Career interruptions and subsequent earnings

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a case study for the Netherlands

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Abstract

In this paper we study the earnings effects of career interruptions caused by unemployment or a period out of the labour force. The model is estimated separately for males and females on a Dutch 1985 labour market survey. The results show that for males there is a short term but no long term wage effect of unemployment, while there is no effect of a period out of the labour force. For females there is no wage effect of unemployment and both a short term and a long term negative wage effect of a period outside the labour force.

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1. Introduction

A worker looses his or her job either voluntarily or non-voluntarily. A voluntary job loss occurs if a worker retires or stops working in the organized labour market in exchange for household production, for example to take care of young children. In the first case the person involved does not return to the labour market, in the second case there is most likely a career interruption since the person involved returns to labour market after the children have grown older. A non-voluntary job loss occurs in case of a dismissal. If it takes some time to find a new job, the worker also experiences a career interruption.

In terms of human capital formation a career interruption may have three distinguished effects. First, the formation of human capital on the job connected to accumulation of work experience stops. Second, the stock of human capital may depreciate due to attrition. Finally, after re-entering a job the depreciated human capital may be restored rapidly. The latter phenomenon is called the rebound effect.

The effects of a career interruption on human capital formation has been studied frequently, by investigating the development of wages with and without a career interruption. In these studies cross-sectional retrospective or panel data are used. The results of the studies differ substantially, in the estimates of both the depreciation rate during the career interruption and the rebound effect. Some studies find a small depreciation rate, other studies find a sharp depreciation effect in combination with a subsequent large rebound effect, causing the net depreciation effect to be small. In the sequel we will discuss some of the empirical studies which are mostly on womens' wages and on voluntary withdrawals.

In this study we distinguish two kinds of career interruptions: unemployment and out of the labour force. We estimate the model separately for males and females.

The paper is set up as follows. Section 2 presents our theoretical framework and discusses the results of empirical studies on the wage effects of a career interruption. Section 3 contains a description of our empirical model. Section 4 describes our data, which are from a Dutch 1985 labour market survey. In section 5 we present the estimation results. Section 6 concludes.

2. The wage effects of a career interruption

2.1 Empirical studies

The effects of a career interruption on the life cycle income of an individual worker is shown in figure 1 (derived from Mincer and Ofek (1982)). For the sake of simplicity, income is drawn as a linear function of age.

- figure 1 about here -

Line ABL of figure 1 represents the age-income profile of a worker who has a payed job from leaving school until retirement. The profile ABCDEFG shows the income of an individual person who has a career interruption at age V. In this case we distinguish four periods: before interruption (AB), interruption (CD), restoration (EF) and post-restoration (FG)[1].

After the career interruption the worker finds a job with a wage that is lower than the pre-interruption wage. This effect is due to the depreciation of the stock of his human capital. The theory of human capital provides a number of arguments for this depreciation, some of which are summarized under the heading atrophy.

According to figure 1, human capital is restored rapidly in the period immediately following re-entry, which is the so called rebound effect. In this restoration period wages rise quickly.

In the post-restoration period the growth rates of income of workers with and without a interrupted working career are assumed to be equal. Both types of workers spend part of their time investing in human capital so that their investment ratio (the ratio of investment expenditures to gross income) will be equal.

Empirical studies on the wage effects of career interruptions differ in numerous aspects. An important difference is that of the data used in the analysis. The data are from different countries and different time periods. Furthermore, some studies use cross-section data with a retrospective element, others use panel data. We give a brief survey which highlights some of these differences, starting with studies based on US data and ending with studies based on European data. The studies we discuss are summarized in table 1.

- table 1 about here -

The seminal empirical study on career interruption and wage formation is by Mincer and Polachek (1974). They estimate earnings functions for married women, containing segments consisting of periods of either work experience or home-time. Women's wages depend on their work history, years of schooling and other variables like mobility, health, number of children. Three sorts of costs are distinguished: direct opportunity costs of forgone

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[1] The broken line ABCDEFG in figure 1 is the profile of an unexpected interrupted working career. Several studies suggest that an individual who anticipates a career interruption accumulates less human capital in the period before interruption (AB) than a worker who expects a continuous working career (Mincer and Polachek, 1974; Mincer and Ofek, 1982; Cox, 1984).

earnings, loss of experience on which future wage growth is conditioned, and a depreciation of previously accumulated human capital. The atrophy effect due to non use of the human capital stock ('getting rusty' as the authors called it) is thought to be by far more important than the usual depreciation of human capital due to use or to aging. The data used in the estimation are from a 1967 cross sectional survey, i.e. the information on work histories is on a retrospective basis. One of the problems in estimating an earnings function is the possible endogeneity of some of the explanatory variables, like for example the experience variable. Apart from OLS the authors also use 2SLS, with the work experience variables depending on exogenous variables. Mincer and Polachek find an average annual depreciation rate during home-time intervals of 1.5%.

Sandell and Shapiro (1978) replicate the Mincer-Polachek study using the same database. Their criticism on the Mincer-Polachek study is threefold. First, some of the regression results are biased because of the use of incorrect data. Second, in interpreting the estimation results one should distinguish between the effect of general training and the effect of firm specific training. The length of general training is equal to the number of years of labour market experience, while tenure with the current employer is a measure of the length of firm specific training. Third, simultaneity is not only important with respect to work experience, but also with respect to home time. In their estimates Sandell and Shapiro find a negligible depreciation effect in non-working periods.

In reaction to the Sandell and Shapiro (1978) article, Mincer and Polachek (1978) scrutinize their original depreciation hypothesis by estimating wage growth equations, using panel data of the period 1967-71. They conclude that there is a annual depreciation due to career interruption of about 2.5% which confirms their original findings.

Corcoran and Duncan (1979) distinguish five periods of work history: years out of the labour force since leaving school, years of work experience prior to working for one's present employer, tenure with the present employer prior to the present position, tenure during training completed in present position and post training tenure in present position. They used cross-sectional data to estimate wage equations for four categories of workers distinguished by sex and race. The variable 'years out of the labour force' only has a significantly negative effect for white women, an effect which is rather small: one half of 1 percent for each year out of the labour force. Corcoran and Duncan conclude that labour force withdrawal has a small and usually insignificant effect on human capital formation.

Next to cross-sectional retrospective data, Mincer and Ofek (1982) use panel data on womens' wages in their estimates. They introduce a new element in the analysis: a restoration period in wage growth, just after the return to work. In their estimates based on cross-sectional data they find a long run depreciation effect due to non participation that is much smaller than the short run effect of 3-8 percent per year. In their estimates based on panel data they find similar effects. The difference between short run (the first year following an interruption) and long run effects is attributed to the rapid wage increase in the restoration period.

Corcoran, Duncan and Ponza (1983) use a wage change specification to estimate the effects of a career interruption for women. They find a short run depreciation of about 3 percent per year. The erosion of human capital is restored rapidly, soon after labour market re-entry. Corcoran et. al. conclude that the net depreciation effect is rather small: there is a sharp negative depreciation effect, but subsequently there is an equally dramatic positive rebound effect.

Cox (1984) compares cross section and longitudinal estimates for the depreciation of human capital of women outside the labour force. He concludes that the depreciation rate using cross sectional data is about 5 percent per year, which is substantially higher than the rate using panel data of about 3 percent per year.

Gronau (1988) estimates a simultaneous model of wages and planned withdrawal. It appears that wages have an effect on planned withdrawal, but planned withdrawal has no effect on wage formation. The wage gap between man and women originates from differences in on-the-job training and job requirements. Labour market withdrawal induces depreciation of human capital.

Ruhm (1991) uses panel data of the period 1971-75 to estimate the effects of career interruptions in both unemployment and earnings equations. The effect on unemployment appears to be small and transitory, the effect on earnings is substantial. Even 4 years after reentering on a job a career interruption has a negative effect of 10-13%. Ruhm concludes that career interruptions lead to scars in earnings, suggesting significant worker attachments to specific jobs.

A few European studies are also summarized in table 1. Dutch studies of the wage effect of career interruptions are by Groot, Schippers and Siegers (1988, 1990). In both studies cross-sectional retrospective data are used. In the analysis there is no distinction between short run and long run effects, while there is no estimate of the rebound effect. In the first study Groot et.al. find a depreciation rate due to nonparticipation in the labour market for women of about one half of 1 percent per year. In the second study an annual depreciation rate for men of about 1 percent is found.

Ackum (1991) uses Swedish panel data of the period 1981-85 to investigate the effect of unemployment on subsequent earnings. She concludes that each additional year of unemployment reduces subsequent earnings by about 2%.

Ermisch and Wright (1991, 1993) use 1980 UK data to investigate the effects of a withdrawal from the labour force. They also distinguish between parttime and fulltime workers and conclude that fulltimers are penalized twice as much as parttimers for a year out of employment.

Edin and Nynabb (1992) basically replicate the study by Gronau (1988), using Swedish panel data of the period 1984-86. They find a positive effect of time spend outside the labour force, but the effect of past separations is smaller than the effect of past experience.

2.2 Modelling wage effects

The starting point of our analysis is the Mincerian earnings function (Mincer (1974)), which specifies at for individual i the logarithm of earnings as a function of education and working experience:

$$\ln W_i = \beta_0 + \beta_1 S_i + \beta_2 X_i + \beta_3 X_i^2 + u_i \qquad [2.1]$$

in which: W_i = individual i's earnings
S_i = i's amount of education
X_i = i's amount of working experience
u_i = disturbance term with expectation zero

Since this earnings function has been motivated in many studies our discussion on the basics of the function is brief (See Oosterbeek (1992) for a recent discussion). The β_j (j=0,1,2,3) parameters describe the process of capital accumulation. The parameter β_1 represents the rate of return on formal education. Empirical studies usually find rates of return of about 5 to 10 percent (see Psacharopoulos (1985) for a survey). The β_2 and β_3 parameters represents the effect of investments in skill augmenting activities, i.e. in working experience. It is assumed that investment decreases linearly over the working period, until it equals zero at the date of retirement. This leads to a wage equation with a (positive) linear and a (negative) quadratic working experience term.

If individuals start working immediately after they have finished their formal education and if they stay on that job for their remaining working life, equation [2.1] can be estimated directly, using information about wages, education and working experience. In reality, workers change jobs, loose their jobs because they are fired or they withdraw from the labour market to become back after a few years. All of these types of change may affect the formation of human capital and thus the development of the wage.

We distinguish between different time periods, all measured in months:
- working experience prior to working at the current job or prior to the last interruption period (E)
- interruption period of unemployment (U) or out of the labour force (O)
- rebound period after the last interruption period, either after

unemployment (R_u) or after a period outside the labour force (R_o); we assume the rebound period to have a maximum length of 24 months
- tenure in the current job (T)

Human capital formation may differ in each of these periods. We use the wage effect of working experience prior to working at the current job or prior to the last interruption period as the reference effect. Therefore, we specify the amount of working experience as follows:

$$X_i = E_i + \beta_3 U_i + \beta_4 O_i + \beta_5 R_{u,i} + \beta_6 R_{o,i} + \beta_7 (T_i - R_{u,i} - R_{o,i}) \qquad [2.2]$$

Consider first the effects of an interruption period of unemployment. If the human capital formation during unemployment is less than on the job, then $\beta_3 < \beta_7$. If there is destruction of human capital during the unemployment period, then $\beta_3 < 0$. If there is a rebound effect after the spell of unemployment, then $\beta_5 > \beta_7$.

The effects of a period outside the labour force are similar. If the human capital formation is less than on the job, then $\beta_4 < \beta_7$. If there is destruction of human capital during the period outside the labour market, then $\beta_4 < 0$. If there is a rebound effect after period outside the labour market, then $\beta_6 > \beta_7$. Finally, if there is more human capital formation in the current job then there was in the previous ones, then $\beta_7 > 1$.

It is obvious, that the long term wage effect of an interruption period depends on the balance of the immediate negative effect during the interruption period and the positive effect during the rebound period. We will first consider the wage of worker j with a period outside the labour force and a subsequent job with a tenure that exceeds the rebound period (>24 months). We compare the development of this wage with that of individual k, with the same personal characteristics and previous employment history ($E_j = E_k$), who gets a job at the same time as individual j starts the period outside the labour force. So:

$$O_j + T_j = T_k \qquad [2.3]$$

If there are no long term effects of the period outside the labour force, then the amount of working experience contributing to human capital formation is the same for both workers:

$$E_k + \beta_7 T_k = E_j + \beta_4 O_j + \beta_6 .24 + \beta_7 (T_j - 24) \qquad [2.4]$$

Substituting T_k from [2.3.] into [2.4.] and rearranging we find:

$$\beta_6 = (\beta_7 - \beta_4).(O_j/24) + \beta_7 \qquad [2.5a]$$

If there is a long term negative effect of the interruption period on the development of the wage, then:

$$\beta_6 < (\beta_7 - \beta_4).(O_j/24) + \beta_7 \qquad [2.5b]$$

Using the general subscript i, we define:

$$\beta_6^* = \beta_6 - (\beta_7 - \beta_4).(O_i/24) - \beta_7 \qquad [2.6a]$$

$$\beta_4^* = \beta_4 - \beta_7 \qquad [2.6b]$$

Then, we can distinguish between three situations with respect to the wage effects of an interruption period <u>outside the labour force</u>:

$\{\beta_6^*=0, \beta_4^*=0\}$: no wage effects
$\{\beta_6^*=0, \beta_4^*<0\}$: temporary, no long term wage effects
$\{\beta_6^*<0, \beta_4^*<0\}$: long term wage effects

Similarly, to incorporate the effects of an interruption period of unemployment, we define:

$$\beta_5^* = \beta_5 - (\beta_7 - \beta_3).(O_i/24) - \beta_7 \qquad [2.7a]$$

$$\beta_3^* = \beta_3 - \beta_7 \qquad [2.7b]$$

Then, we can distinguish between three situations with respect to the wage effects of an interruption period of <u>unemployment</u>:

$\{\beta_5^*=0, \beta_3^*=0\}$: no wage effects
$\{\beta_5^*=0, \beta_3^*<0\}$: temporary, no long term wage effects
$\{\beta_5^*<0, \beta_3^*<0\}$: long term wage effects

Substituting [2.6] and [2.7] into [2.2] and rearranging we find:

$$X_i = E_i + \beta_7.(O_i+U_i+T_i) + \beta_3^*.U_i.(1-(R_{u,i}/24))$$

$$+ \beta_4^*.U_i.(1-(R_{o,i}/24)) + \beta_5^*.R_{u,i} + \beta_6^*.R_{o,i} \qquad [2.8]$$

Using this specification of X_i and estimating wage equation [2.1] we can determine the short term and long term effects of both interruption periods.

3. Econometric framework

For the empirical analysis we distinguish six labor force states:

0. Currently unemployed or out of the labor force;
1. Employed and never had an interruption period;
2. Current tenure after last spell of unemployment is less than two years;
3. Current tenure after last spell of out of the labor force is less than two years;
4. Current tenure after unemployment is more than two years;
5. Current tenure after out of the labor force is more than two years;

Each individual in the sample is observed in only one of these six labor force states. Allocation over the six labor force states is not likely to be random. With non-random selection over labor force states, estimation of the wage equation with variables for the rebound period from unemployment and out of the labor force and variables for the length of previous spells of unemployment and out of the labor force, will suffer from selectivity bias.

The techniques for correcting for selectivity bias are usually applied to cases in which there are only two options (binary choice models). In the two step method proposed by Heckman (1979) probit estimates on the binary choice variable are used to derive sample selection bias correction terms. These correction terms (the inverse Mills ratios) are added to the continuous dependent variable equation.

To fix ideas we first consider the case in which there are only two labor force positions (binary choice case). Let I be a binary indicator variable for the labor force state of the individual i, where:

$$I = 1 \text{ if } \quad Y_i\alpha > 0 \quad \text{and} \quad I = 0 \text{ if } \quad Y_i\alpha < 0. \qquad [3.1]$$

where Y_i is a vector of variables for individual i determining the labor force position of the individual with associated coefficients α.

Let $\phi(.)$ and $\Phi(.)$ denote the standard normal density and distribution functions, respectively. The inverse Mills ratios are defined as: $\lambda_{1i} = \phi(Y_i\alpha)/(1 - \Phi(Y_i\alpha))$ and $\lambda_{0i} = -\phi(Y_i\alpha)/\Phi(Y_i\alpha)$. These correction terms are added to the wage equation.

Commonly in case of sample selection, two wage equations are estimated, one on the cases for which I = 1, and one for the cases for which I = 0. Here we estimate a single wage equation for the entire sample, and still correct for sample selection. In this case the sample selection corrected parameters are obtained from estimating:

$$\log \text{wage} = \beta_0 + \beta_1 S_i + \beta_2 X_i + \beta_8 X^2_i + (\sigma_{12}/\sqrt{\sigma_2})\Lambda_i \qquad [3.2]$$

where: $\Lambda_i = I\lambda_{1i} + (1 - I)\lambda_{0i}$, σ_{12} is the covariance between the selection equation and the wage equation and σ_2 is the variance of the selection equation. This approach is similar to the two step method proposed in Heckman (1978) for endogenous *dummy* variables in simultaneous equation systems.

In this paper we use an extension of the two step method for the binary selection variable to the case in which there are more than two options. We proceed under the assumption that the different labor force states are uncorrelated. Let $I_{ij} = 1$ if individual i is observed in labor force state j; otherwise $I_j = 0$ (j = 1, ..., 5). It is assumed that individual i is observed in labor force state j ($I_{ij} = 1$) if:

$$Y_i\alpha_j + \epsilon_{ij} > \max(\textstyle\sum_k Y_i\alpha_k + \epsilon_{ik}, 0) \quad i \neq k,\ i,k = 1,\ldots,5 \qquad [3.3]$$

where ϵ is a random term capturing unmeasured and unmeasurable effects on the labor force position. The reference group consists of workers currently unemployed or out of the labor force. If we assume that ϵ has a logistic distribution this generates the multinomial logit model, where:

$$\text{Prob}(I_{ij} = 1) = \exp(Y_i\alpha_j)/\exp(1 + \textstyle\sum_k Y_i\alpha_k) \qquad [3.4]$$

The distribution of the multinomial logit model is denoted by $F(Y_i\alpha_j)$, i.e. $F(Y_i\alpha_j) = \text{Prob}(I_{ij} = 1)$. Lee (1983) presents a method for correcting for selectivity bias in models with more than two choices. In this method the multinomial distributions are transformed to standard normal random variables. Let $J(Y_i\alpha_j) = \Phi^{-1}(F(Y_i\alpha_j))$.[2] The selectivity bias correction term for option j (Λ_{ij}) becomes:

$$\Lambda_{ij} = I_{ij}\lambda_{ij} - (1 - I_{ij})\lambda_{ij}[(1 - F(Y_i\alpha_j))/F(Y_i\alpha_j)] \qquad [3.5]$$

where $\lambda_{ij} = \phi(J(Y_i\alpha_j))/F(Y_i\alpha_j)$. The correction terms Λ_{ij} are added to the wage equation. We estimate the following wage equation:

$$\log \text{wage}_i = \beta_0 + \beta_1 S_i + \beta_2 X_i + \beta_8 X^2_i + \omega_1\Lambda_{i1} + \omega_2\Lambda_{i2} + \omega_3\Lambda_{i3} + \omega_4\Lambda_{i4} + \omega_5\Lambda_{i5} + \mu_i \qquad [3.6]$$

[2] The inverse of the standard normal distribution was calculated by the approximate function given by Bock and Jones (1968).

where

$$X_i = E_i + \beta_7.(O_i+U_i+T_i) + \beta_3^*.U_i.(1-(R_{u,i}/24))$$

$$+ \beta_4^*.U_i.(1-(R_{o,i}/24)) + \beta_5^*.R_{u,i} + \beta_6^*.R_{o,i} \qquad [2.8]$$

and μ_i is a normal distributed random term and ω_{ij} is the covariance between $J(Y_i\alpha_j)$ and μ_i.

Because of non linearities in the X terms, the wage equation is estimated by maximum likelihood.

4. The data

The data are taken from the Dutch 1985 labour market survey of the Organisation for Labour Market Research (OSA). The first wave was held in the Spring of 1985 and consisted of 4020 observations. From this data set we took a sub-sample of individuals who reported to be either wage earner, not employed but actively searching for work, or not employed and not actively searching for work. Unemployed workers are defined as all individuals who are not in paid employment but who report to be actively searching for work. Out of the labor force are all individuals who are not in paid employment and who are not searching for work. Past unemployment spells and spells out of the labor force are defined in a similar way. Individuals who are retired, disabled or in full-time education are omitted from the sample.

After further elimination of observations from which information on essential variables could not be retrieved, 1547 observations for males and 1845 observations for females remained for the analysis. Of the 1547 males, 1317 are wage earners while 230 are either currently unemployed or out of the labor force. Of the 1845 observations of females, 736 currently have a paid job while 1009 are unemployed or out of the labor force.

Table 2 about here

In table 2 some descriptive statistics of the sample are given. The dependent variable in the wage equations is the log of the hourly wage rate. The hourly wage rate is defined as weekly earnings divided by hours of paid employment.

5. Estimation results

The parameter estimates of the multinomial logit equation describing the labour market status of the workers are shown in table 3. The reference category in the logit equations consists of individuals who are currently unemployed or out of the labor force. Two explanatory variables are used to describe the present labor force status of the individual: years of education and age.

- table 3 about here -

All coefficients of years of education (α_{i1}) are positive. This indicates that a higher education increases the probability of being observed in employment and decreases the probability of being unemployed or out of the labor force. The coefficient of years of education is highest for workers who have never experience an interruption period (α_{11}). High educated workers have a higher probability of an uninterrupted career than low educated workers. A year of education increases the probability of never having had an interruption period by 30 to 40 per cent, relative to individuals who are currently unemployed or out of the labor force.

Except for the states relating to out of the labor force (i.e. α_{31} and α_{51}) the education coefficient is higher for females than for males. This indicates that for females there is a sharper division between high and low educated individuals in present labor force state than there is for males.

Except for the rebound period out of the labor force, all age coefficients are significantly negative. This indicates that in general older workers are more likely to be unemployed or out of the labor force than younger workers. A year of education decreases the probability of never having had an interruption period by 6 to 12 per cent.

- table 4 about here -

The estimation results with respect to the parameters of the wage equation [2.1] for both males and females are presented in table 4. The table shows estimation results without and with inclusion of selection terms. The coefficients of the sample selection correction terms for the first two years after unemployment (ω_1) are negative. These negative selection effects can be explained from a search-theoretic perspective: the lower the reservation wage, the higher the probability of finding a job. The coefficients of the sample selection correction terms for the first two years after a period outside the labour force (ω_2) are positive. These positive effects may indicate that even though persons outside the labour force do not search for jobs, they occasionally get job offers, which they sometimes accept. There are no selection-effects if tenure exceeds a period of 2 years (coefficients ω_3 and ω_4).

From the OLS-estimates it appears that the average annual rate of return from education is 4.5 % for male and 5.1 % for female workers. As predicted by the human capital theory, the experience-earnings profile is parabolic for both male and female workers. From the results of the estimate in which the selectivity terms are included it appears that the average annual rate of return from eduction is 4.2% for male workers and 5.6% for female workers. These differences compared to the OLS-estimates indicate that there is a selection effect, which induces high quality female workers to enter the labour market.

For male workers the OLS estimation results of parameters β^*_3 and β^*_4 are significantly smaller than zero, indicating that periods of unemployment and out of the labour force have short term effects on subsequent wages. We find no long term negative wage effects of interruption periods for males. After introduction of the selectivity terms the parameter estimates change somewhat. We still find that β^*_3 is significantly smaller than zero, but β^*_4 does not differ significantly from zero. So, only unemployment has significant short term effects.

For female workers the OLS estimates of β^*_3 and β^*_5 do not differ significantly from zero. So, for female workers we find neither a short term nor a long term wage effect of an unemployment period. We also find $\beta^*_4, \beta^*_6 < 0$. This indicates that there are both negative short term and long term wage effects of an interruption period outside the labour market. Introduction of the selectivity terms does not change these results.

The values of the loglikelihoods of different restricted models are presented in table 5, confirming the conclusions drawn from table 4[3].

- *table 5 about here* -

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[3] We have tested for the exogeneity of the experience variables by performing a Hausman specification test (Hausman 1978). With the exception of the coefficient of the instrumental variable for women's unemployment duration, all parameter estimates appeared to be highly insignificant. This suggests that the model is not misspecificied.

We also estimated some fixed effects models. The dependent variable in the fixed effect model is the difference between the log of the wage rate in 1990 and the log of the wage rate in 1986. We included in our sample individuals who were in paid employment both in 1986 and 1990. As very few individuals experienced a spell out of the labor force in this period, we constructed a variable 'months not employed' between 1986 and 1990, which included both unemployment spells and spells out of the labor force. We further included a dummy for voluntary job mobility in the equations. The results showed few significant variables. Only the intercept terms are significantly different from zero and the dummy for male job mobility. The signs of the parameter estimates indicate that the length of the spell not employed decreases wage growth.

In this paper we study the wage effects of career interruptions. We distinguish two types of interruption period: unemployment and out of the labour force. The estimates of the wage equations are corrected for selectivity bias. The model is estimated on Dutch labour market data for males and females separately.

Our analysis differs from previous analyses for two reasons. First, we distinguish between two types of career interruptions: unemployment and out of the labour force. Second, we explicitly investigate whether or not career interruptions have persistent effects on the earnings of workers who have been unemployed or out of the labour force for a while.

The results show that the wage effect of a period of unemployment differs for males and females. For males we find a short term effect, which we do not find for females. There appears to be no long term negative effect of unemployment on subsequent earnings. With respect to an interruption period outside the labour force, the wage effects also differ between males and females. For males we find no wage effect. For females, there is both a short term and a long term negative wage effect.

References

S. Ackum (1991) Youth Unemployment, Labor Market Programs and Subsequent Earnings, Scandinavian Journal of Economics, 93, pp. 531-543.

R.D. Bock and L. V. Jones (1968) The Measurement and Prediction of Judgment and Choice, Holden Day, San Francisco.

M. Corcoran and G.J. Duncan (1979) Work History, Labour Force Attachment, and Earnings Differences between the Races and Sexes, Journal of Human Resources, 14, pp. 3-20.

M. Corcoran, G.J. Duncan and M. Ponza (1983) A Longitudinal Analysis of White Women's Wages, Journal of Human Resources, 18, pp. 497-520.

D. Cox (1984) Panel Estimates of the Effects of Career Interruptions the Earnings of Women, Economic Inquiry, 22, pp. 386-403.

P.A. Edin and J. Nynabb (1992) Gender Wage Differentials and Interrupted Work Careers: Swedish Evidence, Working Paper, 1992:17, Department of Economics, Uppsala University.

J.F. Ermisch and R.E. Wright (1993) Wage Offers and Full-Time and Part-Time Employment by British Women, Journal of Human Resources, 28, pp. 111-133.

R. Gronau (1988) Sex-related Wage Differentials and Women's Interrupted Labour Careers - the Chicken or the Egg, Journal of Labour Economics, 6, pp. 277-301.

L.F.M. Groot, J.J. Schippers and J.J. Siegers (1988) The Effect of Interruptions and Part-time Work on Women's Wage Rate: A Test fo the Variable-Intensity Model, De Economist, 136, pp. 220-238.

L.F.M. Groot, J.J. Schippers and J.J. Siegers (1990) The Effect of Unemployment, Temporary Withdrawals and Part-time Work on Workers' Wage Rates, European Sociological Review, 3, 6, pp. 1-17.

J.J. Heckman (1978) Dummy Endogenous Variables in a Simultaneous Equation System, Econometrica 46, pp. 931-959.

J.J. Heckman (1979) Sample Selection Bias as a Specification Error, Econometrica 47, pp. 153-161.

L.F. Lee (1983) Generalized Econometric Models with Selectivity, Econometrica 51, pp. 507-512.

J. Mincer (1974) Schooling, Experience, and Earnings, National Bureau of Economic Research.

J. Mincer and S. Polachek (1974) Family Investments in Human Capital: Earnings of Women, Journal of Political Economy, pp. S76-S108.

J. Mincer and S. Polachek (1978) Women's Earnings Reexamined, Journal of Human Resources, 13, pp. 118-134.

J. Mincer and H. Ofek (1982) Interrupted Work Careers: Depreciation and Restoration of Human Capital, Journal of Human Resources, 17, pp. 3-24.

H. Oosterbeek (1992) Essays on Human Capital Theory, Dissertation, University of Amsterdam.

G. Psacharopoulos (1985) Returns to Education: a Further International Update and Implications, Journal of Human Resources, 20, pp. 583-597.

C.J. Ruhm (1991) Are Workers Permanently Scarred by Job Displacements?, American Economic Review, 81, pp. 319-324.

S.H. Sandell and D. Shapiro (1978) The Theory of Human Capital and the Earnings of Women, Journal of Human Resources, 13, pp. 103-117.

R. Trost and L-F Lee (1984) Technical Training and Earnings: a Polychotomous Choice Model with Selectivity, The Review of Economics and Statistics 66, pp. 151-156.

R.E. Wright and J.F. Ermisch (1991) Gender Discrimination in the British Labour Market: A Reassessment, Economic Journal, 101, pp. 508-522.

Figure 1 Age-income profile for a worker with continuous and a worker with an interrupted working career.

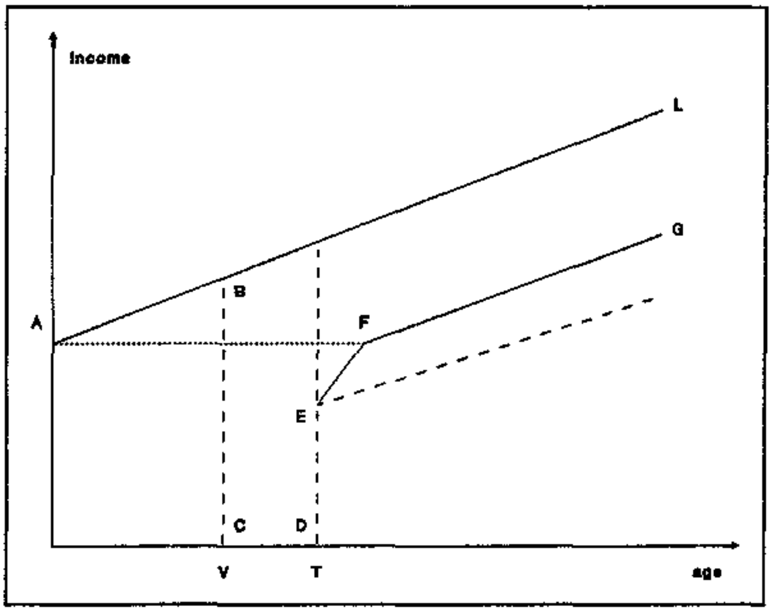

Table 1 Survey of empirical studies on the wage effects of career interruptions

Authors	*Data*	*Simult. bias*	*Selection bias*	*Annual effect (%)*	*Rebo und*
Mincer, Polachek (1974)	USA 1967	yes	no	-1.5	no
Sandell, Shapiro (1978)	USA 1967	yes	no	less than -0.5	no
Mincer, Polachek (1978)	USA 1967-71	yes	no	-2.5	no
Corcoran, Duncan (1979)	USA 1975	no	no	wh fem.: 0.5 others: 0	no
Mincer, Ofek (1982)	USA 1966-74	no	no	short: -9 long: -1	yes
Corcoran, Duncan, Ponza (1983)	USA 1969-78	no	yes	short: -4 long: +[a]	yes
Cox (1984)	USA 1951-73	no	no	-4	no
Gronau (1988)	USA 1976	yes	no	-0.6	no
Ruhm (1991)	USA 1971-75	no	yes	-[a]	no
Groot, Schippers, Siegers (1988/90)	Netherl. 1982	no	no	male: -1 fem: -0.5	no
Ackum (1991)	Sweden 1981-85	no	yes	-2	no
Ermisch, Wright (1991/93)	UK 1980	no	yes	full: -1 part: -0.5	no
Edin, Nynabb (1992)	Sweden 1984-86	yes	no	+1	no

[a] Sign of the effect, size not indicated

Table 2
Sample means (standard errors in parentheses)

	males	**females**
education (years)	10.8 (2.8)	10.4 (2.7)
age (years)	37.0 (10.3)	32.8 (10.2)
work experience (months)	110.0 (106.8)	73.7 (75.0)
past unemployment spells (months)	4.9 (14.9)	4.4 (16.5)
past spells out of the labor force (months)	16.8 (32.1)	52.2 (78.7)
rebound after last spell of unemployment (months)	0.4 (2.3)	0.4 (2.1)
rebound after last spell out of labor force (months)	0.008 (0.18)	0.72 (3.1)
tenure (months)	107.3 (102.7)	57.3 (60.0)
#observations	1317	736

Table 3
Parameter estimates logit equation labor force status females (t-values in parentheses)

	NOINT	ULTY	OLTY	UMTY	OMTY
intercept	-1.368 (1.731)	0.146 (0.223)	-0.028 (0.068)	-1.795 (1.461)	-0.854 (1.811)
years of education	0.370** (5.833)	0.181** (3.240)	0.031 (0.842)	0.309** (3.099)	0.193** (4.770)
age	-0.120** (7.158)	-0.080** (6.528)	0.011 (1.709)	-0.107** (4.063)	-0.029** (3.871)
region 1	0.293 (0.691)	0.035 (0.109)	0.081 (0.387)	-0.967 (1.183)	0.358 (1.465)
region 2	1.105** (3.067)	-0.166 (0.528)	0.311 (1.647)	0.476 (0.920)	0.815** (3.770)
region 3	0.186 (0.485)	-0.129 (0.457)	0.117 (0.661)	-0.219 (0.399)	0.044 (0.202)
technical education	-0.601 (0.731)	-0.369 (0.534)	0.198 (0.546)	-0.077 (0.068)	-0.077 (0.183)
economic/administrative education	0.137 (0.303)	-0.274 (0.590)	0.450 (1.551)	0.438 (0.669)	0.297 (0.953)
medical education	1.056 (1.878)	0.351 (0.573)	0.518 (1.185)	0.466 (0.495)	0.633 (1.404)
other vocational education	-0.589 (1.643)	0.046 (0.157)	0.137 (0.702)	-0.509 (0.900)	-0.181 (0.825)
#observations	1743				
Loglikelihood	-2271.88				

INT = worker is currently unemployed or out of labor force (reference category)
NOINT = worker has had no interruption period
ULTY = current tenure after last spell of unemployment is less than two year
OLTY = current tenure after last spell of out of the labor force is less than two years
UMTY = current tenure after unemployment is more than two years
OMTY = current tenure after out of the labor force is more than two years

Table 3 continued
Parameter estimates logit equation labor force status males (t-values in parentheses)

	NOINT	ULTY	OLTY	UMTY	OMTY
intercept	-0.169 (0.192)	1.256 (1.387)	-8.632** (7.362)	1.827 (1.826)	1.314 (1.647)
years of education	0.334** (4.006)	0.239** (2.762)	0.225* (2.439)	0.135 (1.403)	0.231** (2.952)
age	-0.059** (4.365)	-0.068** (4.796)	0.145** (8.365)	-0.080** (4.883)	-0.033** (2.840)
region 1	-0.116 (0.269)	0.395 (0.916)	0.424 (0.897)	0.114 (0.234)	-0.007 (0.018)
region 2	1.136** (2.709)	0.528 (1.181)	0.927* (1.998)	0.697 (1.444)	0.967** (2.516)
region 3	0.232 (0.603)	0.338 (0.850)	0.493 (1.166)	0.171 (0.382)	0.328 (0.968)
technical education	0.104 (0.022)	-0.384 (0.804)	-0.418 (0.813)	0.325 (0.622)	0.192 (0.447)
economic/administrative education	-0.088 (0.131)	-0.439 (0.636)	-0.755 (1.033)	-0.740 (0.871)	0.282 (0.455)
agricultural education	0.210 (0.235)	-0.103 (0.112)	-1.096 (1.120)	-0.192 (0.174)	0.103 (0.126)
other vocational education	-0.583 (0.915)	-1.262 (1.902)	-1.598* (2.145)	-0.585 (0.796)	-0.763 (1.290)
#observations	1471				
Loglikelihood	-1755.77				

INT = worker is currently unemployed or out of labor force (reference category)
NOINT = worker has had no interruption period
ULTY = current tenure after last spell of unemployment is less than two year
OLTY = current tenure after last spell of out of the labor force is less than two years
UMTY = current tenure after unemployment is more than two years
OMTY = current tenure after out of the labor force is more than two years

Table 4 Parameter estimates wage equations (t-values in parentheses)
estimated equation:
$\log wage_i = \beta_0 + \beta_1 S_i + \beta_2 X_i + \beta_8 X^2_i + \gamma Z + \omega_1 \Lambda_{i1} + \omega_2 \Lambda_{i2} + \omega_3 \Lambda_{i3} + \omega_4 \Lambda_{i4} + \omega_5 \Lambda_{i5} + \mu_i$
where $X_i = E_i + \beta_7.(O_i+U_i+T_i) + \beta_3^*.U_i.(1-(R_{u,i}/24)) \quad + \beta_4^*.U_i.(1-(R_{o,i}/24)) + \beta_5^*.R_{u,i} + \beta_6^*.R_{o,i}$
and: Z = {marital status, industry dummies, region dummies}

	males		females	
	not corrected for selectivity bias	corrected for selectivity bias	not corrected for selectivity bias	corrected for selectivity bias
β_0	1.691 (32.8)	1.809 (28.1)	1.603 (15.8)	1.631 (16.1)
β_1	0.045 (15.5)	0.042 (11.1)	0.051 (10.6)	0.056 (10.4)
$\beta_2/100$	0.173 (7.3)	0.144 (5.4)	0.193 (5.0)	0.163 (4.1)
β^*_3	-1.326 (2.0)	-1.905 (2.6)	0.191 (0.2)	0.564 (0.4)
β^*_4	-0.780 (2.3)	0.220 (0.7)	-0.843 (2.6)	-0.907 (2.4)
β^*_5	-2.340 (0.7)	16.724 (3.1)	1.048 (0.2)	2.594 (0.4)
β^*_6	-42.041 (0.8)	-37.845 (1.3)	-11.288 (5.4)	-14.192 (4.2)
β_7	1.052 (5.6)	1.062 (7.4)	0.958 (3.7)	0.848 (3.1)
$\beta_8/100000$	-0.216 (4.6)	-0.227 (3.9)	-0.267 (2.7)	-0.276 (2.7)
mar. status	0.122 (5.4)	0.092 (4.1)	0.028 (0.8)	0.033 (0.9)
industry 1	-0.004 (0.1)	-0.029 (0.5)	0.028 (0.8)	-0.048 (0.3)
industry 2	-0.039 (1.1)	-0.050 (1.4)	-0.194 (2.7)	-0.205 (2.9)
industry 3	-0.020 (0.3)	-0.034 (0.6)	0.023 (0.2)	0.016 (0.1)
industry 4	0.091 (1.7)	0.043 (0.9)	-0.039 (0.4)	-0.046 (0.5)
industry 5	0.083 (2.3)	0.055 (1.5)	0.008 (0.1)	-0.000 (0.0)
unknown	0.008 (0.3)	0.009 (0.3)	-0.019 (0.3)	-0.024 (0.4)
region 1	0.008 (0.3)	-0.013 (0.5)	-0.033 (0.8)	-0.033 (0.8)
region 2	0.046 (2.2)	0.043 (1.9)	0.054 (1.6)	0.035 (0.9)
region 3	0.035 (1.6)	0.017 (0.8)	0.038 (1.1)	-0.049 (1.4)
ω_1		-0.002 (2.4)		0.000023 (0.7)
ω_2		0.000284 (0.0)		-0.000697 (1.8)
ω_3		0.0000085 (9.4)		0.0141 (1.9)
ω_4		-0.00067 (5.9)		-0.0000009 (0.3)
ω_5		-0.0217 (1.8)		0.00306 (0.5)
σ	0.264 (66.5)	0.255 (67.4)	0.297 (52.5)	0.295 (52.8)
LogL	1026.32	1042.93	450.222	455.188
# obs.	1234	1234	632	632

Table 5
Values of loglikelihood of restricted models and likelihood ratio test

restrictions	**value loglikelihood males not corrected for selectivity bias**	**value of loglikelihood males corrected for selectivity bias**	**value of loglikelihood females not corrected for selectivity bias**	**value of loglikelihood females corrected for selectivity bias**
no restrictions	1026.32	1042.93	450.222	455.188
$\beta^*_5 = 0$	1026.14	1042.69	450.188	455.057
$\beta^*_6 = 0$	1025.04	1042.58	445.722	451.299
$\beta^*_3 = \beta^*_5 = 0$	1022.90	1039.68	450.162	454.941
$\beta^*_4 = \beta^*_6 = 0$	1024.66	1042.58	443.403	451.751
$\beta^*_3 = -\beta_7$	1026.16	1042.76	449.242	454.351
$\beta^*_4 = -\beta_7$	1026.02	1039.82	450.086	455.134