Employment and wages of people living with HIV/AIDS

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Employment and Wages of People Living with HIV/AIDS[1]

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ABSTRACT

The therapeutic advances that have taken place since the mid 1990s have profoundly affected the situation of people living with HIV/AIDS, not only in terms of life expectancy and quality of life but also socio-economically. This has numerous effects on different aspects of the patients' life and, especially, on their working life. We analyse in this paper labour force participation and wages of people living with HIV/AIDS in Spain. We select a control group from the general population. We find that the employment probability decreases by 16.4 percentage points among asymptomatic HIV patients, by 22.5 percentage points among symptomatic HIV patients, and as much as by 41.3 percentage points if the person is in the AIDS phase. In addition, wages of HIV patients are from 9 to 34 per cent (if infected by Intravenous Drug Use) lower. Gender, educational attainment, unearned income, HIV clinical indicators and number of household members are the main determinants of the employment probability of HIV patients. On the other hand, wages do not play a significant role in employment decisions of these individuals.

Keywords: HIV/AIDS; labour supply; wages; unearned income
JEL Class.: I1, J20

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1. Introduction

Following the discovery of the human immunodeficiency virus (HIV), it was feared that it would become one of the biggest public health challenges in decades to follow [Fauci, 1999]. Unfortunately, such suspicions were not unfounded. The HIV/AIDS disease has not only had a strong impact on the health of populations across the globe, but it also represents a serious socio-economic problem for many individuals, families, communities and governments [Ojo and Delaney, 1997; Beck *et al.*, 2001; Hellinger, 2006; ILO, 2006; UNAIDS, 2008].

The vast majority of HIV-positive people are of working age [UNAIDS, 2008]. The loss of workers and work-days due to AIDS-related illnesses or the demands of caring can result in significant declines in productivity, loss of earnings, and attrition in skills and experience [Lisk, 2002; ILO, 2005]. Thus, HIV/AIDS is not only a public health concern but has also become a threat to employment objectives and labour market efficiency.

Studies carried out during the 1980s and early 1990s in high-income countries pointed out that an HIV diagnosis had a strong impact on labour force participation. Scitovsky and Rice (1987) assumed that a typical AIDS patient was too ill to work for 60 per cent of his or her time. Yelin *et al.* (1991) reported that half of those working when they were informed of the diagnosis left work within the following two years. Massagli *et al.* (1994) found that in Boston 76 per cent were working at the moment of diagnosis, while only 53 per cent at the time of the survey (with an average elapsed period of 16 months between the diagnosis and the survey). Similarly, Laursen and Larsen (1996) found that while 50 per cent of the patients were employed when they were diagnosed with AIDS, this percentage fell to a 22 per cent a month after diagnosis and to 6 per cent two years afterwards. Leigh *et al.* (1995) use non-HIV individuals as a control group and concluded that HIV patients with and without AIDS experienced a substantial and significant loss of working days.

The therapeutic advances made since the mid 1990s have substantially changed this panorama and there are some studies making this fact very clear. For example, Dray-Spira *et al.* (2003) stated that between 46.8 and 58.8 per cent of HIV+ people (depending on the region of France under consideration) were employed and a third of the unemployed said they were looking for job. Dray Spira et al (2007) pointed that the employment rate of HIV-infected patients was 25% lower compared to the general population if diagnosed before 1994 and 9% lower if diagnosed from 1994 onward. In addition, the employment rate of highly educated HIV-infected patients diagnosed during the second period was not statistically different from the employment rates of the general population. Rabkin *et al.* (2004) followed a sample of US patients and concluded that those who were employed at baseline kept their jobs, but patients who were unemployed did not manage to return to their jobs or find another job. Goldman and Bao (2004) studied the effect of the use of Highly Active Anti-Retroviral Treatments (HAARTs) on the probability of returning to work, keeping the same position and number of hours worked. Their results indicated that the probability of keeping the job in the six months after start of the treatment increased from 58 to 94 per cent as a result of the treatment. Bernell and Shinogle (2004) stressed that HAARTs substantially increased the zero-positive person's chances of participating in the labour force. Nevertheless, this does not mean that an HIV diagnosis does not affect the patient's participation or that its impact is lesser. Auld (2002) suggested that the decrease in the percentage of HIV-positive people in employment is a consequence of the change in life expectancy following a health shock. He estimated a 25 per cent decrease on the employment probability after diagnosis. Recently, Galarraga *et al.* (2010) examined the effect of antidepressant use on the likelihood of being employed among HIV-positive women receiving HAART in the United States from 1994 to 2004. After addressing potential sources of bias, they concluded that the use of antidepressants is associated with a higher probability of being employed. Sendi *et al.* (2007) suggested that the allocation of time in HIV-infected patients does not differ with level of education (i.e., wage rate), and that availability of non-labour income induces income effects, that is, individuals demand more leisure time. Last, Oliva (2010) stated that about 50 per cent of HIV population in Spain had a job, but there were large differences by gender, educational attainment and clinical stage.

One can conclude that the illness has negative effects on labour force participation. The effects seem to be smaller after the introduction of HAART, although they are still non-negligible (Auld, 2002). However, except for Leigh *et al.* (1995), none of the previous studies used a control group with the same distribution of socio-demographic characteristics. In this context, this paper contributes to the existing literature as it tests the effects of the disease on the employment situation and wages of HIV-positive persons using a comparable control group from the general population in terms of age, gender and educational attainment. We merge administrative data from clinical histories of Spanish HIV+ patients from Canary Islands with a subsample of the linked Canary Islands Health Survey and Canary Islands Survey on Income and Living Conditions. We propose a neoclassical model of labour supply including classical variables (age, gender, education, children at home, and unearned income), objective health variables (stage of the illness, viral count and CD4 cells count) and self reported health variables (health related quality of life). We think that the strategy of using a homogeneous control group together with the inclusion of all mentioned variables will allow us to correctly identify the effects of the health shock on the labour supply at the extensive margin. Our results show that the employment probability decreases by 16.4 percentage points among asymptomatic HIV patients, by 22.5 percentage points among symptomatic HIV patients, and as much as by 41.3 percentage points if the person is in the AIDS phase.

The evidence on the effect of HIV/AIDS on wages is scarcer. Auld (2002) found that HIV diagnosis does not have an effect on wages and the effect of CD4 counts is non-significant. We add to the existing evidence investigating the effect that the disease and its stage have on the wages. We find that wages of HIV patients are from 9% to 34% (if infected by Intravenous Drug Use) lower.

The rest of the paper is structured as follows. The data collection process and the main features of the sample are described in detail in section 2. Section 3 is dedicated to the analytical framework, where a specification of a reduced-form participation equation is considered. We present in section 4 the main results and we also discuss their implications. The paper ends up with a summary of the main conclusions.

2. Data collection and sample of analysis

2.1. Population with HIV

A cross-sectional multi-centre study of 572 patients diagnosed with HIV/AIDS was carried out in order to collect the data needed. Patients receiving outpatient care were recruited in autumn 2003 from four hospital outpatient clinics in the Canary Islands. Individuals included in the study had to fulfil at least one of the following criteria: a) treated by the Infectious Diseases Unit of one of the different hospitals during 2003; or b) to attend a day surgery from the Infectious Diseases Unit of one the hospitals. We used the classification system proposed in 1993 by the Centre for Disease Control (CDC) in the United States to classify the severity of the HIV infection into asymptomatic HIV, symptomatic HIV and AIDS (Ancelle Park, 1993).

We use data from the patients' medical records and self-completed questionnaires. Employment information was collected using a questionnaire previously tested in a pilot study (Oliva *et al.*, 2003). 400 questionnaires were posted to the home addresses of HIV+ people who initially consented to participate in the study, of which 246 were completed (a response rate of 60 per cent). After selecting the sample to individuals aged 20 to 60, discarded questionnaires that had been very incorrectly completed and of patients that were in prison, the valid sample is reduced to 219. The characteristics of this sample of individuals are similar to the initial sample of 572 patients (López-Bastida *et al.*, 2009). It is estimated that this sample represented from 8.3 to 11.3 per cent of the known HIV+ population in the Canary Islands (Castilla and de la Fuente, 2000).

The date of diagnosis, the most probable cause of infection, defence levels and the current stage of the illness (asymptomatic, symptomatic or AIDS) are obtained from the medical records. These variables were collected by qualified personnel in the health centres. On the other hand, patients themselves fulfilled the questionnaire with information on labour force participation, wages, quality of life and socioeconomics characteristics (age, gender, education, number of household members, presence of children and other household income).

2.2. Control group

The control group is selected from the sample of 1,153 individuals aged at least 16 from the 2004 Canary Islands Health Survey (CIHS) and Canary Islands Survey on Income and Living Conditions (CISILC). The CIHS and CISILC contain information on the variables we need to merge to the records of the treatment group, i.e., demographics, household and individual socioeconomic characteristics, labour market outcomes, self-reported health status (EQ-5D), diagnosed diseases and utilization of health care services.

Using this representative sample of the general population two control groups are selected. First, each individual with HIV is matched to all the individuals from the general population who have the same age and gender. Each control individual can be used more than one. Then, we construct weights to be used in the regression analysis as follow:

1) Weights are equal to one if the individual is a HIV+ patient

2) For each HIV+ patient i, each of his/her matched control receives weight $1/n_{ci}$ where n_{ci} is the number of controls matched to HIV+ patient i

3) The final weight used for each control is the overall sum of all the partial weights he/she receives to be matched to different treated individuals

We construct the second control group similarly, but we use age, gender and education as exact matching variables.

2.3. Variables

Outcomes

Our outcome variables are labour force participation and wages.

Health variables

We first control for specific health variables expected to be relevant for the population living with HIV, such as defence level or stage of the disease and the most likely cause of infection. Clinical history classifies the stages of illness into three levels: asymptomatic HIV (dichotomic variable), symptomatic HIV (dichotomic variable) and AIDS (dichotomic variable). The defence level is measured by the lymphocytes CD4/μl. The individual base would be the one that showed a high defence level in the most recent analytical test (more than 500 CD4s/μl) (we assume that individuals of general population are in this category), whereas a low defence level is assigned if the patient shows less than 200 lymphocytes CD4/μl and a medium defence level is assigned if $200<CD4/\mu l<500$. Defence levels and stage of illness cover similar effects as far as the classification of the illness is concerned (AIDS stage) which is associated not only to the defence level but also to the appearance of an opportunist disease (Ancelle Park, 1993). Most probably cause of infection has two categories: Intravenous Drug Use and other causes. People who have contracted the disease from Intravenous Drug Use (IDU) might be systematically different to those who have contracted it through other means. These systematic differences could in turn generate different conditional employment functions that are not exclusively captured by the health variables. It would be of interest to disaggregate the other causes of infection but unfortunately, the limited size of the sample discourages us to do it.

In addition, we control for self assessed health using a Health Related Quality of Life (HRQOL) measure. HRQOL was measure through a generic measure, the EQ-5D questionnaire (Rabin and Charro, 2001). The EQ-5D has five questions asking for a self-perceived status of five different functional conditions related to mobility, personal care, daily activities, pain /discomfort and anxiety /depression. In each dimension, the interviewed person can choose between three possible answers: 'absence of problems', 'moderate problems' and 'incapacity to perform the activity or severe problems'. A respondent health status is defined by combining one level from each of the 5 dimensions (EQ-5D). A total of 243 possible health statuses can be defined in this way. In order to translate this number to a single *health score*, a 'preferences index score or tariff' is needed. This questionnaire has been validated in Spain, and an estimated set a score value was obtained using the Time Trade Off method (Badía *et al*, 1999).

Other explanatory variables

We also control for the effect of other socio-demographic variables as age, sex, education, household composition, wages and unearned income. These variables are obtained from a specific questionnaire posted to the home addresses of HIV+ people who initially consented to participate in the study. As far as unearned income is concerned, this has been defined as the difference between total income of the household and the wage of the individual. Thus, this variable contains the individual's unearned income (including sickness or unemployment benefits) and the income of other members of the household.

2.4 Descriptive statistics: HIV+ patients, general population and control groups

Table 1 shows the main characteristics of the different samples of analysis. The first column shows the mean of the variables of interest for the sample of individuals with HIV+, the second column for the full sample of the general population, while columns 3 and 4 show weighted means of control group 1 (matched using age and gender) and 2 (matched using age, gender and educational attainment). We see that while the age distribution of HIV-positive patients and the general population is similar, the percentage of females is clearly lower among the HIV-positive patients. By construction, the percentages of males and females in control groups 1 and 2 are the same as in the HIV+ population.

We find that both average employment rates and wages are similar between HIV-positive individuals and general population. However, this similarity is due to the low percentage of women in the sample of HIV+ individuals, whose labour force participation is lower compared to men. The comparison of the outcome variables between HIV+ and the two control groups put forward this effect, as the average employment rate of a sample with the same age-gender distribution as our sample of interest is 16.1 percentage points higher, and the wages 247€ higher. Similar differences appear when the comparison is done with respect to the sample matched in terms of age, gender and educational attainment.

The CD4 count for 6.5 per cent of the HIV+ people was low, 24.6 per cent had a medium CD4 count, and 68.9 per cent had a high count. A 50.3 per cent of the HIV+ people were in an asymptomatic phase, a 24.6 per cent in a symptomatic phase and 25.1 per cent in AIDS phase. Intravenous Drug Use was the most likely cause of transmission for 16.6 per cent of HIV+ people and sex or blood transfusion were the most likely cause of transmission for 83.4 per cent.

In addition, there are important educational differences between HIV+ patients and the general population. We find that while the percentage without education is similar in the two samples, the percentage with secondary education is higher in the general population, and correspondingly the percentage with primary education is also lower in this sample. Surprisingly, the percentage with higher education is similar in the two samples. The high percentage of HIV-positive individuals with higher education in our sample is explained by their pattern of infection. Oliva (2010) finds that 8.95 per cent of the individuals in the 2001-2004 HHAS sample have passed through higher education. However, there are large differences between the two surveys in the percentage infected through drug use (55 per cent in the HIV/AIDS Hospital Survey vs. 16.6 per cent in our sample). Once we control by source of infection, the differences in educational attainment between the two samples almost disappear.[5] On the other hand, the differences in educational attainment between HIV-positive individuals remain with respect to control group 1 but not with respect to group 2 because one of the variables used for grouping the last one is education.

We find that although self reported health status (EQ-5D set score values-TTO method) is higher in the general population, it is not very different from the one reported by HIV+ patients. Last, HIV+ patients live in households with a smaller sample size (2.3 vs. 3.1) and with lower household income from sources other than the individual earnings (470€ vs. 1,238€).

Table 1. Means of HIV+ patients, general population and control groups 1 and 2

	VIH=1	VIH=0 (all)	Control group 1	Control group 2
Age	40.80	40.57	40.80	40.91
Female	0.156	0.562	0.156	0.156
Male	0.844	0.438	0.844	0.844
No education	0.020	0.017	0.006	0.020
Primary education	0.422	0.280	0.274	0.422
Secondary education	0.296	0.502	0.501	0.296
Higher education	0.261	0.201	0.219	0.261
Children	0.032	0.1379	0.220	0.193
Household size	2.342	3.070	3.068	3.082
Work	0.578	0.550	0.739	0.734
Wage 2003	592.99	558.21	839.87	846.41

[5] Results not shown but available from the authors upon request.

Other household income	469.75	1237.82	969.12	926.65
Euroqol (set score value TTO Methods)	0.796	0.825	0.842	0.829
Low cell count (CD4/μl<200)	0.065			
Medium CD4 cell count (200≤CD4/μl <500)	0.246			
High CD4 cell count (CD4/μl≥500)	0.689			
VIH+ Asymptomatic	0.503			
VIH+ Symptomatic	0.246			
AIDS	0.251			
Infected through Intravenous Drug Use (IDU)	0.166			
Infected through sex or blood transfusion	0.834			
N	199	812	447	275

Notes.

1. Mean values for control groups 1 and 2 are obtained using the constructed weights.

3. Empirical model

3.1. Specification of the model

The information about labour market variables that we have in our sample relates to the indicator of participation and wages of participants. We do not have information on hours that could be very useful whenever individuals decide at the intensive margin. Usual labour supply models predict responses in hours but neither the evidence shows large responses for healthy individuals (see for example Borjas, 1999) nor for unhealthy ones (for instance, Kahn, 1998). Moreover, our labour market in Spain is not flexible enough to capture significant responses at that level (see Labeaga and Sanz, 2001). Under these considerations, we propose to estimate two reduced-form equations of labour force participation and wages, according to the following model (that can be derived from a typical neoclassical model of labour supply):

$$1(h_i^*) = f(D_i, Z_i, \delta, \alpha) \quad (1)$$

where $1(h_i^*)$ represents the indicator of participation, h_i^* the potential (latent) hours, D_i the indicator for HIV+ patients, Z_i are exogenous individual and household characteristics, as well as health indicators and δ and α are parameters. The observability rule is:

$$h_i = \begin{cases} 1 & if \quad h_i^* > 0 \\ 0 & if \quad h_i^* \le 0 \end{cases} \quad (2)$$

and assuming linearity for *f(.)*

$$h_i^* = \delta D_i + \alpha' Z_i + u_i \quad (3)$$

where h^* is a latent variable defining the qualitative nature of *h*. We assume that the errors u_i are normally distributed and we use a standard probit model to estimate the parameters of interest.

Similarly, we assume that *log(wages)* depend linearly on D_i, X_i are exogenous characteristics, β and γ parameters and ε_i is an individual error term, as shown in equation (4)

$$\log w_i = \beta D_i + \gamma' X_i + \varepsilon_i \quad (4)$$

Information on wages is only observed for the subsample of individuals participating in the labour market, which leads to the well-known sample selection problem (Heckman, 1976). We follow the standard procedure of assuming joint normality and we estimate the joint model using the Heckman´s two step procedure. Equation (4) is then estimated in two stages. At the first stage, we fit the reduced form probit model for the participation equation and construct the Mill's ratio using the parameter estimates. Then, at the second we estimate (4) by OLS conditional on participation adding the selection term to account for potential endogenous selection into participation (Heckman, 1976, 1979). Under joint normality of (u_i, ε_i), full information maximum likelihood provides efficient estimates.

3.2. Identification strategy

We face a first identification problem concerning the parameters in a model like (1)-(4). Identification could be based on exclusion restrictions and also on the non-linearity of the participation equation. In order to identify the parameters at the two stages we use household characteristics (household size, other household income, and the presence of children 5 years old and younger in the household) as exclusion restrictions. These variables are only included in the participation equation but not in the wage equation.

A second challenge has to do with identification of the treatment parameter δ in (3). The effect on participation for infected patients should be the difference between the probability observed and the probability that we would observe if they were not infected. This last probability is, of course, unobserved. Any unobserved factor correlated with the treatment D_i could bias the parameter estimate thus avoiding identification of causal effects. Several approaches can be used to disentangle consequences arising directly from infection from those correlated with infection (other health shocks) affecting participation but unobserved to us. Auld (2002) uses repetition of observations for the same individuals at the time of infection and some time after the shock. Even in these circumstances, he claimed for further research because changes for participation or hours of work can be attributed to variations in life expectancy confounded with unobserved changes in morbidity. We follow an alternative approach. Since it is not possible to observe the counterfactual of working without being affected by the health shock for individuals infected by HIV, we built homogeneous control groups and follow the assumption that alternative variables (even unobservables) will affect behaviour of controls and treatments in the same way (conditional on observables). This last hypothesis is, in our case, non-testable but it is still possible to conduct sensitivity analysis using different controls as we do in the empirical section below.

4. Results

4.1. Reduced form models

Table 2 presents the marginal effects of the probit models of the participation equation. It shows the results of four different models.[6] In model 1, we study the effects of HIV on labour force participation. Models 2 and 3 analyse this effect, but controlling for clinical severity of the health status (model 2 by using the stage of illness and model 3 using the level of defences). The high correlation between CD4 count and stage of the disease (Ancelle-Park, 1993) prevents them from being considered in a single model. So, the variables stage of the disease and CD4+ T-lymphocyte count could be considered substitutes. The purpose of using both types of indicators is to examine whether the estimated marginal coefficients are of a similar magnitude or if they vary according to health indicator. Last, model 4 shows the same specification as model 1, but only for the subsample of men as they represent 84% of the sample. An indication of the confidence of these results is that they are robust across the different specifications.

Table 2. Participation results. Marginal effects and standard errors

	M1	**M2**	**M3**	**M4**
	Marginal effects (SE)	**Marginal effects (SE)**	**Marginal effects (SE)**	**Marginal effects (SE)**
HIV	**-0.231** (0.057)		**-0.210** (0.063)	**-0.193** (0.062)
Most likely cause of transmission (IDU)	**-0.280** (0.110)	**-0.271** (0.114)	**-0.261** (0.113)	**-0.268** (0.124)
HIV+ asymptomatic		**-0.164** (0.074)		
HIV+ symptomatic		**-0.225** (0.086)		
AIDS		**-0.413** (0.089)		
CD4 cells counts (200<CD4s<500)			0.009 0.074	
CD4 cells counts (CD4s<200)			**-0.564** 0.168	
Age	**0.062** (0.019)	**0.064** (0.019)	**0.058** (0.019)	**0.059** (0.021)
Age²	**-0.001** (0.000)	**-0.001** (0.000)	**-0.001** (0.000)	**-0.001** (0.000)
Female	**-0.147** (0.053)	**-0.140** (0.054)	**-0.151** (0.053)	
Household members	**-0.042** (0.020)	**-0.042** (0.020)	**-0.040** (0.020)	*-0.035* (0.022)
Children aged <6	0.068 (0.070)	0.067 (0.070)	0.064 (0.071)	0.119 (0.078)
Primary education	*0.274* (0.123)	**0.286** (0.121)	*0.236* (0.122)	**0.352** (0.131)
Secondary education	**0.358** (0.138)	**0.363** (0.137)	**0.313** (0.133)	**0.440** (0.160)
Higher education	**0.320** (0.091)	**0.324** (0.090)	**0.288** (0.095)	**0.359** (0.093)

6 Since our specifications do not contain wages, we should bear in mind that the results could be inconsistent whenever the wage has significant effects on the probability of participating. We estimate participation equations, for all samples and specifications, including the predicted log(wage) as an explanatory variable, and find that it is highly insignificant. We cannot rule out that the non-significance is due to high collinearity between the predicted wage and the other explanatory variables as we don´t have further exclusion restrictions, but we attribute it to the diminishing importance of wages in labour supply decisions once an individual has been infected. We do not show these results, but they are available from the authors upon request.

log(other household income)	**-0.039** (0.006)	**-0.038** (0.006)	**-0.040** (0.007)	**-0.036** (0.007)
EQ-5D	0.028 (0.097)	0.008 (0.099)	0.014 (0.098)	0.019 (0.108)
Number of observations	646	646	646	435
Log-Likelihood	-327.976	-324.526	-322.301	-213.911
chi^2	90.671	93.887	90.636	75.890
Pseudo R^2	0.180	0.189	0.195	0.177
% correctly predicted	72.91%	72.60%	73.68%	70.28%

Notes:

1. Values significantly different from zero in bold typeface (at $P<0.05$) and italics (at $P<0.10$).

HIV+ has a clearly significant and negative effect on labour force participation, and the magnitude of the effect is different depending on both the cause of transmission and/or the severity of the illness. As for the cause of infection (when people is HIV+), IDU infected persons are distinguished, in terms of participation, from those who have been infected via sexual transmission or by blood transfusion. It must be stressed that IDU infected patients have an even lower probability of participating (around 27-28 percentage points lower). Thus, the probability of participation is decreased 23 per cent if the individual who is HIV+ has been infected via sexual transmission or by blood transfusion, but it is decreased by 50-51 percentage points when it is an HIV+ individual IDU infected.

On the other hand, Models 2 and 3 add information on the health status (stage of disease and CD4 cells counts). As far as the stage of the illness is concerned, we find that the more advanced the stage of the illness, the lower is the employment probability, as expected. Thus, the employment probability decreases by 16.4 percentage points among asymptomatic HIV patients, by 22.5 percentage points among symptomatic HIV patients, and as much as by 41.3 percentage points if the person is in the AIDS phase. We find that there are no differences in the probability of being employed between HIV+ individuals with medium and high levels of defences. However, the probability of being in employment is further decreased by 56.4 percentage points if the individual has low levels of CD4 cells counts (CD4s<200). It is important to note that the results for the treatment hold even after controlling for subjective and objective health measures because it seems to confirm the effect of reducing life expectancy on labour market participation.

The other variables that significantly explain the probability of participating are age, gender, the number of household members, educational attainment and unearned income. We see that both age and gender have the expected signs. The marginal effect of age shows the usual inverted hump-shaped profile: the probability of being employed increases until individuals are aged 29 to 32 and it decreases thereafter. On the other hand, the likelihood that women participate in the labour market is between 14.0 to 15.1 percentage points lower than the one for men.

Educational attainment is positively related with participation in the labour force, and the higher increase in the probability of working is found for primary education. The probability of working of individuals with primary education is between 23.6 and 28.6 percentage points higher than the probability of individuals with no education, and the percentage rises up to 35.2 percentage points among the subsample of men. The probability of participation is consequently higher among individuals with secondary or higher education compared to individuals with primary education, being once again the effects higher among men. This suggests that education may play a less important role among females.

Unearned income is clearly significant in all the specifications with the expected sign: the higher the unearned income, the lower the probability of being employed. We also find that the higher the number of household members, the lower the probability of being employed. This is not due to the presence of children, as having a child younger than 6 is not associated with the probability of being employed (non-significant effect). The effect of household size could reflect the availability of other household members to work suggesting the existence of an added worker effect.

Finally, regarding the relationship between the health status and the employment probability, we find that the EQ-5D presents the expected positive sign (higher health-related quality of life is associated with higher probability of being employed) although it is not statistically significant.

Table 3 presents parameter estimates of the specifications of the log-wage equation. The results of Models 1 to 4 discussed above are also shown here and they are also robust across the different specifications. The Mill´s ratio included in each of the models is obtained from the corresponding participation equation. It is marginally significant and has a moderate positive effect, which could be relevant at the time of correctly predicting wages that are going to be used as instruments.

Table 3. Parameter estimates, log-wage equation

	M1	**M2**	**M3**	**M4**
	Coefficient (SE)	**Coefficient (SE)**	**Coefficient (SE)**	**Coefficient (SE)**
HIV	*-0.091* (0.052)		-0.084 (0.056)	**-0.127** (0.057)
Most likely cause of transmission (IDU)	*-0.249* (0.147)	-0.240 (0.153)	*-0.266* (0.148)	-0.198 (0.158)
HIV+ asymptomatic		-0.088 (0.060)		
HIV+ symptomatic		-0.085 (0.080)		
AIDS		-0.161 (0.157)		
CD4 cells counts (200<CD4s<500)			-0.046 (0.111)	
CD4 cells counts (CD4s<200)			-0.019 (0.107)	
Age	*0.005* (0.003)	*0.006* (0.003)	*0.006* (0.003)	0.004 (0.004)
Female	**-0.160** (0.060)	**-0.157** (0.060)	**-0.161** (0.061)	
Primary education	**0.501** (0.108)	**0.502** (0.110)	**0.511** (0.109)	
Secondary education	**0.552** (0.105)	**0.551** (0.107)	**0.562** (0.105)	0.063 (0.060)
Higher education	**0.854** (0.108)	**0.853** (0.109)	**0.864** (0.109)	**0.344** (0.071)
Euroqoltet	0.105 (0.079)	0.106 (0.079)	0.109 (0.079)	**0.175** (0.087)
Mills (λ)	*0.098* (0.050)	**0.102** (0.051)	*0.094* (0.050)	*0.098* (0.053)
Number of observations	399	399	399	282
Adjusted R^2	0.186	0.184	0.182	0.164

Notes.

1. Values significantly different from zero in bold typeface (at P<0.05) and italics (at P<0.10).
2. In order to identify the parameters of the log wage and participation equations, household size, other household income, and the presence of children 5 years old and younger in the household are excluded from the log wage equation.

The results show that HIV+ individuals not only have lower participation rates, but also lower wages if employed. The decrease in wages is associated with the cause of infection; wages of HIV+ individuals infected via sexual transmission or by blood transfusion are 9% lower compared to non-HIV+ individuals, while wages of IDU infected patients are 34% lower. The robustness of these effects as well as the differences found could confirm some kind of discrimination since the employer could have some information about the health shock. On the other hand, the severity of the illness seems not to be related with the level of wages, as we find no significant effects associated to the different stages of the disease, as well as to the different level of CD4 counts.

The estimated coefficients of the other explanatory variables show the expected sign. Age is positively related to higher wages, women receive lower wages and the higher the educational attainment, the higher the wage. Last, higher self-reported health is associated with higher wages, although the effect is only significant for the subsample of men.

4.2. Results using the second control group

In order to assess the robustness of our results to the choice of the control group, tables 4 and 5 show the estimated parameters when the second control group is used (individuals in the control group are matched on age, gender and educational attainment). We find that the results remain the same not only regarding the sign, but also the magnitude of the effect of the variables of interest.

Table 4. Participation equation. Control group 2

	M1	M2	M3	M4
	Marginal effects (SE)	**Marginal effects (SE)**	**Marginal effects (SE)**	**Marginal effects (SE)**
HIV	**-0.253** (0.066)		**-0.231** (0.072)	**-0.236** (0.068)
Most likely cause of transmission (IDU)	**-0.255** (0.108)	**-0.245** (0.112)	**-0.243** (0.112)	*-0.235* (0.122)
HIV+ asymptomatic		**-0.194** (0.084)		
HIV+ symptomatic		**-0.245** (0.095)		
AIDS		**-0.427** (0.095)		
CD4 cells counts (200<CD4s<500)			0.006 (0.078)	
CD4 cells counts (CD4s<200)			**-0.576** (0.147)	
Number of observations	474	474	474	368
Log-Likelihood	-248.53	-245.46	-242.51	-185.87
chi^2	72.225	72.979	71.603	53.477
Pseudo R^2	0.175	0.185	0.195	0.163

% correctly predicted	72.15%	73.42%	74.47%	70.46%

Notes.

1. Values significantly different from zero in bold typeface (at P<0.05) and italics (at P<0.10).
2. The same explanatory variables as shown in Table 2 are included in the estimation.

Table 5. Wage equation. Control group 2

	M1	**M2**	**M3**	**M4**
	Coefficient (SE)	**Coefficient (SE)**	**Coefficient (SE)**	**Coefficient (SE)**
HIV	-0.089 (0.059)		-0.086 (0.058)	**-0.117** (0.058)
Most likely cause of transmission (IDU)	*-0.236* (0.147)	-0.228 (0.153)	*-0.254* (0.149)	-0.156 (0.157)
HIV+ asymptomatic		-0.094 (0.061)		
HIV+ symptomatic		-0.082 (0.081)		
AIDS		-0.134 (0.158)		
CD4 cells counts (200<CD4s<500)			-0.047 (0.111)	
CD4 cells counts (CD4s<200)			0.044 (0.134)	
Number of observations	295	295	295	245
Adjusted R^2	0.200	0.198	0.194	0.215

Notes.

1. Values significantly different from zero in bold typeface (at P<0.05) and italics (at P<0.10).
2. The same explanatory variables as shown in Table 3 are included in the estimation.

5. Discussion and concluding remarks

The introduction of Highly Active Anti-Retroviral Treatments to treat individuals living with HIV/AIDS has improved not only their health status, but also their employment rates. However, the employment rates of HIV/AIDS patients are still lower than those of the general population. In this study, we analyse the effect of HIV/AIDS on the employment rate of those living with HIV/AIDS using a control group with similar socio-demographic characteristics. In addition, we investigate the importance of the stage of the disease using two alternative indicators (stage of disease and levels of defence) and using an indicator that reflects the marked influence of unobserved factors (most likely cause of infection). To the best of our knowledge, this is the first paper that uses a control group in the HAART era to investigate those effects.

HIV+ has a clearly significant and negative effect on labour force participation and the magnitude of the effect is different depending on both the cause of transmission and/or the severity of the illness. The probability of participation is decreased by 23 percentage points if the individual who is HIV+ has been infected via sexual transmission or by blood transfusion, but it is strongly decreased (by 50-51 percentage points) when it is an HIV+ individual IDU infected. As far as the stage of the illness is concerned, we find that the more advanced the stage of the illness, the lower is the employment probability. Thus, the employment probability decreases by 16.4 percentage points among asymptomatic HIV patients, by 22.5 percentage points among symptomatic HIV patients, and as much as by 41.3 percentage points if the person is in the AIDS phase and the probability of being in employment is further decreased by 56.4 percentage points if the individual has low levels of CD4 cells counts (CD4s<200). On the other hand, HIV+ individuals not only have lower participation rates, but also lower wages if employed. The decrease in wages is associated with the cause of infection; although the severity of the illness seems not to be related with the level of wages. These results are robust to the choice of the control group both qualitative and quantitatively. They suggest that some discrimination by the employers could be at stake, as the differences exist after conditioning on the exact same distribution of age, gender and educational attainment.

A common conclusion in the empirical literature is that patients diagnosed before the HAART era may have stopped working under the assumption that the health damage was irreversible. The results found in this paper confirm that wages are not important in the labour supply of HIV infected patients, while in addition to the stage of the illness other household income seems crucial. Other important factors include some socio-demographic characteristics and health variables. While the effects of HIV/AIDS on participation are now smaller than in the past, there could still be an effect at time of the diagnosis (due to the effect of new information about reduced life expectancy) as well as with the evolution of the illness (which also affects life expectancy). We do the exercise comparing treated and control groups based on a selection of observable socioeconomic characteristics, thus the results are not contaminated by their confounding effects. Still, unobserved factors differently affecting the two groups could bias the result of the treatment parameter whenever those factors are correlated with the HIV infection.

In light of our results, we cannot affirm that HIV infected patients are going to be more socially vulnerable or are going to be at risk of exclusion. But their participation rates are lower than those from non-infected individuals from the general population with the same characteristics, and they get lower wages when participating than their healthy counterparts. Since it is not possible for us to confirm whether lower participation is a consequence of lower life expectancy (poorer health status) or the lower demand of employers towards HIV infected patients, we will not only support public education policies on healthy habits but also public non-discriminating policies on employment and wages of this vulnerable population. This way of acting, independently of the form of infection, will ensure equity as well as lower risk of poverty and social exclusion.

This study is not exempt from limitations. First, the small sample size suggests proceeding with a certain amount of caution with the conclusions. Second, some relevant variables such as mental health and the intensity of the psychological affliction were not available. Third, the characteristics of our sample slightly differ from the characteristics of the Spanish HIV+ population shown in other studies (Oliva 2010), as the percentage of women and the share of the patients infected for intravenous drug use are lower in this survey. This is mainly due to the non-inclusion of hospitalized and imprisoned individuals in our sample, whereas the Hospital HIV/AIDS Survey (HHAS) includes them. Representativeness of the survey is of special importance when trying to extrapolate conclusions to the HIV-positive population. In our case, the patients' profile fits with the new cases of HIV diagnosed in the last decade according to the Spanish HIV-epidemiological surveillance (Centro Nacional de Epidemiología, 2011). Therefore, our results are likely to be able to forecast the future employment outcomes of new cases of infection. In addition, the use of data from patients who attend the outpatient public health care services should not be considered a weakness of the study as most patients will belong to this group given the chronic nature of the illness. Finally, our results were obtained from two cross-sectional surveys performed in the Canary Islands (Spain). Obviously, it would have been preferable to have longitudinal databases, where HIV-positive persons and a control group could be followed for several years but, unfortunately, this type of survey went beyond our means.

Despite these limitations, these results may serve as the basis for making medium term predictions and for the design of integral policies. These policies should go beyond isolated public health policies or strictly employment policies, but joint efforts from the two sectors would be needed in order to improve the well-being and opportunities of people with this health problem to integrate in society with all their rights and without the risk of suffering from discrimination.

References

Ancelle Park RM. 1993. European expanded AIDS definition. *The Lancet* 341(8842):441.

Auld, M.C. 2002. Disentangling the effects of life expectancy and morbidity on labor market outcomes, *Health Economics* 11: 471-483.

Badia, X., Roset, M., Montserrat, S., Herdman M., Segura A. 1999. The Spanish version of EuroQol: a description and its applications. European Quality of Life scale. Med Clin (Barc) 112 Suppl 1:79-85.

Beck EJ, Miners AH, Tolley K. 2001. The cost of HIV treatment and care. A global review. *Pharmacoeconomics* 19(1):13-39.

Bernell SL, Shinogle JA. 2004. The relationship between HAART use and employment for HIV-positive individuals: an empirical analysis and policy outlook. *Health Policy* 71: 255-64.

Borjas, J.G. 1999. Labor Economics. McGraw-Hill/Irwin, New York.

Castilla J, De la Fuente L. 2000. Trends in the number of human immunodeficiency virus infected persons and AIDS cases in Spain: 1980-1998. *Med Clin (BArc)* 115(3): 85-9.

Centro Nacional de Epidemiología. 2011. Vigilancia epidemiológica del VIH/SIDA en España. sistema de información sobre nuevos diagnósticos de VIH. Registro nacional de casos de SIDA. Available at: http://www.isciii.es/ISCIII/es/contenidos/fd-servicios-cientifico-tecnicos/fd-vigilancias-alertas/fd-enfermedades/Informe_VIH-sida_Junio_2011.pdf (accessed: March 9 2012)

Dray-Spira R, Lert F, Marimoutou C, Bouhnik AD, Obadia Y. 2003. Socio-economic conditions, health status and employment among persons living with HIV/AIDS in France in 2001. *AIDS Care* 15: 739-48.

Dray-Spira R, Lert F; VESPA Study Group. 2007. Living and working with HIV in France in 2003: results from the ANRS-EN12-VESPA Study. AIDS 21 Suppl 1:S29-36.

Fauci AS. 1999. The AIDS Epidemic. Considerations for the 21st Century. *New England Journal Medicine* 341(14): 1046-1050.

Galárraga O, Salkever DS, Cook JA, Gange SJ. 2010. An instrumental variables evaluation of the effect of antidepressant use on employment among HIV-infected women using antiretroviral therapy in the United States: 1996-2004. Health Economics 19(2):173-88.

Goldman DP, Bao Y. 2004. Effective HIV treatment and the employment of HIV(+) adults. *Health Serv Res* 39: 1691-712.

Heckman J. 1976. The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. *Annals of Economics and Social Measurements* 5: 475-92.

Heckman J. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47: 153-161.

Hellinger F.J. 2006. Economic Models of Antiretroviral Therapy: Searching for the Optimal Strategy. *Pharmacoeconomics* 24(7):631-42.

International Labour Organization. 2006. HIV/AIDS and work: global estimates, impact on children and youth, and response. ILO Programme on HIV/AIDS and the World of Work Geneva.

International Labour Organization. 2005. ILO Programme on HIV/AIDS and the world of work: HIV/AIDS and employment. Governing Body 292nd Session (available at http://www.ilo.org/public/english/protection/trav/aids/aboutiloaids.htm).

Kahn, M. 1998. Health and labor market performance: the case of diabetes. Journal of Labor Economics 16: 878-900.

Labeaga JM, Sanz J. 2001. Oferta de trabajo y fiscalidad en España. Hechos recientes y tendencias tras el nuevo IRPF. *Papeles de Economía Española* 87: 230-243.

Laursen E, Larsen L. 1995. Socio-economic status of AIDS patients. *Scandinavian Journal of Social Medicine* 23: 189-92.

Leigh JP, Lubeck DP, Farnham P, Fries JF. 1995. Potential and actual workdays lost among patients with HIV. *J Acquir Immune Defic Syndr Hum Retrovirol* 8: 392-398.

Lisk F. 2002. Labour market and employment implications of HIV/AIDS. ILO Programme on HIV/AIDS and the World of Work Geneva.

López-Bastida J, Oliva J, Perestelo L, Serrano P. 2009. Direct and Indirect Costs in Ambulatory patients Living with HIV/AIDS. *BMC Health Services Research* 9: 55.

Massagli MP, Weissman JS, Seage GR 3rd, Epstein AM. 1994. Correlates of employment after AIDS diagnosis in the Boston Health Study. American *Journal of Public Health* 84: 1976-81.

Ojo K, Delaney M. 1997. Economic and demographic consequences of AIDS in Namibia: rapid assessment of the costs. *International Journal of Health Planning and Management* 12: 315-326.

Oliva J, Roa C, del Llano J. 2003. Indirect Costs in HIV/AIDS Ambulatory Patients in Spain: A Pilot Study. *Pharmacoeconomics* 21: 1113-1121.

Oliva J. 2010. Labour participation of Spanish people living with HIV between 2001-2004. *Health Economics* 19: 491–500

Rabin R., de Charro F. 2001. EQ-5D: A measure of health status from the EuroQol Group. *Annals of Medicine* 33(5): 337–343.

Rabkin JG, McElhiney M, Ferrando SJ, Van Gorp W, Lin SH. 2004. Predictors of employment of men with HIV/AIDS: a longitudinal study. *Psychosomatic Medicine* 66: 72-78.

Scitovsky AA, Rice DP. 1987. Estimates of the direct and indirect costs of acquired immunodeficiency syndrome in the United States, 1985, 1986, and 1991. *Public Health Rep*. 102: 5-17.

Sendi P, Brouwer WB, Bucher HC, Weber R, Battegay M; Swiss HIV Cohort Study. 2007. When time is more than money: the allocation of time between work and leisure in HIV-infected patients. *Social Science and Medicine* 64(11):2355-61

UNAIDS. 2008. Report on the global AIDS epidemic, UNAIDS, World Health Organization, Geneva.

Yelin EH, Greenblatt RM, Hollander H, McMaster JR. 1991. The impact of HIV-related illness on employment. *American Journal of Public Health* 81: 79-84.

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