JOB SEARCH: INTENSITY AND RESERVATION WAGE IN THE SPANISH LABOUR MARKET

Juan M. Blanco and Andrés Picazo-Tadeo
UNIVERSITY OF VALENCIA

ABSTRACT

The aim of this paper is to illustrate that, under certain assumptions, the influence of unemployment benefits (UB) on the efficiency in labour allocation depends crucially on the way UB affect job search. Individual job search is influenced by UB in a twofold way: decreasing search intensity and increasing reservation wage. While the former lowers the discounted value of individual lifetime production, the latter has an ambiguous effect on such value. In order to separate empirically one effect from each other, a bivariate probit model with partial observability is estimated using individual data.

Key Words: Job Search; Unemployment Benefits.

JEL Clasifications: J64/J65.

(*) Juan M. Blanco. Departamento de Análisis Económico. UNIVERSIDAD DE VALENCIA. Ada. Blasco Ibáñez, 30. 46010 -VALENCIA- SPAIN. Tf: 34-6-3864408. FAX: 34-6-3600608. E. Mail: blancoj@mozart.econom.uv.es

1.-   Introduction.

Unemployment is a major problem currently affecting industrial economies. Spain is the country where unemployment reaches the highest level all over the developed world. It is widely accepted that a great deal of such unemployment is not merely a consequence of the business cycle, but rather it comes from certain rigidities in the labour market and, moreover, it is the result of certain welfare programs. Such kind of unemployment is considered to be part of the Equilibrium Unemployment Rate or NAIRU.

The discussion of the reasons for this [so high] NAIRU constitutes one of the main economic debates nowadays. Frictional unemployment, is considered to be one component of such unemployment. It arises from the process of job search that unemployed undertake until they find and accept a job. Unemployment benefits [UB] affect search by changing unemployed individual's behaviour. Most empirical studies on job search, carried out in a wide range of countries, point out that UB lengthen the unemployment spells and raise the NAIRU. However, the estimated magnitude of this effect varies notably among studies [see Atkinson and Micklewright (1991)].

UB affect individual behaviour in a twofold way: i) they lower search intensity, basically by decreasing the number of hours the individual allocates to search, resulting in a lower probability of being offered a job, and ii) they raise the reservation wage or minimum wage the unemployed is willing to accept. This latter reduces the probability of accepting a job once it has been offered. Several recent studies have been targeted to study the influence of UB on the Spanish labor market either on search intensity or on reservation wage [see Bover, Arellano and Bentolilla (1996), Antolín (1995), Cebrián, García, Muro, Toharia and Villagómez (1994)].

Although most economists admit UB increase the length of unemployment spells, opinions about the effects of UB on allocation of resources are mixed. Some authors consider UB incentive the unemployed to stay out of work longer, preventing him from generating a valuable production [see Feldstein (1974)]. Others consider that longer search permits workers to find jobs suiting better their skills and, provided that information is far form perfect in the labour market [so allocation of labour resources is not efficient], UB improve the allocation of resources [see Baily (1978)].

We will maintain along this paper that in order to evaluate the influence of UB on allocation of labour resources, it is not enough to study the effect on unemployment duration; rather it is necessary to determine how much of this effect comes from lower search intensity and how much is the result of higher reservation wage. Longer expected unemployment duration would result in a worse labour resources allocation if UB lower search intensity and consequently decrease the number of jobs an individual is being offered in a period. This result would not necessarily hold if UB lengthen unemployment duration through raising reservation wage since this will allow individuals to search for better paid jobs and, provided the market is competitive, to accept jobs in which they are more productive. It is worthwhile to empirically split these two effects.

This paper is organized in the following way. In section two, concerning theoretical considerations, a model aimed at showing the effect of UB on a discounted life cycle production is developed, meeting the level of UB that maximizes aggregate production. In the third section, an equation of accepted wages is estimated, while in the fourth we estimate a model which allows to calculate the effect of UB on both, the probability of receiving a wage offer and the probability of accepting it. In both cases the source of data is the *Spanish Survey of Conditions of Life and Work* (ECVT). The article finishes setting outcomes and conclusions. Annexes 1 and 2 show some mathematical developments, while Survey and data are described in Annex 3.

2.- Theoretical Considerations

UB lengthen unemployment spells but, does it mean society is losing production by maintaining idle resources? or, on the opposite, is society gaining production since additional search allows to allocate labour resources in a more productive way?. Next we show that the answer to this question depends crucially on the way UB affect duration: through either intensity of search or reservation wage.

Suppose an unemployed individual starts a search for a job lasting n periods, being n a stochastic variable. After these n periods, individual finds a job in which he remains forever. During the process of search, he receives offers from a known probability distribution of wages F(w). Jobs differ among them just by their wage level. During each period of search of infinitesimal longitude, denoted by ε, the probability of receiving an offer is Θ; such probability depends on individual characteristics and on labour market conditions, but also on search intensity [which in turn depends on time and income the individual allocates to search]. The unemployed individual sets a reservation wage, called w^r, accepting a job if the offered wage is equal to or higher than such a reservation wage. The probability of accepting a job, once offered, is $P=1-F(w^r)$. Without a great loss of generality and for the sake of simplicity, we suppose that both Θ and P are constant along the process of search[1]. In consequence, the probability of leaving unemployment during an infinitesimal period turns out to be:

$$\Pi = P\Theta\varepsilon \tag{1}$$

Let us assume additionally that differences among wage offers an individual receives are due to different productivities across jobs. Moreover, productivity varies across individuals in the same job, inducing employers to pay different to each individual[2]. Productivity acts as individual job matching mechanism, and consequently, search process affects subsequent worker's productivity. Assuming a competitive la-

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[1] This is a consequence of assuming that both reservation wage and search intensity remain constant along time. They can vary as a result of an exogenous variable change but not as a consequence of duration.

[2] This assumption is crucial: if each individual is equally productive in every job and/or all individuals are equally productive in each job, search will not generate any beneficial productive effect.

bour market, wage equals marginal productivity. The expected discounted addiction to production an unemployed generates is:

$$E(Y) = E_n \left[\int_n^\infty w^e \exp(-\delta t) dt \right] \qquad (2)$$

where δ is the appropriate discount rate and the expected wage is:

$$w^e = E(w|w > w^r) = \frac{1}{P} \int_{w^r}^\infty w \, f(w) \, dw \qquad (3)$$

Developing expression (2) and given that ΘP remains constant along time, we find that [see the algebra in Annex 1]:

$$E(Y) = \frac{\Theta P}{\delta(\delta + \Theta P)} w^e \qquad (4)$$

The unemployed individual receives x monetary units of UB per period until he finds a job. This amount x is constant along time and unlimited in duration. These assumptions will be dropped in the empirical estimation as they will not be necessary any more (in the empirical estimation we do not estimate this model properly but a single implication of it). We suppose UB program is financed through taxation without dead burden. UB affect both Θ [through lower search intensity] as well as the probability of accepting a job P [through the reservation wage]. In consequence, assuming individual utility function is locally additive in time and income, the effect of an infinitesimal variation in UB on individual discounted life cycle production could be split in three components [see Annex 1 for algebra], according to the expression:

$$\frac{\partial E(Y)}{\partial x} = \left[w^e \frac{P\delta^2}{b^2} \right] \frac{\partial \Theta}{\partial x} - \left[w^e \frac{\Theta f(w^r)\delta^2}{b^2} \right] \frac{\partial w^r}{\partial x} + \left[\frac{\Theta P}{b} \left(\frac{f(w^r)}{P} \right) (w^e - w^r) \right] \frac{\partial w^r}{\partial x} \qquad (5)$$

where $b = \delta(\delta + \Theta P)$.

First term of the right hand side in (5) reflects the effect of UB on the expected production through their effect on search intensity; if UB reduce search inten-

sity $[\partial\Theta / \partial x < 0]$, they will also reduce expected production in an amount that is proportional to the expected wage [due to UB delay the expected entrance to employment]. Second and third terms reflect the effect coming through increased reservation wage. Second one, negative in sign, picks up the influence of UB in delaying job acceptance through increasing reservation wage and so reducing expected production. The third one, reflects that UB, by increasing reservation wage, raise the expected wage [and so productivity]. In summary, if the individual searches with less intensity when receiving UB the intensity effect will result in a lower production, while the reservation wage effect will get an ambiguous result due to the opposed signs of the pure production effect [third term] and the duration effect [second term].

When evaluating the effects of UB on labour resources allocation, it is not enough to study their influence on unemployment duration [first and second terms], but it is also necessary to study how UB affect reservation wage [third term].

Provided that E(Y) is strictly concave in x [see conditions in Annex 2], it is possible to find the necessary condition for a level of UB to maximize the expected production. For an interior maximum, optimal quantity of UB, called x', must satisfy the following condition:

$$\frac{\eta_{\Theta x}}{\eta_{Px}} = \frac{\delta + \Theta P}{\delta}\left(\frac{w^e - w^r}{w^e}\right) - 1, \tag{6}$$

where $\eta_{\Theta x}$ is the UB elasticity of the probability of receiving a wage offer, and η_{Px} is the UB elasticity of the probability of accepting the offer. Case of non existence of an interior maximum, the optimum will be $x' = 0$. This result also holds when, after re-employment, dismiss or quit probabilities are allowed and subsequent unemployment spells may occur.

3.- Estimation of an Equation of Accepted Wages.

From the point of view of the policymaker, it is important to know whether the Spanish UB system exercises its influence mainly through search intensity or through reservation wage. However, there exists in Spain no Survey containing enough statistical information to be able to separate both effects in a direct way. In order to separate one from each other, it would be necessary a dynamic panel on unemployed individuals with information about UB revenues, time and expense allocated to job search and the minimum wage they would be willing to accept. Faced to this limitation, we have to look for alternative indirect methods.

According to expression (1) and taking logs, the marginal effect of UB, variable x, on the probability of leaving unemployment will be:

$$\frac{\partial \log \Pi}{\partial x} = \frac{\partial \log \Theta}{\partial x} + \frac{\partial \log P}{\partial x} \tag{7}$$

this expression, after some calculations, can be written as:

$$\frac{\partial \log \Pi}{\partial x} = \frac{\partial \log \Theta}{\partial x} - \frac{\partial \log w^r}{\partial x} \frac{f(w^r)}{P} w^r \tag{8}$$

The reservation wage is not directly observable, instead, we usually observe accepted wages, whose expectancy is given by the expected wage [expression (3)]. Therefore, and after some algebra, the effect of a variation in x on the log of the reservation wage will be:

$$\frac{\partial \log w^r}{\partial x} = \frac{P w^e}{f(w^r)\left(w^e - w^r\right)w^r} \frac{\partial \log w^e}{\partial x} \tag{9}$$

By estimating the effect of UB on accepted wages, we will infer their influence on reservation wages, provided that we know the reservation wage and the wage distribution function; if both are unknown, the estimation just would allow to know the sign of the effect of UB on the reservation wage but not its magnitude. Given that:

$$E(w|w > w^r) = w^e > w^r \tag{10}$$

the effects of UB on both accepted and reservation wages have the same sign.

Using relationship (9), the expression (8) can be rewritten as:

$$\frac{\partial \log \Pi}{\partial x} = \frac{\partial \log \Theta}{\partial x} - \frac{w^e}{\left(w^e - w^r\right)} \frac{\partial \log w^e}{\partial x} \qquad (11)$$

Following expression (11), the marginal influence of UB on the probability of receiving a wage offer $[\partial \log \Theta / \partial x]$, could be determined by knowing, i) the marginal effect of UB on accepted wages, ii) the influence of UB on the probability of leaving unemployment $[\partial \log \Pi / \partial x]$ and, finally, iii) the mark up of expected wage on reservation wage. While (ii) is usually treated through conventional duration models, and the marginal effect stated in (i) through the estimation of an equation of accepted wages [as a function of personal characteristics of the unemployed and UB], the mark up of expected wages on reservation wages is not easily obtainable as it requires to know the reservation wage and the distribution function of wage offers [Kiefer and Neumann (1979) propose a method for estimating the reservation wage, although, as Flinn and Heckman (1982) pointed out, this method is only applicable when the unemployed receives only one wage offer per period].

Estimating an equation of accepted wages is a way of knowing whether UB affect or not reservation wages. If the coefficient of UB appears to be non significant, we should conclude that UB exercise all their influence on unemployment duration through search intensity.

[TABLE 1]

Table 1 shows the estimated parameters of an equation of accepted wages using the subsample of individuals that left unemployment [Annex 3 describes the sample selection process]. The dependent variable is the log of accepted wages. Since the available statistical information on accepted wages is give n by intervals, we estimate using maximum likelihood techniques with multicensored dependent variable [see Stewart (1983)]. The positive and significant effect of the replacement ratio [in square root] means that the quantity of UB affects reservation wage, although it becomes

impossible to quantify such relation without knowing the reservation wage or the wage offer distribution function. On the other hand, the number of remaining months of eligibility when accepting a job does not affect in a significant way accepted wages.

These previous results lead us to refuse the hypothesis that UB do not affect reservation wage, therefore it is necessary to search for another method of estimation in order to separate one effect from each other.

4.- Reservation Wage versus Search Intensity.

Following expression (1), in a period of unitary length, an unemployed individual i faces a probability of leaving unemployment given by:

$$\Pi_i = \Theta_i P_i \qquad (12)$$

The probability of receiving a wage offer depends on i) a group of "exogenous" variables reflecting mainly firm's decisions [personal characteristics, labour market conditions, among others] and on ii) individual decided search intensity [that is, time and expenditure allocated to search] affected by UB. Then, we can write:

$$\Theta_i = \Theta[M_{1i}, I_i(N_{1i})] \qquad (13)$$

where M_{1i} is a (1xm) vector which contains variables being exogenous to the unemployed decision, I_i represents search intensity and N_{1i} is a (1xn) vector which contains other variables affecting search intensity [including UB]. The effect of UB will be undetermined since when receiving UB individuals will allocate less time to search, but they will spend more in this activity [Barron and Mellow (1981)].

Accepting a linear relationship for the probability of receiving a wage offer, we can write:

$$\Theta_i = M_{1i}\beta_1^m + N_{1i}\beta_1^n + \varepsilon_{1i} = X_{1i}\beta_1 + \varepsilon_{1i} \qquad (14)$$

where $X_{1i} = [M_{1i}, N_{1i}]$, β_1^m and β_1^n are two vectors of parameters of dimension (mx1) and (nx1) respectively, $\beta_1 = [\beta_1^m, \beta_1^n]^T$ and the error term $\varepsilon_{1i} \sim N(0, \sigma_1^2)$.

Let us assume that the probability of accepting a wage offer depends on a set of variables including personal characteristics, labour market conditions and unemployed's reservation wage [which is, in turn, influenced by personal characteristics and UB]. It is important to point out that the reservation wage is set by the individual's decision while most variables determining the probability of being offered a job are out of the individual's control.

Let w_i^0 be the offered wage, which is supposed to depend linearly on a set of variables, so that:

$$w_i^0 = M_{2i}\beta_2^h + u_{2i}^0 \tag{15}$$

where $u_{2i}^0 \sim N(0, \sigma_0^2)$, M_{2i} is a (1xh) vector of variables that includes personal characteristics of unemployed i and the labour market situation, and, finally β_2^h is a (hx1) vector of parameters.

We assume also a lineal specification for the reservation wage given by the following expression:

$$w_i^r = N_{2i}\beta_2^z + u_{2i}^r \tag{16}$$

where $u_{2i}^r \sim N(0, \sigma_r^2)$, N_{2i} is a (1xz) vector of variables including personal characteristics and UB and β_2^z is a (zx1) vector of parameters. It should be pointed out that some variables may be included in both vectors M_{2i} and N_{2i}. The individual i will accept a wage offer if it is higher than his reservation wage, this is, when $P_i = w_i^0 - w_i^r > 0$, or:

$$P_i = M_{2i}\beta_2^h - N_{2i}\beta_2^z + (u_{2i}^0 - u_{2i}^r) > 0 \tag{17}$$

Defining $X_{2i} = [M_{2i}, -N_{2i}]$, $\beta_2 = \left[\beta_2^h, \beta_2^z\right]^T$, and the composed error term $\varepsilon_{2i} = (u_{2i}^0 - u_{2i}^r)$, we find that:

$$P_i = X_{2i}\beta_2 + \varepsilon_{2i} \tag{18}$$

where $\varepsilon_2 \sim N(0, \sigma_r^2 + \sigma_0^2 - 2\sigma_{r0})$.

The available statistical information does not allow to observe whether an unemployed receives or not a wage offer, but rather the final outcome of a process in which, in a first step, he could receive or not a wage offer and, in a second step, and provided that the offer has been received, he decides to accept or refuse it. Both events can be characterized by two dichotomous variables, which equal to 1 if the

unemployed receives a wage offer and, once received, if he decides to accept it, re-spectively. Then, it is observable a dichotomous variable [taking the value 1 if the unemployed leaves unemployment and 0 otherwise] which is the product of the two dichotomous quoted latent variables.

Given the statistical information, it is not possible to use traditional methods for separately estimating expressions (14) and (18). Alternatively we use a bivariate probit model with partial observability that allows the treatment of situations in which we observe the final outcome of two decisions driving to a single result [basic references can be found in Poirier (1980) and Abowd and Farber (1982)]. Partial ob-servability involves two basic problems that should be made explicit; first, the esti-mated parameters are less efficient than those obtained with complete information; second, it arises a problem of identification which has to be carefully treated.

In this paper we consider the fact of leaving unemployment as being the out-come of a search process in which, first, individual searches until he receives an offer and, second, he decides to accept or refuse it. Searching is represented by expression (14); Y_{1i} is a dichotomous variable equal to 1 if individual i receives a wage offer and 0 otherwise, then:

$$\Theta_i = X_{1i}\beta_1 + \varepsilon_{1i}, \text{ where } \begin{cases} Y_{1i} = 1 \text{ if } \Theta_i > 0 \\ Y_{1i} = 0 \text{ otherwise} \end{cases} \tag{19}$$

and:

$$Pr(Y_{1i} = 1) = Pr(\Theta_i > 0) = Pr(\varepsilon_{1i} > -X_{1i}\beta_1) \tag{20}$$

Given that it is only observable if the individual i leaves unemployment, this is, if once a wage offer has been received he accepts it, the probability represented by expression (20) can not be estimated separately, but rather it is necessary to consider the decision process once the unemployed faces a wage offer. According to expression (18), for an unemployed that has received a wage offer, the probability of accepting it and leaving unemployment, this is, the probability for the offered wage to be higher than his reservation wage, is:

$$\Pr(Y_{2i} = 1 | Y_{1i} = 1) = \Pr(P_i > 0) = \Pr(\varepsilon_{2i} > -X_{2i}\beta_2) \tag{21}$$

where Y_{2i} is a dichotomous variable taking the value 1 if the unemployed i accepts the offer and 0 otherwise:

$$P_i = X_{2i}\beta_2 + \varepsilon_{2i}, \text{ where } \begin{cases} Y_{2i} = 1 \text{ if } P_i > 0 \\ Y_{2i} = 0 \text{ otherwise} \end{cases} \tag{22}$$

The final outcome of the job search process can be formally written as:

$$Y_i = Y_{1i} * Y_{2i}, \text{ where } \begin{cases} Y_i = 1 \text{ if } Y_{1i} = 1 \text{ and } Y_{2i} = 1 \\ Y_i = 0 \text{ otherwise} \end{cases} \tag{23}$$

Therefore, for an individual i, the probability of leaving unemployment will be determined by the following expression:

$$\Pr(Y_i = 1) = \Pr\left[(Y_{1i} = 1) \text{ and } (Y_{2i} = 1)\right] = \Pr(Y_{1i} = 1)\Pr(Y_{2i} = 1 | Y_{1i} = 1)$$
$$= \Pr(\Theta_i > 0)\Pr(P_i > 0) = \Pr(\varepsilon_{1i} > -X_{1i}\beta_{1i})\Pr(\varepsilon_{2i} > -X_{2i}\beta_{2i}) \tag{24}$$

while the probability of remaining unemployed will be:

$$\Pr(Y_i = 0) = 1 - \Pr(Y_i = 1) \tag{25}$$

The log of the likelihood function derived from (23) is:

$$\log L(\Gamma) = \sum_{Y=1} \log\left[F(X_1\beta_1)F(X_2\beta_2)\right] + \sum_{Y=0} \log\left[1 - F(X_1\beta_1)F(X_2\beta_2)\right] \tag{26}$$

where Γ is the vector of parameters on which depends the likelihood function and F is the distribution function of a standardized univariate normal.

If the set of variables included in X_1 and X_2 coincides exactly, the parameters on which depend expressions (14) and (18) could not be identified since there would be two global maxima, becoming impossible to distinguish β_1 from β_2. However, if there exists only one variable included in X_1 or X_2 and excluded from the other one,

both sets of parameters are identifiable [see Poirier (1980)]. Using Theorem 1 of Rothemberg (1971) and expressing the information matrix of (25) as:

$$\frac{\partial \log L}{\partial \Gamma \partial \Gamma'} = -A'A \tag{27}$$

the vector Γ will be locally identified if and only if the information matrix (27) is nonsingular. If $\beta_1 \neq \beta_2$, the nonsingularity of $-A'A$ is guaranteed except in a reduced number of very peculiar cases which are carefully treated in Poirier (1980).

The main difficulty met when estimating the proposed model is to determine which variables will enter equation (14) and which will enter equation (18), given that both have to be estimated jointly. Theory of the individual behaviour, experience from other studies and the possibility to test diverse specifications constitute the main help[3].

An attractive hypothesis that would explain the outcome obtained in the estimation of the accepted wages equation is the following; both dimensions of UB, i) months of eligibility and ii) perceived quantity of money, affect differentially the probability of receiving a wage offer and the probability of accepting once it has been received. While the benefit duration affects mainly search intensity [equation (14)], quantity of UB affects mainly the reservation wage [equation (18)]. According to this hypothesis, an unemployed would increase his intensity of search when the period of UB is finishing, while search would be less intense at the beginning of the period. This hypothesis results coherent with the signs of the estimated parameters in the equation of accepted wages [Table 1]; while the number of months remaining to the end of the UB eligibility does not exert a significant effect on accepted wage, its quantity [measured as the replacement ratio] affects the decision of taking the wage offer.

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[3] Given the complexity in estimating this kind of models, it is better to start with a very simple specification, building the model up until an specification coherent with the theory is reached. On the other hand, given its static nature, it becomes necessary to collapse the search process to a single period, in which we observe if the unemployed abandons or not unemployment. It is also necessary to assume that individual receives at most one offer during that period. Given the high level of unemployment in Spain, only a few individuals would receive more than one offer in a period.

Estimates in the first column of Table 2 correspond to equation (14) while estimates in the second one correspond to equation (18).

[TABLE 2]

While the number of months of eligibility appears to be significant in equation (14), the replacement ratio affects negatively and significantly the probability of accepting a wage offer, once received [equation (18)]. These results appears to confirm the above hypothesis.

Age has a negative but decreasing effect on the probability of receiving a wage offer; this constitutes an expected outcome as firms prefer to hire younger workers, due to their greater capacity to learn. The parameter of family income is negative in sing, although the effect is not significant. The number of workers in household, does not affect significantly the probability of receiving a wage offer.

In equation (18), the interpretation of the parameters corresponding to variables affecting both wage offer distribution and reservation wage is not immediate. This is the case of variables like being male, the number of years of education or age. We should expect these three variables to affect positively the expected offered wage, but they also raise reservation wage. Therefore, their final impact on the probability of accepting a wage offer depends on the balance between these effects. We also expect a positive relationship between family income and reservation wage, such that the higher is the former the greater is the latter and the lower is the probability of accepting a wage offer. The negative sign of the parameter associated to family income in equation (18) supports this argument. Having been individually or collectively dismissed in previous job [as opposite of having quitted] decreases the probability of accepting a job. According to the estimation results, having been previously working as self employed confers a lower potential wage. Finally, the replacement ratio [measured as the average rate during the first year of unemployment] affects negatively the probability of accepting a job, due to UB raise reservation wage.

The elasticity of the probability of receiving a wage offer with respect to the length of UB amounts to -0.08, while the elasticity of the probability of accepting it with respect to the replacement ratio [measured by its square root] amounts to -0.125.

Therefore, the total effect of UB on unemployment duration correspond to an elasticity equal to -0.2, from where a proportion of 3/5 comes through reservation wage and 2/5 through search intensity.

The above outcomes allow to evaluate the effect of the Spanish UB system on labour resources allocation. Using expression (5), the ratio between elasticities is 0.65; accepting a discount rate equal to 10 percent and having calculated an annual probability of leaving unemployment (ΘP) equal to 54 percent, in order the UB system in Spain to be efficient in terms of average variables, the difference between average accepted wage and reservation wage should be around 26 percent. However, the true difference only can be obtained assuming a determined wage offer distribution function, being this procedure very sensitive to changes in the assumed distribution. We leave the estimation of the true wage offer distribution and the reservation wage for further research.

5.-   Concluding Remarks.

In this paper we develop a model concerning the effect of UB on the discounted aggregate expected production of an economy. UB affect two individual decisions in the process of job search: i) they lower search intensity and ii) they raise reservation wage. The reduction of search intensity, lengthening the expected duration of unemployment, delays the expected date in which the unemployed individual leaves unemployment [and so reducing the discounted production he will generate]. Higher reservation wage has two opposite effects: i) it increases the number of months searching, but, on the other hand, ii) it raises the expected productivity of labour by allocating labour force in better paid [and therefore more productive] jobs. UB effect on discounted future production is ambiguous depending on the balance between the effect on search intensity and the effect on reservation wage. Moreover, if there exists an optimal level of UB it should maximize the level of expected production: marginal increase in production due to a higher reservation wage has to equal marginal decrease in production due to a greater duration of unemployment.

In order to split empirically both effects of UB, we use a set of data from the *Survey of Conditions of Life and Work in Spain*. To evaluate the influence of the Spanish UB system on the allocation of labour resources, we estimate an equation of accepted wages, getting the outcome that the replacement ratio earned when accepting a job has a positive and significant effect on accepted wage. This result allows to assert that UB raise reservation wage, but does not allow to know the magnitude of such effect if wage offer distribution and the reservation wage are unknown. Afterwards, we use a bivariate probit model with partial observability that permits to jointly estimate both, the probability of receiving a wage offer and the probability of accepting it once offered. The elasticities of the probability of receiving a wage offer and the probability of accepting it with respect to UB reach the figures of -0.08 and -0.125 respectively. Although the effect on search intensity seems to be less intense, it would be more desirable to reduce the period of UB eligibility instead of lowering the amount of UB transfers if decreasing UB budget were needed.

ANNEX 1
MATHEMATICAL APPENDIX
Effect of Unemployment Benefits on per-capita Production.

The discounted life cycle production that will generate an unemployed can be written as:

$$E(Y) = E_n\left[\int_n^\infty w^e \exp(-\delta t)dt\right]$$
(A.1)

being the expected wage $w^e = \dfrac{1}{P}\int_{w^r}^\infty w\, f(w)\, dw$.
(A.2)

Given that the expected wage does not depend on t, we find that:

$$E(Y) = w^e E_n\left\{\int_n^\infty \exp(-\delta t)dt\right\} = w^e E_n\left[-\frac{\exp(-\delta t)}{\delta}\right]_n^\infty = \frac{w^e}{\delta}E[\exp(-\delta n)]$$
(A.3)

If n is an stochastic variable distributed exponentially, such that the hazard function (ΘP) remains constant over time, we find that $f(n) = \Theta P\exp(-P\Theta n)$, $F(n) = 1 - \exp(-\Theta Pn)$ and $E(n) = 1/\Theta P$. This implies that:

$$E[\exp(-\delta n)] = \int_0^\infty \exp(-\delta n)\, f(n)\, dn = \left[\frac{-\Theta P}{\delta + \Theta P}\exp[-(\delta + \Theta P)n]\right]_0^\infty = \frac{\Theta P}{\delta + \Theta P}$$
(A.4)

Substituting expression (A.4) in (A.3), we get:

$$E(Y) = \frac{\Theta P}{\delta(\delta + \Theta P)}w^e$$
(A.5)

However, given that $\Theta = \Theta(x)$, $P = P(w^r)$ and $w^r = w^r(x)$, we have:

$$\frac{\partial E(Y)}{\partial x} = \frac{\partial E(Y)}{\partial P}\frac{\partial P}{\partial w^r}\frac{\partial w^r}{\partial x} + \frac{\partial E(Y)}{\partial \Theta}\frac{\partial \Theta}{\partial x}$$
(A.6)

where: $\dfrac{\partial E(Y)}{\partial \Theta} = \dfrac{P\delta^2}{\left(\delta^2 + \Theta P\delta\right)^2}w^e$
(A.7)

and, $\dfrac{\partial E(Y)}{\partial w^r} = w^e\dfrac{-\Theta f(w^r)\left(\delta^2 + \Theta P\delta\right) + \Theta^2 P\delta f(w^r)}{\left(\delta^2 + \Theta P\delta\right)^2} + \dfrac{\Theta P}{\left(\delta^2 + \Theta P\delta\right)}\dfrac{\partial w^e}{\partial w^r}$
(A.8)

But given that:
$$\frac{\partial w^e}{\partial w^r} = \frac{f(w^r)}{1 - F(w^r)}\left(w^e - w^r\right)$$
(A.9)

we find that:
$$\frac{\partial E(Y)}{\partial w^r} = -w^e \frac{\Theta f(w^r)\delta^2}{\left(\delta^2 + \Theta P\delta\right)^2} + \frac{\Theta P}{\left(\delta^2 + \Theta P\delta\right)}\left[\frac{f(w^r)}{P}\right]\left(w^e - w^r\right)$$
(A.10)

Introducing expressions (A.7) and (A.10) in (A.6), we find:

$$\boxed{\frac{\partial E(Y)}{\partial x} = \left[w^e \frac{P\delta^2}{b^2}\right]\frac{\partial \Theta}{\partial x} - \left[w^e \frac{\Theta f(w^r)\delta^2}{b^2}\right]\frac{\partial w^r}{\partial x} + \left[\frac{\Theta P}{b}\left(\frac{f(w^r)}{P}\right)\left(w^e - w^r\right)\right]\frac{\partial w^r}{\partial x}}$$
(A.11)

where $b = \delta(\delta + \Theta P)$.

Equating expression (A.11) to zero and solving for $\dfrac{\partial \Theta}{\partial x}$, we get:

$$\frac{\partial \Theta}{\partial x} = \left[\frac{\Theta f(w^r)\delta^2}{P\delta^2} - \frac{b\Theta f(w^r)}{P\delta^2}\left(\frac{w^e - w^r}{w^e}\right)\right]\frac{\partial w^r}{\partial x}$$
(A.12)

Substituting $\dfrac{\partial w^r}{\partial x} = -\dfrac{\partial P}{\partial x}\dfrac{1}{f(w^r)}$ in (A.12), we have:

$$\frac{\left(\dfrac{\partial \Theta}{\partial x}\right)}{\left(\dfrac{\partial P}{\partial x}\right)} = -\frac{\Theta}{P}\left[1 - \frac{\delta + \Theta P}{\delta}\left(\frac{w^e - w^r}{w^e}\right)\right]$$
(A.13)

Expressing (A.13) in term of elasticities, we can write:

$$\frac{\left(\dfrac{\partial \Theta}{\partial x}\dfrac{x}{\Theta}\right)}{\left(\dfrac{\partial P}{\partial x}\dfrac{x}{P}\right)} = -\left[1 - \frac{\delta + \Theta P}{\delta}\left(\frac{w^e - w^r}{w^e}\right)\right]$$
(A.14)

Rearranging expression (4.14), we find:

$$\frac{\eta_{\Theta x}}{\eta_{Px}} = \frac{\delta + \Theta P}{\delta}\left(\frac{w^e - w^r}{w^e}\right) - 1$$
(A.15)

ANNEX 2
CONDITIONS FOR STRICT CONCAVITY OF E(Y)

Rewriting expression (3), we have

$$E(Y) = \frac{\Pi}{\delta(\delta + \Pi)} w^e \qquad (A.16)$$

Taking partial derivatives in (A.16), we find:

$$\frac{\partial E(Y)}{\partial x} = \frac{w^e}{(\delta + \Pi)^2} \Pi_x + \frac{\Pi}{(\delta + \Pi)} w_x^e \qquad (A.17)$$

where $\Pi_x = \frac{\partial \Pi}{\partial x}$ and $w_x^e = \frac{\partial w^e}{\partial x}$.

Taking second derivatives and rearranging resulting expression, we get:

$$\boxed{\frac{\partial^2 E(Y)}{\partial x^2} = 2 w_x^e \Pi_x - 2 \frac{w^e}{(\delta + \Pi)} \left(\Pi_x \right)^2 + w^e \Pi_{xx} + \frac{\Pi}{\delta(\delta + \Pi)} w_{xx}^e} \qquad (A.18)$$

where $\Pi_{xx} = \frac{\partial^2 \Pi}{\partial x^2}$, and $w_{xx}^e = \frac{\partial^2 w^e}{\partial x^2}$.

As showed in most empirical studies $\Pi_x < 0$ and $w_x^e > 0$, so sufficient conditions to concavity become:

$$\boxed{\Pi_{xx} \leq 0 \text{ and } w_{xx}^e \leq 0} \qquad (A.19)$$

ANNEX 3
SAMPLE DESCRIPTION

The *Spanish Survey of Conditions of Life and Work* (ECVT) was elaborated in 1985. Individuals are inquired about their labour past; the answers to these questions and to those refering to personal characteristics, constitute the base of the sample on which this study is carried out. In the Survey individuals are not asked about having received UB during the period of search of employment; instead they are inquired about having ever received revenue in concept of UB. This limitation implicates that we only can be sure if it have existed UB for those individuals that have experienced only one period of unemployment in their life. Similarly, these Survey limitations implicate that the maximal duration of UB can only be determined for those individuals having worked in a single firm before becoming unemployed. In consequence, the sample is selected among those individuals having changed of job only once in their life and being working when the Survey was carried out, and those unemployed having worked in a single firm before becoming unemployed. They were also eliminated those individuals having declared to have quitted their previous job for maternity, marriage, retirement or military service reasons, and also those having decided to leave the labour force. These sample selection criteria could result in a bias in the current sample. Nevertheless, we think that such a bias is not seriously affecting the results. First, it should be noted that the descriptive statistics of the current sample are not much different from the population's ones, except in the case of age, which is lower in the sample. On the other hand, *Heckmans' lambda* in Table 1 estimations is not significative.

The final outcome is a sample of 980 observations. For the estimation of accepted wages equation they were eliminated those individuals still unemployed when answering the Survey and those not answering the amount of the accepted wage; the result is a sample of 414 individuals. In order to jointly estimate the probabilities of receiving a wage offer [equation (14)] and accepting it [equation (18)], they were eliminated those individuals whose unemployment duration was censored in a longitude inferior to one year, after which it resulted a sample of 796 observations. Finally, for those individuals having received UB sometime in their life, the maximum duration of benefits was obtained considering the Spanish UB laws in force in 1985.

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TABLE 1
EQUATION OF ACCEPTED WAGES
WITH MULTICENSURED DEPENDENT VARIABLE

VARIABLE	Coefficient [Statistic "t"]	Coefficient [Statistic "t"]
Constant	1.911 [7.601]	2.062 [7.327]
Age [years]	0.066 [4.446]	0.066 [4.414]
Age square	-0.001 [-4.286]	-0.001 [-4.224]
Male	0.246 [4.400]	0.227 [3.898]
Primary School	0.242 [2.958]	0.244 [2.895]
Secondary School	0.324 [3.209]	0.320 [3.167]
Vocational Training	0.253 [2.819]	0.241 [2.678]
University [3 years]	0.729 [5.658]	0.692 [5.234]
University [5 years]	0.970 [9.609]	0.918 [8.334]
Replacement ratio when leaving unemployment [square root]	0.244 [2.408]	0.226 [2.587]
Remaining months of UB eligibility	-0.001 [-0.339]	-0.001 [-0.339]
Seniority [years]	0.007 [3.661]	0.007 [3.613]
σ	0.477 [20.803]	0.476 [20.807]
Lambda		-0.152 [-1.164]
N. Observations	414	
Log Likelihood	-476.4	-475.7

TABLE 2
JOINT ESTIMATION OF EQUATIONS (14)
AND (18) BY MAXIMUM LIKELIHOOD.
Bivariate Probit with Partial Observability.

VARIABLE	PROBABILITY OF RECEIVING A WAGE OFFER. Equation (14) $\Pr(Y_1 = 1)$. Coefficient [Statistic "t"]	PROBABILITY OF ACCEPTING IT. Equation (18) $\Pr(Y_2 = 1 \mid Y_1 = 1)$. Coefficient [Statistic "t"]
Constant	4.268 [3.092]	1.630 [2.348]
Family income	-0.003 [-0.954]	-0.006 [-1.662]
Age	-0.251 [-2.805]	-0.036 [-2.943]
Male		0.504 [2.343]
Years of education		0.059 [2.187]
Average replacement ratio [square root]		-0.520 [-1.948]
Number of dependent children		0.071 [0.354]
Self employed in previous work		-0.738 [-2.297]
Individually or collectively dismissed		-0.399 [-1.708]
Age square	0.004 [2.600]	
Number of months of eligibility for UB	-0.009 [-1.607]	
Number of workers in the household	0.021 [0.205]	
Log. Likelihood	-496.3	
N. Observations	796	
Chi-square (14)	107.5	