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Labor Supply Dynamics, Unemployment and Human Capital Investments

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ABSTRACT

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In the last decades, the OECD labor markets faced important labor supply changes with the arrival of women and the cohorts of the baby-boom. Using a survey where workers declare their true employment experience, this paper argues that these supply trends imply more inexperienced workers. It then investigates the important consequences of this fact on the skill composition of the labor force, between-groups wage inequality and the level of unemployment. The main result is that a labor market with wage rigidities may not recover from such a temporary labor supply shock: with a younger and less experienced labor force, there is higher unemployment among low-experience workers, they do not accumulate enough on-the-job human capital, this reduces in the long-run the supply of skilled (experienced) workers and the demand for unskilled workers. This intertemporal multiplication of supply shocks generates multiple equilibria, and the rigid economy is stuck to the bad equilibrium even after the shock. In a competitive market, in contrast, wage inequality and notably, the wage return to experience becomes higher but there is no persistence of the supply shock. Higher education prevents this intertemporal multiplication of supply shocks.

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Economists concerned by the rise in European unemployment have paid little attention to the increase in the active population. One reason for this lack of interest is that relations between labor supply and unemployment cannot persist in the long run in representative agent models, since capital stock will increase endogenously, as will the productivity of labor. This is the conventional Solowian view applied to non-clearing labor markets. In some models, however, the size of the labor force can affect equilibrium unemployment through a composition effect.[1]

Precisely, one of the most substantive changes in the OECD labor markets since the 1960's is the massive entrance of women and the larger cohorts of young workers, which arguably, cannot be considered as homogeneous variations in the size of population. I will first document here this trend, using French microeconomic data from Enquête Actifs Financiers 1992, where information on true employment experience is available. Young and female workers have a smaller number of (efficient) units of employment experience. It is worth noting that important empirical works (Welch 1979, Bloom et al. 1987, Murphy et al. 1988 among others, and more recently Shimer 1998) have similarly concluded to the importance of the adverse impact of the baby-boom cohorts in the labor markets.[2] It is regrettable to notice that there are few theoretical works on this question, since labor supply (composition and dynamics) and other labor market variables (such as unemployment, relative wages or human capital investment) interact in a complex way.

So, in the second part of the paper, I will clarify some of these interactions between labor supply and the level of employment, unemployment and schooling in the last part of the paper. Section 2 introduces the notations of a model of labor markets with endogenous participation, unemployment and human capital. Skilled workers are those with some employment experience or some education or, in other words, unskilled workers are those with neither experience nor education. Unemployment arises from wage rigidities at the bottom of the distribution of wages. In Section 3, two labor supply variables are considered: the growth rate of population, taken

[1]This is the case in Pissarides (1990), where labor force growth affects equilibrium unemployment by increasing the share of young workers through more new entrants into the labor force. See also Nickell (1991), and, on relative wages, the theoretical part in Welch (1979).

[2]Shimer's conclusion, notably, is that U.S. unemployment rate variations in time reflect partly the age composition of the labor force. I investigated this trend using macroeconomic data in Wasmer (2001) and considered some possible unemployment consequences. It was notably shown that unemployment of youngsters, relative to prime-age workers, was positively associated with declines in the supply of experience, consistently with a simple demand/supply framework with additional wage rigidities.

exogenous, and the distribution of opportunity costs of participating to the labor market in the second period of workers' life.

The key result is that a labor market with large enough wage rigidities is unstable and lead to multiple equilibria. This result is obtained under constant returns to scale in production. Moreover, one reaches and stays in the high unemployment equilibrium after a large (even temporary) supply shock. This is in fact the result of an intertemporal transmission of shocks by the skill composition of the labor force. Higher unemployment today leads to a lower number of skilled workers the following period and therefore reduces the demand for unexperienced workers, increasing youth unemployment.[3] Endogenous participation plays a stabilizing role; when unemployment is too high, the unskilled workers leave the labor force, but the multiplicity of equilibria remains. In this section, only wage flexibility may allow to leave the bad equilibrium, at the cost of higher wage inequality between experienced and inexperienced.

In Section 4, it is shown that one can exit from the dilemma inequality/unemployment through higher education. Indeed, optimal human capital investment decisions induce low-experience groups to improve their skills; new cohorts invest in education, women invest in on-the-job skills. The multiplicity of equilibria vanish when workers can fully arbitrate between higher education and early participation to the labor market. In the logic of the model, increasing educational attainment of workers is due to both adverse labor supply trends and to increased demand for education, the latter being the conventional view (e.g. Katz and Murphy 1992). Section 5 concludes.

1 Labor Supply

In all OECD countries, there is an increasing number women in the labor force and, also to some extent, of the 25-34 year old workers. Other measures of the age composition of the labor force give similar results, with sometimes an increase in the average age of the labor force in the second half of the 80's. See Wasmer (1998) for a detailed description of these trends and the choice of the definition of 'young' workers.

[3]This is not the first paper where this kind of intertemporal transmission of the shocks of the labour market is implicitly present; Pissarides (1992) and Ortega (1993) are two examples in a job matching framework. However, unlike the two previous papers, this model does not need search frictions, and its emphasis is on labor supply trends as initiators of the amplification of the shocks. It also goes further into the analysis of the composition of the supply of skills.

To express these trends in terms of human capital implication, I measured (Wasmer 2001) the change in the supply of experience based on macroeconomic participation data and showed that most OECD countries faced a decline of experience in the 70's, early 80's, and then an increase in experience in the 90's. In previous work (Wasmer 1997), I also decomposed the fitted hourly wage (from two wage equations for each gender) of all individuals in the labor force into two components, experience (on the x-axis) and education (on the y-axis). It appeared clearly that the education component of fitted wages rose in France over the past decades (data are available for the years 1970, 1977, 1985 and 1993). A quite large decline in the 'experience' component in wages during the period 1970-77 was also observed. In a second period, after 1977, the decrease in the average efficiency units of experience of the labor force decelerates, and there is a strong rise in the supply of education. I obtained very similar results for the US.

Here, I investigate the same issue with another microeconomics dataset for France,the survey 'Actifs Financiers 1992'. This is a unique dataset in which individuals declared their number of years in part-time and full time employment during their working life. A description of the variables and the instruments is reported in appendix 1. The goal here is to show the difference between real and potential experience (potential experience being age minus (imputed) age at the end of education, the usual proxy in 90% of the studies), and accordingly, to understand to what extent women can be considered as "young", i.e. low-experienced.

Table 1 reports 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), rows 2-5 sort individuals according to potential experience and the last four rows according to the quartile of hourly wage (in this case, the sample is restricted to the active employed). The third and sixth column give the relative difference between potential and real experience. It appears quite clearly from the tables that even in 1992, the average real experience of women was by 16% lower than their potential experience. When compared to men, it appears that the high-skill women actually have experience levels similar to those of men: the relative gap between the real and the potential experience of women in the fourth quantile is 11%, close to the men's average (9.6%). Finally, young workers of both gender have difficulties in 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 behavior of workers in 1992, but the entire participation history of these workers. The differences between actual and potential experience are much larger for the oldest women ($exp > 30$), about 22%, while the corresponding figure is 3.5% for men.

Beyond gross differences, it is important to compare the return of real experience by gender. This will allow us to get an estimate of the number of efficiency units of experience supplied by different groups, by multiplying the return and the quantity of experience supplied by workers. Using a classical Mincer wage equation (Mincer 1974), one finds the following coefficients for experience (controlling for education with seven dummy variables)[4].

[Insert tables 1 and 2 here]

Even when considering true experience instead of potential experience[5], it appears that after 20 years of employment experience (the median number of years of experience), the average return to experience is 3.34% for men whereas it is 2.16% for women; the gender gap in the return to experience is about 45%; Interestingly, this 45% figure is close to Mincer's estimates; he reports (1997, p. S31) that he assumes the female investment ratio in human capital to be half of the corresponding figure for men. Depending on the sample (notably excluding the very low wage workers), the difference can sometimes be smaller than 45%, but always remain above 30%.

In addition, these results and the coefficients for education can be used for calculating the number of years of work experience required for an unskilled worker (with no diploma) to reach the wage of a worker with no experience but with a bachelor degree. It turns out that the average return to education is compensated in 13 years (for men) and in 23 years (for women), but that the wage gap between workers with no diploma and workers with the highest level of education can never be totally compensated by the accumulation of employment experience.

The natural conclusion is that, at the same level of employment experience, the 'efficient

[4] The variables in the particpation equation (Heckman) are (Age - Age of First Paid Activity) and its square, a dummy variable for being married, the number of children less than three, six and eighteen years old and a dummy for the participation of individual's mother. Using these variables to intrument real experience gives extremly similar results (available on request).

[5] It is sometimes considered that potential experience is a good instrument for real experience. There is obviously a tradeoff between taking care of the correlation between real experience and the residuals, and treating the systematic bias due to measurement error in experience (especially for women). These specific issues are investigated in Wasmer (1997).

units' of experience supplied by women are 45% lower (provided that there is no gender discrimination in the wage return to experience, see Wasmer 1998 for a discussion) and accordingly an increasing relative supply of female workers, added to the increasing size of the cohorts of new entrants into the labor market, decrease the per-worker level of experience.

2 A model

Given the evidence presented in the previous section, representative agents' models cannot address the impact of labor supply trends on labor market outcomes. This section is devoted to building the simplest dynamic model which can incorporate the impact of heterogeneity in the supply trends on equilibrium unemployment. Note that the model presented here differs from the previous literature on the link between human capital theory and life-cycle decisions (e.g. Weiss 1986, Mincer 1997 and the subsequent references) in two ways: unemployment is introduced, and the aggregate returns to different skills are endogenous, since the focus of the paper is macroeconomic.

2.1 Production technology

I assume that there are only two broad types of occupations in the economy. The first occupation can be filled by everyone and the second cannot be filled by the unskilled. In this latter category, skills like education (in professions like engineers) and/or experience (in managerial occupations) are required. The production technology combines the skilled and the unskilled. The efficiency units of employment of skilled workers (with experience or education) are denoted by E_t^S, and the efficiency units of employment of unskilled workers by E_t^U. The constant return to scale production function of the representative firm will be: $Y = Y(E_t^S, E_t^U, \tau)$, where τ is a technology parameter which represents biased technological progress raising the relative demand for skilled workers.[6] Some degree of imperfect substitutability between experience and education will be introduced.[7] Capital is ruled out; at a fixed interest rate, the above production function is the long-run reduced form of a more general technology with three factors, that is, capital, skilled

[6] This is a commonly invoked explanation for the rise in inequality in the US, e.g. Juhn, Murphy and Pierce (1993) and Katz and Murphy (1992).

[7] Experience can be an imperfect substitute for education for informational reasons: there is a strand of research by Jovanovic and Nyarko (1994) which studies the properties of learning through experience. Basically, experience is a signal extraction on some unknown parameter, upon which a decision must be made.

and unskilled labor.

2.2 Workers

Cohorts of size P_t of agents enter the labor market at time t. The growth rate of the cohorts is n_t. The agents live two periods. As in Welch (1979), workers move from the low to the high occupation between the first and second period of life, provided that they can accumulate enough human capital. There are two ways of accumulating human capital. The first is to spend the first period of one's life in education and work the second period. The second is to obtain employment experience in first period. With these simplifying assumptions, one capture the essential mechanism of the model at a low analytical cost.

Workers in the second period of their life can be in four different situations. They can be 1. experienced, or 2. educated; they can also be 3. inexperienced and uneducated ; finally, they can be 4. out of the labor force. The skilled belong to categories 1 and 2, the unskilled to category 3. I will denote the educated workers by superscripts Ed , the experienced ones by Ex, the old unskilled (inexperienced and uneducated) by O, and the young workers by Y.

The experienced and educated workers will not be perfect substitutes (this is detailed in section 4). In contrast and to keep the model simple, the young workers (E_t^Y) and the old unskilled workers (E_t^O) are perfect substitutes in the production, $E_t^U = E_t^Y + E_t^O$. This means that, whatever the reason for not having accumulated experience (unemployment, inactivity or simply age), workers are neither discriminated nor have suffered any human capital loss. This is an important difference to previous works assuming that unemployment duration has a specific adverse impact on workers, as in Pissarides (1992).

Since the focus of this paper is macroeconomic, I first present a quite 'crude' description of experience accumulation, compared to the literature summarized by Weiss (1986). An attempt to go further is however undertaken in Section 4.2. I assume that only a fraction $1 - u_t$ of a cohort of young can get enough employment experience, where u_t is the unemployment rate for young workers. Linearity in u_t is chosen so that the exposition of the argument is simplified, but a more general specification[8] would lead to the same results.

[8]Assume, for instance, that each period is subdivided into p smaller subperiods where a lottery is held each time to distribute the jobs. The experience level to access the skilled jobs could be q successive spells of employment, with $q < p$. Then, the fraction of them who access skilled jobs is a function $\Phi(u_t\ , p, q)$, with $\Phi_1 > 0$, $\Phi_2 > 0$ and $\Phi_3 < 0$. What simply matters is that the aggregate outcome at period t depends strongly on past outcomes. In

2.3 Unemployment

The wage of the unskilled may not always be market-clearing, due to some downwards rigidities. Unemployment only affects the unskilled; the wages of the skilled are market-clearing. The wage rigidity can be linked to the existence of a wage setting curve, linking wages and unemployment as in efficiency wages model, to the existence of Nash-Bargaining linked to search frictions, the existence of unions setting wages given the labor demand curve of the firms, or risk-averse workers buying an insurance to risk-neutral firms. A frequent short-cut to get a non-market-clearing wage for the unskilled is to assume that it decreases with unemployment, like in the wage curve models. From now on, I use the convenient notation $e_t = 1 - u_t$ (the employment to labor force ratio). The unemployment rate of unskilled workers is common to both young and old unskilled. The wage setting can then be represented by a double log functional form, of the type

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

but the results of the model remain the same if one instead chooses a log linear formulation for the wage curve. Given that skilled workers can apply to unskilled jobs, we have to check ex-post that $w_t^U < w_t^S$. In the proof of Proposition 1, we offer a simple condition on the parameter reflecting the relative demand for skilled workers.

There is another way to introduce a wage rigidity: as in Saint-Paul (1995), one may assume a minimum wage indexed on the average wage (as the French minimum wage, for instance). In this model with two types of workers, this is equivalent to having a maximum dispersion of wages, i.e. a constant indexation rate $\gamma < 1$ and the condition on wages writes $w^U \geq \gamma . w^S$. This yields simpler results, and in the extension of the model (Section 4), to clarify the exposition of the arguments, I will chose this specification.[9]

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 only requires agents who live two periods. More realism could be introduced by modelling more than two periods, at the cost of additional complexity and without qualitative changes.

[9]Notably, a nice feature of this assumption is that, when the equality is satisfied, the wage distribution is constant, as is more or less the case in Europe. See Davis (1992), Blanchflower et al. (1993).

2.4 Endogenous participation

Participation is modelled as a static extension of the neo-classical model of labor supply. The value of non-market time for workers depends on their age. In the first period of time, this value is denoted by Λ_1 and in the second period, it is denoted by Λ_2. We assume that $\Lambda_2 > \Lambda_1$. and that Λ_1 is close to zero. As we will see, this will imply that in the first period of life, young workers will participate to the labor market. This is an empirical fact: the participation rates of female workers not enrolled in education are higher at lower ages and then decline with time.[10]

This reservation wage is a pecuniary equivalent of utility when the worker is not in the labor force. In the second period, those with an *expected wage* higher than the reservation wage will participate. The participation rate of the unskilled in the second period is thus simply $\rho^O = 1$ if $e_t w_t^O > \Lambda_2$ and a number between 0 and 1 if $e_t w_t^O = \Lambda_2$. Similarly, the participation rate of the skilled is $\rho^{Exp} = 1$ if $w_t^S > \Lambda_2$. and another number between 0 and 1 if $w_t^S = \Lambda_2$. Given that we only consider situations for which $w_t^U < w_t^S$, $w_t^S = \Lambda_2$ would imply $w_t^U < \Lambda_2$ i.e. that old workers all retire from the labor force ($\rho^O = 0$), a case that we will rule out here. So, from now on, $\rho^{Exp} = 1$.

We have here two variables describing the composition of labor supply and the trend to more inexperienced workers: an increase in the size of cohorts by a larger n_t and an increase in the participation rate of workers (e.g. women), by a lower Λ_2.[11] A third important component of the labor supply of workers is the level of human capital (both schooling and on-the job training). Incorporating these human capital investment decisions are postponed to section 4: the model without education is a useful benchmark to start with.

[10] In Wasmer (1998), I introduced at the beginning of the second period a shock on leisure (birth, disease), leading to a distribution of reservation wages w^r in the population, with a cumulative density function $F(.)$. In order to simplify the exposition, I take here the degenerate distribution. The proofs are much simplified and the main results are preserved.

[11] In the above mentionned version of the discussion paper, I used a non-degenerate distribution of reservation wages which has the advantage of treating the problem of the heterogeneity of the labor force and more specifically about gender differences in participation. This is ignored here.

3 Model Without Education

3.1 Labor supply

In absence of educational investment, the only skilled workers are the experienced ones, whose labor supply is $L_t^S = L_t^{Ex}$. The unskilled workers are both the young, and the old inexperienced ones. Unskilled labor supply is therefore the sum the two categories: $L_t^U = L_t^Y + L_t^O$. The time structure of the model provides the following dynamic labor supply equations:

$$L_t^{Ex} = P_{t-1}.e_{t-1} \tag{2}$$

$$L_t^O = P_{t-1}.(1-e_{t-1}).\rho_t^O \tag{3}$$

$$L_t^Y = P_t, \tag{4}$$

where ρ_t^O is the participation rate of old, unskilled workers. Eq. (4) just states that the entire cohort of young workers participate, whereas Eq. (2) indicates that the experienced workers who participate are the young employed participants of the previous period, i.e. L_{t-1}^Y multiplied by their probability of having been employed e_{t-1} times the current participation rate. A similar interpretation holds for (3).

Full employment of skilled workers implies that $N_t^S = L_t^S$ and the definition of the employment rate of the unskilled implies that $E_t^S = e_t L_t^U$. As usual with constant returns to scale in production, the important variable to consider will be the ratio of $z_t = E_t^S / E_t^U = \frac{1}{e_t} \frac{e_{t-1}}{1+n_t+(1-e_{t-1})\rho_t^O}$.

3.2 A non-market-clearing labor market

With some wage rigidity which may be an accurate representation of a European labor market, there will be some positive unemployment at t. Then, the dynamics of this economy can be summarized by the dynamics of this variable e_t, by Proposition 1:

Proposition 1. *The dynamics of employment is as follows (see Figure 1). There is a flat part when the participation rate of unskilled workers adjusts and is below 1. The limit of* e_t *when* e_{t-1} *goes to 1 is strictly below 1. In between, the slope of* $e_t(e_{t-1})$ *is always strictly positive, can be very large and may intersect the 45° line. In the generic case, we thus have multiple steady-state equilibria. The stability of the low employment equilibrium is insured by the adjustment of participation. The stability of the high employment equilibrium is insured by the wage pressure of unskilled workers. If the curve intersects the 45° line once only, there would only be one equilibrium.*

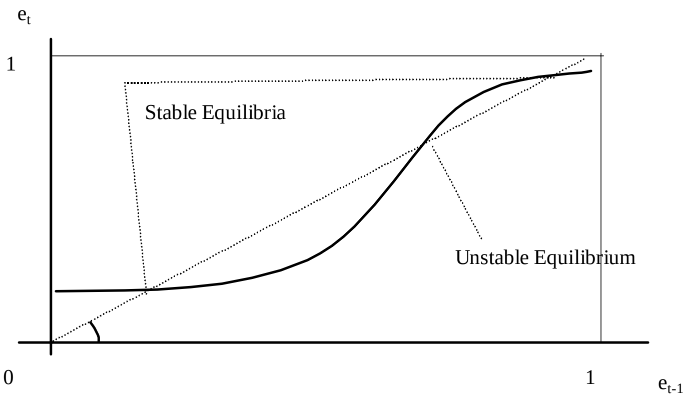

Figure 1:

Proof. The proof is in four steps and two lemmas.

a) Let us first prove equation (5). We have as a first order condition that

$$w_t^U = F_U(z_t)$$

where z_t is the current ratio of skilled to unskilled workers and F_U is the first-order derivative of the production function with respect to unskilled labor, rearranging the inputs into a ratio z_t given the constant-returns to scale assumption. Using the double log-wage equation, we thus obtain

$$\exp(b)(1-e_t)^{-\phi} = F_U\left(\frac{e_{t-1}/e_t}{1+n_t+(1-e_{t-1})\rho_t^O}\right) \tag{5}$$

b) Second, since the wage of the unskilled goes to infinity when e_t tends to 1, we have to check that the wage of the skilled workers does not become lower than the wage of the unskilled (otherwise, some skilled workers would apply to unskilled jobs). For that, one has the usual ratio of first order-conditions, which states that, at large wages ($\rho^O = 1$),

$$\frac{w_t^U}{w_t^S} = \frac{F_U(z_t)}{F_S(z_t)} = r\left(z_t\right)$$

where r is an increasing function of $z_t = \frac{e_{t-1}/e_t}{1+n_t+(1-e_{t-1})\rho_t^O}$. In the case of a Cobb-Douglas production function for instance, r is linear. So, indeed, wages of the unskilled increase faster with e_t than wages of the skilled workers. Note however, that z_t remains bounded (at least for values of n_t above -1). So, under the assumption that skilled are 'sufficiently more productive, their wage remains above the wage of the unskilled, i.e. it itself goes to infinity. The interpretation is that, as the wages increase due to wage pressure, along these relative demand curves, the demand for both labor is reduced, so that the hierarchy on wages remain the same. With a Cobb-Douglas $\ln Y = \alpha \ln E_t^S + (1-\alpha)\ln E_t^U$[12], we have

$$\frac{w_t^U}{w_t^S} = \frac{1-\alpha}{\alpha}\frac{e_{t-1}}{e_t(2+n_t-e_{t-1})} < \frac{1-\alpha}{\alpha}\frac{1}{(1+n_t)e_t} \text{ for all } e_{t-1} < 1$$

When e_t is sufficiently close to 1, say larger than 1-ε for an arbitrarily small $\varepsilon > 0$, then $\frac{w_t^U}{w_t^S} < 1$ if $\alpha > \frac{1}{1+\frac{1}{(1+n_t)(1-\varepsilon)}}$. As ε goes to 1, and for small n_t, (say 1%) the wage of the skilled remains above the unskilled if $\alpha > 1/2 + n_t/2$.

c) We can now establish the existence of two regimes. The regime 1 has a participation rate of the old unskilled workers ρ^O equal to 1, and the regime 2 has a participation rate smaller than 1. Let us start with the second regime.

Lemma 1. *There exists a range of values of e_{t-1} between 0 and a value denoted by $e_{t-1}^{\text{sup reg2}}$ for which e_t is a constant of both time and of e_{t-1}. Let us denoted it by $\overline{e}$. If parameters are such that $\overline{e} < e_{t-1}^{\text{sup reg2}}$ then, at constant growth rate n_t, there exists a stable equilibrium given by the intersection of the straight line $e_t = \overline{e}$ and of the 45° line. One can also determine the participation rates such that, at constant growth rate n_t, $e_t = e_{t-1} = f(\text{technology}, n_t, \phi, \Lambda_2)$. See the left part of Figure 1 for an illustration of the case $\overline{e} < e_{t-1}^{\text{sup reg2}}$.*

Proof. Indeed, in the second regime with partial participation, we have then $e_t w_t^U = e_t \Lambda_2 = e^{b-\phi\ln(1-e_t)}$ which implies that e_t is a constant $\overline{e}$, also determined by $\ln\overline{e} + \phi\ln(1-\overline{e}) = b - \ln\Lambda_2$. Using the second part of equation (5), we also obtain $\Lambda_2 = F_U\left(\frac{e_{t-1}/\overline{e}}{1+n_t+(1-e_{t-1})\rho_t^O}\right)$. The right-hand side is increasing in e_{t-1} and decreasing in ρ_t^O. Thus, participation is increasing in e_{t-1}. The limit $e_{t-1}^{\text{sup reg2}}$ at which all unskilled workers participate is determined by $\Lambda_2 = F_U\left(\frac{e_{t-1}^{\text{sup reg2}}/\overline{e}}{2+n_t-e_{t-1}^{\text{sup reg2}}}\right)$ and can be larger or smaller than $\overline{e}$. If $\overline{e} < e_{t-1}^{\text{sup reg2}}$, then there exists a participation rate $\overline{\rho} < 1$ for the old unskilled, such that there is a stable employment rate $e_{t-1}(\overline{\rho}) = \overline{e}$. This participation rate is determined by $\Lambda_2 = F_U\left(\frac{1}{1+n_t+(1-\overline{e})\overline{\rho}}\right)$.

■

d) **Lemma 2**. *In the full-participation regime, we have a dynamic link between e_t and e_{t-1}. This link is positive if skilled and unskilled workers are complement. The limit $e_t = 1$ is never reached : $e_t(e_{t-1} = 1) < 1$.*

[12] In that case the technology parameter τ defined in Section 2.1 is simply α.

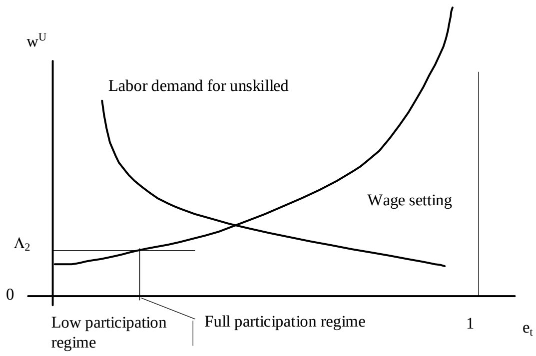

Figure 2:

Proof. In the full-participation regime, we have

$$b - \phi \ln(1 - e_t) = \ln Y_2(e_{t-1}, e_t(2 + n_t - e_{t-1})) \tag{6}$$

where Y_2 is the derivative with respect to the second argument of the production function. The left-and side is a wage setting curve, increasing in e_t. The right-hand side is a labor demand function, representing the demand for unskilled workers. It is decreasing in e_t by concavity of Y (i.e. $Y_{22} < 0$). This labor demand curves is also shifted up by higher e_{t-1} and by lower n_t, and finally, by lower τ (the parameter reflecting the relative demand for skilled workers). *A higher e_{t-1} simply means more skilled workers at time t, and thus, given complementarity between skilled and unskilled, higher relative demand for unskilled workers.* A higher n_t simply means more competition among the unskilled, and thus lower employment. See Figure 2 for an illustration.

Coming back to equation (6), one see that it implies a dynamic link between e_t and e_{t-1} which is increasing. The endogeneity of participation of unskilled (regime 2) adds a flat part at low e_{t-1}. Differentiating with respect to e_t and e_{t-1}, we obtain $\frac{de_t}{de_{t-1}} = \frac{Y_{12} - e_t Y_{22}}{\left[\frac{Y_2 \phi}{1-e_t} - Y_{22}(2+n_t-e_{t-1})\right]}$. Given that skilled and unskilled are assumed to be complement $Y_{12} > 0$ and that there are decreasing returns to scale $Y_{22} < 0$, we have in all cases that e_t is increasing in e_{t-1}. When -1 approaches one, the right-hand side of (6) is equal to $\ln Y_2(1, e_t(1 + n_t))$. To the extent that the production function has no infinite slope for finite values of the arguments, that value is bounded. Since the left-hand side of (6) goes to infinity in 1, this implies that there exists a finite, smaller than 1 limit for e_t when e_{t-1} goes to 1. The interpretation is simply that wage pressures are so large at full employment that this can never be a stable equilibrium.

To obtain the concavity, we need to compute the second order derivative $\frac{d^2 e_t}{de_{t-1}^2}$ which implies third order derivatives in the production function. We thus have no strong results here in the general case and the function can take all concavities. We can look at a more specific (Cobb-Douglas) case. Then we have the following dynamic link between e_t and e_{t-1}.

$$\alpha \ln e_t - \phi \ln(1 - e_t) + b = \ln(1 - \alpha) + \alpha \left[\ln e_{t-1} - \ln(2 + n_t - e_{t-1})\right] \tag{7}$$

One is referred to appendix 2 for the second order derivatives calculations. One can simply note that a simulation of (7) with $\Lambda_2 = 0$, $\alpha = 0.5$, $\phi = 0.1$ and $b = -0.96$ leads to three intersections with the 45° line, and so to three equilibria ($e = 0, e = 0.86$ and $e = 0.57$), the latter being unstable. With a positive value of Λ_2, one can thus replace the equilibrium at zero by a positive stable equilibrium with $e = 0.50$.

■

The model offers the possibility of multiple equilibria, and more specifically, the possibility of both a stable low-employment equilibrium and a stable high-employment equilibrium. The intuition is simple: there is an intertemporal amplification of shocks, through the skill composition of the labor force. If there is low employment in a given point in time, the next period level of skilled workers will be low since fewer workers accumulate experience. So, the demand for unskilled remains weak, employment is low and participation to the labor market is low too. The high employment equilibrium has just the opposite properties: high level of skilled workers, so high demand for unskilled, and so on...

One can derive a corollary to Proposition 1:

Proposition 2. *A temporary shock on n_t, if sufficiently large, 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, higher unskilled wage pressures. Dynamic adverse effects (the existence of, and the switch to, a low employment equilibrium) are driven by the irreversibility of skill loss due to unemployment, and are reinforced by the same four factors.*

Proof. All the effects above shift the relative demand for skilled workers and thus imply a temporary decrease in the curve $e_t(e_{t-1})$. See Figure 3 for an illustration with higher n_t. Starting from A, if the curves moves downwards, e_t evolves temporarily below the 45 degree line. If e_t becomes lower than a cutoff value (defined by the unstable, intermediate intersection between the original curve and the 45

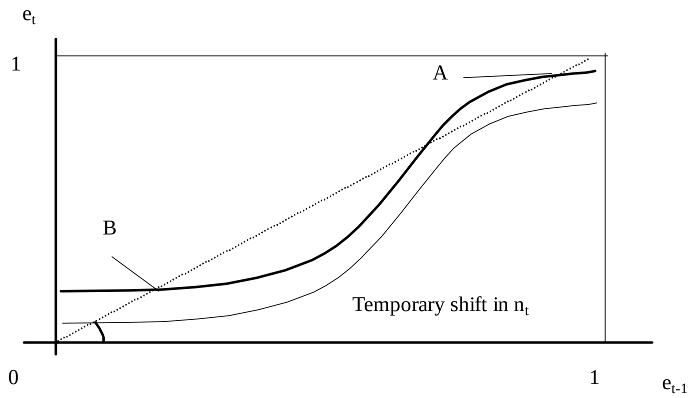

Figure 3:

degree line), then e_t irreversibly converges to B.

■

The permanent effect of a temporary shock deserves some further comments. In figure 3, a temporary downward shift of the curve $e_t\ (e_{t-1})$ may lead to a permanent change of equilibrium, if the temporary level of employment e_t is on the left side of the unstable equilibrium (the one in the middle of the graph). In this case, the level of employment converges to the low equilibrium. The economic intuition is the same as the intuition for the multiplicity of equilibria: the temporary supply shock increases unemployment among young/low-experience workers. On average, the young cohorts accumulate less experience, the supply of skills the next period is lower, which reduces the demand for unskilled workers. When the temporary shocks disappear, the labor force still exhibits some trace of the shock; that is, the low level of experience in the labor force. If the shock is too big, the economy cannot recover the previous high equilibrium employment and instead shifts to the low employment equilibrium.

This persistence and amplification of the shocks may characterize well the situation of Spanish or Italian southern regions in the 80's, or Irish peripheral regions before the spectacular growth performance of the 90's. A combination of high demographic growth, rigid wage scales and very large unemployment rates (40% to 50% are not unusual among young workers) self-reinforced their effects by dynamically reducing the quality of the labor force, due to the absence of learning on-the-job, or more generally, of works habits. To investigate the importance of wage rigidities, one can now focus on the polar case with market-clearing wages.

3.3 Competitive wages

In this case, wages are market-clearing, i.e. equal to the marginal productivity of labor at full-employment, $e_t = 1$ for all t. The wage of the unskilled is determined by $w_t^U = F_U\left(\frac{1}{1+n_t}\right)$ if $F_U\left(\frac{1}{1+n_t}\right) > \Lambda_2$ and Λ_2 otherwise and the wage of the skilled workers is given by $w_t^S = F_S\left(\frac{1}{1+n_t}\right)$. Of course, this function has a negative slope.

Proposition 3. *In a flexible labor market, there is only one equilibrium. Higher n_t increases inequality. Increased demand for skilled workers also increases inequality in regime 2.*

Proof. In regime 1 (full participation), higher n_t increases the supply of young workers and reduce their absolute and relative wage since the wage of the skilled (experienced) workers is increased. In regime 2 ($\rho^O < 1$), the wage of the unskilled reaches the floor Λ_2 and wage inequality rises only due to the increase in the wage of skilled workers. Since there is full employment in both regimes, the employment to labor force ratio is identically equal to one. The skill composition of the labor force is thus invariant to labor supply shocks. An increase in the shift parameter τ also raises dispersion in wages. This is trivial in the regime 2. With a participation rate below 1, i.e. in regime 1, a decrease in the demand for unskilled workers reduces their participation and thus their total employment level, but has no effect on their wage. The effect on the wage of skilled workers of a change in τ then depends on the substituability between skilled and unskilled workers and we have no general result here.

■

This flexible economy, with full employment and uniqueness of equilibrium, exhibits no persistence of temporary supply shocks, because the intertemporal transmission of shocks described in the previous sub-section no longer exists.[13] An economy with flexible wages can thus not be stuck at a low employment/unemployment equilibrium. Still, a larger number of young workers increases wage inequality between old and young workers. Lower aggregate participation (higher Λ_2) *per se* may reduce inequality, at least at full employment.

[13] The fact that there is no full participation in regime 1 does not affect the skill composition of the workforce because it was assumed it only affects workers in period 2 of their life, so that all young workers participate, are employed and accumulate experience in this regime.

3.4 Conclusion

This section has illustrated the key difference between an economy with rigid wages and an economy with flexible wages: in the former, a big supply shock generates crowding out on the market for inexperienced workers, and thus prevents young workers from accumulating experience, reduces the employment opportunities of women and reduces participation rates. The economy cannot recover from the big temporary supply shock and remains stuck to the low employment/low participation equilibrium. European experiences may fit this description quite well. By contrast, the flexible economy accepts some wage inequality between experienced and inexperienced, but offer them experience which is thus dynamically more efficient.

Among these results, there are two which deserve further comments since they can be tested. First, in partial equilibrium, participation and unemployment rates are negatively linked, since participation decisions are endogenous and negatively depend on unemployment. The full equilibrium result is more difficult to derive here. This actually implies that the test of the link between unemployment and labor supply should deal with a classical simultaneous equation problem, a difficulty acknowledged in Wasmer (1997, ch. 2). Second, in the stable upper steady-state equilibrium, the growth rate of the cohorts is positively correlated with unemployment.

4 Investments in human capital

There is fortunately an alternative to the trade-off between wage inequality in the flexible labor market and unemployment and its persistence in the rigid one. So far, we have assumed that the only source of human capital accumulation was on-the-job experience, itself evolving as aggregate factors like unemployment. In reality, individual's decisions may partly counteract the difficulty of getting experience through work. Notably, the investments in skills by workers, which is another important aspect of the endogeneity of participation on the labor market, may reflect the aggregate conditions. I first study the choices of education which shows that the multiplicity of equilibria disappear, and then treat briefly on-the-job investment to characterize the behavior of female workers. In order to simplify the exposition of the argument, I focus on regime 2 (full participation). Results with endogenous participation are discussed in the discussion paper version of this model.

4.1 Schooling

In human capital theory, education is an investment according to an arbitrage between the cost of education (postponed activity, direct cost of education) and the benefits, that is, mainly higher productivity and wages. There are other positive private returns to education: unemployment probabilities or unemployment 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 is given in Saint-Paul (1993)).

The model is now extended to match these facts. Acquiring some education is here the answer to disequilibrium situations: when wage inequality or unemployment rises, the incentive for young workers to differ their time of entrance on the labor market will increase. Agents can either go to university and work only the second period of their life, directly as skilled workers, or choose to work in their first period as unskilled worker and if fortunate enough, acquiring enough job experience to be able to have a skilled occupation in the second period. For simplicity, education will be a binary choice: there are only two levels of education, 0 and 1. Young workers only arbitrate between education and activity. The expected life-time income V at time $t-1$ of those with and without education is then:

$$V_{t-1}(ed=1) = 0 + \beta . w_t^{Ed} \tag{8}$$

$$V_{t-1}(ed=0) = e_{t-1} . w_t^{Y} + \beta [e_{t-1} . w_t^{Ex} + (1-e_{t-1}) . e_t w_t^{O}] \tag{9}$$

with β is a discount factor. The first equation shows the usual trade-off between 0 earning today and high wage tomorrow. The second equation still shows the same trade-off, a positive wage today (but facing the risk of unemployment), with tomorrow, if lucky at $t-1$ with probability e_{t-1}, the wage of the experienced workers at time t. If unlucky at $t-1$ (with probability $1-e_{t-1}$), the workers face at time t the possibility of becoming unemployed again (zero income) or to be employed with probability e_t at the wage of old, unskilled workers.

Denote now the share of a cohort which gets educated by s_t. The dynamic labor supply equations are now $L_t^{Ex} = P_{t-1} . e_{t-1}(1-s_{t-1})$; $L_t^{Ed} = s_{t-1} . P_{t-1}$; $L_t^{U} = (1-s_t) . P_t + P_{t-1} . e_{t-1} . (1-s_{t-1})$. In the latter equation, the unskilled are those without education or experience.

There are three possible steady-state equilibria. The first equilibrium is such that $V_{t-1}(1) < V_{t-1}(0)$: there are no educated workers in this economy: $s_t = 0$. The second equilibrium is such that a fraction $0 < s_t < 1$ of the cohort is enrolled in education, this fraction being determined by the equality of life-time income, $V_{t-1}(1) = V_{t-1}(0)$. The third equilibrium is such that $V_{t-1}(1) > V_{t-1}(0)$: there are only educated workers in this economy: $s_t = 1$. The selection of the equilibrium depends both on labor market aggregate conditions and on complementarity between skill groups. The next (technical) Proposition sums up:

Proposition 4. *In the market-clearing labor market, when the skilled and unskilled are complements, then equilibrium 3 (without the unskilled) is impossible. If experienced and educated workers are complements, equilibrium 1 (without educated workers) is impossible in both the rigid and the flexible economies.*

Proof. With constant returns to scale, complementarity implies an Inada condition, that is, if one factor of production is not employed, there is an infinite demand for this factor, such that an equilibrium without it is not possible. ■

So, in order to have an interior solution such that $V_{t-1}(1) = V_{t-1}(0)$, it will be assumed from now that the three factors (unskilled, experienced and educated workers) are complements in the production. I here study the interesting case $0 < s_t < 1$.

I first solve the model in a steady-state and derive some comparative static results. The question here is how the steady-state level of education endogenously evolves in response to the different shocks on technology and population growth. Hence, $V(1) = V(0)$ yields to a supply curve of education, which can be rewritten as: $\beta.(w^{Ed} - e.w^{Ex}) = e.w^U[1 + \beta(1 - e)]$.

The degree of substitutability between education and experience is not so important as long as the Inada conditions described in the previous proposition are satisfied. To simplify the presentation, I have then chosen the following Cobb-Douglas production function, which simplifies the equations: $Y = (E_t^U)^{1-\alpha-\delta}(E_t^{Ed})^{\alpha}(E_t^{Ex})^{\delta}$ where α represents a demand shift parameter on education, and δ a demand shift parameter on experience. The marginal product of labor conditions will provide the equation of demand for education.

Results with a double log wage curve are almost the same (see Wasmer 1998) as with a relative wage rigidity of the type: $\frac{w^{Ed}}{w^U} = \frac{1}{\gamma}$, but less simple to expose, so I chose the latter wage rigidity. So, the rigidity on relative wages can be rewritten, using the marginal product of labor educated and unskilled:

$$\lambda \frac{s}{1-s} = e(2 + n - e) \tag{10}$$

where $\lambda = \frac{1-\alpha-\delta}{\alpha\gamma}$. 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 the relative productivity of the educated with respect to the unskilled workers. This leads to a higher relative demand for the unskilled so the higher their employment rate.

Replacing the wage constraint in the supply condition on education now yields a *supply of educated workers* described by

$$\beta \frac{\delta}{\alpha} \frac{s}{1-s} + e.\gamma(1+\beta(1-e)) = \beta \tag{11}$$

which defines a negative relation between education and employment; the lower employment, the higher the incentives for young workers to acquire education. It can be observed that α and δ have opposite effects: an increase in the demand for education makes education more attractive, but an increase in the demand for experience makes activity in the first period more attractive and education thus less attractive.

Proposition 5. *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. In the space (e, s), an increase in δ or α shifts the supply of education upward but an increase in n has no effect. An increase in α and n and a decrease in δ shifts demand for education downward. ■.

The demographic shock (increased n) explains higher unemployment for the unskilled and higher education. The technological parameters explains one stylized fact only, whereas their effect is ambiguous for one of the two equilibrium quantities s and e (represented by the symbol $\gtrless$). The supply explanation (higher n) fits all the facts. One can also study the dynamics of educational choices in response to demographic shocks (see Wasmer 1998).

4.2 On-the-job

The model can easily be extended to incorporate on-the-job skills investment. See appendix 3. The important conclusion here is that the investment in human capital will be increasing with n_t in steady-state and will be positively related to the equilibrium employment rate. The dynamics of this system yields to the same situations as described by figure 1 (without the horizontal line implied by endogenous participation). Again, multiple equilibria are possible, as well as stable or unstable dynamics.

Interpreting this investment in human capital from the 'low-experience' groups as the investment of women, we have here several predictions: the supply trend will increase female on-the-job human capital investments, even more so when unemployment is low and wage inequality important. The gender wage gap will decrease, to a larger extent when unemployment is low. Spain and France vs. the US may be a striking illustration of the latter point, since gender inequality seems much larger in the former countries.

5 Concluding comments

It is not clear that all the consequences of the coïncidence of rising female participation and the baby-boom have been explored. This work can be seen as a first step in this direction. Our findings are as follows. An economy with wage rigidity prevents the unskilled from acquiring skills. If the unskilled are also younger workers, this phenomenon can be transmitted from one period to another and leads to multiple equilibria. Market clearing wages remove this possibility to the extent that all young workers participate to the labor market. Although we have not explored this possibility here, massive withdrawal from the labor market by youngsters may lead to the same adverse consequences as in a rigid labor market.

Further, given wage rigidities in a European-type economy, a unique equilibrium with education is more efficient, given the optimality of agent's decision, than an economy which is stuck at the low equilibrium, like the economy of Section 3.2, because in the latter economy, skills cannot be accumulated. So, even though the social planner problem has not been formally derived, one can get the intuition that the flexible labor market should be preferred to the rigid one, and the rigid economy where agents have the option of obtaining higher education should be preferred to the economy where schooling is rationed but adapts with a lag to economic conditions. The worst outcome is reached in the rigid economy without education at all.

What about the relevance of the study of labor supply trends? Many authors have acknowledged than the peak in the sizes of the cohorts in the 70's has had consequences for the US wage distribution (see, for instance, Welch 1979, Murphy et al. 1988) and for the unemployment rates (Bloom et al. 1987). The theoretical model of the previous sections is based on these contributions, and has been extended in two directions: female participation as an explicit component of the supply trend; and the exploration of the links between the supply of education and the supply of experience. On the latter point, an important prediction is that higher education of the workforce is indirectly caused by labor supply trends.

The model suggests many others links between unemployment, wage inequality, gender differences and participation. Notably, a fact supporting the model is the increase in the wage return to experience in the US over time, as reported in Juhn et al. (1993), for instance. Since 1963, the return to experience is constituted by the price of the skills which increased most, to a much larger extent than the return to education. As indicated in Section 1, there has also been a decline in the supply of 'experience' - this claim is based on some additional work on CPS micro-data, not reported here (see Wasmer 1997) -, and the correlation between the series between 1964 and 1997 is -0.64. It is tempting to see a causality at this stage: a lower supply of skills (experience) increases the return to experience.

In addition, as indicated in Section 3.4, a comparison of unemployment rates across countries may also yield interesting results. Among countries with fairly similar wage-setting institutions (e.g. continental Europe), low unemployment countries are those with a weak demography in the 70's and the early 80's (Scandinavian countries, Germany) as opposed to France or Spain, and the growth of female participation should be positively associated with unemployment. Also, higher investment in human capital from 'low-experience groups' like women generates a prediction about the evolution of gender differences. They should decrease in response to adverse supply shocks, particularly when unemployment is low, but remain high in high unemployment countries.

Table 1: France 1992, cell averages, men in the labor force

	Men			Women		
	Real Exp.	**Pot. Exp.**	**%Gap**	**Real Exp.**	**Pot. Exp.**	**%Gap**
All	20.7	22.9	0.096	17.8	21.4	0.168
$exp \leq 10$	5.9	6.6	0.106	5.3	6.4	0.172
$11 \leq exp \leq 20$	14.0	15.5	0.097	13.4	15.6	0.141
$21 \leq exp \leq 30$	23.3	25.2	0.075	21.9	25.3	0.134
$exp \geq 31$	33.2	34.4	0.035	29.7	37.9	0.216

Table 2: France 1992, variable: Log Hourly Wage. Heteroskedasticity consistent standard error in parentheses.

	Men GLS	**Wom. GLS**	**Wom. Heckman**
Experience	0.049 (0.002)	0.030 (0.004)	0.029 (0.005)
Exp. Sq. (x100)	-0.078 (0.005)	-0.042 (0.010)	-0.038 (0.011)
Mills ratio	-	-	0.223 (0.066)
R^2	0.356	0.239	0.251
N obs	3641	3 108	2 984

...

- **Appendix 1: Survey 'Actifs Financiers 1992'**

In the survey Actifs Financiers 1992, individuals are asked about their past, notably the age at end of schooling, the age of the first paid job, the number of periods of employment interruptions, the reason for these interruptions (unemployment, inactivity or disease), and finally, real employment experience as measured by the number of years in employment (defined as paid activity excluding "Petits boulôts") and the number of years in full-time employment . This is quite unique in micro-surveys, since employment experience is usually 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. 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 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 include premia and wages from temporary employment and secondary activities. Individuals declare the corresponding number of months, as well as the percentage with respect to full-time employment. There is no problem of top-coding here. One is referred to Wasmer 1998 for the name of all these variables in the survey. he sample is restricted to 15-65 year old workers who are not retired. About 10% of the sample whose current or last activity is self-employment, are excluded, since the return to experience in this type of activity may differ from the return to paid activity.

- **Appendix 2: concavity of $e_t(e_{t-1})$ with a Cobb-Douglas production function**

Differentiating equation (7), using the more convenient notation $y = e_t$ and $x = e_{t-1}$, one finds

$\frac{dy}{dx} = \frac{\frac{1}{x}+\frac{1}{2+n_t-x}}{\frac{\phi/\alpha}{1-y}+\frac{1}{y}} > 0$ and

$$sgn(\frac{d^2y}{dx^2}) = sgn\left[\frac{-1/x^2+1/(2+n-x)^2}{1/x+1/(2+n-x)} + \frac{-\phi/a(1-y(x))^{-2}+1/y^2(x)}{\phi/\alpha(1-y(x))^{-1}+1/y(x)}\right]$$

When x is close to zero, the negative terms dominate, but, given endogenous participation, we know that $x > e_{t-1}^{\text{sup reg2}}$ defined in Lemma 1. Overall, and depending on the values of the parameters and notably of technology, we may have the different cases discussed in the Proposition, some of them represented in Figure 1.

- **Appendix 3: on-the-job human capital investments**

Let us assume that it takes one period for the investment to be effective. During the first period of life, workers invest i_{t-1} in skills on-the-job per period of employment. Those skills become effective in the second period, yielding an average of $h_t = h(e_{t-1}.i_{t-1})$ units of skills[14], where $h' > 0$, $h'' < 0$. The total amount of investments in skills is increasing in the employment rate, since there are more opportunities for undertaking the investment. The program of a representative young worker is to maximize $(w_{t-1}^Y - i_{t-1}).e_{t-1} + \beta.[h(e_{t-1}.i_{t-1}).Ew_t^{Ex}]$ where β is a discount factor. The first order condition simply yields $h'(i_{t-1}) = \frac{1}{\beta.Ew_t^{Ex}}$. This implies that h_t is a function $\Omega(.) = h[h'^{-1}(.)]$ of e_{t-1}, Ew_t^{Ex} and β with Ω_1, Ω_2 and Ω_3 all positive.

Under rationale expectations, Ew_t^{Ex} will be equal to w_t^{Ex}. The labor supply dynamic equations (2-4) are still valid. However, since all young workers can invest in human capital, there will no longer be older inexperienced workers: $L_t^O = 0$, and (2) must be augmented with the amount of human capital invested by the young workers the previous period, which implies that the ratio of efficient units of skilled workers to unskilled workers becomes:

$$\frac{E_t^{Ex}}{E_t^Y + E_t^O} = \frac{1}{e_t}\frac{h_t}{1+n_t} \tag{12}$$

Under market-clearing wages, the first-order condition on skilled labor gives the return to human capital as a decreasing function of this ratio: there exists a function k such that $w_t^{Ex} = k(\frac{h_t}{1+n_t}) = k\left(\frac{\Omega(1,w_t^{Ex},\beta)}{1+n_t}\right)$, with $k' < 0$. Since the right hand-side is decreasing in w_t^{Ex}, there is only one solution to the wage, which is increasing in n_t and decreasing in β. It follows that the investment in human capital will be increasing in n_t. The observable return to experience is $h_t.w_t^{Ex}$ which will also strongly increase in n_t.

With relative wage rigidities, say $\frac{w^Y}{w^{Ex}} = \gamma$, the wage w_t^{Ex} only depends on technology and γ, and equation (12) gives:

$$e_t = \frac{h_t}{1+n_t}.A_{T,\gamma} \tag{13}$$

and the system thus evolves according to (13) and $h_t = \Omega(e_{t-1})$. The dynamics of this system depends only on the concavity of $\Omega(e_{t-1})$, yielding to the situations described by Figure 1 (without the horizontal line implied by endogenous participation). Again, multiple equilibria are possible, as well as stable or unstable dynamics. If, for instance, $h(x) = \frac{x^{1-\eta}}{1-\eta}$, $0 < \eta < 1$, then $\Omega(e_{t-1})$ has an elasticity $(1-\eta)/\eta$ which can be either higher or lower than 1.

[14]This formulation, implicitly assuming identical workers, is a simplification, since workers may have had different trajectories at the end of the first period. This actually provides a way of generating a wage distribution. This interesting property is not exploited here, but postponed to future research.

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