	0.123	0.118
q_s	0.060	0.059	0.058	0.059	0.058
$\theta_l.q_l + \theta_s.q_s$	0.864	0.849	0.830	0.806	0.776
$\overline{s}$	0.120	0.116	0.111	0.107	0.101
u	0.122	0.120	0.118	0.117	0.115
N_l	0.790	0.809	0.831	0.854	0.880
N_s	0.088	0.070	0.051	0.029	0.004
$N_s/N = y_N$	0.100	0.080	0.058	0.033	0.005

Lower productivity growth, from 4% to 0%, increases the share of short-term job offers from 2.9% to 43.7% and of short-term jobs, from 0.4% to 8.8%. Unemployment increases from 11.5% to 12.2%: here the capitalization effect dominates the wage setting effect, because the parameter β is low. From this simulation, it appears that the aggregate effects of growth are quite weak. However, the distributional effects are very important, since the share of short-term jobs is increased by 25% for each percentage point of growth lost. The model reproduces the stylized fact that downturns are period of rising inequalities. Here, inequality arises from differences in the duration of jobs, not from wages.

In table 5.3, we see that, with higher values of β, the capitalization effect of growth can be totally offset by the wage setting effect. It means that lower growth reduces wage pressure so much that unemployment does not increase. Unemployment even decreases from 8.69 to 8.61% of the labour force when growth rate falls from 4% to 0%. The share of short-term job offers and of short-term jobs is very similar to the previous simulations.

Table 5.3. Variation: β= 0.6, A=1.0

Productivity growth g	0	0.01	0.02	0.03	0.04
$\theta_l = V_l/U$	0.913	0.953	0.996	1.042	1.092
$\theta_s = V_s/U$	0.709	0.561	0.398	0.222	0.032
$\theta = \theta_l + \theta_s$	1.623	1.513	1.394	1.264	1.125
$\theta_s/\theta = y_V$	0.438	0.370	0.286	0.176	0.029
q_l	1.050	1.020	1.000	0.979	0.957
q_s	0.450	0.453	0.459	0.466	0.475
$\theta_l.q_l + \theta_s.q_s$	1.270	1.230	1.180	1.120	1.060
$\overline{s}$	0.120	0.116	0.112	0.106	0.101
u	0.0861	0.0861	0.0863	0.0865	0.0869
N_l	0.822	0.841	0.861	0.883	0.908
N_s	0.091	0.073	0.052	0.030	0.005
$N_s/N = y_N$	0.100	0.080	0.057	0.033	0.005

We now return to the benchmark simulation, and see how the replacement ratio, the cost structure, population growth and job duration affect the equilibria.

- Benchmark

g	0.01	0.04
$\theta_s/\theta = y_V$	0.37	0.03
$N_s/N = y_N$	0.08	0.005
u	0.120	0.115
g_0	0.042	

- Effect of the replacement ratio: $\lambda = 0.7$

g	0.01	0.04
$\theta_s/\theta = y_V$	0.37	0.03
$N_s/N = y_N$	0.08	0.005
u	0.170	0.160
g_0	0.042	

- Effect of the hiring cost structure: $\gamma_l = 0.30, \gamma_s = 0.05$

g	0.01	0.04
$\theta_s/\theta = y_V$	0.66	0.50
$N_s/N = y_N$	0.19	0.12
u	0.125	0.120
g_0	0.075	

- Effect of population growth: $n = 0.04$

g	0.01	0.04
$\theta_s/\theta = y_V$	0.37	0.03
$N_s/N = y_N$	0.097	0.006
u	0.158	0.154
g_0	0.042	

- Effect of the separation rates: $s_l = 0.1, s_s = 0.32$

g	0.01	0.04
$\theta_s/\theta = y_V$	0.37	0.03
$N_s/N = y_N$	0.04	0.00
u	0.123	0.120
g_0	0.028	

The distribution of jobs is very sensitive to changes in the hiring costs or in the separation rates. Aggregate variables, unemployment, vacancy rates and labour market tightness are by contrast very sensitive to the aggregate parameters like the replacement ratio.

Finally we could wonder if the introduction of short duration contracts sufficiently lowers the bargaining power of insiders to improve the efficiency of the labour market and to increase employment. We come back on the benchmark simulation, that we compare with the case with only long-term jobs allowed in the economy.

- With two types of jobs

	0	0.01	0.02	0.03	0.04
$\theta = \theta_l + \theta_s$	8.30	8.01	7.66	7.22	6.69
$\theta_l.q_l + \theta_s.q_s$	0.864	0.849	0.830	0.806	0.776
$\overline{s}$	0.120	0.116	0.111	0.107	0.101
u	0.122	0.120	0.118	0.117	0.115

- With long-term jobs only

	0	0.01	0.02	0.03	0.04
θ	4.98	5.32	5.68	6.08	6.51
$\theta.q(\theta)$	0.670	0.692	0.715	0.740	0.766
$\overline{s}$	0.100	0.100	0.100	0.100	0.100
u	0.123	0.126	0.123	0.119	0.116

The difference between an economy with dualism, and one where dualism is not allowed, is though generally weak yet stronger in periods of low growth. A fraction of workers suffer from the low growth, paying the cost in terms of shorter contracts.

5.6 Empirical Evidence

5.6.1 The rise in turnover between Employment and Unemployment in France

In a paper by Cohen and Lefranc (1994), the authors discuss the effect of changes in the productivity growth on the French labour market by showing that the separation rate (the exit rate from employment) of the male 25-49 years old workers is strongly and negatively correlated to the growth of labour productivity. The transitions between three different states, Employment, Unemployment and Not in Labour force (E, U, N hereafter) are obtained from labour force survey Enquête Emploi: people of the sample are asked, which state they are in, and which state they were in a year before. Dividing each of the six flows by the population of the original state, we obtain a transition rate from state i to state j. We can therefore define a matrix, where the element of the i^{th} column and of the j^{th} row is the probability for an individual to transit from i to j between t and $t + dt$. After a mathematical transformation (see appendix 4 for details), we get the matrix of the monthly transitions. The separation rates

Figure 5-6: France: transition employment-unemployment and employment-inactivity for men

(figures 5-6 and 5-7), disaggregated by sex (denoted by $s-e$, or $exit-e$), exhibit the clear pattern discussed in Cohen and Lefranc: the increase in the male exit rate from employment and the constancy of its female counterpart. Remarkably, the inflows into unemployment are increasing in both cases. This is also true for the 25-49 years old which by definition excludes most of the new young entrants and the retiring people.

The model of sections 2 to 5 provides a theoretical interpretation of Cohen and Lefranc's correlation: as already discussed in introduction about figure 5-1, all this rise in the separation rate can be attributed to the rising fraction of temporary contracts in total employment, which in turn is linked to lower growth.

5.6.2 Test of the model

The model predicts that the increased use of temporary contracts is caused by a decrease of the productivity growth, by higher population growth and by high hiring cost differential between jobs. These predictions can be tested on the first two parameters in a cross-section of countries. We denote by TMP_1 the share of temporary contracts to all the jobs in 1983, TMP_2 the share

Figure 5-7: France: transition employment-unemployment and employment-inactivity for women

of temporary contracts in 1991. Relevant data are available for 15 OECD countries. We denote by n and nl the growth rates of population and of labour force respectively.. If we denote by $g(s,t)$ the average growth rate of GDP per head between s and t, we may define the slowdown of growth by $dg = g(76,94) - g(60,75)$, to get a proxy of the slowdown in productivity growth. We use this difference in the regression analysis, since the actual share of temporary contracts is likely to be on a transition path rather than in a steady-state equilibrium. Therefore, the speed of adjustment to the steady-state value is likely to be both highly correlated to the changes in growth conditions and a good proxy for the long-run value of temporary contracts.

In all the specifications reported in table 4, the countries with more temporary contracts are the countries where the slowdown in growth was important and the population growth was large, as one expected from the model:

Table 5.4. Regression analysis,OLSQ

$TMP_2 = 2.32(0.51) + 14.61(1.16).n - 2.64(1.58).dg$

$R^2 = 0.29$, 15obs

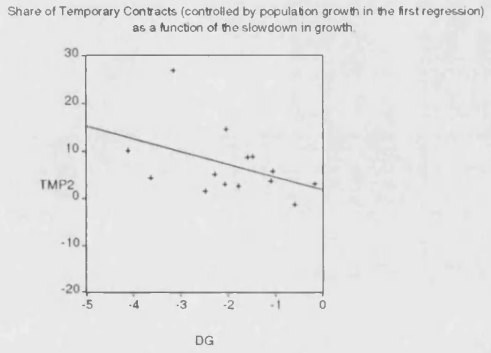

Figure 5-8: Regression Analysis in a Cross-Section of 15 OECD countries

$(TMP_2 - TMP_1) = -1.46(0.36) + 2.01(0.18).n - 1.42(0.96).dg$

$R^2 = 0.08$, 15 obs

$TMP_1 = 3.78(1.09) + 12.6(1.32).n - 1.23(0.96).dg$

$R^2 = 0.22$, 15 obs

$TMP_2 = 3.86(0.83) + 4.28(0.62).nl - 3.03(1.78).dg$

$R^2 = 0.24$, 15 obs

(t-Stat in parentheses)

See also the figure 5-8 and the regression lines linking the share of temporary contracts in 1991 to the slowdown of growth (controlled by the population growth, that is removing from TMP_i the effect of population). We suggest that the effects described in the model are likely to be at work in the reality: a low growth is associated with lower value of long-term jobs for firms and a high population growth makes the recruitment of workers in short-term jobs easier. Other tests, including cross-industry data, are possible and left for future work.

5.7 Conclusion

This work shows that in an equilibrium unemployment model à la Pissarides with exogenous growth, the firms have much more easily recourse to temporary contracts when growth is low. In this latter case, firms prefer high turnover workers with low turnover costs, to workers with

longer tenures but with higher turnover costs. When growth is low, then population has also a positive impact on the share of temporary jobs. In addition, when the share of short duration jobs increases, so does the inflow into unemployment, which shifts the Beveridge curve to the right and reinforces the rise in unemployment.

Finally, for some values of the parameters, in particular if the share of the workers in the surplus of a match is high (wages are set by a Nash-Bargaining), the relation between technological growth and unemployment can be negative: high growth implies higher wage pressure due to more long-term jobs, which can negatively affect employment beyond the rise in labour demand due to higher growth.

This analysis is consistent with the French inflows into unemployment changes over the last 25 years and with the OECD cross-country differences in the extent of recourse to temporary contracts.

- **Appendix 1. Returns to scale of the matching technology and properties of the exit rates from unemployment.**

It is easy to see that $h_l = h(U, V_l)$ is constant return to scale in (U, V_l) by definition. The same is true for $h(U, V)$, constant return to scale in (U, V). Now with $h(U, V_l + V_s) - h(U, V_l)$, we argue that this quantity is increasing return to scale in (U, V_s) at constant V_l. **Proof.** For that, it is sufficient to show that the quantity $H(z) = \frac{h(zU,V_l+zV_s)-h(zU,V_l)}{z} = h(U, V_l/z) + h(U, V_l/z + V_s)$ is increasing in z, the scale factor. This is true since $\partial H(z)/\partial z = V_l/z^2[h_s(U, V_l/z) - h_s(U, V_l/z + V_s)]$, with h_s the derivative of h with respect to the second argument. By concavity of $h(.,.)$ in each of its arguments, the quantity is strictly larger than 0 for $V_s > 0$. ■

We also derive some properties of the exit rates from unemployment: the transition rate from unemployment to jobs l is equal to $\theta_l.q_l = \theta_l x(\theta_l)$. Given that x has an elasticity of $-\eta$ smaller than 1 in absolute value, the exit rate is increasing in θ_l. The same is true for the exit rate from unemployment, $\theta_l.q_l + \theta_s.q_s = \theta.x(\theta)$, which is increasing in θ. Unfortunately, this property does not hold for the transition from unemployment to jobs s.

- **Appendix 2. Determination of (5.13)**

We have (5.11)

$$(r-g)U = z + \sum \theta_i.q_i.(E_j - U) \tag{5-11}$$

We also have (5.12)

$$(r-g)E_j = w_j(1+s_j.f_j) + s_j(U-E_j) \tag{5-12}$$

(5.11) and (5.12) yields:

$$(r-g+s_j)(E_j-U) = w_{ej} - z - \sum_{j=l,s} \theta_j.q_j.(E_j-U) \tag{5.31}$$

Dividing by $r-g+s_j$ and adding both lines for $j=l$ and s:

$$\sum_{j=l,s} p_j(E_j-U) = \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j}(w_{ej}-z) - \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} \sum_{j=l,s} \theta_j.q_j.(E_j-U) \tag{5.32}$$

We call now:

$$\xi = \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} \tag{5.33}$$

and we have:

$$(1+\xi) \sum_{j=l,s} \theta_j.q_j.(E_j-U) = \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} w_{ej} - \xi.z \tag{5.34}$$

and so:

$$\sum_{j=l,s} \theta_j.q_j.(E_j-U) = \frac{1}{1+\xi} \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j}(w_{ej}-z) - \frac{\xi}{1+\xi} z \tag{5.35}$$

Now we can replace in (5.31), and we have demonstrated (5.13):

$$(r-g+s_i)(E_i-U) = w_i(1+s_i.f_i) - \{z + \sum_{j=l,s} \frac{\theta_j q_j.w_j.(1+s_j.f_j)}{r-g+s_j}\} / \{1 + \sum_{j=l,s} \{\theta_j q_j\} / \{r-g+s_j\}\} \tag{5-13}$$

- **Appendix 3. Determination of wages**

Wages are bargained such as to share the marginal surplus of the firm and the surplus of the workers. The marginal surplus of the firms follows the following asset value:

$$(r-g)J_i = \exp(gt).MPL(k) - w_{\epsilon i} + s_i(V_i - J_i) \tag{5.36}$$

with V_i the marginal value of a vacancy, given by:

$$(r-g)V_i = -\gamma_{0i} + q_i(J_i - V_i) \tag{5.37}$$

and V_i is equal to 0 if all the vacancy opportunities are exhausted.

Assume different bargaining power β_j for each job. The bargaining yields to:

$$\frac{\beta_j}{E_j - U} = \frac{1-\beta_j}{J_i - V_i} \tag{5.38}$$

We have:

$$\frac{\beta_j}{E_j - U} = \frac{\beta_j.(r-g+s_j)(1+\xi)}{w_{\epsilon j}(1+\xi) - z - \sum_{j=l}^{s} \frac{\theta_j.q_j.}{r-g+s_j} w_{\epsilon j}} \tag{5.39}$$

and from $V_j = 0$:

$$J_i = \gamma_{0i}/q_i = \frac{\exp(gt).MPL(k) - w_{\epsilon i}}{r-g+s_i} \tag{5.40}$$

so:

$$\frac{\beta_j}{E_j - U} = \frac{\beta_j(1+\xi)[\exp(gt).MPL(k) - w_{\epsilon j}]}{J_j} . \frac{1}{w_{\epsilon j}(1+\xi) - z - \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} w_{\epsilon j}} \tag{5.41}$$

Therefore, dividing by J_j and taking the inverse:

$$\beta_j(1+\xi)[\exp(gt).MPL(k) - w_{ej}] = (1-\beta_j)(w_{ej}(1+\xi) - z - \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} w_{ej}) \quad (5.42)$$

and after simplification:

$$w_{ej} = \beta_j[\exp(gt).MPL(k) + (1-\beta_j)\frac{z + \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} w_{ej}}{1+\xi} \quad (5.43)$$

This last result is very important since it proves that, if we add the assumption of the same bargaining power for each job $\beta_l = \beta_s = \beta$, then the equivalent wage, $w_{ei} = w_i(1 + s_i.f_i)$ is the same for both contracts. Then the solution is easy: from 5.43 and with $w_e = w_{el} = w_{el}$ it follows that:

$$w_e = \beta[\exp(gt).MPL(k) - w_e] + (1-\beta)z$$

Using the fact that

$$\sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} = \sum_{j=l,s} \frac{\theta_j \gamma_j}{\exp(gt).MPL(k) - w_e}$$

it comes finally:

$$w_{ei} = w_i(1+s_i.f_i) = [\lambda(1-\beta) + \beta[MPL(k).exp(gt) + \sum_{j=l,s} \theta_j q_j] \quad (5.44)$$

Note that $E_l > E_s$ because $s_l < s_s$.

We can also derive the same equations when the production function is not symmetric in the two types of jobs, for instance

$$Y = F(K, \exp(gt)(\alpha.N_l + N_s))$$

where $\alpha > 1$ quantifies the difference in productivity of long-term jobs workers. In that case, this can be found in the first order condition of the firm maximization, in the firm' s marginal asset value of a match, but not in the workers valuation.. In that case, 5.43 would become:

$$w_{ej} = \alpha.\beta_j[\exp(gt).MPL(k) + (1-\beta_j)\frac{z + \sum_{j=l,s} \frac{\theta_j.q_j}{r-g+s_j} w_{ej}}{1+\xi} \quad (5.45)$$

Unfortunately, the symmetric solution in wages cannot be defined.

- **Appendix 4. Infra-year transitions**

Let $Q(dt = 12)$ be this matrix associated, during the period t and $t + 12$. In our case,

$$Q(dt) = Id + P(dt = 12) = \begin{pmatrix} 1 - eu - en & ue & ne \\ eu & 1 - ue - un & nu \\ en & un & 1 - ne - nu \end{pmatrix}$$

for a vector of states

$$X(t) = \begin{pmatrix} E \\ U \\ N \end{pmatrix}(t)$$

representing the number of persons in each state at t. Therefore, $X(t + 12) = Q(dt = 12).X(t)$ and the net flows in level are given by $P(dt = 12).X(t)$. A criticism can be easily made: when the rates in the matrix P are far from 0, like the ue rate which is about 50%, the probability of multiple infra-period transitions cannot be neglected, and the flows in level are underestimated. It is therefore better to estimate from the matrix $Q(dt = 12)$, the matrix $Q(dt)$ for smaller dt (in the limit, when dt tends to 0, the matrix $P(dt)/dt$ gives the Markovian transition matrix). For our purpose, which is to get rid of the multiple transitions, the monthly matrix is sufficient. It is clear that $Q(dt) * Q(dt') = Q(dt + dt')$, and assuming:

1. the monthly matrix to be constant over the year, and 2. no state dependence of the individuals,

we can, by taking the unique 12th root of $Q(dt = 12)$ whose all coefficient are strictly between 0 and 1, estimate the monthly rates and therefore the monthly flows, obtained by multiplying the rates by the real stocks.

- **Appendix 5. Temporary work: the main features**

In France there has been a spectacular rise in the demand for temporary contracts. Between 1983 and 1991, the share of temporary workers in total employment increased from 3.3 to 10.2%, while in UK, it stayed around 5.5%, in Germany it stayed around 10%, and in Belgium it stayed around 12%. A similar rise has been observed in Spain. Overall, in Europe, this share increased from 4% to 10% (according to Bentolila and Dolado, 1994).

The legislation on the renewal is nevertheless restrictive: the maximum duration is two years, and they are renewable twice only. See OECD Employment Outlook, and Grubb and Wells (1993) for more details.

Men are concerned as much as women: in 1991, 47.4% of all temporary jobs are for men. The concentration is of course a decreasing function of age: 44.5% of the temporary workers are between 15 and 24 years old, while these 15-24 years old workers represent a share of only 15.8% of all salary earners. Nevertheless, the 25-54 years old represents 53.4% of these contracts (for a fraction of 78.3% of total salary earners).

Evidence from other countries suggests that a majority of the temporary workers could not find a permanent job: 90% in Spain, 60% in Italy. However, the corresponding figure is not available for France. In the UK in contrast, their number is only 30%. From the employer side, the main reasons for he recourse to these contracts are: seasonal factors, replacement of absent workers, occasional jobs with specific skills, screening, etc.... But in the surveys where these answers come from, there is no distinction between temporary and interim contracts. Other reasons are provided when the distinction is made (see Mc Gregor and Sproull, 1991, quoted in the OECD survey): reduced wages, fewer employment rights, flexibility in staffing levels. These latter facts justify the way we modelled the short-term jobs, with low hiring costs, low firing costs and of course low durations.

Chapter 6

Equilibrium Urban Unemployment

Abstract: We introduce a spatial dimension in a search equilibrium unemployment model. By assuming that workers' search efficiency decreases with the distance to the employment-center, two urban equilibrium configurations emerge: either the unemployed reside close to the employment-center or far away from it, depending on the values of the commuting costs and of the surplus associated with search, which depends on the labour market equilibrium. The labour market equilibrium itself depends crucially on these urban equilibria. We show that the unemployment level is lower in the first urban equilibrium.

6.1 Introduction

Most synthesis of unemployment (see e.g. Layard, Nickell and Jackman, 1991) introduce the spatial dimension at a fairly aggregate level and generally at the regional level. It is usually shown that unemployment is unevenly distributed between regions and that this phenomenon persists in the long run (Blanchard and Katz, 1992, Gordon, 1987, part 1, Holzer, 1989, McCormick and Sheppard, 1992, Blanchflower and Oswald, 1994, ch.2). Even though it is commonly observed that unemployment is unevenly distributed within cities, the explanation of urban unemployment and in particular of intra-urban unemployment differences is still in its infancy. In the US metropolitan areas, unemployment rates tend to be larger in the city-center than in the suburbs (see table 6.1a). In Europe the pattern is less clear. If we take a large city like Paris, we see that the contrary is true while (Greater) London (see Hasluck, 1987, p.11,

figure 1.3(b)) and (extended) Brussels (see Thomas and Zénou, 1997, figure 3) resemble the US metropolitan areas. How can we explain such differences ? The natural explanation that comes to mind is the historical reasons, reflected by the type and location of amenities within a city (Brueckner, Thisse and Zénou, 1997).

Another explanation of urban unemployment is the fact that *access to employment* within a city is strongly affected by residential location. Since workers do not reside in the same location in the city, they do not have the same access to employment. This is the idea of the *spatial mismatch* hypothesis introduced by Kain (1968) and reviewed more than twenty years later by Holzer (1991): residing in segregated areas distant from and poorly connected to major centers of employment growth, African Americans face strong geographic barriers to finding and keeping well-paid jobs. In this context, African Americans are forced to stay in the ghetto in the city-center and are therefore far away from jobs, located at the city outskirts, because of the discrimination in the housing market in the suburbs. In France, the same problem exists. In Table 6.1.b, we have reported unemployment of the 500 prioritary districts in France. According to Castellan, Marpsat and Goldenberg (1992), these districts have a geographical specificity in the sense that they are closer to the periphery than the center (0.9 km versus 2.3 km in average), in general physically separated from the centers by ring roads, rivers or railroads, and poorly connected to the center since there is a railroad in 70% of the districts, but a station in only 40% of the cases.

[*Insert Table* 6.1*a and* 6.1*b*]

In this paper, we want to emphasize the fact that *space is an obstacle in the access of job opportunities.* In other words, workers living further away from jobs have poorer labour market information than those living closer. This is particularly true for younger and/or less-skilled workers who rely heavily on informal search methods for obtaining employment (Holzer, 1987).[1] The reliance on these informal methods of job search suggests that information on available job opportunities may decay rapidly with distance from the home (Ihlanfeldt and Sjoquist, 1990) and that the black disadvantage is entirely attributable to residential segregation (Ihlanfeldt

[1] In Holzer (1988), it is shown that among the 16-23 years old workers who reported job acceptance, 66% used informal search channels (30% direct application without referral and 36% friends/relatives), for only 11% using state agencies or 10% newspapers.

1997).[2] Another empirical study (Zax and Kain ,1996) has illustrated this fact. By studying a 'natural experiment' (the case of a large firm in the service industry which relocated from the center of Detroit to the suburb Dearborn in 1974), they show that the suburbanization of employment tends to reduce black opportunities and increase black unemployment. Among the workers whose commuting time was increased, blacks were over-represented, and not all workers could follow the firm. This had two consequences: first, segregation forced some blacks to quit their jobs. Second, the share of black workers in job applications drastically decreased (53% to 25% in 5 years before and after the relocation), and the share of black workers in hirings also fell down from 39% to 27%. Zax and Kain concluding remarks are: "... with employment in the Detroit region shifting from locations at which black workers have higher probabilities of employment to locations at which they have lower probabilities, black workers must search more locations in order to prevent their aggregate probability of employment from declining. If search is costly, some decline is unavoidable. Therefore, the "spatial mismatch " must certainly cause some, as yet unestimated, increase in black unemployment in the Detroit metropolitan area."

The empirical relevance of urban unemployment and of the relation between space and job opportunity is quite clear. However, the theoretical explanation of the cause of urban unemployment and of the location of the unemployed is still very recent and there is so far no complete theory (Zénou, 1997). Zénou and Smith (1995) were the first to explicitly introduce the location of the unemployed workers with an endogenous level of urban unemployment (due to efficiency wage reasons). This paper is in the same vein only more oriented towards the micro-macro interactions, following Benabou (1993) who investigates the combination of local complementarities in human capital accumulation and global complementarities in production. Here, we build a model of search in a monocentric city in which local factors (rental price, distance to employment-centers) and global factors (labour market tightness, wages) influence the location choices of the workers (the urban equilibrium) and the labour market equilibrium. A central assumption here is that the probability of getting a job is inversely related to the distance to the employment-center. This is one way *to emphasize the fact that the geographical*

[2] Of course differences in access of information on job opportunities can also be explained by the the social network and the neighborhood where workers live (Benabou, 1993, O'Regan and Quigley, 1993, Topa, 1997, Wilson 1987, 1996). In this paper we focus on the geographical distance as a barrier to access to employment.

distance to the employment-center and thus access to employment is a key factor to explain urban unemployment. The first (and main) reason for this, consistently with the empirical observations made by Holzer (1987), Ihlanfeldt and Sjoquist (1990), Ihlanfeldt (1997), Zax and Kain (1996)... developed above, is that information about available jobs circulates through informal networks and the further away workers live the poorer is this information. The second reason is that among the numerous forces that aggregate people in cities, the labour market forces are especially relevant: people come to cities to get an access to employment. This second reason is especially appropriate when the local labour market considered has the size of an agglomeration, i.e. incorporating the city-center, the suburbs and the periphery in a broad sense.

Within this framework, we have different urban equilibria since the unemployed want to be as close as possible to the CBD in order to increase their probability of getting a job and the employed want the same location because they bear higher commuting costs. As a result, the equilibrium configuration will depend on the shape of the search intensity function since the slope of the bid rent of the unemployed depends only on this function and on the linear transport cost. If this function is linear with distance (as a first simplifying assumption), then there will be only two possible configurations: either the unemployed are close to the CBD or they are further away from the CBD. If we further introduce search effort, then we prove that search efficiency is decreasing and convex with the distance to the CBD. This convexity can lead to a third urban equilibrium in which the unemployed will locate at the vicinity of the CBD and at the outskirts of the city whereas the employed will reside in between them.

We then derive the labour market equilibrium in which urban unemployment is due to frictions in the labour market: even if firms pay the reservation wage of workers, there will still be a level of durable unemployment in the city because there is a stochastic rationing that cannot be eliminated by price adjustment. We explore different wage setting mechanisms that give similar results. The important point in our analysis is that the labour market equilibrium depends crucially on the urban equilibrium configurations, and the urban equilibrium itself depends on aggregate variables (wages and labour market tightness) because these variables affect location choices. If for example, unemployed workers reside far away from the city-center, aggregate matching is not efficient and firms are reluctant to make job offers. On the

other hand, when the unemployed reside close to the city-center, firms post more vacancies and aggregate unemployment is lower. *In our model, in the low equilibrium (in which the matching is not efficient) workers can not move towards jobs because of the high land price.* This is part of the story we want to explain and the other part is certainly due to racial discrimination and bad environment.

It is important to observe that search models have rarely been introduced in a spatial framework. Exceptions include Jayet (1990a,b), Simpson (1992), Coulson, Laing and Wang (1997). However, these authors focus on different issues and in particular they do not model explicitly the intra-urban equilibrium in which the location of the unemployed and the employed workers is determined endogenously and influences the labour market equilibrium.

The remainder of the paper is organized as follows. Section 2 presents the model and its notations. In section 3, we derive the different equilibrium urban configurations. The labour market equilibrium with exogenous wages is then studied in section 4 whereas the case with endogenous wage bargain is analysed in section 5. Finally, section 6 concludes.

6.2 The model and general notations

The model is a matching model of search *a la* Pissarides (1990). Firms and workers are all (*ex ante*) identical. A firm is a unit of production that can either be filled by a worker whose production is y units of output or unfilled and thus unproductive. The latter case may happen because the allocation of resources is time consuming and involves frictions in the labour market. The former case concerns the two sides of the labour market. In order to find a worker, a firm posts a vacancy that can be filled according to a random Poisson process. Similarly, workers who are looking for a job will find one according to a random Poisson process. In this context, the number of unemployed workers U and the number of vacancies V are both determined at a given period of time. Moreover, there are a number of contacts between the two sides of the market during a small time interval dt that we assumed to be determined by the following *matching* function:

$$x(\overline{s}U, V)dt \tag{6.1}$$

where $\overline{s}$ is the average efficiency of search of the unemployed workers (a worker i has an efficiency of search equal to s_i). We assumed that $x(.)$ is increasing both in its arguments, concave and homogeneous of degree 1 (or equivalently has constant return to scale). Observe that here the number of job contacts as described by (6.1) is equivalent to the number of job matches, i.e., all job contacts lead to job matches. We could have differentiated the two concepts (job contact versus job match) as in Pissarides (1990, ch.5) by multiplying $x(\overline{s}U, V)dt$ by a probability that a job contact is transformed into a job match but this will complicate the analysis without altering our main results. Therefore, (6.1) is the well behaved matching function that gives the number of jobs formed at any moment of time as a function of the number of "efficient units" of searching workers and the number of firms looking for workers. In this context, the probability for a vacancy to be filled during a small time interval dt is:

$$\frac{x(\overline{s}U, V)dt}{V} \tag{6.2}$$

By constant return to scale, (6.2) can be rewritten as:

$$q(\theta)dt \equiv x(\frac{1}{\theta}, 1)dt \tag{6.3}$$

where $\theta = V/U\overline{s}$ is a measure of labour market tightness in efficiency units. By using the properties of $x(.)$, it is easily checked that $q'(\theta) \leq 0$: the greater the labour market tightness, the lower the probability of filling a vacancy for a firm. Observe that we assume that firms have no impact on their own search efficiency and considers $\overline{s}$, U and V as given. Similarly, for a worker i with efficiency s_i, the probability of having a contact with a vacancy during a small time interval dt is:

$$\frac{x(\overline{s}U, V)}{U}\frac{s_i(d)}{\overline{s}}dt = \theta q(\theta)s_i(d)dt = p(d)dt \tag{6.4}$$

where d is the distance from the workplace. Contrarily to the standard model of job matching as proposed by Pissarides (1990) in which there is no spatial dimension, we make here the important assumption that s_i depends on the location of the unemployed workers in the city: the closer to the workplace the location, the greater the efficiency and the more likely is to have a contact ($s_i = s_i(d)$ where d is the location of the worker with $s_i'(d) < 0$). As already

discussed in the introduction, we focus here on low-skill workers who rely strongly on informal search methods to get a job. We therefore assume here that search costs are higher and informal information networks are less effective for those residing further away from jobs' location (this is empirically verified, at least for the unskilled workers; see e.g., Holzer, 1987, 1991).[3]

Therefore, *the endogenous choice of workers' locations will be strongly influenced by the search process and by the labour market conditions.* Once the match is realized the wage is determined (first exogenously and then through a Nash bargaining). At each period, there is also a probability δdt that the match is destroyed. All these transition probabilities describe a Poisson process. In order to determine the equilibrium, we will proceed as follows. We determine first the urban equilibrium configurations. Then, depending on the location of the unemployed and thus on the aggregate search efficiency $\overline{s}$, we determine the labour market equilibria.

6.3 Equilibrium urban configurations

We use here the standard framework in urban economics of the monocentric city (see Fujita, 1989). All firms are assumed to be located at the central business district (CBD hereafter) whereas workers decide endogenously their optimal residence between the CBD and the city fringe. The assumption that firms cannot chose their location can be seen as a short run assumption. In the long run, the equilibrium may not hold if the cost for a firm to leave the other firms is smaller than the gain associated to the other location, hereafter the fact that the firm will be closer from the unemployed. However, by an argument of symmetry, it will be shown later that even in relaxing the assumption that firms are located in the CBD, in most of the cases, the choice of this location is itself the result of an equilibrium.

The city is linear, closed and landlords are absent.[4] There is a continuum of workers that are distributed uniformly along the linear city and consume all the same amount of land (normalized to 1). The density of residential land parcels is taken to be unity so that there are exactly d

[3] See Appendix 1 where this assumption is derived endogeneously. In this case, search efficiency depends on the optimal level of workers' effort. This effort is associated to the distance to the workplace by a cost-benefits trade-off and gives the same negative dependance between search efficiency and distance.

[4] All these assumptions are very standard in urban economics and relaxing them will not alter the main conclusions but just yield to more complicate results.

units of housing within a distance d of the CBD.

Employed workers go to the CBD to work and to shop while unemployed workers go to the CBD to be interviewed and to shop. Let us denote by $\alpha_s d, \alpha_e d$ and $\alpha_u d$ the transportation cost at a distance d from the CBD for respectively shopping, working and unemployed specific activities (interviews, registration), with $\alpha_s \geq 0, \alpha_e \geq 0$, $\alpha_u \geq 0$. In this context, the transportation cost for the employed workers is equal to $(\alpha_s + \alpha_e)d$ and for the unemployed worker it is equal to $(\alpha_s + \alpha_u)d$. All workers bear land rent costs at the market price $R(d)$ and receive a wage w when employed and an unemployment benefit b if unemployed. We denote by I_u and I_e the expected lifetime net income of the unemployed and the employed respectively. We assume that location changes are costless. With the Poisson probabilities defined above, infinite lived workers have the following intertemporal utility functions:

$$rI_u(d) = b - (\alpha_s + \alpha_u)d - R(d) + p(d)\left[Max_{d'} I_e(d') - I_u(d)\right] \tag{6.5}$$

$$rI_e(d) = w - (\alpha_s + \alpha_e)d - R(d) + \delta\left[Max_{d'} I_u(d') - I_e(d)\right] \tag{6.6}$$

where r is the exogenous discount rate. Let us comment (6.5). When a worker is unemployed today, he resides in d and his net income is $b - (\alpha_s + \alpha_u)d - R(d)$. Then he can get a job with a probability $p(d)$ and then will optimally relocate in d' and obtain an increase in his income of $I_e(d') - I_u(d)$. We assume here that relocation costs are zero and that when a worker changes his employment status he automatically change his residence. The interpretation of (6.6) is similar. In equilibrium, all unemployed workers enjoy the same level of utility as well as employed workers: $rI_u = r\overline{I_u}$ and $rI_e = r\overline{I_e}$, both determined by the urban equilibrium. Therefore, bid rents, i.e., the maximum rent that workers are ready to pay in order to reach the equilibrium utility, are respectively equal to:[5]

$$\Psi_u(d, \overline{I_u}, \overline{I_e}) = b - (\alpha_s + \alpha_u)d + p(d)\overline{I_e} - (r + p(d))\overline{I_u} \tag{6.7}$$

[5] As it can be seen from (6.7) and (6.8), bid rent is the inverse of the indirect utility function. Moreover, bid rent is a useful concept do determine the optimal location of workers. Indeed, since all workers of the same group enjoy the same level of utility in equilibrium, the optimal location of each worker is that location at which his bid rent curve is tangent to the market rent curve from below (see Fujita, 1989, p.24).

$$\Psi_e(d, \overline{I_u}, \overline{I_e}) = w - (\alpha_s + \alpha_e)d + \delta\overline{I_u} - (r + \delta)\overline{I_e} \tag{6.8}$$

The determination of urban equilibrium involves the slopes of the bid rents. They are respectively equal to:

$$\frac{\partial \Psi_u(d, \overline{I_u}, \overline{I_e})}{\partial d} = -(\alpha_s + \alpha_u) + p'(d)(\overline{I_e} - \overline{I_u}) \leq 0 \tag{6.9}$$

$$\frac{\partial \Psi_e(d, \overline{I_u}, \overline{I_e})}{\partial d} = -(\alpha_s + \alpha_e) \leq 0 \tag{6.10}$$

where $p'(d) = \theta q(\theta) s'(d) < 0$. These slopes (in absolute values) can be interpreted as the marginal cost that the worker is ready to pay in order to be marginally closer to the CBD. On one hand, for the unemployed this marginal cost is the sum of the marginal commuting cost, $(\alpha_s + \alpha_u)$, and the marginal probability of finding a job times the (intertemporal) surplus of being employed. On the other hand, the employed bear only at the margin commuting cost equal to $(\alpha_s + \alpha_e)$ since the probability of losing a job δ is totally exogenous and do not depend on the location of workers. To find the equilibrium location of all workers in the city, we must compare these slopes.

Assume that the intersections of the slopes of the two bid rents is of zero measure. This implies that we exclude mixed configurations where both employed and unemployed are located at the same place and that we consider only separated configurations where only one type of workers locate within the same segment. Let us denote by d_f the city fringe, and by $h_u(d)$ and $h_e(d)$, the density functions of the unemployed and the employed households at each location d[6].

Definition 1 *The urban equilibrium is such that:*

$$R(d) = Max \left\{ \Psi_u(d, \overline{I_u}, \overline{I_e}), \Psi_e(d, \overline{I_u}, \overline{I_e}), R_A \right\} \quad at\ each\ d \in [0, d_f]$$

$$R(d) = \Psi_u(d, \overline{I_u}, \overline{I_e}) \quad if\ \ h_u(d) > 0,\ h_e(d) = 0 \quad at\ each\ d \in [0, d_f]$$

$$R(d) = \Psi_e(d, \overline{I_u}, \overline{I_e}) \quad if\ \ h_e(d) > 0,\ h_u(d) = 0 \quad at\ each\ d \in [0, d_f]$$

[6] Given the assumption that workers are distributed uniformally in the city, the density functions have their values in {0,1}.

$$R(d_f) = R_A$$

With this definition of equilibrium, we can have a large variety of equilibria. However, in this paper, for analytical simplicity, we focus only on linear bid rent slopes, i.e., $p''(d) = 0$ in which only two urban equilibria are possible: the first one (labelled Equilibrium 1) where the unemployed reside at the vicinity of the CBD and the second one (labelled Equilibrium 2) where the unemployed locate at the outskirts of the city. For that we assume that $s(d) = s_0 - ad$ with $s_0 > 0$ and $a > 0$. Obviously, the urban equilibrium results as a trade off between the difference in commuting costs, $(\alpha_e - \alpha_u)$, and the marginal probability of getting a job since here both the employed and the unemployed want to be as close as possible to the CBD (employed workers want to save commuting costs and unemployed workers want to increase their probability to get a job). Thus, Equilibrium 1[7] occurs if and only if:

$$(\alpha_e - \alpha_u) < \theta_1 q(\theta_1) a(\overline{I_{e_1}} - \overline{I_{u_1}}) \tag{6.11}$$

Equation (6.11) means that the differential space costs between the employed and the unemployed is smaller than the gradient in space of the expected return for an unemployed of being more efficient in search (the marginal probability of exit from unemployment times the surplus). Thus if (6.11) holds, the employed bid away the unemployed towards the periphery of the city. In the other equilibrium, we have the opposite result:

$$(\alpha_e - \alpha_u) > \theta_2 q(\theta_2) a(\overline{I_{e_2}} - \overline{I_{u_2}}) \tag{6.12}$$

It is important to notice that all what improves workers' position ($\theta q(\theta)$ and $(\overline{I_e} - \overline{I_u})$) can help to switch from equilibrium 2 to equilibrium 1. Another remark is that when the employed have lower costs than the unemployed, the only possible equilibrium is the first one since the unemployed have all the incentives to go closer to the CBD.

Let us define the two urban equilibria by remembering that the city is closed, linear and landlords are absent. We normalize the labour force L to 1, i.e. $L = U + N = 1$, where N is the number of employed workers. Therefore, the unemployment rate u is equal to the

[7] We index by 1 all variables that will determine at the labor market equilibrium 1. We do the same thing for Equilibrium 2.

unemployment level U.

Definition 2 *The urban equilibrium 1* $(\overline{I_{u_1}}, \overline{I_{e_1}}, d_b^1, d_f^1)$ *is such that:*

$$d_b^1 = u_1 \tag{6.13}$$

$$d_f^1 = 1 \tag{6.14}$$

$$\Psi_e(d_b^1, \overline{I_{u_1}}, \overline{I_{e_1}}) = \Psi_u(d_b^1, \overline{I_{u_1}}, \overline{I_{e_1}}) \tag{6.15}$$

$$\Psi_e(d_f^1, \overline{I_{u_1}}, \overline{I_{e_1}}) = R_A \tag{6.16}$$

This equilibrium is illustrated in Figure 1. By using (6.7), (6.8), (6.13) and replacing them in (6.15) and 6.16), we obtain:

$$\overline{I_{e_1}} - \overline{I_{u_1}} = \frac{w_1 - b - (\alpha_e - \alpha_u)u_1}{r + \delta + p(u_1)} \tag{6.17}$$

where w_1, u_1, θ_1 will be determined at the labour market equilibrium. The values of $\overline{I_{e_1}}$ and $\overline{I_{u_1}}$ can be calculated using (6.16) and (6.17). The average efficiency intensity is equal to:

$$\overline{s_1} = s_0 - a\overline{d_1} = s_0 - a\frac{u_1}{2} \tag{6.18}$$

We can now define the second urban equilibrium.

The urban equilibrium 2 $(\overline{I_{u_2}}, \overline{I_{e_2}}, d_b^2, d_f^2)$ is such that:

$$d_b^2 = 1 - u_2 \tag{6.19}$$

$$d_f^2 = 1 \tag{6.20}$$

$$\Psi_e(d_b^2, \overline{I_{u_2}}, \overline{I_{e_2}}) = \Psi_u(d_b^2, \overline{I_{u_2}}, \overline{I_{e_2}}) \tag{6.21}$$

$$\Psi_u(d_f^2, \overline{I_{u_2}}, \overline{I_{e_2}}) = R_A \tag{6.22}$$

This equilibrium[8] is illustrated in Figure 2. By using (6.7), (6.8), (6.19) and replacing them

[8] In the first equilibrium, unemployed may have exploding debt, since they receive b and pay at most $R(0)$. A sufficient condition for avoiding the problem is that $R(0) > b$.

in (6.21) and (6.22), we obtain:

$$\overline{I_{e_2}} - \overline{I_{u_2}} = \frac{w_2 - b - (\alpha_e - \alpha_u)(1 - u_2)}{r + \delta + p(1 - u_2)} \tag{6.23}$$

where w_2, u_2, θ_2 will be determined at the labour market equilibrium. Similarly, $\overline{I_{e_2}}$ and $\overline{I_{u_2}}$ can be calculated by using (6.22). The average efficiency intensity is equal to:

$$\overline{s_2} = s_0 - a\overline{d_2} = s_0 - a(1 - \frac{u_2}{2}) \tag{6.24}$$

Proposition 1: *Whatever the labour market equilibrium, the average search efficiency in the urban equilibrium 1 is greater than the one in the urban equilibrium 2, i.e.,* $\overline{s_1} > \overline{s_2}$.

Proof. $\overline{s_1} > \overline{s_2} \Leftrightarrow -u_1/2 > -(1 - u_2/2) \Leftrightarrow u_1 + u_2 < 2$ which is always true. ■

Before analysing the labour market equilibrium, it can be explained why in this model, the location of the firms in the CBD is not a strong assumption. The model is perfectly symmetric in distance: workers will be located either to the right and to the left of the CBD. Then, if a firm wanted to locate closer to the unemployed to face a smaller $\overline{s}$, it would have to chose one side, and therefore to be further away from the unemployed of the other side. With our assumption of linearity of $s(d)$, the firm will in fact be indifferent between being located in the CBD or in the middle of the unemployed. Thus, as long as we do not model the rent paid by the firm, the location of the firms in the CBD can be seen as the result of an equilibrium.

Before determining the labour equilibrium we can give a general definition of it.

Definition 3 *A steady-state labour market equilibrium is a triple* (w, θ, u) *such that, given the matching technology defined by (6.1), all agents (workers and firms) maximize their respective objective function, i.e. this triple is determined by a steady-state condition, a free-entry condition for firms and a wage setting determination.*

This labour market equilibrium will be studied in two cases. First, when wages are exogenous, second when they are the outcome of a bargaining over the surplus.

6.4 The labour market equilibrium with exogenous wage

In this section, we assume that the wage in the economy is exogenous and equal to $w_1 = w_2 = \overline{w}$.

6.4.1 Free-entry condition and labour demand

We denote by I_J and I_V the intertemporal profit of a job and of a vacancy respectively. If γ is the search cost for the firm per unit of time, and y is the product of the match, then I_J and I_V are written as (Poisson process):

$$rI_J = y - \overline{w} + \delta(I_V - I_J) \tag{6.25}$$

$$rI_V = -\gamma + q(\theta)(I_J - I_V) \tag{6.26}$$

As in Pissarides (1990), we assume that firms post vacancies up to a point where

$$I_V = 0 \tag{6.27}$$

which is a free entry condition. Thus, we have:

$$I_J = \frac{\gamma}{q(\theta)} = \frac{y - \overline{w}}{r + \delta} \tag{6.28}$$

In other words, the value of a job is equal to the expected search cost, i.e. the cost per unit of time times the average duration of search for the firm. Notice that this value is increasing in $\overline{s}$ the average search efficiency determined by the urban equilibrium since $\theta = V/(u.\overline{s})$ and $q' < 0$.

From the free entry condition (6.28), we have a decreasing relation between labour market tightness and wages, which is:

$$\overline{w} = y - (r + \delta)\frac{\gamma}{q(\theta)} \tag{6.29}$$

Notice that this labour demand curve is independent on the type of urban equilibrium. It is because, independently of workers' location, firms post vacancies up to $I_V = 0$. This is illustrated in Figure 3. The L^d curve (6.29) is independent of d_b and is downward sloping in the plane (θ, w). Since the wage is independent of the urban equilibrium, we have a unique $\theta^* = \theta_1 = \theta_2$. This means that, depending on the values of θ^*, only one urban equilibrium will prevail.

Theorem 1: *There is a unique urban equilibrium. If $\theta^* q(\theta^*) > \overline{m}$ (resp. $< \overline{m}$), Equilibrium*

1 (resp. Equilibrium 2) prevails, where

$$\overline{m} = \frac{(\alpha_e - \alpha_u)(r+\delta)}{a(\overline{w}-b) - (\alpha_e - \alpha_u)s_0} > 0 \tag{6.30}$$

Proof. By using (6.29) and Lemma 3,[9] we have: $\overline{w}(\theta = 0) = y$. Since by Lemma 3, the labour demand (6.29) is downward sloping and since $y > \overline{w}$, there exists a unique θ^* and thus a unique urban equilibrium.

Moreover, by replacing (6.17) in (6.11), (6.23) in (6.12), the result follows. ■

Observe that the RHS of (6.30) is composed only by exogenous parameters and therefore does not depend on the labour market equilibrium. The intuition of this theorem is straightforward. When the probability to obtain a job is very high, the unemployed will locate close to the employment center whereas in the other case, they will reside at the outskirts of the city.

As stated above, equation (6.29) determine a unique θ^* which gives a unique relation between v and u. (6.29) rewrites:

$$q(\theta) - \left(\frac{r+\delta}{\overline{w}-y}\right)\gamma = 0 \tag{6.31}$$

By totally differentiating (6.31), it is easily checked by using Lemma 2 that:

$$\frac{dv}{du} = -\frac{\partial\theta/\partial u}{\partial\theta/\partial v} > 0 \tag{6.32}$$

This upward sloping curve in the $u - v$ space is called the VS curve. There is a unique θ but since $\overline{s}_1 \neq \overline{s}_2$, there are two VS curves labelled VS_1 and VS_2. Moreover, equation (6.31) has only one unknown, θ, thus we can rewrite it in the $u - v$ space as:

$$v_k = \theta^* u_k \overline{s}_k \qquad k = 1, 2 \tag{6.33}$$

whose slopes are

$$\frac{\partial v_1}{\partial u_1} = \theta^*(\overline{s}_1 + u_1.\frac{\partial \overline{s_1}}{\partial u_1}) = \theta^*(s_0 - a.u_1) \tag{6.34}$$

$$\frac{\partial v_2}{\partial u_2} = \theta^*(\overline{s}_2 + u_2.\frac{\partial \overline{s_2}}{\partial u_2}) = \theta^*(s_0 - a.(1 - u_2)) \tag{6.35}$$

[9] All Lemmas are stated and demonstrated in Appendix 2.

and

$$\frac{\partial v_1}{\partial u_1} > \frac{\partial v_2}{\partial u_2} \Leftrightarrow u_1 + u_2 < 1$$

6.4.2 Steady-state labour market equilibrium

We can now close the model by the following steady-state condition on the flows:

$$\theta q(\theta)\overline{s}_k u_k = (1 - u_k)\delta \quad , \quad k = 1, 2 \tag{6.36}$$

which is equivalent to:

$$u_k = \frac{\delta}{\delta + \theta q(\theta)\overline{s}_k} \quad , \quad k = 1, 2 \tag{6.37}$$

This equation can be rewritten as:

$$\delta(1 - u_k) - v_k q(\theta_k) = 0 \tag{6.38}$$

This equation can be mapped in figure 4 in the plane (u_k, v_k): it is the so-called *Beveridge curve* UV_k . By using Lemmas 4 and 5, the Beveridge curve (6.38) is decreasing in the plane (u_k, v_k) and the one corresponding to Equilibrium 2 is above the one corresponding to Equilibrium 1.

Theorem 2: *When the wage is exogenously determined, there exits a unique and stable labour market equilibrium characterized by:*

$$\theta^* = \theta_1 = \theta_2 \quad , \quad u_1^* < u_2^* \quad , \quad \overline{s}_1^* > \overline{s}_2^*$$

Proof.

Existence and uniqueness: In the plane (u, v), for each urban equilibrium, we have an upward sloping curve (6.31), the VS curve, that cuts the axes and a downward sloping curve (6.38), the Beveridge curve (UV), that does not cut the axes. We have therefore a unique labour equilibrium.

Stability: We use the same argument as in Pissarides (1990).

Next, from Lemma 5, the Beveridge curve 2 (the one corresponding to the urban equilibrium

2) is always above the Beveridge curve 1. By using (6.34) and (6.35), we have therefore that: $u_2^* > u_1^*$. ■

The following comments are in order. There is obviously a "bad" and a "good" urban equilibrium. Indeed, in urban equilibrium 1 when all unemployed are close to the employment center, *for the same level labour tightness the level of unemployment is lower and average search efficiency is higher compared to urban equilibrium 2.* This means that in the latter equilibrium, in average, workers tend to stay unemployed for a longer period than in equilibrium 1. An intuitive interpretation is that "segregated" cities i.e., cities where unemployed workers are far away from the employment-center, are less efficient than "integrated" cities. This leads to interesting government policy predictions. Indeed, the (local) government should try to impose equilibrium 1. How this is possible ? By looking at Theorem 1, the following policies are possible. The government *should, other things being equal, increase the wage received by workers (i.e. subsidize it, in partial equilibrium) and decrease the level of unemployment benefits.* This will lead to a more integrated city because the unemployed will be induced to reside at the vicinity of the employment center. Another interesting policy is that the government should decrease the differential $\alpha_e - \alpha_u$, for instance in *subsidizing all the commuting costs.* It is commonly observed in the American cities than the main problem of access to employment is the commuting cost. A lot of "segregated" cities like e.g. Los Angeles, CA, Detroit, MI, or St. Louis, MO, have a very bad transportation system and thus the access to employment is very difficult. Our model shows that subsiding the commuting cost by creating for example an efficient transportation system will change the shape of the city and will cut the level of unemployment. The (local) government can also help job seekers. They can help them by *reducing their fixed search cost s_0 or by increasing their variable search cost a,* both policies inducing them to be closer to the employment-center. We can summarize these results by the following proposition.

Proposition 2: *By reducing the level of unemployment benefit and/or by subsiding the wages or the commuting cost, the government can cut the level of urban unemployment and a segregated city (Eq 2) can be transformed into an more integrated one (Eq 1).*

Proof. All these actions tends to reduce $\overline{m}$ in Theorem 1, therefore increasing the likelihood that $\theta^* q(\theta^*) > \overline{m}$. ■

The effect of the exogenous wage on the equilibrium is also interesting to analyse..

Proposition 3: *When the exogenous wage increases from the reservation wage of workers* ($I_e = I_u$), i.e., $b + (\alpha_e - \alpha_u).(1 - u_2)$ *to* y, *then we have urban equilibrium 2, then 1, then 2 again.*

Proof. See Lemmas 8 and 9 ■

The intuition of Proposition 3 is the following. When wages are too low, unemployed workers have no incentives to go closer to the CBD to search because the surplus of being employed is low. By contrast, when wages are extremely high (close to y) then firms have no incentive to post vacancies and aggregate labour market tightness is low.

Proposition 4 (the optimal level of wage): *There are two local minima in unemployment with respect to the exogenous wage, one associated with the reservation wage of workers, the second with the first intersection of the two curves in figure 3.*

Proof. In equilibrium 2, on the Beveridge curve, u is always decreasing in θ. This is also true in equilibrium 1 in most of the cases. See lemma 10. Therefore, u is minimized in the second equilibrium for the maximum value of θ^*, i.e., for the lowest possible wage, and in the first equilibrium, for the highest θ^* compatible with this equilibrium, i.e., in the first intersection of the two curves of figure 3. ■

We have here an interesting case where unemployment does not decrease monotonically with wages. Since there are incentive mechanisms in the model affecting the location choices, themselves implying search efficiency, there could be a level of wage larger than the reservation wage, that minimizes unemployment.

Remark 1: By optimal, we mean minimizing unemployment. It is well known[10] in search models that there can be a strictly positive level of unemployment maximizing welfare. This is not our focus here.

Remark 2: Aggregate conditions also play a role in the determination of equilibrium: the output y of the match affects the profitability of the match, therefore the level of job openings and thus θ in (6.29). Bad aggregate conditions increase the tendency to reject the unemployed at the periphery.

Remark 3: In the model, there is a perfect access to credit market, if for instance in

[10] See Pissarides (1990), chapter 8 and subsequent references.

equilibrium 1, the unemployed pay high rents in order to maximize their present-discounted value of utility. This perfect access to credit could be modified, in assuming for instance that the unemployed face credit constraints. This would obviously complicate the model. This points out another type of policy action, which is to subsidize the access to credit of the unemployed, such that they can locate in the city at their optimal distance. Otherwise, we would have involuntary locations which would add up to involuntary unemployment due to search frictions.

6.5 Wage bargaining

Let us consider an endogenous wage setting. We assume that at each period, the total intertemporal surplus is shared through a Nash-Bargaining process between firms and workers. The total surplus is the sum of the surplus of the workers, $\overline{I_e} - \overline{I_u}$, and the surplus of the firms that we define now.

From the free entry condition (6.28), we still have a decreasing relation between labour market tightness and wages (6.29). By contrast, the wage setting curve WS (6.42) or (6.43) is upward sloping and depends crucially on the type of urban equilibrium (see Figure 5).

At each period, the wage is determined by :

$$w_k = Arg\max(\overline{I_{e_k}} - \overline{I_{u_k}})\beta(I_{J_k} - I_{V_k})^{1-\beta} \qquad k = 1, 2 \tag{6.39}$$

where k denotes the urban equilibrium.

Observe that $\overline{I_{u_k}}$, the threat point for the worker in the urban equilibrium k, does not depend on the current location of the worker, which will relocate if there is a transition. First order condition yields:

$$\frac{\beta}{1-\beta}\left(\frac{\partial \overline{I_{e_k}}}{\partial w_k} - \frac{\partial \overline{I_{u_k}}}{\partial w_k}\right) I_{J_k} + \left(\overline{I_{e_k}} - \overline{I_{u_k}}\right)\frac{\partial I_{J_k}}{\partial w_k} = 0 \tag{6.40}$$

Since the wage is negotiated at each period, $\overline{I_{u_k}}$ does not depend on w_k. By using (6.6) and (6.28), we can rewrite (6.40) as:

$$(\overline{I_{e_k}} - \overline{I_{u_k}})(w_k) = \frac{\beta}{1-\beta}\frac{\gamma}{q(\theta_k)} \tag{6.41}$$

This defines a positive relationship between wages and labour market tightness, that is sometimes interpreted as a wage setting function or a labour supply function. According to the type of urban equilibrium that we get, this wage setting equation will differ. In urban equilibrium 1, we obtain:

$$w_1 = (1-\beta)\left[b + (\alpha_e - \alpha_u)u_1\right] + \beta\left[y + s(u_1)\theta_1\gamma\right] \tag{6.42}$$

The wage setting curve described by (6.42) is a positively slope curve in the plan (w, θ). Let us interpret (6.42). The first part of the RHS of (6.42), $(1-\beta)\left[b + (\alpha_e - \alpha_u)u_1\right]$, is what firms must compensate in terms of transportation costs to induce workers just employed to stay in the city plus the unemployment benefit. If we look closer, one can see that the firm must exactly compensate the transportation cost difference (between the employed and the unemployed) of the unemployed worker who is the further away from the CBD, i.e. located at $d_b^1 = u_1$. This is what we call the "compensation effect". Zénou and Smith (1995) have obtained a similar condition in the case of efficiency wages. Therefore, when u_1 increases, this marginal unemployed worker is further away from the CBD and firms must increases their wage to compensate the transportation cost difference. The second part of the RHS of (6.42), $[\beta y + s(u_1)\theta_1\gamma]$ has an opposite effect. When u_1 rises the average unemployed (i.e. the one located in $\overline{d} = u_2/2$) is further away from the city-center and then his outside option decreases. This is what we call the "outside option effect". The first effect is a pure spatial cost since $(\alpha_e - \alpha_u)u_1$ represents the space cost differential between a worker and a unemployed worker paying the same bid rent whereas the second effect is a mixed labour-spatial cost one. Notice that these effects are two externalities in the model, caused by the spatial dimension. This is an addition to the thin market externality of the matching technology, already present in Pissarides. In urban equilibrium 2, we obtain:

$$w_2 = (1-\beta)\left[b + (\alpha_e - \alpha_u)(1-u_2)\right] + \beta\left[y + s(1-u_2)\theta_2\gamma\right] \tag{6.43}$$

The equation is exactly similar to (6.42) if one replaces u_1 by $1-u_2$. However, the two externalities described before have exactly the opposite effect on the wage setting: the first

one (space cost differential) cuts the bargain wage when u_2 increases whereas the second one (mixed labour-spatial cost effect) rises the bargain wage when u_2 increases: this is because now, an increase in u_2 moves the first employed to the left, while in equilibrium 1, it moved it to the right. Observe also that while the two wages are upward sloping in the plane (w_k, θ_k), WS_1 is steeper than WS_2 but the intercept of WS_1 is lower (see Lemma 6). This is illustrated in Figure 5: for small values of θ, $w_2 > w_1$ whereas for large values of θ, $w_2 < w_1$. In other words, if the labour market is not very tense (there are few vacancies compared to efficient units of unemployed workers), the probability to get a job is low and thus the compensation effect dominates the outside option effect. In the other case when the labour market is very tense, we obtain the opposite result.

6.5.1 Steady-state labour market equilibrium

The two equations (6.29) and (6.42) (resp. (6.43) in the second equilibrium) determine wages and labour tightness parametrized by u_k. As in the previous section, the model is closed by a steady-state condition on the flows:

$$u_k = \frac{\delta}{\delta + \theta_k q(\theta_k)\overline{s}_k} \quad , \quad k = 1, 2 \tag{6.44}$$

This equation is plotted in figure 4 in the plane (U, V): it is the so-called *Beveridge curve* UV. The distance to the origin of the curve is strongly depending on $\overline{s}$. The curve of the equilibrium θ is given by the intersection in figure 3.

Therefore, we have three equations (6.42) (or (6.43) for equilibrium 2), (6.29) and (6.36) and three unknowns w_k, θ_k and u_k $(k = 1, 2)$. We can obtain the equilibrium values (denoted by the superscript star) as a function of exogenous variables: $w_k^*(.)$, $\theta_k^*()$ and $u_k^*(.)$.

Theorem 3: *In each urban equilibrium, there exists a unique labour market equilibrium.*

Proof. Since for each urban equilibrium the Beveridge curve is decreasing and convex and does not cut the axes and since the curve $\theta_k(u_k)$ is increasing and concave for the urban equilibria, it must be that the labour equilibrium exists and is unique. ■

6.5.2 Existence and uniqueness of urban equilibrium

Condition (6.11) has to be satisfied in urban equilibrium 1 and the inverse inequality (6.12) has to be satisfied in urban equilibrium 2.

Proposition 5: *At the labour market equilibrium with endogenous wage, urban equilibrium 1 prevails iff* $\theta_1^* > \bar{l}$ *and urban equilibrium 2 prevails iff* $\theta_2^* < \bar{l}$, *where*

$$\bar{l} = \frac{(\alpha_e - \alpha_u)}{a\gamma}\left(\frac{1-\beta}{\beta}\right) > 0 \tag{6.45}$$

Proof. If we replace $\overline{I_e} - \overline{I_u}$ in (6.11) and (6.12) respectively with (6.41), the result follows. ■

Proposition 6:

If $\theta_1^* < \theta_2^*$, *then if an urban equilibrium exists, it is unique. We have three cases:*

- *if* $\theta_1^* < \theta_2^* < \bar{l}$, *urban equilibrium 2 exists and is unique;*
- *if* $\bar{l} < \theta_1^* < \theta_2^*$, *urban equilibrium 1 exists and is unique;*
- *if* $\theta_1^* < \bar{l} < \theta_2^*$, *there is no urban equilibrium.*

If $\theta_2^* < \theta_1^*$, *an urban equilibrium always exists but is not necessarily unique. We have also three cases:*

- *if* $\theta_2^* < \theta_1^* < \bar{l}$, *urban equilibrium 2 exists and is unique;*
- *if* $\bar{l} < \theta_2^* < \theta_1^*$, *urban equilibrium 1 exists and is unique;*
- *if* $\theta_2^* < \bar{l} < \theta_1^*$, *both urban equilibria exist.*

This proposition describes all the possible situations that can arise when the wage is endogenously determined.

Remark 4: The critical value $\bar{l}$ defined by (6.45) is exactly equal to $\widetilde{\theta}$ (see (6.56) in Lemma 6) which is the unique value of θ when the line WS_1 defined by (6.42) intersects the line WS_2 defined by (6.43).

Theorem 4: *There exists a unique urban equilibrium and only the two following cases are possible. If* $\theta_2^* < \theta_1^* < \bar{l}$, *urban equilibrium 2 exists and is unique. If* $\bar{l} < \theta_1^* < \theta_2^*$, *urban equilibrium 1 exists and is unique.*

Proof. θ_k is determined by the intersection of the labour demand curve and the wage setting line (see Figure 5). Two situations are possible. Either the labour demand curve cuts the wage setting before the intersection point $(\widetilde{w}, \widetilde{\theta})$ (which defined in Lemma 6) or after it. In the first case, we have: $\theta_2^* < \theta_1^* < \overline{l} = \widetilde{\theta}$, and then according to Proposition 4, there is only one unique urban equilibrium which is equilibrium 2. In the second case, we have: $\overline{l} = \widetilde{\theta} < \theta_1^* < \theta_2^*$ and according to Proposition 4 only equilibrium 1 exists. ■

Observe that multiple urban equilibria can never happen here because the condition for multiple equilibria is $\theta_2^* < \overline{l} < \theta_1^*$ and it can never be satisfied since the intersection of the labour demand with the wage setting line never satisfies this condition. This is due to the fact that $\overline{l} = \widetilde{\theta}$. Observe also that we exclude the case when the labour demand curve intersects the two wage setting curves at exactly $(\widetilde{w}, \widetilde{\theta})$. This corresponds to the urban equilibrium where the slopes of the bid rents for the unemployed and the employed are equal and this can never happen because of our assumption on bid rents.

6.6 Conclusion

We have developed a model that integrates land and labour markets. Search efficiency is assumed and then proved to be negatively depending on distance. In this case, the urban configuration of workers has a strong impact on average search efficiency and therefore on incentives for firms to create jobs. The rent plays a major role here: according to the different incentives for the workers to be closer from the CBD (transport costs and search efficiency), a category of workers can reject the other to the periphery. In the case where unemployed are far from the city center, the outcome is likely to be very bad since search efficiency will be in average very low. The key issues underlined in the present paper are:

- first, urban equilibrium matters on the labour market and have an impact both on equilibrium unemployment and on search effort.
- second, higher wages due for instance to greater bargaining power increase the surplus of the workers and as a consequence, their incentive to be closer from the CBD and more efficient in their job search. This generates a more efficient labour market.

- third, with respect to Benabou's important contributions (1993, 1996), the welfare aspects of location-segregation of workers don't rely on a trade-off between local complementarities in human capital accumulation and global complementarities in the production, but instead on the interactions between local factors (rent, distance to employment centers) and global factors (labour market tightness, wages).

- last, aggregate changes (for instance variations in y the production of a match) tend to be amplified by the endogenous choices of locations of workers: bad aggregate conditions are associated with rising suburbanization of the unemployed. Since suburbanization has adverse effects on search, location choices play a role of amplificator of the aggregate conditions.

Appendix 1: Endogeneous choice of search effort

In the previous sections, we have made the assumption that search efficiency is a decreasing function of distance between workers and firms. In search theory, efficiency is primarily seen as a function of effort of workers, rather than from the location of workers. We can modify the model in this direction to get slightly more complicated results, but easy to understand given that the intuitions of the model are exactly the same.

The search process of the workers is modelled as follows. The search efficiency s depends on the worker's effort, which is denoted by e. We assume decreasing returns to scale in the effort, i.e., $s'(e) > 0$ and $s''(e) \leq 0$. As before each interview is made in the CBD and therefore involves transport costs. Thus we assume that the search commuting cost is an increasing and convex (or linear) function of the effort level e devoted to job search, i.e., $\alpha'_u(e) > 0$ and $\alpha''_u(e) \geq 0$. There is therefore a trade-off between the search costs which are here associated to direct costs and the gains associated with a higher probability to exit from unemployment. The value of unemployment can now be written as:

$$rI_u(d) = b - (\alpha_s + \alpha_u(e))d - R(d) + p(e)\left[Max_{d'} I_e(d') - I_u(d)\right] \tag{6.46}$$

where $p(e) = \theta q(\theta) s(e)$. The the value of employment is still

$$rI_e(d) = w - (\alpha_s + \alpha_e)d - R(d) + \delta\left[Max_{d'} I_u(d') - I_e(d)\right] \tag{6.47}$$

The unemployed worker located at a distance x from the CBD chooses e^* that maximizes his intertemporal utility (6.46). First order condition yields:

$$p'(e^*)(\overline{I_e} - \overline{I_u}) = \alpha'_u(e^*)d \tag{6.48}$$

The interpretation is straightforward. The LHS of (6.48) is the marginal probability generated by one more interview times the surplus of a worker when he leaves unemployment whereas the RHS of (6.48) is the marginal commuting cost of searching for a job. Of course both are equated when $e = e^*$. By totally differentiating (6.48), we obtain:

$$\frac{\partial e^*}{\partial d} = \frac{\alpha'_u(e^*)}{\theta q(\theta) s''(e^*)(\overline{I_e} - \overline{I_u}) - \alpha''_u(e^*)d} < 0$$

and thus

$$\frac{\partial s}{\partial d} = \frac{\partial s}{\partial e}\frac{\partial e}{\partial d} < 0 \tag{6.49}$$

The bid rent of the employed and its slope are still the same and given by:

$$\Psi_e(d, \overline{I_e}, \overline{I_u}) = w - (\alpha_s + \alpha_e)d + \delta(\overline{I_u} - \overline{I_e}) - \overline{I_e}$$

$$\frac{\partial \Psi_e(d, \overline{I_e}, \overline{I_u})}{\partial d} = -(\alpha_s + \alpha_e) < 0$$

The bid rent of the unemployed is now:

$$\Psi_u(d, \overline{I_e}, \overline{I_u}) = b - [\alpha_s + \alpha_u(e^*(d))]\, x + a(e^*(d))(\overline{I_e} - \overline{I_u}) - \overline{I_u} \tag{6.50}$$

and by the Envelope theorem, the slope of the unemployed bid rent is:

$$\frac{\partial \Psi_u(d, \overline{I_e}, \overline{I_u})}{\partial d} = -[\alpha_s + \alpha_u(e^*(d))] < 0 \tag{6.51}$$

$$\frac{\partial^2 \Psi_0(d, \overline{I_e}, \overline{I_u})}{\partial d^2} = -\left(\frac{\partial \alpha_u}{\partial e^*}\frac{\partial e^*}{\partial d}\right) > 0 \tag{6.52}$$

It follows that the unemployed bid rent is decreasing and convex with the distance to the CBD. Thus different configurations can emerge. The two as before and third one when the unemployed locate both at the vicinity of the CBD and at the outskirts of the city whereas the employed reside in between the

unemployed.

The average search intensity is now given by an integral defined over the location of unemployed:

$$\overline{s} = \int_{Unemployed} s(e^*(x))dx \tag{6.53}$$

where x replaces distance in the integral for convenience.

Appendix 2

Lemma 1: For both the exogenous and endogenous wage, we have the following properties of the function $q(\theta)$ and $\theta q(\theta)$:

$$q'(\theta) < 0 \quad ; \quad q''(\theta) > 0$$

$$-1 < \eta_q = \frac{\partial q(\theta)}{\partial \theta}\frac{\theta}{q(\theta)} < 0$$

Proof. The results stem directly from the properties of the matching function $x(.)$. ■

Lemma 2: For the two urban equilibria, the following relations always hold along the (VS) curve (6.33):

$$\frac{\partial \theta_k}{\partial v_k} > 0 \quad ; \quad \frac{\partial \theta_k}{\partial u_k} < 0 \qquad k = 1, 2$$

Proof. Since $\theta_k = v_k/(\overline{s}_k u_k)$, we have:

$$\frac{\partial \theta_k}{\partial v_k} = \frac{1}{u_k \overline{s}_k} > 0 \qquad \forall k = 1, 2$$

Next,

$$\frac{\partial \theta_k}{\partial u_k} = -\frac{v_k}{(u_k \overline{s}_k)^2}\left(\overline{s}_k + u_k \frac{\partial \overline{s}_k}{\partial u_k}\right)$$

Let us start with urban equilibrium 2 where $\overline{s}_2 = s_0 - a(1 - u_2/2)$ and $\partial \overline{s}_2/\partial u_2 = a/2 > 0$. This implies that:

$$\frac{\partial \theta_2}{\partial u_2} < 0$$

Consider now urban equilibrium 1 where $\overline{s}_1 = s_0 - a u_1/2$ and $\partial \overline{s}_1/\partial u_1 = -a/2 < 0$. We have therefore:

$$\frac{\partial \theta_1}{\partial u_1} = -\frac{v_1}{(u_1 \overline{s}_1)^2}\left(\overline{s}_1 - u_1 \frac{a}{2}\right)$$

This can easily be rewritten as:

$$\frac{\partial \theta_1}{\partial u_1} = -\theta_1 \left(\frac{1}{u_1} - \frac{a}{2\overline{s}_1} \right)$$

But

$$\frac{1}{u_1} > \frac{a}{2\overline{s}_1} \quad \Leftrightarrow s_0 - a u_1 = s(u_1) > 0$$

which is always true. Therefore,

$$\frac{\partial \theta_1}{\partial u_1} < 0$$

■

Lemma 3: For both the exogenous and endogenous wage, in the plane (θ, w), the labour demand curve (6.29) is downward sloping and convex. It cuts the axes at $w(\theta = 0) = y$ and $\theta(w = 0) = \overline{\theta} > 0$ where $\overline{\theta}$ is defined by the following equation: $q(\overline{\theta}) = (r + \delta)\gamma / y$.

Proof. By differentiating (6.29), we obtain:

$$\frac{\partial w}{\partial \theta} = (r + \delta)\gamma \frac{q'(\theta)}{q(\theta)^2} < 0$$

$$\frac{\partial^2 w}{\partial \theta^2} = -2.(r + \delta)\gamma \left[\frac{q''(\theta)q(\theta) - 2q'(\theta)^2}{q(\theta)^3} \right]$$

By assuming that $\eta_{q'} > 2\eta_q$, we have:

$$\frac{\partial^2 w}{\partial \theta^2} > 0$$

where $\eta_{q'} = \frac{\partial q'(\theta)}{\partial \theta} \frac{\theta}{q'(\theta)}$ and $\eta_q = \frac{\partial q(\theta)}{\partial \theta} \frac{\theta}{q(\theta)}$.

Then by using (6.29), we easily obtain:

$$w(\theta = 0) = y \quad \text{and} \quad \theta(w = 0) = \widetilde{\theta} = \frac{1 - \beta}{\beta} \frac{(\alpha_e - \alpha_u)}{a\gamma} > 0$$

■

Lemma 4: For both the exogenous and endogenous wage, in the plane (v_k, u_k), $k = 1, 2$, the Beveridge curve (6.36) is decreasing. It cuts the axes at $u_k(v_k = 0) = +\infty$ and $v_k(u_k = 0) = +\infty$.

Proof. By totally differentiating (6.38):

$$\frac{dv_k}{du_k}.q(\theta_k) + v_k q'(\theta_k)(\partial\theta_k/\partial u_k) = -\delta.\overline{s_k}.[1 + (1-u)/\overline{s_k}.\partial\overline{s}_k/\partial u_k]$$

Then, since $q'(\theta_k)(\partial\theta_k/\partial u_k) > 0$ from Lemma 2, in equilibrium 1, we always have $dv_1/du_1 < 0$. In equilibrium 2, $1 + (1-u)/\overline{s}.\partial\overline{s}/\partial u_k$ can be rewritten as $1/\overline{s_k} : [s(1/2)] > 0$. Then, in all cases,

$$\frac{dv_k}{du_k} < 0 \quad \forall k = 1, 2$$

Next, by using (6.36), we have:

$$v_k(u_k = 0) = +\infty \qquad \text{and} \qquad u_k(v_k = 0) = +\infty$$

■

Lemma 5: For both the exogenous and endogenous wage, in the plane (θ, w), the Beveridge curve in urban equilibrium 2 is always above the Beveridge curve in urban equilibrium 1.

Proof. Since the two Beveridge curves have the same slopes everywhere and do not cut the axes, we must show that if $v_1 = v_2 = v$ then $u_1 < u_2$. By using (6.36) and by observing that $\delta(1-u_k) = x(\overline{s_k}u_k, v)$, we have:

$$x(\overline{s_k}u_k, v) + \delta.u_k = \delta \tag{6.54}$$

By the implicit functions theorem, there exists locally a function $u = F(\overline{s_k}, v)$. Given the monotonicity of the arguments in (6.54), the function exists everywhere, and it is easy to check that $F_1 < 0$. Therefore, since $s_1 > s_2$ from Proposition 1, we get the result.

■

Lemma 6: For the endogenous wage only, in the plane (θ_k, w_k), $k = 1, 2$, the two lines (6.42) and (6.43) are upward sloping. The line (6.42) is steeper than (6.43) but the intercept of (6.42) is lower than the one of (6.43). The intersection point between these two lines is equal to:

$$\widetilde{w} = (1-\beta)\left[b + \frac{1}{a}(\alpha_e - \alpha_u)s_0\right] + \beta y \tag{6.55}$$

$$\widetilde{\theta} = \frac{1-\beta}{\beta}\frac{(\alpha_e - \alpha_u)}{a\gamma} \tag{6.56}$$

Proof. Along (6.42) we have $\partial w_1/\partial\theta_1 = \beta(s_0 - au_1)\gamma$. Along (6.43) we have $\partial w_2/\partial\theta_2 = \beta(s_0 - a(1-u_2))\gamma$. Then we have $\partial w_1/\partial\theta_1 > \partial w_1/\partial\theta_2 \Leftrightarrow u_1 + u_2 < 1$. This is always true for reasonable values of u_1 and u_2.

$w_1(\theta_1 = 0) = (1-\beta)\left[b + (\alpha_e - \alpha_u)u_1\right] + \beta y$

$< w_2(\theta_2 = 0) = (1-\beta)\left[b + (\alpha_e - \alpha_u)(1-u_2)\right] + \beta y \Leftrightarrow u_1 + u_1 < 1.$

To find the intersection point, one has to solve (6.42)=(6.43). ■

Lemma 7: For the endogenous wage only and whatever the urban equilibrium, we have the following relation:

$$\frac{\partial\theta_k}{\partial u_k} < 0 \qquad , \qquad \forall k = 1,2 \tag{6.57}$$

Proof. Observe from (6.42) or (6.43) that:

$$\frac{\partial w_k}{\partial d_{bk}} = (1-\beta)(\alpha_e - \alpha_u) - \beta a\gamma\theta_1 \tag{6.58}$$

along the wage setting curves. From (6.45) $\partial w_k/\partial d_{bk}$ is positive in Equilibrium 1, and negative in Equilibrium 2. Therefore, since $d_{b1} = u_1$ and $d_{b2} = 1 - u_2$, we have in all cases $\partial w_k/\partial d_{bk} > 0$, then by intersection with (6.31), (6.57) is true in all urban equilibria. ■

Lemma 8: In the exogenous wage case, there are either 0 or 2 intersections of the curve $\theta^l(\overline{w})$ where θ^l is determined by $\theta^l q(\theta^l) = \overline{m}$ and the L^d curve (6.29).

Proof. $\overline{m}$ is monotonically decreasing in $\overline{w}$ from $+\infty$ in $b + (\alpha_e - \alpha_u).s_0/a$ to 0 in $+\infty$. Therefore, the limit value of θ which determines the urban equilibrium is also decreasing from $+\infty$ to 0 over the same interval of $\overline{w}$. Then, we have to compare this value of θ to the labour demand curve (6.31), decreasing from a positive value in 0 to 0 in $\overline{w} = y$. See also figure 3. Except in the case where there would be a single tangency point, both curves never intersect or intersect twice. ■

Lemma 9: Denote by w_a and w_b the wages of the two intersections. If $\overline{w} < w_a$ or $\overline{w} > w_b$ then we are in urban equilibrium 2. If $w_a < \overline{w} < w_b$ then we are in equilibrium 1.

Proof. In the first case, $\theta^* < \theta^l$, then from Theorem 1, we are in the second equilibrium. In the second case, $\theta^* > \theta^l$, then from Theorem 1, we are in the first equilibrium. ■

Lemma 10: On the Beveridge curve, the lowest wage is reached at the highest θ^*.

Proof. On the Beveridge curve, we have: $\frac{1-u}{u}\frac{1}{s}\delta = \theta q(\theta)$. Denote by $F(u) = log(\frac{1-u}{u}\frac{1}{s})$. Then $F' < 0$ in the two urban equilibria. In the second equilibrium, $F' = \frac{2u_2-1}{u_2(1-u_2)} - \frac{a/2}{s_2} < 0$ as long as $u_2 < 0.5$. In the first equilibrium, $F' = \frac{2u_1-1}{u_1(1-u_1)} + \frac{a/2}{s_1} < 0 \Leftrightarrow (1-2u_1).(s_0 - au_1\frac{1-3/2u_1}{1-2u_1}) < 0$ which is true if $u_1\frac{1-3/2u_1}{1-2u_1}$ is in the range [0,1], and if $u_1 < 0.5$ ■

Table 6.1a: Unemployment rates in large U.S. MSAs

	Unemp. center	Unemp. suburbs
New York, NY, MSA	8.2	4.5
Los Angeles, CA PMSA	8.9	7.2
Chicago, IL PMSA	6.7	4.4
Houston, TX PMSA	7.0	4.5
Philadelphia, PA PMSA	7.6	5.2
San Diego, CA MSA	6.5	6.3
Dallas, TX PMSA	5.9	3.9
Phoenix, AZ MSA	3.8	3.3
Detroit, MI PMSA	10.0	4.0
San Antonio, TX MSA	5.0	3.2

PMSA: Primary Metropolitan Statistical Area; MSA: Metropolitan Statistical Area ;

Unemp. center: Unemployment rate in the city center in 1995 ; Unemp. suburbs: Unemployment rate in the suburbs in 1995

Source: U.S. Bureau of the Census.

Table 6.1b: Unemployment rates in Prioritary Districts, France

	PD	Agglomerations with at least 1 PD	France
Unemp. rate	19.7	11.5	10.8
U.R: Men 20-24	24.1	16.8	14.8
U.R: Women 20-24	34.0	24.0	25.3
Share of long term unemp.	30.7	27.8	28.2

PD: Prioritary Districts; Source: French Census 1990; Long term Unemployed: more than 2 years.

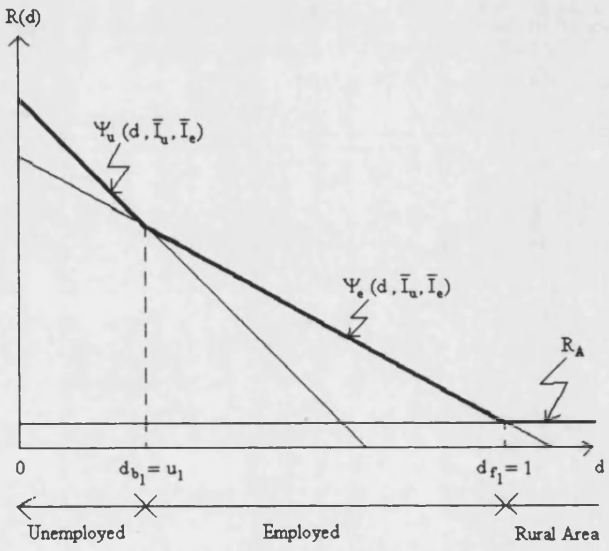

Figure 6-1: Urban Equilibrium 1 (UE)

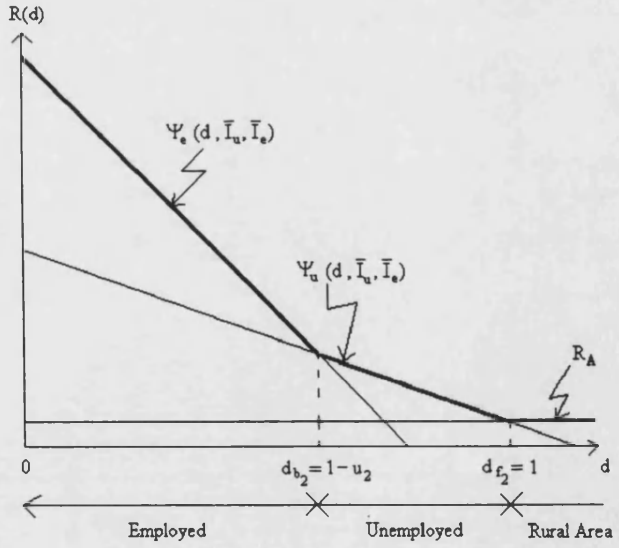

Figure 6-2: Urban Equilibrium 2 (EU)

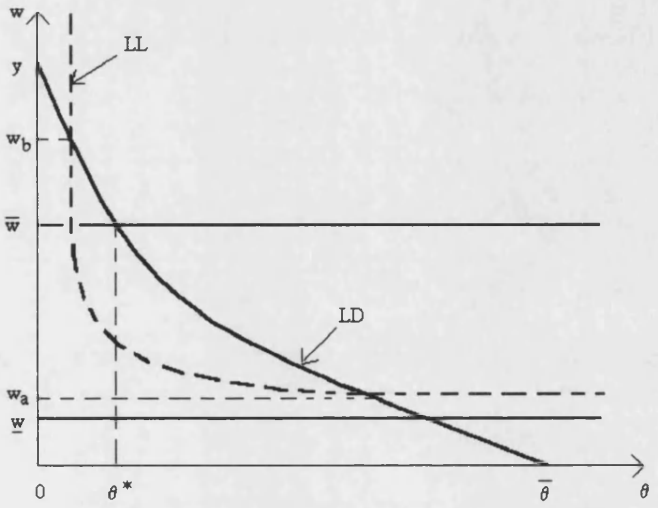

Figure 6-3: Labour Demand and Exogeneous Wage

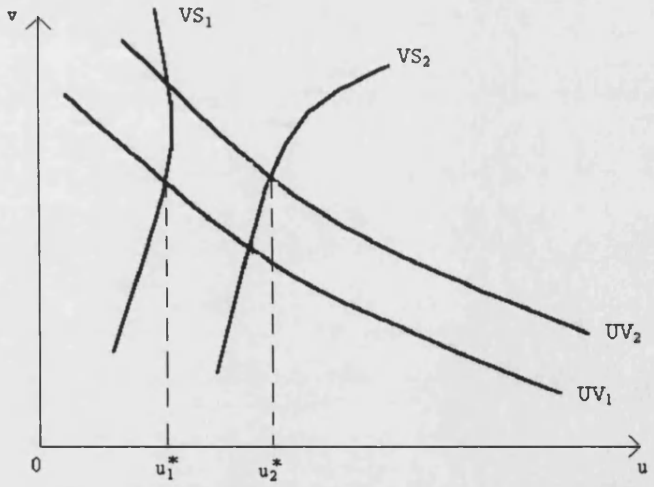

Figure 6-4: Labour Market Equilibrium

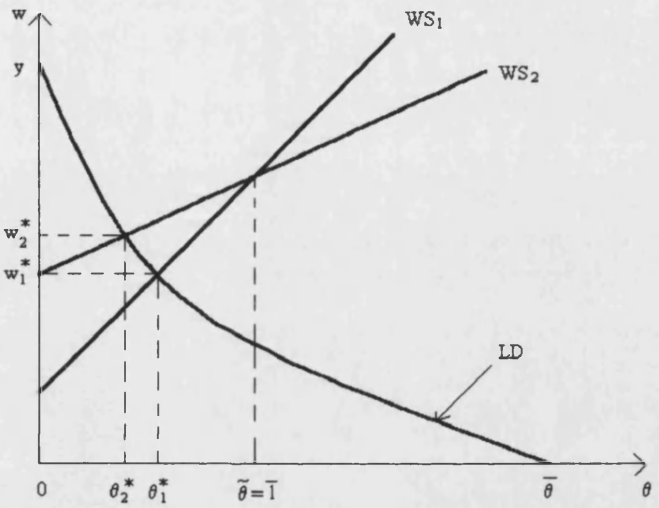

Figure 6-5: Labour Demand and Endogenous Wage Setting

Bibliography

[1] Abowd J.M., Corbel P., Kramarz F. (1996), "The entry and exit of workers and the growth of employment: an analysis of French establishments", NBER wp 5551

[2] Abowd J.M., Kramarz, F., Lollivier, S., Pelé, L. (1996), "Wage Inequalities and Firm-Specific Compensation Policies in France", Annales d'Economie et de Statistique, 0(41-42), Jan.-June 1996, pages 369-86.

[3] Abowd J.M., Kramarz F., Margolis D.N. (1994), "High-Wage Workers and High-Wage Firms", wp 9454, Crest

[4] Abowd J, Zellner A (1985), "Estimating Gross Labour Force Flows", Journal of Economic and Business Statistics 3, 254-283

[5] Acemoglu D. (1996), "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence", mimeo MIT

[6] Aghion P., Howitt P. (1990), "A model of growth through creative destruction", Econometrica 60, p323-351

[7] Aghion P., Howitt P. (1994), "Growth and unemployment", Review of Economic Studies, 61, 477-494

[8] Atkinson A., Micklewright J. (1991), "Unemployment Compensation and Labour Market Transitions: A critical review", Journal of Economic Literature, Vol XXIX, pp 1679-1727

[9] Banerjee A., J. Dolado, J., Galbraith, D. Hendry (1993), Co-integration, Error-Correction, and the Econometric Analysis of Non-Stationary Data, Oxford University Press

[10] Bean C.R. (1993), "European Unemployment: a Retrospective", prepared for the European Economic Association Meeting in Helsinski, 27-29 August 1993

[11] Bean C.R. (1994), "European Unemployment: A Survey", Journal of Economic Literature, Vol XXXII, p573-619, June

[12] Bean C. (1994b), "European Unemployment, two decades later", European Economic Review

[13] Bean C.R., Layard L., Nickell S. (1987), The Rise in Unemployment, Oxford Basil Blackwell

[14] Becker G. Human Capital (1964) reprinted 1975,1993, Chicago and London, University of Chicago Press

[15] Benabou, R. (1993), "Workings of a City: Location, Education and Production", Quarterly Journal of Economics, 108, 619-52

[16] Benabou, R. (1996), "Heterogeneity, Stratification and Growth: Macroeconomic Implications of Community Structure and School Finance", American Economic Review, 86, 584-609

[17] Ben Porath Y.(1967), "The Production of Human Capital and the Life-Cycle of Earnings", Journal of Political Economy, 75:352

[18] Bentolila, J. Dolado (1994), "Lessons from flexibility in Spain" , Economic Policy, 9(18), April 1994, pages 53-99.

[19] Berger M.C. (1983), "Changes in Labor Force Composition and Male Earnings: A Production Approach", The Journal of Human Resources, XVII(2)

[20] Bertola G., Ichino, A. (1995), "Wage Inequality and Unemployment: United States vs. Europe", NBER Macroannuals, pp13-66

[21] Blanchard O.J. , Diamond P. (1989a), "The Beveridge Curve", Brooking Papers on Economic Activity 1989:1, p1-76

[22] Blanchard O.J. , Diamond P. (1989b), The Agregate Matching Function, in Diamond ed, Growth, Productivity and Unemployment, MIT Press

[23] Blanchard O.J. , Diamond P. (1990a), "The Cyclical Behavior of the Gross Flows of US Workers", Brooking Papers on Economic Activity 1990:2, p85-155

[24] Blanchard O.J. , Diamond P. (1990b), "Ranking, Unemployment Duration, and Wages", NBER, WP n 3387, published in the Review of Economic Studies; 61(3), July 1994, pages 417-34.

[25] Blanchard O.J. , Diamond P. (1992), "The Flow approach to Labour Markets", NBER, WP n 4000

[26] Blanchard O.J., Fischer S. (1989), Lectures on Macroeconomics, MIT Press

[27] Blanchard, O. and L. Katz (1992), "Regional evolutions", Brookings Papers on Economic Activity, 1, 1-61.

[28] Blanchard O.J., D. Quah (1989), "The Dynamics Effects of Aggregate Demand and Supply Disturbances", American Economic Review, Vol 79(4), 655-673, September

[29] Blanchard O.J., L.H. Summers (1986), Hysteresis and the European Unemployment Problem, in S.Fisher (ed.) NBER Macroannuals, Cambridge, Mass, MIT Press

[30] Blanchet D., Tapinos G. (1989), "Conséquences des Facteurs Démographiques pour le Niveau et la Structure de l'Emploi et du Chômage", mimeo INSEE, Novembre

[31] Blanchflower D. (1996), "Youth Labor Markets in Twenty Three Countries: A Comparison Using Micro-Data", Center For Economic Performance DP No 284, LSE

[32] Blanchflower D., R. Freeman (1992), "Unionism in the United States and Other Advanced OECD Countries", Industrial Relations, Vol 31, No1

[33] Blanchflower D., Loveman G. and Katz L.F. (1993), "A Comparison of Changes in the Structure of Wages in Four OECD Countries", Center For Economic Performance Discussion Paper

[34] Blanchflower, D.G. and A.J. Oswald (1994), The Wage Curve, Cambridge: M.I.T. Press.

[35] Blau F., A. Beller (1988), "Trends in Earnings Differentials by Gender 1971-1981", Industrial and Labor Relations Review, Vol 41, No 4

[36] Blau F.D., L.M. Kahn (1992), "The Gender Earnings Gap: Some International Evidence", NBER wp 4224

[37] Bloom D., Freeman R, and Korenman S. (1987), "The labour market consequences of generational crowding", European Journal of Population 3, pp131-76

[38] Borzeix A. and Maruani M. (1988), "When a Strike Comes Marching Home", in Jenson, E ed; Hagen, E and Reddy, C. eds, .. Feminization of the labor force: Paradoxes and promises, Europe and the International Order series. New York: Oxford University Press

[39] Brueckner, J., Thisse, J-F. and Y. Zénou (1996), "Why is central Paris rich and downtown Detroit poor ? An amenity-based theory", CORE Discussion Paper 9665, Université Catholique de Louvain.

[40] Bruno M., J.D. Sachs (1985), Economics of Worldwide Stagflation, Oxford: Basil Blackwell

[41] Burda M., Wyplosz C. (1993), "Gross workers and job flows in Europe", CEPR discussion p 868, Nov 93

[42] Burda M., Wyplosz C. (1994), "Gross workers and job flows in Europe", European Economic Review 38(6), p1287-1315

[43] Burdett K., Kiefer N., Mortensen D., Neumann G. (1984), "Earnings, Unemployment, and the Allocation of Time Over Time", Review of Economic Studies LI, 559-578

[44] Burdett K., and Mortensen D. (1989), "Equilibrium Wage Differentials and Employer Size" , Northwestern Center for Mathematical Studies, DP 860

[45] Burgess S. (1994), "Matching Models and Labour Market Flows", European Economic Review, pages 809-16

[46] Buchinsky M. (1994), "Changes in the U.S. wage structure 1963-87: Application of Quantile Regression Models", Econometrica 62(2), March, pp 405-58

[47] Calmfors L., J. Driffill (1988), "Centralization of Wage Bargaining", Economic Policy No 6, April

[48] Card D., Kramarz F., Lemieux T. (1995), "Changes in the Relative Structure of Wages and Employment: A Comparison of the United States, Canada, and France", forthcoming in Canadian Journal of Economics

[49] Castellan, M., M. Marpsat and M.F. Goldberger (1992), "Les quartiers prioritaires de la politique de la ville", INSEE Première 234, december.

[50] CEPR Report (1994), "Unemployment: What Choice for Europe", G. Alogoskoufis, C. Bean , G. Bertola, D. Cohen, J. Dolado, G. Saint-Paul

[51] Clark K., L. Summers (1982), "Labor Force Participation: Timing and Persistence", Review of Economic Studies, XLIX, 825-844

[52] Cohen D. (1988), "The rise of conservatism", Economic Policy 8, 91-120

[53] Cohen D. (1994), Misfortunes of prosperity, MIT Press

[54] Cohen D., Lefranc A. (1994), "French Unemployment: Hysteresis or Adjustment to a new equilibrium?", mimeo Delta

[55] Coulson, E., Laing, D. and P. Wang (1997), "Spatial mismatch in search equilibrium", Working Paper, The Pennsylvania State University.

[56] Combault P. (1992), "Les salariés au SMIC en Juillet 1990", Dossiers Statistiques du Travail et de l'Emploi No 78, Mars

[57] Davis S.J. (1992), "Cross-Country Patterns of Change in Relative Wage", NBER Macroannuals, 239-292

[58] DP: BPE, BPEE (1994), "Décomposition tendence-cycle: les méthodes statistiques univariées", Ministère de l'Economie.

[59] Doeringer P.B, and Piore M.J. (1971), Internal Labour Market and Manpower Analysis, M.E. Sharpe, Inc., New York

[60] Dolado J., F. Kramarz, S. Machin, A. Manning, D. Margolis, C. Teulings (1996)," Minimum Wages, The European experience", Economic Policy, pp 319-372

[61] Dreze J.H. and Bean C.R. (1990), Europe's Unemployment Problem, MIT Press

[62] Eberts R., E. Groshen (1991), Structural Changes in US. Labor Markets, M.E. Sharpe, Inc. New York

[63] Entorf H., Franz W., Kōnig , Smolny W. (1990), "The Development of German Employment and Unemployment: Estimation and Simulation of a Small Macro Model", in Dreze and Bean eds., Europe's unemployment problem, MIT Press

[64] Entorf H., Kramarz F. (1994), The impact of New Technologies on Wages: Lessons from Matching Panels on Employees and on Their Firms", DP 9407, Crest

[65] Fitoussi J-P. (1994), "Wage Distribution and Unemployment: The French Experience", American Economic Review Papers and Proceedings, 59-64, May

[66] Fougère D., Kamionka T. (1992), "A Markovian Model of the French Labour Market", Annales d'Economie et Statistiques 27, 149-188

[67] Fujita, M. (1989), Urban Economic Theory, Cambridge: Cambridge University Press.

[68] Gagey F., Lambert J.P., Ottenwalter B. (1990), "Structural Mismatch, Demand and Capacity constraints in the Rise in Wage Unemployment", in Dreze and Bean eds., Europe's unemployment problem, MIT Press

[69] Germain J.M., Rabault (1994), "Quelques commentaires sur le filtre d'Hodricks-Prescott", Ministère de l'Economie, note DP n 1994061

[70] Goldin C. (1994), "The U-shaped female labor force function in economic development and economic history", NBER wp 4707

[71] Gosling A., S. Machin, C. Meghir (1996), "The Changing Distribution of Male Wages in the UK", Discussion Paper 271, Center For Economic Performance, LSE

[72] Goux D. and E. Maurin (1995), "Demand for Skilled Labor, Technical Changes and International Trade, The French Case, 1970-93", mimeo INSEE

[73] Grant J.H., Hamermesh D.S. (1982), "Labor Market Competition Among Youths, White Women and Others", Review of Economics and Statistics, 354-360

[74] Greene W. (1993), Econometric Analysis, second ed., Prentice-Hall International, Inc

[75] Gregg P., J. Wadsworth (1995), "A Short History of Labour Turnover,Job Tenure and Job Security 1975-1993", Oxford Review of Economic Policy

[76] Grubbs D., Wells W. (1993), " La réglementation de l' emploi et les formes de travail dans les pays de la CEE" , Revue Economique de l'OCDE.

[77] Hall R. (1982), "The Importance of Lifetime Jobs in the US Economy", American Economic Review 72, vol4

[78] Hartog J., van Ophem H. (1994), "On-the-job search and the cyclical sensitivity of job mobility", European Economic Review

[79] Hamermesh D.S. (1986), "The Demand for Labor in the Long Run", in Handbook of Labor Economics, Vol I, edited by O. Ashenfelter and R. Layard, Elsevier Science Publisher BV

[80] Hamermesh D.S., J. Grant (1979), "Econometric Studies of Labor-Labor Substitution and their Implications for Policy", The Journal of Human Resources, XIV(4)

[81] Harvey A. (1993), Time Series Models, Harvester Wheatsheaf, second ed.

[82] Hasluck, C. (1987), Urban Unemployment. Local Labour Markets and Employment Initiatives, Essex: Longman Group.

[83] Hatanaka M. (1996), Time-series-based Econometrics, Unit Roots and co-integration, Oxford University Press

[84] Heckman J., Killingsworth M. (1986), "Labour supply of women", in Ashenfelter and Layard, Handbook of Labour Economics.

[85] Hendry D.F. (1995), Dynamic Econometrics, Oxford Univ

[86] Hénin P.Y. and al. (1993), La Persistance du Chômage, Economica ed.

[87] Hildreth A., Millard S., Mortensen D., Taylor M. (1994), "Wages, work, and unemployment: work history evidence on allocating time between labour market states", WP University of Essex

[88] Holzer, H. (1987), "Informal job search and black youth unemployment", American Economic Review, 446-452.

[89] Holzer, H. (1988), "Search method used by unemploymed youth", Journal of Labor Economics, 6, 1-20.

[90] Holzer, H. (1989), Unemployment, Vacancies and Local Labor Markets, W.E. Upjohn Institute for Employment Research.

[91] Holzer, H. (1991), "The spatial mismatch hypothesis: what has the evidence shown ?", Urban Studies, 28, 105-122.

[92] Ihlanfeldt, K.R. (1997), "Information on the spatial distribution of job opportunities within metropolitan areas", Journal of Urban Economics, 41, 218-242.

[93] Ihlanfeldt, K.R. and D.L. Sjoquist (1990), "Job accessibility and racial differences in youth employment rates", American Economic Review, 80, 267-276.

[94] INSEE Résultats, Emploi-Revenu, 62-63 (1994), Marché du travail, séries longues, Bordes M., Guillemeot D.

[95] INSEE: collection C106/1985 (1985), La situation démographique en 1982, Brigitte Faur

[96] INSEE: collection D10/1971 (1971), La situation démographique en 1968 et 1969, S.Hemery, Q.C.Dinh

[97] INSEE: collection D65/1979 (1979), La situation démographique en 1975 et 1976, Nicole Guignon-Back

[98] INSEE Résultats (1992), Démographie, Société n 16-17, Christine Couet, Yves Court

[99] Jackman R., R. Layard, 1991, "Does Long Term Unemployment Reduce a Person's Chance of a Job", Economica, 58(229), 93-106

[100] Jackman R., R. Layard, S. Nickell (1996), "Combatting Unemployment: Is flexibility Enough¿, Paper for the OECD Conference on "Interactions between Structural Reform, Macroeconomic Policies and Economic Performance", Paris, January 1996

[101] Jackman R., R. Layard, S. Savouri (1991), "Mismatch: A Framework for Thought", in F. Padoa Schioppa (ed.), Mismatch and Labour Mobility, CEPR. Cambridge: Cambridge University Press.

[102] Jayet, H. (1990a), "Spatial search processes and spatial interaction: 1. Sequential search, intervening opportunities, and spatial search equilibrium", Environment and Planning A, 22, 583-599.

[103] Jayet, H. (1990b), "Spatial search processes and spatial interaction: 2. Polarization, concentration, and spatial search equilibrium", Environment and Planning A, 22, 719-732.

[104] Jovanovic N., Nyarko Y. (1994), "The Transfer of Human Capital", NBER wp 4823, August

[105] Juhn C., K. Murphy, B. Pierce (1991), "Accounting for the Slowdown in Black-White Wage Convergence", in Workers and their Wages, M. Kosters, ed., AEI Press, Washington, D.C.

[106] Juhn C., K. Murphy, B. Pierce (1993), "Wage Inequality and the Rise in Return to Skill", Journal of Political Economy, pp410-42

[107] Juhn C., K. Murphy, R. Topel (1991), "Why has the Natural Rate Increased Over Time?", Brooking Papers on Economic Activity, pp75-126

[108] Kain, J. (1968), "Housing segregation, negro employment, and metropolitan decentralization", Quarterly Journal of Economics, 82, 32-59.

[109] Katz L., K. Murphy (1992), "Changes in Relative Wages, 1963-1987: Supply and Demand Factors", Quarterly Journal of Economics, February

[110] Krugman P. (1994), "Past and Prospectives Causes of High Unemployment", in Reducing Unemployment: Current Issues and Policy Options, Jackson Hole Conference, WY

[111] L'Horty Y. (1994), "Flux sur le marché du travail et formation du chômage en France depuis 1970", Ministère de l'Economie, note DP n A2-94-13, published in Economie et Statistiques, 1997

[112] Layard R. (1997), "Preventing Long-Term Unemployment: an Economic Analysis", in Unemployment Policy. Government Options for the Labour Market, in D. Snower and G. de la Dehesa eds., University Press, Cambridge

[113] Layard R., Barton M., Zabalza A. (1980), "Married Women's Participation and Hours", Economica 47, 51-72

[114] Layard N., S. Nickell, R. Jackman (1991), Unemployment. Macroeconomic Performance and the labor Market, Oxford University Press

[115] Levy R. and Murnane F. (1991), "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations", Journal of Economic Litterature Vol XXX (September), pp1333-1381

[116] Lindbeck A., D.J. Snower (1986), "Wage Setting, Unemployment, and Insider-Outsider Relations", American Economic Review Papers and Proceedings, 235-239

[117] Lindbeck A., D.J. Snower (1989), The Insider-Outsider Theory of Employment and Unemployment, MIT Press

[118] Lippi M., L. Reichlin (1993), "The Dynamic Effects of Aggregate Demand and Supply Disturbances: Comment", American Economic Review, 644-658

[119] Lippi M., L. Reichlin (1994), "VAR Analysis, Nonfundamental Representations, Blaschke Matrices", Journal of Econometrics 63, 307-325

[120] Mac Cormick, B. and S. Sheppard (1992), "A model of regional contraction and unemployment", The Economic Journal, 102, 366-377.

[121] Malinvaud E. (1986), "The Rise of Unemployment in France", Economica 53, S197-S217

[122] Manacorda M., Petrongolo B. (1996), "The Race Between Demand and Supply of Education", Center For Economic Performance, DP 307, LSE

[123] Manning A. (1992), "Productivity Growth, Wage Setting and the Equilibrium Rate of Unemployment", Center for Economic Performance, LSE, Discussion Paper 63

[124] Manning A. (1993), "Endogenous Labour Market Segmentation in a Matching Model", Center for Economic Performance, LSE, Discussion Paper 126

[125] Manning A. (1996), "Movin'On Up. Interpreting the Earnings-Experience Profile", August, mimeo Dpt of Economics, LSE

[126] Mincer J. (1962), Labour Force Participation of Married Women. In Aspects of Labour Economics (H.G Lewis, eds) Washington DC. NBER

[127] Mincer J. (1966), Labour Force Participation and Unemployment. In Prosperity and Unemployment (R.A Gordon, and M.S. Gordon eds) New York

[128] Mincer J. (1974), Schooling, Experience, and Earnings, National Bureau of Economic Research, New York 1974

[129] Mincer J. (1985), "Intercountry Comparisons of Labor Force Trends and of Related Developments: An Overview", Journal of Labour Economics, vol 3, No 1

[130] Mortensen D.T. (1982), "The Matching Process as a Non-Cooperative/Bargaining Game". In J.J. McCall (ed.), The Economics of Information and Uncertainty, 233-254. Chicago: University of Chicago Press

[131] Mortensen D.T, C.A. Pissarides (1994), "Job Creation and Job Destruction in the Theory of Unemployment", Review of Economic Studies, 64, 397-415

[132] Murphy K.M., R.H. Topel (1987), "The Evolution of Unemployment in the United-States: 1968-1985", in Fisher S. ed., NBER Macroannuals

[133] Narendranathan W., Nickell S., Stern Z. (1985), "Unemployment Benefits revisited", The Economic Journal, 95, 307-329

[134] Nickell S. (1991), "Wages, Unemployment and Population Changes", Oxford Applied Economic Discussion Paper, 122, October 1991.

[135] Nickell S., S. Bell (1995), "The Collapse in Demand for the Unskilled and Unemployment across the OECD", Oxford Bulletin of Economics and Statistics 11(1), pp40-62

[136] OECD (1993), Main Economic Indicators, Historical Statistics 1962-1991

[137] OECD (1993), Employment Outlook, p18-29

[138] OECD Education at a Glance (1994)

[139] OECD Employment Outlook (1995)

[140] O'Neill J. (1985), "The Trend in the Male-Female Wage Gap in the United States", Journal of Labor Economics; 3(1), Part 2 January, pp S91-116

[141] O'Regan, K. and J. Quigley (1993), "Family networks and youth access to jobs", Journal of Urban Economics, 34, 230-248.

[142] Ortega Javier (1993), "Loss of Skill During Unemployment and Complementarities in the Production", DP Delta 93-26

[143] Phelps E.S. (1972), "The Statistical Theory of Racism and Sexism", American Economic Review 62, 659-661.

[144] Pissarides C.A. (1986), "Unemployment and Vacancies in Britain", Economic Policy

[145] Pissarides C.A. (1989), "Unemployment Consequences of an Ageing Population. An application of Insider-Outsider Theory", European Economic Review, 33(2/3), p355-66

[146] Pissarides C.A. (1990), Equilibrium Unemployment Theory, Oxford, Basil Blackwell

[147] Pissarides C.A. (1992), "Loss of Skill During Unemployment and the Persistence of Employment Shocks", Quarterly Journal of Economics, 1371-1391, November

[148] Pissarides C.A. (1994), "Search Unemployment with On-the-Job Search", Review of Economic Studies, 64, 457-475

[149] Rice P. and Mc Vicar D. (1997), "Participation in Full-Time Education in England and Wales: An Analysis of Post-War Trends", mimeo Dt. of Economics, University of Southampton

[150] Romer P. (1987), "Crazy Explanations for the Productivity Slowdown", NBER Macroeconomics Annual

[151] Romer P. (1990), "Capital, Labor and Productivity", Brooking Paper on Microeconomics

[152] Saint-Paul G. (1994), "On the Political Economy of Labour Market Flexibility", NBER Macroeconomics Annuals,151-195

[153] Saint-Paul G. (1995a), "Some Political Aspects of Unemployment", European Economic Review

[154] Saint-Paul G. (1995b), "Labor Market Institutions and the Cohesion of the Middle class", discussion paper 1298, CEPR

[155] Schultz P. (1981), Economics of Population, Reading MA:Addison Wasley Pub

[156] Simpson, W. (1992), Urban Structure and the Labour Market. Worker Mobility, Commuting, and Underemployment in Cities, Oxford: Clarendon Press.

[157] Smith, T.E. and Y. Zénou (1997), "Dual labor markets, urban unemployment and multicentric cities", Journal of Economic Theory, 75.

[158] Snower D. and G. de la Dehesa eds. (1997), Unemployment Policy. Government Options for the Labour Market, University Press, Cambridge

[159] Sorrentino C. (1993) "International comparisons of unemployment indicators", Monthly Labor Review, March.

[160] Sorrentino C. (1995), "International unemployment indicators, 1983-93", Monthly Labor Review, August.

[161] Thomas, I. and Y. Zénou (1997), "Segregation and labor discrimination in Brussels. Theory and evidence", mimeo, Université Catholique de Louvain.

[162] Topa G. (1997), "Social Interactions, Local Spillovers and Unemployment", mimeo NYU

[163] Topel Robert H. (1994a), "Wage Inequality and Regional labor Market Performance in the US", in Toshiaki Tachibanaki, ed., Savings and Bequests, Ann Arbors University Michigan Press

[164] Topel Robert H. (1994b), "Regional Labor Markets and the Determinants of Wage Inequality", American Economic Review Papers and Proceedings, 84, 17-22, May

[165] Wasmer E. (1997a), "A note on the emergence of dualism in matching models", mimeo LSE

[166] Wasmer E. (1997b), "A note on Mincer's proxy in Wage Equation", mimeo Crest

[167] Weiss, A. (1995), "Human Capital vs. Signalling Explanations of Wages", Journal of Economic Perspectives, 9(4), Fall 1995, pages 133-54

[168] Welch F. (1979), "Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust", Journal of Political Economy, S65-97

[169] Wilson, W.J. (1987), The Truly Disadvantaged, Chicago: University of Chicago Press.

[170] Wilson, W.J. (1996), When Work Disappears. The World of the New Urban Poor, New York: Alfred A. Knop.

[171] Zax, J. and J. Kain (1996), "Moving to the suburbs: do relocating companies leave their black employees behind ?", Journal of Labor Economics, 14, 472-493.

[172] Zénou, Y. (1997), "Unemployment in cities", in Economics of Cities, J-M. Huriot and J-F. Thisse eds., Cambridge University Press, forthcoming.

[173] Zénou, Y. and T.E. Smith (1995), "Efficiency wages, involuntary unemployment and urban spatial structure", Regional Science and Urban Economics, 25, 547-573.