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**INTERRUPTED WORK CAREERS AND THE STARTING SALARIES
OF FEMALE WORKERS IN BRITAIN**

David Campbell

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Abstract

Evidence from previous studies suggests that part of the observed wage differential between males and females is due to the spells of non-participation experienced by women. During these career breaks, no new investment in human capital occurs and the existing stock of skills depreciates, placing women at a disadvantage when they re-enter the labour market. By considering a simple life cycle human capital model, it is possible to show that women anticipating interrupted careers will invest in less full-time education and enter the labour market with a lower starting salary than males. This effect is greatest for women anticipating long breaks, or breaks occurring at an early age. Using data from the National Child Development Study, it is found that women planning spells of non-participation enter the labour market earlier than males and with approximately 10% lower starting salaries.

JEL Classification: C23, J31

Keywords: schooling, starting salary

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NON-TECHNICAL SUMMARY

A popular area of research within economics relates to studying the observed wage differential that exists between males and females in the labour market. These studies show that, on average, women earn less than males for a number of reasons. Part of the wage differential is found to be due to discrimination, where equally productive women are rewarded differently to males. A significant proportion of the wage gap, however, may be explained in terms of the career breaks that women take for child raising purposes.

Taking time out of the labour force lowers the earnings of females relative to males in several ways. Firstly, during the years of non-participation, women may not acquire any new productivity enhancing skills which would normally be expected to increase their earnings. In addition, the stock of skills held by women may depreciate during the time spent out of the labour force, lowering their earnings capacity at the point of re-entry. Finally, if women anticipate taking time out of the labour force, their incentive to invest in new skills will be lower in the years leading up to the break since there will be fewer periods over which the benefits of the investment can be collected. A consequence of this is that women may choose to invest in less schooling than males, creating a further reason for why women are observed with lower earnings than men.

Using data from the National Child Development Study (NCDS), this study finds some evidence to support the hypothesis that women who go on to experience career interruptions leave full time education and enter the labour market earlier than both men and women who experience no such interruptions. If those observed with intermittent participation enter the labour market with less schooling, it would be expected that they would receive lower salaries in their first jobs. The evidence presented in this study finds that the anticipation of a career break lowers starting salaries by 10% as a consequence of women entering the labour market with a smaller stock of productivity related skills.

INTERRUPTED WORK CAREERS AND THE STARTING SALARIES OF FEMALE WORKERS IN BRITAIN

1. Introduction

In the UK, a number of studies have been undertaken in order to identify the factors responsible for creating the observed wage gap between males and females. Although the emphasis of these studies is on estimating the extent to which discrimination exists in the labour market, it is found that a large proportion of the wage gap is explained in terms of differences in personal characteristics and the effect of time spent out of the labour force (Miller, 1987). Each year that women spend out of the labour force lowers subsequent earnings relative to males in three main ways. Firstly, it is widely assumed that no additional investment in human capital is made during the years of non-participation. Secondly, the existing stock of skills depreciates during the career break, placing women at a disadvantage when they re-enter the labour market. A third effect of the career break is that if the period of non-participation is anticipated, women may choose to invest in less human capital than males in each of the years leading up to the break. This third effect creates a wage differential before women experience career interruptions since they are observed with a lower stock of human capital. There are a number of studies that generally estimate the aggregate of these effects by relating a worker's current earnings to past spells of participation and non-participation (Mincer and Polachek, 1974; Corcoran and Duncan, 1979; Swaffield, 2000). Most of these studies find that past periods of non-participation negatively affect current earnings, with Mincer and Ofek (1982) calculating the total cost of a year of non-participation to be approximately 1.5%. This is interpreted as a total cost since it estimates the wage penalty that arises from reduced investment in human capital during the year spent out of the labour force and in the years leading up to the break, plus the depreciation of the existing capital stock.

An alternative approach for analysing the effect of interrupted careers is to relate earnings at a particular point in time to spells of non-participation occurring in the future (Gronau, 1988; Blau and Ferber, 1991). The advantage of this methodology is that it enables the effect that future non-participation has on the incentive to invest in human capital to be isolated. This is because at the time at which earnings are observed, the spell of non-participation has yet to occur. Any negative impact that a year of future non-participation is found to exert on current earnings is then free of any depreciation effect associated with time out of the labour force. Since the year of non-participation has not yet been realised, the negative coefficient also does not capture the year's worth of human capital accumulation that is sacrificed by being out of the labour force. Instead, a negative relationship between current earnings and future non-participation reflects the extent to which the anticipation of career breaks weakens the incentive to invest in human capital in the years prior to the break occurring. Women who anticipate taking time out of the labour force will accumulate less human capital earlier in their lives, generating a gender wage gap in the years before their career plans are realised.

This study analyses the effect that future spells of non-participation have on the starting salaries of women relative to men of similar ability. By developing a model that considers human capital investments undertaken over the complete life cycle, it is possible to show that women planning interrupted careers will devote a lower proportion of their time to human capital accumulation in each period prior to the break commencing. An important implication of this is that women will spend fewer of their early years engaged in full time education and, therefore, enter the labour market at an earlier date than those planning continuous participation. With intermittent participants transporting a lower stock of human capital into the labour market, their earnings at the point of entry are predicted to be lower. Using data from the National Child Development Study (NCDS), an attempt is made to find evidence for

the idea that future periods of non-participation induce women to enter the labour market at an earlier date and with a correspondingly lower starting salary. One of the advantages of estimating an earnings equation of this form is that it enables the gender wage gap to be detected at the earliest observable time. Existing UK studies tend to examine the wage gap at a point later in the life cycle and then consider the proportions of the differential that are due to differences in stocks of human capital, the depreciation effect of non-participation, and discrimination. Since the methodology adopted within this study examines initial earnings, which are observed before any career interruptions take place, the observed gender wage gap in starting salaries is attributed purely to differences in the quantity of human capital taken into the labour market. The analysis may therefore be seen as focusing on the effect that future career breaks have on the early investment decisions of women relative to those planning continuous participation in the labour market.

The remaining sections of this paper are structured in the following way. Section 2 outlines the human capital model that is used to obtain the predictions concerning the effects that career interruptions have on the investment decisions and starting salaries of individuals. Section 3 then describes the statistical model and how data from the National Child Development Study (NCDS) is used to estimate the various equations of the model. The fourth section begins by presenting some descriptive statistics as a way of offering some preliminary evidence for the theoretical predictions before discussing the results obtained from estimating the statistical model. The results indicate that women experiencing any kind of interruption by the age of 33 enter the labour market at a significantly earlier date and with 10% lower starting salaries than comparable men. Further estimations for the sample of women find that each additional year spent out of the labour force lowers initial pay by 1%. The magnitude of this effect remains at 1% when the starting salary equation is re-estimated

by two stage least squares (2SLS) treating non-participation as endogenous, but the statistical significance is reduced. The final section summarises the main findings of the statistical analysis and discusses some of its possible limitations.

2. The Life Cycle Human Capital Approach and Interrupted Work Careers

In this section, a theoretical framework is outlined that may be used to compare the human capital investment decisions of those individuals who plan continuous participation throughout their working lives and those anticipating a spell of non-participation. In the model presented below, individuals are assumed to be able to perfectly plan their lifetime labour market participation and that there is no discrepancy in any time period between planned participation and realised participation. It is shown that the incentive to invest in additional human capital is weaker for those planning a career interruption, with this effect being greatest for those planning longer breaks or breaks occurring earlier in the life cycle. With a lower investment ratio in each period, intermittent participants are then predicted to enter the labour market earlier and with a lower starting salary than continuous participants.

2.1 The Continuous Participation Case

The benefit to an individual planning continuous participation from investing in an additional unit of human capital at time t is to raise their potential earnings in each subsequent period until the date of retirement, T . If such investments depreciate at a rate equal to δ then the increase in potential earnings in period τ (where $\tau > t$) arising from the investment undertaken at t may be written as:

$$wI(t)e^{-(r+\delta)(\tau-t)}$$

where w is the wage per unit of human capital and r is the discount rate. The full benefit to the individual from the investment at t in terms of the increase in potential earnings over the remaining periods of the life cycle may then be found by integrating the above expression between $\tau = t$ and $\tau = T$:

$$B(t) = \frac{wI(t)}{r + \delta} \left[1 - e^{-(r+\delta)(T-t)} \right]. \quad (1)$$

The link between the proportion of time allocated to investment, $x(t)$, and the resulting amount of human capital produced is given by the following production function:¹

$$I(t) = Ax(t)^b K(t), \quad (2)$$

where A and b are productivity parameters relating to the individual's ability or the institution in which the investment is undertaken.

Using the benefit function, the production function and a cost function that considers the cost of human capital investments only in terms of foregone earnings (see Appendix), it may be shown that the optimal proportion of time allocated to investment in any period for those planning continuous participation, $x_{CP}^*(t)$, is given by:

$$x_{CP}^*(t) = \left\{ \frac{Ab}{r + \delta} \left[1 - e^{-(r+\delta)(T-t)} \right] \right\}^{\frac{1}{1-b}}. \quad (3)$$

Inspection of (3) reveals that as t increases, the term $e^{-(r+\delta)(T-t)}$ increases from a value close to zero to a value equal to one when $t = T$. This implies that the optimal investment ratio for those with continuous participation will decline over time reaching zero at the date of retirement. The first and second derivatives of (3) imply that $x_{CP}^*(t)$ will initially decline at an

¹ This form of production function is common within the human capital literature and produces the result that the investment decision in any period is independent of the current stock of human capital.

increasing rate, but beyond a certain point, the rate of decline will start to decrease.² The upper curve in Figure 1 depicts the investment profile for individuals with continuous participation in the labour market. Initially the desired value of $x_{CP}^*(t)$ obtained from solving the optimisation problem may exceed the value of one, in which case the actual optimal investment ratio will be set to its maximum value of one, but over time it will decline and eventually reach zero at the retirement date. The time horizon over which $x_{CP}^*(t)$ is constrained to being equal to one relates to periods of full time education and is denoted by S_{CP} . By setting the left-hand-side of (3) equal to one and solving for t , it is possible to derive the following equation for the number of periods a continuous participant devotes to full time education:³

$$S_{CP} = T + \frac{\ln(1 - 1/B_1)}{B_2} \quad \text{where} \quad B_1 = \frac{Ab}{(r + \delta)} \quad \text{and} \quad B_2 = (r + \delta). \quad (4)$$

2.2 The Intermittent Participation Case

Consider now the case of individuals who plan to experience an interruption at some point within their working lives. Suppose the interruption occurs in such a way that there is no participation in the labour market between periods g and c (where $c > g$). The benefit to an individual from an investment undertaken at a time before the interruption occurs (i.e. $t < g$) is given by:

$$B(t) = \frac{wI(t)}{r + \delta} \left[1 - e^{-(r+\delta)(g-t)} \right] + \frac{wI(t)}{r + \delta} \left[e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(T-t)} \right]. \quad (5)$$

² See appendix for the derivatives of (3).

³ The derivation of (4) is shown in the appendix.

In the equation above, the first term on the right-hand-side represents the part of the total benefit of the investment made at t arising from the addition to potential earnings over the period between the time of the investment occurring (t) and the time at which the gap in participation begins (g). The second term on the right-hand-side is the contribution made to the total benefit arising from the effect that the initial investment has on potential earnings from the time that the individual returns to the labour market (c) to the date of retirement (T). Using the same approach as for the case of individuals with continuous participation, the optimal investment ratio for individuals with interrupted participation, $x_{IP}^*(t)$, may be expressed as:

$$x_{IP}^*(t) = \left\{ \frac{Ab}{r + \delta} \left[1 + e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(g-t)} - e^{-(r+\delta)(T-t)} \right] \right\}^{\frac{1}{1-b}}. \quad (6)$$

Equation (6), therefore, defines the optimal proportion of time allocated to the acquisition of human capital for an individual with an anticipated break in their lifetime labour market participation. This equation, however, is only applicable for investment decisions made in the periods leading up to the start of the interruption i.e. when $t < g$. During the time of the interruption it is assumed that no investment in human capital occurs and that the individual's earnings are zero. On returning to the labour market, the individual with intermittent participation will have the same sequence of values for $x^*(t)$ for the remaining time periods ($c < t < T$) as individuals with complete participation, assuming that all parameter values in (3) and (6) are identical for the two cases. This is because past investments in human capital do not influence the current investment decision which may be seen by noting that the optimal investment ratio in (3) and (6) is independent of the current stock of human capital $K(t)$. The value of $x^*(t)$ is essentially determined by the number of periods of participation remaining so once the interruption is complete, the incentive to invest for those who have returned to the

labour market following a break becomes identical to those with complete participation. This means that the two investment profiles coincide for all $t > c$ until the date of retirement.⁴ The first and second derivatives of (6) imply that the shape of the investment profile for individuals with interrupted careers will be similar to that associated with workers with continuous participation with $x_{IP}^*(t)$ initially declining at an increasing rate over a certain range and then falling at a decreasing rate. Analysing equations (3) and (6) and their associated derivatives enables Figure 1 to be constructed which illustrates the investment profiles for individuals with continuous participation and interrupted participation.

Figure 1 shows that the optimal investment ratio for intermittent workers will be lower than that of workers with complete participation in every period over the range prior to the start of the break. This result may also be seen by referring to equations (3) and (6). Denoting $B_1 = Ab/(r + \delta)$, $B_2 = (r + \delta)$, and defining the length of the break as $L = (c - g)$, it may be shown that the difference between the optimal investment ratio for continuous participants and intermittent participants can be written as:

$$x_{CP}^*(t)^{(1-b)} - x_{IP}^*(t)^{(1-b)} = B_1 e^{-B_2(g-t)} [1 - e^{-B_2 L}]. \quad (7)$$

In (7) it can be seen that when no break occurs ($L = 0$), the right-hand-side is equal to zero implying that the optimal investment ratio in any period is identical for the two cases. When a break is planned ($L > 0$), however, the right-hand-side of (7) is positive meaning that individuals with continuous participation will be associated with a higher investment ratio in each period than those with intermittent participation. As the length of the break increases, the

⁴ This is a somewhat extreme consideration of the human capital model. Following re-entry into the labour market there are likely to be strong reasons why the investment profiles for continuous and intermittent participants are not identical. This is beyond the scope of this study which only examines the effect of non-participation on the very early labour market experiences of women.

term in square brackets moves closer to one, increasing the value of the right-hand-side and therefore increasing the differential between the investment ratios of continuous and intermittent workers. It may also be seen in (7) that as the start date for the break moves to an earlier date in the life cycle (i.e. g falls), the right-hand-side increases which implies that the difference between the investment ratios for the two types of worker widens. The most important predictions of the model outlined in this section, therefore, are that the existence of a career break lowers the incentive to invest for intermittent workers relative to continuous participants and that this differential widens as the length of the break increases and as the break commences earlier in the life cycle.

The other notable feature of Figure 1 is that as a result of intermittent participants investing in less human capital in each period, the date at which they leave full time education and enter the labour market occurs earlier than for continuous participants. In the diagram, it may be seen that the number of periods over which the optimal investment ratio is constrained to being equal to one is S_{IP} for intermittent workers and S_{CP} for the case of continuous participants. In section 2.1, an expression for S_{CP} was derived by finding the value of t when the optimal investment ratio equalled one. A similar equation may then be derived for S_{IP} by setting the left-hand-side of (6) equal to one and solving for t . The date at which the intermittent participant is just on the verge of leaving full time education and entering the labour market is then given by equation (8):

$$S_{IP} = T + \frac{\ln(1 - 1/B_1)}{B_2} - \frac{\ln\left[1 + e^{B_2(T-g)} - e^{B_2(T-g-L)}\right]}{B_2}. \quad (8)$$

The difference in the amount of time devoted to full time education between the two groups may then be found by subtracting (8) from (7), leading to (9):

$$S_{CP} - S_{IP} = \frac{1}{B_2} \ln \left[1 + e^{B_2(T-g)} - e^{B_2(T-g-L)} \right]. \quad (9)$$

Inspection of (9) reveals that if no break occurs, there will be no difference between S_{CP} and S_{IP} since g will equal T , L will equal zero, and the value of the terms in square brackets will simply be equal to one. When a break does exist, however, g takes a value less than T , L will become positive, and the value of the terms in square brackets will exceed one, creating a positive differential between S_{CP} and S_{IP} . It may also be seen that this differential will widen as the length of the break (L) increases, or as the start date for the break (g) decreases, assuming that all else remains equal between the two groups of individuals.⁵

2.3 The Effect of Human Capital Investments on Earnings

Within the labour market, investments in human capital are rewarded by increasing an individual's potential earnings. Devoting time to investment increases the stock of human capital held by an individual which raises potential earnings in accordance with the market wage per unit of human capital, w . Actual earnings, however, will be less than potential earnings in any period where positive investment occurs since the cost of investment is defined as being the part of potential earnings sacrificed by the individual when they choose to spend a proportion of their time investing rather than earning in the labour market. It may be shown that actual earnings in any period t of the post full time education phase of the life cycle is given by the following expression:⁶

$$\log y(t) = \log(wK_0) + s(A - \delta) + \log \left[1 - x^*(t) \right] + \int_{\tau=s}^t \left[Ax^*(\tau)^b - \delta \right] d\tau. \quad (10)$$

⁵ The effects that changes in the length of the break and its timing have on the schooling differential are verified in appendix by differentiating (9) with respect to L and g .

⁶ See appendix for the derivation of this equation.

In this equation, the third term on the right-hand-side represents the negative effect that the current investment rate has on earnings, while the fourth term reflects the positive impact that past investments made on-the-job have on current earnings. The first observable value for earnings occurs just beyond the point when the individual leaves full time education and enters the labour market for the first time. The starting salary may therefore be written as:

$$\log y_{FST} = \log(wK_0) + s(A - \delta). \quad (11)$$

Equation (11) is most easily derived from (10) by considering an individual who invests in no additional human capital beyond the schooling phase. Their earnings would remain constant and in any period t , would equal the value of their human capital taken into the labour market. Equation (11) implies that the starting salary increases with the initial stock of human capital and with the number of years spent in full time education, s . Each year of additional education raises initial earnings in accordance with the rate of return to schooling, $(A - \delta)$. In the previous section, it was shown how the introduction of a planned interruption results in a lower optimal investment ratio for intermittent workers compared to those with continuous participation in each period prior to the break occurring. From Figure 1, this implies that individuals planning interrupted careers will devote less time to full time education than workers anticipating complete participation, if all else is identical for the two cases. With intermittent workers entering the labour market with lower schooling, it may be seen from (11) that these workers will have lower starting salaries than those planning continuous participation, assuming that all other factors are equal. It is this theoretical prediction that forms the basis of the empirical analysis within this study where an attempt is made to find support for the idea that starting salaries for women are systematically related to the length and timing of future career interruptions.

3. Statistical Framework and Data Description

The data used in this study is taken from the National Child Development Study (NCDS) which is a longitudinal survey of approximately 18,000 individuals born in the UK in the first week of March 1958. Information on the cohort was collected at birth and then at ages 7, 11, 16, 23, and 33. Most of these waves of the NCDS were used in order to test the theoretical predictions outlined in section 2. Equation (8) implies that the date at which an intermittent participant enters the labour market for the first time, denoted by S , will be determined by ability (given by the parameters A and b), future career plans (given by g and L), and the other parameters of the model. It should be noted that (8) may also be used to give the entry date for continuous participants since for these individuals, the length of the break (L) is equal to zero. It is assumed that the other parameters of the model (T , r and δ) are the same for both continuous and intermittent participants. A statistical approximation for the equation representing the date of labour market entry for an individual may then be expressed as:

$$S_i = \alpha_1 + \alpha_2 ABILITY_i + \alpha_3 PARTICIPATION_i + \alpha_4 CTRL1_i + \varepsilon_{1i}, \quad (12)$$

where ε_{1i} is a random error term. In (12), the point at which the individual leaves full time education and enters the labour market, S , is given by the date at which their first job commences. This information is recorded in the fourth sweep of the NCDS, which was undertaken when the cohort members were aged 23. *ABILITY* refers to the individual's level of ability recorded in the NCDS at age 11, which in accordance with equations (4) and (8), is predicted to positively affect the schooling decision. The term *PARTICIPATION* relates to a set of variables designed to capture the type of participation plans held by each individual. *CTRL1* refers to a set of additional control variables that are believed to have a possible influence on the date at which labour market entry occurs. The variables included in *CTRL1*

are dummy variables capturing the social class of the cohort member's father, which is obtained from the sweep of the NCDS taken at age 11.

In section 2.3, equation (11) was given for the starting salary of an individual which depends on the initial stock of human capital, the wage per unit of human capital, the date of entry (s), a productivity parameter (A), and the rate of depreciation. It is assumed that all of these factors are the same for individuals except the date of labour market entry. In the model, there are two measures of productivity, A and b . To keep the analysis as simple as possible it is assumed that individuals differ only with respect to b , which is interpreted as a measure of ability. The effect of this assumption is that differences in ability only appear in the equation determining entry dates and not the structural equation for initial earnings. The structural equation for starting salaries is given by (13) below. In this equation, the rate of return to schooling ($A - \delta$) is constrained to be equal across individuals due to the assumption that individuals only differ with respect to b and not A . Information relating to starting salaries is obtained from the fourth sweep of the NCDS, which gives the gross weekly pay that was received by individuals in their first job:

$$\ln Y_i = \alpha_5 + \alpha_6 S_i + \alpha_7 CTRL2_i + \varepsilon_{2i}, \quad (13)$$

where $\alpha_5 = wK_0$, $\alpha_6 = A - \delta$ and ε_{2i} is a random error term. The variables included in $CTRL2$ relate to the socio-economic group associated with the first job, establishment size, and whether the first firm is in the public sector or private sector. These control variables are obtained from the NCDS at age 23 and are included in order to allow for differences in the starting salaries of individuals that arise as a result of factors specific to the first firm that the individual works for. To analyse the effect that non-participation plans have on starting

salaries, it is possible to substitute (12) into (13) to obtain the following reduced form equation:

$$\ln Y_i = \beta_1 + \beta_2 ABILITY_i + \beta_3 PARTICIPATION_i + \beta_4 CTRL1_i + \beta_5 CTRL2_i + \mu_i \quad (14)$$

where $\beta_1 = \alpha_5 + \alpha_6 \alpha_1$, $\beta_5 = \alpha_7$, $\beta_2 = \alpha_6 \alpha_2$, $\mu_i = \alpha_6 \varepsilon_{1i} + \varepsilon_{2i}$, $\beta_3 = \alpha_6 \alpha_3$ and $\beta_4 = \alpha_6 \alpha_4$.

The estimation of equations (12) and (14) is the main way used in this study to test the empirical validity of the theoretical predictions outlined in section 2 concerning the effect that future career breaks have on the date of labour market entry and starting salaries of individuals. Several different versions of these equations are estimated which differ with respect to the variables contained within the *PARTICIPATION* term. A range of variables were derived from the NCDS as a way of capturing the career plans held by individuals. Among the files that form the fifth sweep of the NCDS is a work history file that contains information on the start and end dates for periods of employment and non employment that have taken place in the individual's working life. For the spells of non employment, it is possible to determine whether the individual was unemployed during this time or out of the labour force for child raising purposes. Using the information contained within this history file, it was possible to derive two variables for the women in the NCDS cohort which provide the relevant information relating to their career plans. The first variable derived, *NP*, refers to the total number of years that each woman reported being out of the labour force for child raising purposes by the time they were 33 years of age. The second variable, *GAPSTART*, gives the age of the woman when the first of these interruptions occurred.

For the initial estimations of (12) and (14), *PARTICIPATION* includes dummy variables indicating whether the individual was a male (*MEN*), a woman with no interruptions before

age 33 (*WNB*), or a woman who did experience a positive amount of non-participation prior to age 33 (*WB*). The purpose of these initial estimations is to assess the effect that the existence of any type of career break has on the entry dates and starting salaries of women relative to similar males and females who are observed with continuous participation. The equations are then re-estimated where the dummy variable capturing women with a break (*WB*) is replaced with four dummy variables indicating women with different types of interruption. In section 2, it was shown how the date of labour market entry and starting salary is predicted to be lower for those anticipating longer breaks, or breaks occurring earlier in the life cycle. Using the variables relating to the total amount of non-participation (*NP*) and the date at which the first break occurs (*GAPSTART*), it was possible to describe each female's interruption as being either short/early, short/late, long/early, or long/late.⁷ Comparing the coefficients associated with these four types of interruption then allows an insight to be gained into the effects that the length and timing of the break have on both the date of labour market entry and initial earnings.

Following the estimation of equations (12) and (14) using dummy variables to capture career plans, the equations are re-estimated for the sample of women where the number of years of non-participation (*NP*) is entered as a continuous variable. This specification enables the theoretical predictions relating to the length of the break to be tested since the coefficient associated with *NP* in each equation captures the effect that an additional year of non-participation has on the date of entry and initial earnings respectively. Within this set up, the effects of the timing of the break are no longer explicitly modelled. When the number of years

⁷ If the total amount of time spent out of the labour force by age 33 (*NP*) is less than four years, the break is described as being 'short'. More than four years out of the labour force constitutes a 'long' break. The distinction between an 'early' or 'late' break is based on whether the date of the first interruption (*GAPSTART*) occurred before or after age 26.

of non-participation is included as a continuous variable, it is not feasible to also include a continuous variable capturing the timing of the break because of the high degree of correlation between the two variables. This correlation arises since when analysing interruptions occurring before age 33, women who are observed as having accumulated a high number of years of non-participation must have started taking time out of the labour market at a relatively early age.⁸ For this reason, only the total number of years of non-participation is entered as a continuous variable. The implication of this in the starting salary equation, given by (14), is that the coefficient associated with NP will incorporate both the effect that an additional year of non-participation has on earnings along with any effect arising from the timing of the year of non-participation. Women with a high value for NP in (14) may be observed with lower earnings as a result of experiencing a high number of years of non-participation, and also as a result of taking their break early, but it is not possible to separately identify these two effects.⁹

When estimating equations (12) and (14) with the inclusion of NP , it is possible that the coefficients obtained are biased due to the potential endogeneity of years of non-participation. It may be the case that instead of planned periods of non-participation inducing female workers to enter the labour market with a lower starting salary, the causality runs in the opposite direction in that it is lower initial earnings that encourages future non-participation.

⁸ The correlation coefficient between years of non-participation and the age at which the first break occurred was found to be -0.65.

⁹ If data were available for the whole working life, it may be possible to incorporate measures of both the total quantity of non-participation and the age at which the break started. This is because women with, for example, 10 years of non-participation could be observed as starting their break over a large range of ages. With data from the NCDS only available up to age 33, however, women with a high value for NP must have started their non-participation at a relatively young age. Higher values for NP will, therefore, also reflect interruptions occurring relatively early in the working life.

Under these circumstances, an additional equation may be written for the number of years of non-participation as:

$$NP_i = \beta_6 + \beta_7 \ln Y_i + \beta_8 CTRL3_i + \varphi_i. \quad (15)$$

Equations (14) and (15) form a simultaneous equation system with starting salary (Y) and years of non-participation (NP) being the joint dependent variables. OLS estimation of (14) will generate biased coefficient estimates arising from the correlation between the error term and years of non-participation. In order to obtain unbiased estimates of the coefficients in (14) and (15), a two stage least squares (2SLS) approach is adopted. This involves estimating a reduced form for both starting salary and non-participation where each of these joint dependent variables is regressed on all the exogenous variables in the system. Identification of the equations in the system comes about as a result of the control variables included in each of the equations. In (15) an additional set of control variables ($CTRL3$) are included that are not present in (14). These variables are all obtained from the age 33 sweep of the NCDS and relate to partner's economic status, the number of children, and whether the individual owned their own home in 1991¹⁰ After estimating the reduced form for years of non-participation, the second stage of the 2SLS approach involves obtaining the predicted values of non-participation and using these in (14) in place of the actual values for non-participation. The predicted values of non-participation will be uncorrelated with the error term asymptotically, and so OLS can be applied to re-estimate the structural equation for initial earnings. In a similar way, it would also be possible to estimate (15) using the predicted values obtained from the reduced form equation for starting salary in place of the actual values.

¹⁰ It could be argued that not all of these variables are exogenous in the non-participation equation, (15). In particular, the number of children could be the consequence of non-participation rather than the cause. The validity of instruments is a common criticism of 2SLS estimation but is often unavoidable due to the availability of suitable variables.

In addition to undertaking a 2SLS approach where starting salary and years of non-participation are treated as the two jointly dependent variables, it is also possible to follow a similar procedure where entry date and non-participation are viewed as being the endogenous variables within the system. Equation (15) could be re-written with the date of labour market entry (S) included in place of initial earnings (Y). The interpretation of this is that earlier entry into the labour market may encourage future non-participation, rather than in (12) where the causality runs in the opposite direction. A 2SLS treatment could then be undertaken for equations (12) and (15) where the joint dependent variables are the date of labour market entry and years of non-participation.

4. Empirical Findings

The final sample of individuals extracted from the NCDS consists of 1378 men and 1286 women. Although this represents only a small fraction of the total number of individuals within the NCDS cohort, the criteria for including individuals in the final sample needs to be relatively strict due to the nature of the theory being tested. The variables included in equations (12) and (14) require information to be available on the date the first job started, the salary received within that job, and a range of job characteristics such as the size of the firm and whether the firm is in the private sector or public sector. In addition, data is required for each individual's level of ability, father's social class, and the amount of time spent out of the labour force for child raising purposes. Since all of this information is needed for each individual and is obtained from several waves of the NCDS, the final sample sizes are relatively restricted.

4.1 Summary Statistics

Table 1 presents the means and standard deviations for the starting wage, the date at which the first job commenced and a measure of ability at age 11 for several groups of workers from the sample of 2664 individuals. The sub-samples of individuals considered are designed to reflect the different types of participation plans held among the individuals within the full sample. Men are assumed to represent the continuous participation case and are expected to be associated with similar starting salaries to those women who had taken no time out of the labour force by the age of 33, who are referred to in Table 1 as *WNB*. The sample of women who did report having experienced an interruption by the time they were 33 (*WB*) are then subdivided into four further groups that differ with respect to the length and timing of their non-participation spells. The first group, *WBSE*, consists of women who experienced a ‘short/early’ break, defined as those with less than four years of non-participation and whose first reported spell of non-participation occurred before age 26. The remaining three groups consist of women whose breaks may be described as ‘short/late’ (*WBSL*), ‘long/early’ (*WBLE*), and ‘long/late’ (*WBLL*). The purpose of dividing the women reporting an interruption by age 33 into these four groups is to determine whether the length and timing of the break affects the date of labour market entry and initial earnings in the manner predicted by the theory outlined in section 2.

The figures presented in Table 1 would appear to offer some preliminary support for the theory of human capital accumulation and interrupted work careers. For the 1286 women, those who do go on to experience an interruption before age 33 (*WB*) are, on average, observed as entering the labour market at an earlier age and with a lower starting salary than

those women who experience no interruptions (*WNB*).¹¹ The sample of 640 women with an interruption are then divided into four groups according to the length and timing of their spells of non-participation. By comparing the figures for those with short/early and short/late breaks, it may be seen that those who interrupted their career at an earlier age are associated with earlier entry into the labour market and lower initial earnings. Similar results are observed by comparing the two groups experiencing long/early and long/late breaks, where an interruption occurring at an earlier age appears to reduce both the time devoted to full time education and the starting salary. In addition to the timing of the break, the total amount of time spent out of the labour force would also appear to influence the entry date and starting salary in a way consistent with the theory. By comparing the figures given for women with short/early and long/early breaks (as well as those for short/late and long/late breaks), it may be seen that women experiencing relatively long interruptions enter the labour market earlier and with a correspondingly lower starting salary.¹² Overall, therefore, the figures in Table 1 suggest that among the women who do experience interrupted careers, the duration of the break and its timing within the life cycle does influence both the date at which individuals enter the labour market and earnings at the point of entry in the direction predicted by the theory.

The other notable feature of the figures presented in Table 1 is that women who do not experience an interruption by age 33 (*WNB*) are seen as entering the labour market later and with a higher starting salary than men. In the model outlined in section 2, these two groups of individuals may be viewed as representing the continuous participation case and so may be

¹¹ In performing the relevant *t*-test, the null hypothesis of equality between the mean starting salaries and entry dates for women with no breaks and those with future interruptions is rejected.

¹² With the exception of the mean starting salaries of women with short/late and long/late breaks, all of the differences in the mean starting salaries and entry dates across the four groups of intermittent participants described here are significant within the 5% level.

expected to have similar patterns of human capital accumulation. One possible explanation for the difference in entry dates and starting salaries between these two groups rests in their levels of ability. It may be seen in the final column that women with no interruptions are observed as having higher ability at age 11 than males. Human capital theory predicts that among individuals planning similar levels of participation, those with higher ability will devote more time to full time education and therefore enter the labour market later and with higher earnings. Differences in the level of ability may also partly explain the differences in entry dates among the four groups of women who did experience an interruption in Table 1. Although women with a long/early break are observed with an earlier entry date than those planning a short/late break, they are also observed as having lower ability. Any effect that non-participation plans have on the decision to enter the labour market is then confounded with the independent effect that ability has on the investment decision. It then becomes necessary to use regression analysis in order to separately identify the effect that career plans have on the decision to cease full time education and enter the labour market for the first time. Table 2 shows the importance of being able to adequately control for ability when assessing the effects of planned periods of non-participation. For the combined sample of 2664 men and women, it may be seen that there is a general tendency for individuals within a higher ability group to enter the labour market at a later date and with a higher starting salary.

4.2 Ordinary Least Squares Estimates

The first set of results presented arise from estimating the entry date and starting salary equations when each individual's level of future participation is captured by a dummy variable. Initially, the equations are estimated where individuals are classified as being either a male (*MEN*), a woman with no break before age 33 (*WNB*), or a woman with a break (*WB*). The variable *WB* simply captures whether or not a woman experienced any kind of

interruption before age 33 and does not allow for any differences in either the length or timing of the break. Identifying individuals within these three broad categories enables some preliminary evidence to be presented concerning the influence that career breaks have on the investment decisions and starting salaries of females relative to continuous participants. The first column in Table 3 below shows the results obtained from estimating equation (12) which relates the date of labour market entry to future participation, ability at age 11, and father's social class at age 11. The third column in Table 3 then presents the OLS estimates of the starting salary equation, (14).

By examining the results shown in column 1 of Table 3, it may be seen that some support is found for the theoretical predictions concerning the effects that ability and future participation have on the date of labour market entry (which is defined as the age in months when the first job commenced). Individuals with higher ability at age 11 are found to enter the labour market significantly later implying that these individuals devote a greater proportion of their life to full time education. For women who do go on to experience any type of career break at some point before age 33 (*WB*), entry into the labour market occurs significantly earlier than comparable men (who represent the excluded case), and also women who do not experience any such interruptions (*WNB*).

Contrary to the predictions outlined in the theoretical section, it is also found that women with no breaks enter the labour market significantly later than similarly able males. In terms of the theory, similarly able males and females with continuous participation would be expected to enter the labour market at approximately the same time as a result of having similar investment profiles. If women with no interruptions to their careers enter the labour market later than men, it would then be expected that they would be associated with higher starting

salaries. The results presented in column 3 of Table 3, however, suggests that this is not the case since women with no interruptions to their careers (*WNB*) earn 2.5% less than males at the point of entry, although this wage differential is found to be statistically insignificant. One possible explanation for this is that female workers anticipating no career interruptions signal their intentions to future employers by investing in additional units of human capital during the schooling phase of the life cycle which yield no return at the point of labour market entry.

The other important feature of the results given in the third column of Table 3 is that women who do experience spells of non-participation before they reach the age of 33 (*WB*) earn significantly less than comparable men at the point of entry. The coefficient associated with *WB* implies that women who experience a future break receive, on average, 9.5% lower starting salaries than males.¹³ With respect to the other variables included in the estimation of (14), it may be seen that ability exerts a positive and significant effect on starting salaries. Both career plans and ability will influence initial earnings through their effect on entry dates, so in order to examine the role played by career plans in determining earnings it is necessary to control for ability. The results also imply that those working in the private sector (*PRIVATE*) and in establishments with fewer employees (captured by the *SIZE* variables) are associated with lower starting salaries for the same level of ability and participation plans. Those whose first job places them in a professional or non-manual socio-economic grouping (*SEG1-SEG3*) are generally observed as having higher initial earnings than those within the manual socio-economic groups (*SEG5-SEG7*).

¹³ This figure is calculated as a result of interpreting the coefficient associated with a dummy variable in the usual manner i.e. taking the anti-log of the coefficient and subtracting one (Halvorsen and Palmquist, 1980).

The results shown in columns 1 and 3 of Table 3, therefore, suggest that women who do interrupt their careers by the age of 33 are associated with earlier entry in to the labour market and lower starting salaries than comparable men and women with no interruptions. Following this result, equations (12) and (14) were re-estimated where the sample of women with a break was divided into four groups according to the total amount of time spent out of the labour force and the age at which the first interruption occurred. The results from these estimations are reported in columns 2 and 4 of Table 3. For the entry date equation, it may be seen that three out of the four coefficients attached to the career break dummy variables have the expected negative sign and are statistically significant. Women classified as having a short/late break are found to enter the labour market later than men, although the effect is insignificant. In the starting salary equation, all of the coefficients have the anticipated sign although only two are significant. The largest pay penalty is observed for women experiencing a long/early break, where earnings are reduced by 14.1% relative to men. Women with a short/early break earn 8.5% less than males, although they do not earn significantly more than women with a long/early break.¹⁴ This provides some evidence, therefore, for the hypothesis that longer interruptions lead to earlier entry in to the labour market and lower initial earnings. Among those with late breaks (*WBSL*, *WBLL*), however, there is little support for the prediction relating to the length of the break with both groups earning around 5.5% less than men. The figures given in column 4 also provide some evidence that breaks occurring earlier in the life cycle have a greater detrimental effect on earnings, which may be seen by comparing the coefficient attached to *WBSE* with *WBSL*, and also *WBLE* with *WBLL*.

¹⁴ The test of equality between the *WBSE* and *WBLE* coefficients yields an *F*-statistic of 1.71, which has a *p*-value of 0.19.

Table 4 presents the results obtained from re-estimating equations (12) and (14) for the sample of 1286 women where future career interruptions are captured by the total number of years spent out of the labour force by age 33, *NP*. Column 1 of Table 4 indicates that each additional year spent out of the labour market significantly lowers the age (measured in months) at which women first enter the labour market. This negative effect exists after controlling for the level of ability at age 11, which is in itself found to be a positive and highly significant determinant of the entry date. In terms of initial earnings, the figures in column 3 indicate that the number of years of non-participation also exerts a significantly negative effect on female starting salaries. Each additional year spent out of the labour force is estimated to lower initial earnings by approximately 1%. A woman experiencing a break with duration equal to the mean length of 4.89 years would therefore earn around 5% less than a woman with no interruptions at the point of entry.

4.3 Two Stage Least Squares Estimates

As was discussed in the description of the statistical model, it may be inappropriate to treat the variable capturing years of non-participation (*NP*) as exogenous. In addition to years of non-participation exerting a negative effect on starting salaries, a feedback effect may exist in the sense that it is the realisation of lower initial earnings that encourages non-participation. Under these circumstances, starting salary and years of non-participation will represent the endogenous variables in a simultaneous equation system expressed by equations (14) and (15). The results presented in column 3 of Table 4 relating to the estimation of the earnings equation (14) may then be biased due to the possible correlation between the error term and the variable *NP*. Unbiased coefficient estimates for the earnings equation may be obtained by estimating equation (14) by two stage least squares (2SLS).

The first stage in estimating equation (14) by 2SLS involves estimating a reduced form equation by OLS for the total number of years of non-participation (*NP*). This reduced form involves regressing years of non-participation on all the exogenous variables within the system. The regression will therefore include all of the three groups of control variables within (14) and (15) and also the measure of ability, but exclude initial earnings as an explanatory variable.¹⁵ Using the estimated coefficients obtained from this regression, predicted values for non-participation are then computed which, in the second stage, are used in the starting salary equation instead of the actual values. It may be seen in column 4 of Table 4 that when estimated by 2SLS, each additional year of future non-participation lowers initial earnings by around 1%.¹⁶ The magnitude of this effect is therefore the same as that which was found when the equation was estimated by OLS (Table 4, column 3), but is insignificantly different from zero at conventional levels. For the remaining explanatory variables in the final column of Table 4, the estimated effects on earnings are found to be similar in terms of magnitude and significance to the initial OLS estimates.

In examining the effects of interrupted careers, an OLS regression was also run in section 4.2 to examine the effect that future non-participation had on the date of labour market entry (Table 4, column 1). The second column of Table 4 presents the results from estimating this entry date equation by 2SLS. In the same way that starting salaries and participation plans may be simultaneously determined, it is also possible to consider entry dates and participation

¹⁵ For the *CTRL3* variables identified in (15), dummy variables are used to capture whether the woman's partner at 33 was a full-time employee, a part-time employee, unemployed, or engaged in an alternative activity. Home ownership at age 33 is also captured by a dummy variable, while the number of children and the number of children squared are entered as continuous variables.

¹⁶ The sample size falls slightly in columns 2 and 4 of Table 4 due to missing observations on the set of instruments, *CTRL3*.

plans as the endogenous variables within a simultaneous equation system. Equation (12) shows how the date of labour market is related to future levels of non-participation, but in a similar way to (15), years of non-participation may be partly determined by the date of labour market entry instead of initial earnings. In this case, another reduced form equation for years of non-participation may be estimated which is then used to compute predicted values for non-participation.¹⁷ These predicted values may then be used in place of the actual values in the structural equation (12) that has the date of labour market entry as the dependent variable. The results from estimating this equation are shown in Table 4, column 2. The coefficient associated with *NP* implies that after controlling for ability, years of non-participation exerts a negative and significant effect on the date at which women first enter the labour market. Each additional year of non-participation lowers the age at which labour market entry occurs by 1.6 months.

5. Conclusions

This study has attempted to find empirical evidence in support of the theoretical predictions offered by the life cycle human capital framework regarding the effect that anticipated spells of non-participation have on the investment incentives of women. It may be shown that individuals planning intermittent participation in the labour market will invest in less human capital in each period prior to the break occurring than similarly able individuals planning continuous participation. When looking at individuals over the complete life cycle, an implication of this is that intermittent participants will devote fewer years of their lives to full time education and, therefore, enter the labour market earlier. With less human capital having

¹⁷ This reduced form, however, will not contain the variables *CTRL2* since these control variables are viewed as only influencing earnings within the first job.

been accumulated at the point of entry, women planning career breaks would then be expected to receive lower earnings in their first job. It is also possible to show that the negative influence that non-participation has on entry dates and starting salaries increases with the duration of the break and the earlier it occurs within the life cycle.

The statistical analysis undertaken using a sample of individuals taken from the NCDS provides some evidence to support the negative relationship between non-participation and human capital investment. In the most basic version of the statistical model considered, it was found that women experiencing any kind of interruption by the age of 33 entered the labour market at a significantly earlier date and with a 10% lower starting salary than men of similar ability. Relative to women with no interruptions, these intermittent participants received approximately 7.5% less pay in their first job. When the sample of women with an interruption was then divided into four groups according to the type of break experienced, some evidence was also found to support the idea that long periods of non-participation occurring early in the life cycle exerted the greatest negative effect on the date of entry and initial earnings. Throughout the initial estimations it was found that women with no interruptions were associated with earnings that were, on average, 2.5% less than men, but entered the labour market at a significantly later date. This result could be consistent with a signalling hypothesis in that women planning a strong attachment to the labour market signal their intentions to potential employers by investing in an additional quantity of human capital that is not formally rewarded at the point of entry.

The entry date and starting salary equations were also estimated for females where future career plans were captured by the total number of years of non-participation accumulated by age 33. OLS estimation of these equations showed that each year spent out of the labour force

induced significantly earlier entry into the labour market and also lowered initial earnings by 1%. Including non-participation as a continuous variable enables a conventional two stage least squares procedure to be undertaken with starting salary and non-participation as the joint dependent variables. The results from the 2SLS estimation also found that each year of non-participation lowered initial earnings by 1%, although the effect was no longer significant. A significantly negative relationship, however, was found to exist between years of non-participation and the date of labour market entry when the entry date equation was estimated using a similar 2SLS technique.

One of the main findings throughout the empirical analysis is that it would appear that the evidence concerning the relationship between career breaks and entry dates is more convincing than that between career breaks and starting salaries. The coefficients associated with the non-participation variables in the entry date equation have a tendency to have greater t -ratios than those in the starting salary equation. The model predicts that those anticipating career breaks will enter the labour market earlier, which will in turn, lead to a lower starting salary. The evidence, however, would appear to be stronger regarding the first link in the chain. One of the possible reasons for why the evidence concerning the subsequent relationship between non-participation and initial earnings is weaker lies in the use of the control variables (*CTRL2*) included in the starting salary equation, (14). If intermittent participants, who enter the labour market earlier, are more inclined to work in smaller firms or private sector firms, then they may be expected to have lower earnings as a result of opting to work in these types of firm. When estimating the starting salary equation with the inclusion of control variables capturing the characteristics of the firm, part of the total impact of non-participation then becomes embodied within these additional controls. This may mean that in the estimation of the starting salary equation given by (14), the overall effect of non-

participation is being understated. By estimating the earnings equation without these controls, the coefficient associated with non-participation will capture the effect that those planning to interrupt their careers tend to work in smaller firms, in addition to the fact that such workers enter the labour market with a lower human capital stock. In estimating the equation without the controls for the characteristics of the firm, the coefficient associated with non-participation increased in terms of magnitude and significance, but the explanatory power of the model was reduced considerably.¹⁸

It is also possible that the estimated effects that career breaks have on entry dates and starting salaries is understated because of the way that women who experience interrupted careers are defined. The most recent data available from the NCDS refers to individuals when they were 33 years of age. In the empirical analysis within this study, a woman was defined as having experienced a career interruption if they reported having spent time out of the labour force for child raising purposes by the time they were 33. Women who did not report any spells of non-participation before age 33 are defined as representing the continuous participation case. It is likely, however, that among the sample of women who experienced no interruptions before age 33, many would have gone on to experience a break at a later age. Comparing the starting salaries of women who did experience a break with those who did not may then lead to an underestimate of the effect that non-participation has on earnings being obtained. This is because among the group of women considered as having continuous participation, there will be some women who experience breaks that are yet to be observed. The presence of women who do go on to experience a break among the group of continuous participants will lower the

¹⁸ Estimating (14) without the controls relating to socio-economic group, establishment size and private sector (i.e. *CTRL2*), the coefficient (and *t*-ratio) attached to *NP* became -0.02 (4.705). This compares to -0.01 (3.025) in Table 4, column 3. The R^2 of the model, however, falls from 0.295 to 0.111.

mean starting wage of continuous participants, which will in turn lead to the estimated effect that career breaks have on starting salaries being understated. This limitation could be overcome if data concerning an individual's level of participation were available in each year leading up to the date of retirement.

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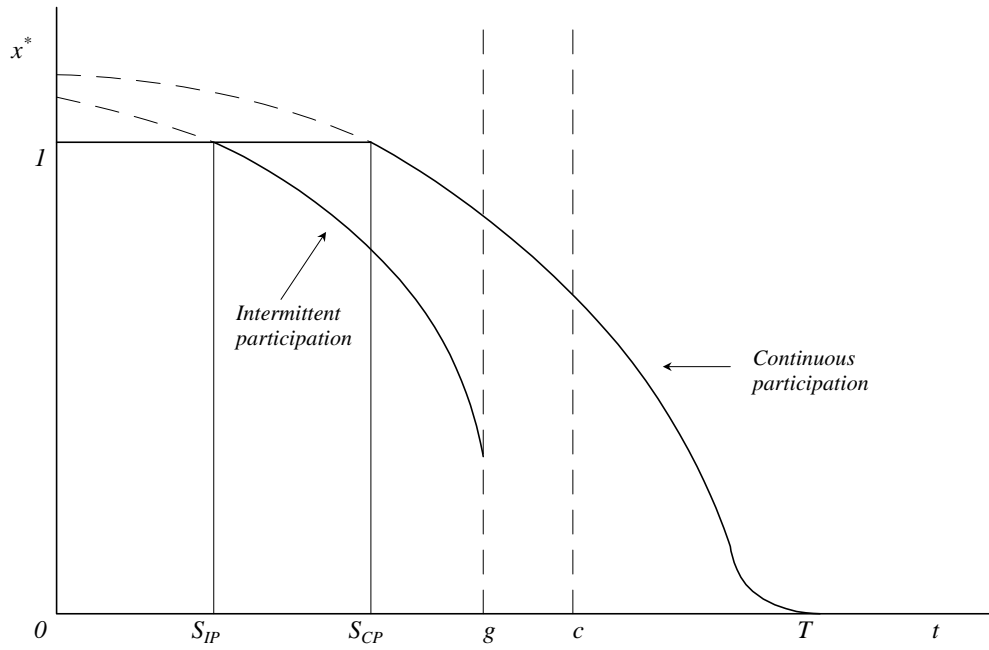
Figure 1**The Investment Profile for Continuous and Intermittent Participants**

Table 1**Mean Starting Salary, Entry Date and Ability**

<i>Sample:</i>	<i>N</i>	<i>Starting salary (£)</i>		<i>Entry date (months)</i>		<i>Ability at 11</i>	
<i>ALL</i>	2664	91.03	(44.94)	218.53	(26.24)	48.85	(14.80)
<i>MEN</i>	1378	92.29	(45.97)	217.55	(25.68)	47.24	(15.24)
<i>WOMEN</i>	1286	89.69	(43.79)	219.57	(26.80)	50.57	(14.11)
<i>WNB</i>	646	96.17	(49.66)	223.76	(28.80)	50.03	(14.71)
<i>WB</i>	640	83.14	(35.78)	215.34	(23.91)	51.11	(13.46)
<i>WBSE (short/early)</i>	101	83.89	(32.14)	214.71	(21.82)	51.98	(12.65)
<i>WBSL (short/late)</i>	191	92.14	(37.80)	226.47	(27.86)	55.35	(11.63)
<i>WBLE (long/early)</i>	253	75.15	(33.62)	206.35	(16.74)	46.66	(13.84)
<i>WBLL (long/late)</i>	95	85.50	(36.65)	217.59	(24.18)	53.48	(13.35)

Samples:

<i>ALL</i>	All individuals in the sample
<i>MEN</i>	All men
<i>WOMEN</i>	All women
<i>WNB</i>	Women who experienced no breaks before age 33
<i>WB</i>	Women who did experience a break before age 33
<i>WBSE</i>	Women who experienced a short/early break (first break occurring before or at age 26, total time out of labour force by age 33 less than or equal to four years)
<i>WBSL</i>	Women with a short/late break (after age 26, less than four years)
<i>WBLE</i>	Women with a long/early break (before or at age 26, more than four years)
<i>WBLL</i>	Women with a long/late break (after age 26, more than four years)

Notes:

1. Starting salary is deflated gross monthly earnings in the first job.
2. Entry date is measured as the age in months when first job started.
3. Ability is measured at age 11 and scored out of 80.
4. Standard deviations in parentheses.

Table 2**Starting Salary and Entry Dates according to Ability for Men and Women**

<i>Ability score</i>	<i>N</i>	<i>Starting salary (£)</i>		<i>Entry date (months)</i>	
0-32	418	84.19	(45.36)	202.36	(11.98)
33-40	336	79.04	(44.04)	206.13	(18.08)
41-48	440	84.32	(37.97)	214.43	(23.38)
49-56	534	90.02	(42.32)	220.17	(26.37)
57-64	537	98.10	(49.32)	227.34	(27.92)
65-80	399	107.53	(43.53)	236.35	(27.35)

Table 3
Estimation of (12) and (14) using Career Break Dummy Variables

	Entry Date equation (12)		Starting Salary equation (14)	
	Dependent variable: <i>S</i>		Dependent variable: $\ln Y$	
	(1)	(2)	(3)	(4)
<i>FSC1</i>	19.640 (11.058)	19.259 (10.877)	0.127 (3.924)	0.124 (3.835)
<i>FSC2</i>	13.222 (11.292)	12.811 (10.948)	0.088 (4.136)	0.084 (3.922)
<i>FSC3</i>	5.839 (3.792)	5.526 (3.594)	0.019 (0.678)	0.014 (0.504)
<i>FSC5</i>	-3.800 (2.634)	-3.701 (2.576)	-0.029 (1.100)	-0.028 (1.060)
<i>FSC6</i>	-3.377 (1.405)	-3.074 (1.284)	-0.010 (0.222)	-0.007 (0.154)
<i>FSC7</i>	0.334 (0.132)	0.013 (0.005)	-0.009 (0.207)	-0.012 (0.256)
<i>ABILITY</i>	0.647 (21.098)	0.634 (20.649)	0.002 (3.678)	0.002 (3.447)
<i>SIZE2</i>	-	-	0.047 (1.740)	0.050 (1.838)
<i>SIZE3</i>	-	-	0.136 (5.590)	0.138 (5.654)
<i>SIZE4</i>	-	-	0.144 (5.804)	0.146 (5.896)
<i>SIZE5</i>	-	-	0.170 (6.476)	0.172 (6.570)
<i>PRIVATE</i>	-	-	-0.191 (10.079)	-0.190 (10.016)
<i>SEG1</i>	-	-	0.246 (7.214)	0.246 (7.212)
<i>SEG2</i>	-	-	0.168 (2.892)	0.168 (2.892)
<i>SEG3</i>	-	-	0.260 (10.043)	0.258 (9.943)
<i>SEG5</i>	-	-	-0.099 (3.816)	-0.100 (3.884)
<i>SEG6</i>	-	-	0.020 (0.785)	0.021 (0.818)
<i>SEG7</i>	-	-	0.174 (3.806)	0.173 (3.870)
<i>WNB</i>	3.565 (3.313)	3.619 (3.377)	-0.025 (1.191)	-0.025 (1.176)
<i>WB</i>	-4.592 (4.249)	-	-0.100 (4.681)	-
<i>WBSE</i>	-	-5.430 (2.349)	-	-0.089 (2.094)
<i>WBSL</i>	-	1.877 (1.076)	-	-0.058 (1.779)
<i>WBLE</i>	-	-8.800 (5.734)	-	-0.152 (5.187)
<i>WBLL</i>	-	-5.117 (2.148)	-	-0.057 (1.301)
constant	182.91 (114.36)	183.68 (114.66)	4.287(101.07)	4.293(101.15)
N	2664	2664	2664	2664
R ²	0.271	0.278	0.221	0.223
F	109.81	85.07	37.50	32.97

Notes:

1. Being male (*MEN*) represents the excluded category of future participation.
2. Variables *WNB* to *WBLL* are defined in the same way as in Table 1.
3. *FSC1-7* relates to a father's social class of professional, intermediate non manual, skilled non manual, skilled manual (excluded category), semi-skilled manual, unskilled manual, and no father figure respectively.
4. *SEG1-7* indicates socio-economic group in the first job of professional, employers and managers, intermediate non manual, junior non manual (excluded category), skilled manual, unskilled manual, and other group respectively.
5. *SIZE1-5* indicates establishment with less than 10 employees (excluded category), 11-24, 25-99, 100-499, and 500 or more respectively.
6. *PRIVATE* indicates whether first job was in a private firm.
7. *ABILITY* is a measure of ability at age 11 and is scored out of 80.
8. *t*-ratios in parentheses.

Table 4

Estimation of (12) and (14) for Women using Years of Non-participation (NP)

	Entry Date equation (12)		Starting Salary equation (14)	
	Dependent variable: S		Dependent variable: $\ln Y$	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
<i>FSC1</i>	21.926 (8.588)	21.569 (8.369)	0.119 (2.722)	0.119 (2.697)
<i>FSC2</i>	13.395 (7.892)	13.175 (7.709)	0.080 (2.758)	0.080 (2.749)
<i>FSC3</i>	2.335 (1.018)	2.338 (1.018)	-0.008 (0.212)	-0.009 (0.241)
<i>FSC5</i>	-3.880 (1.773)	-3.485 (1.574)	-0.089 (2.403)	-0.095 (2.550)
<i>FSC6</i>	-6.463 (1.833)	-6.551 (1.856)	0.045 (0.760)	0.045 (0.750)
<i>FSC7</i>	-1.491 (0.429)	-1.610 (0.462)	-0.075 (1.274)	-0.076 (1.284)
<i>ABILITY</i>	0.605 (12.823)	0.596 (12.475)	0.002 (2.659)	0.002 (2.593)
<i>SIZE2</i>	-	-	0.096 (2.592)	0.095 (2.573)
<i>SIZE3</i>	-	-	0.158 (4.775)	0.160 (4.807)
<i>SIZE4</i>	-	-	0.194 (5.920)	0.194 (5.896)
<i>SIZE5</i>	-	-	0.224 (6.275)	0.223 (6.230)
<i>PRIVATE</i>	-	-	-0.209 (8.276)	-0.211 (8.327)
<i>SEG1</i>	-	-	0.297 (5.089)	0.312 (5.215)
<i>SEG2</i>	-	-	0.118 (1.246)	0.120 (1.266)
<i>SEG3</i>	-	-	0.290 (8.756)	0.291 (8.679)
<i>SEG5</i>	-	-	0.084 (1.344)	0.084 (1.336)
<i>SEG6</i>	-	-	-0.061 (1.753)	-0.062 (1.766)
<i>SEG7</i>	-	-	0.138 (0.800)	0.138 (0.801)
<i>NP</i>	-1.265 (6.637)	-1.584 (4.682)	-0.010 (3.025)	-0.009 (1.473)
constant	187.94 (73.699)	189.21 (68.769)	4.233 (76.070)	4.234 (73.789)
N	1286	1281	1286	1281
R ²	0.2892	0.2864	0.2951	0.2959
F	64.94	61.58	27.90	27.54

APPENDIX

A.1 The Investment Ratio

The cost of investing in human capital is given by the following cost function:

$$C[x(t), K(t), t] = wx(t)K(t).$$

The net benefit of an investment made at t is then given by:

$$NB[x(t), K(t), t] = Ax(t)^b K(t) \frac{w}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] - wx(t)K(t).$$

The optimal value of $x(t)$ is then found by differentiating net benefit with respect to $x(t)$ and setting this derivative equal to zero. This then gives:

$$x_{CP}^*(t) = \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{1}{1-b}}.$$

The first derivative of this is given by:

$$\frac{dx_{CP}^*(t)}{dt} = -\frac{1}{1-b} \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{b}{1-b}} Ab e^{-(r+\delta)(T-t)}. \quad (\text{A.1})$$

The second derivative is:

$$\begin{aligned} \frac{d^2 x_{CP}^*(t)}{dt^2} = & - \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{b}{1-b}} \frac{Ab(r+\delta)}{1-b} e^{-(r+\delta)(T-t)} \\ & + \frac{Ab}{1-b} e^{-(r+\delta)(T-t)} \frac{b}{1-b} \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{b}{1-b}-1} Ab e^{-(r+\delta)(T-t)}. \end{aligned}$$

The overall sign of the second derivative will depend upon the magnitudes of the two terms on the right-hand-side, one of which is negative and the other positive. The size of these two terms changes over time and the second derivative will become positive when:

$$\begin{aligned} & \frac{Ab}{1-b} e^{-(r+\delta)(T-t)} \frac{b}{1-b} \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{b}{1-b}-1} Ab e^{-(r+\delta)(T-t)} \\ & > \left\{ \frac{Ab}{r+\delta} [1 - e^{-(r+\delta)(T-t)}] \right\}^{\frac{b}{1-b}} \frac{Ab(r+\delta)}{1-b} e^{-(r+\delta)(T-t)} \end{aligned}$$

$$\Rightarrow e^{-(r+\delta)(T-t)} > 1-b. \quad (\text{A.2})$$

For the case of individuals with intermittent participation, the optimal investment ratio in any period prior to the break occurring is:

$$x_{IP}^*(t) = \left\{ \frac{Ab}{r+\delta} \left[1 + e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(g-t)} - e^{-(r+\delta)(T-t)} \right] \right\}^{\frac{1}{1-b}}.$$

The first derivative is:

$$\begin{aligned} \frac{dx_{IP}^*(t)}{dt} &= \frac{1}{1-b} \left\{ \frac{Ab}{r+\delta} \left[1 + e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(g-t)} - e^{-(r+\delta)(T-t)} \right] \right\}^{\frac{b}{1-b}} \\ &\quad \times Ab \left[e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(g-t)} - e^{-(r+\delta)(T-t)} \right]. \end{aligned}$$

It may be shown in a similar way to the case of continuous participation that the second derivative will be positive when:

$$-\left[e^{-(r+\delta)(c-t)} - e^{-(r+\delta)(g-t)} - e^{-(r+\delta)(T-t)} \right] > 1-b. \quad (\text{A.3})$$

By comparing the conditions for the investment profile to be convex for the two cases, it may be seen that the profile for those with intermittent participation will become convex at an earlier date since the term on the left-hand-side in (A.3) will always be greater than that in (A.2) at a point in time. The value of the optimal investment ratio at the point where the profiles become convex, however, will be the same in both cases, which may be seen by using (A.3) and (A.2) in the relevant equations for the optimal investment ratios. Points on the investment profile for those with continuous participation will appear on the profile for those with intermittent participation at an earlier date.

A.2 Earnings

An individual's earnings at time t is:

$$y(t) = [1 - x(t)]wK(t). \quad (\text{A.4})$$

The following differential equation gives the human capital stock at t :

$$\frac{dK(t)}{dt} = I(t) - \delta K(t).$$

Substituting in for the production function (2) and dividing through by $K(t)$ gives:

$$\frac{dK(t)/dt}{K(t)} = Ax(t)^b - \delta.$$

Integrating both sides:

$$\log K(t) = \log K_0 + \int_{\tau=0}^t [Ax(\tau)^b - \delta] d\tau, \quad (\text{A.5})$$

where K_0 is the initial stock of human capital. Taking the log of (A.4) gives:

$$\log y(t) = \log[1 - x(t)] + \log w + \log K(t). \quad (\text{A.6})$$

Using (A.5) in (A.6) implies:

$$\log y(t) = \log(wK_0) + \log[1 - x(t)] + \int_{\tau=0}^t [Ax(\tau)^b - \delta] d\tau. \quad (\text{A.7})$$

For s years of schooling where the optimal investment ratio is equal to one, (A.7) may be rewritten as:

$$\begin{aligned} \log y(t) &= \log(wK_0) + \log[1 - x(t)] + \int_{\tau=0}^s [A(1)^b - \delta] d\tau + \int_{\tau=s}^t [Ax(\tau)^b - \delta] d\tau \\ &= \log(wK_0) + s(A - \delta) + \log[1 - x(t)] + \int_{\tau=s}^t [Ax(\tau)^b - \delta] d\tau. \end{aligned} \quad (\text{A.8})$$

The growth in earnings may then be expressed as:

$$\frac{d \log y(t)}{dt} = -\frac{dx^*(t)/dt}{1 - x^*(t)} + Ax^*(t)^b - \delta. \quad (\text{A.9})$$

A.3 The Difference between the Optimal Investment Ratios of Continuous and Intermittent Participants

The optimal investment ratio for a continuous worker is:

$$x_{CP}^*(t) = \left\{ \frac{Ab}{r + \delta} \left[1 - e^{-(r+\delta)(T-t)} \right] \right\}^{\frac{1}{1-b}}.$$

For ease of exposition, this may be rewritten as:

$$x_{CP}^*(t) = \left\{ B_1 \left[1 - e^{-B_2(T-t)} \right] \right\}^{\frac{1}{1-b}} \quad \text{where} \quad B_1 = \frac{Ab}{r + \delta} \quad \text{and} \quad B_2 = (r + \delta).$$

Using this notation, the optimal investment ratio of an intermittent worker is:

$$x_{IP}^*(t) = \left\{ B_1 \left[1 + e^{-B_2(g+L-t)} - e^{-B_2(g-t)} - e^{-B_2(T-t)} \right] \right\}^{\frac{1}{1-b}},$$

where $L = c - g$ (length of break). This can be expressed as:

$$\begin{aligned} x_{IP}^*(t) &= \left\{ B_1 \left[1 + e^{-B_2(g-t)} (e^{-B_2L} - 1) - e^{-B_2(T-t)} \right] \right\}^{\frac{1}{1-b}} \\ &= \left\{ B_1 \left[1 - e^{-B_2(T-t)} \right] - B_1 e^{-B_2(g-t)} \left[1 - e^{-B_2L} \right] \right\}^{\frac{1}{1-b}}. \end{aligned}$$

Then, using the expression for continuous participants above:

$$x_{IP}^*(t) = \left\{ x_{CP}^*(t)^{(1-b)} - B_1 e^{-B_2(g-t)} \left[1 - e^{-B_2L} \right] \right\}^{\frac{1}{1-b}};$$

$$x_{IP}^*(t)^{(1-b)} = \left\{ x_{CP}^*(t)^{(1-b)} - B_1 e^{-B_2(g-t)} \left[1 - e^{-B_2L} \right] \right\};$$

$$x_{CP}^*(t)^{(1-b)} - x_{IP}^*(t)^{(1-b)} = B_1 e^{-B_2(g-t)} \left[1 - e^{-B_2L} \right].$$

A.4 Solving for the Number of Periods Spent in Schooling

For continuous participants:

$$x_{CP}^*(t) = \left\{ B_1 \left[1 - e^{-B_2(T-t)} \right] \right\}^{\frac{1}{1-b}}.$$

The left-hand-side will equal one at the time the individual leaves full time education

($t = S_{CP}$), giving:

$$1 - \frac{1}{B_1} = e^{-B_2(T-S_{CP})}.$$

Taking natural logs:

$$\begin{aligned} \ln \left(1 - \frac{1}{B_1} \right) &= -B_2(T - S_{CP}); \\ \Rightarrow S_{CP} &= T + \frac{\ln(1 - 1/B_1)}{B_2}. \end{aligned} \quad (\text{A.10})$$

Using the same method, it may be shown for the case of intermittent participation that the number of periods devoted to full time schooling is:

$$S_{IP} = T + \frac{1}{B_2} \ln(1 - 1/B_1) - \frac{1}{B_2} \ln \left[1 + e^{B_2(T-g)} - e^{B_2(T-g-L)} \right]. \quad (\text{A.11})$$

The first derivatives of this are:

$$\frac{\delta S_{IP}}{\delta g} = \left[1 + e^{B_2(T-g)} - e^{B_2(T-g-L)} \right]^{-1} \left[e^{B_2(T-g)} - e^{B_2(T-g-L)} \right], \quad (\text{A.12})$$

which is positive implying that the later the break (the higher is g) the greater is the time spent in education; and:

$$\frac{\delta S_{IP}}{\delta L} = - \left[1 + e^{B_2(T-g)} - e^{B_2(T-g-L)} \right]^{-1} e^{B_2(T-g-L)}, \quad (\text{A.13})$$

which is negative implying that the longer the break, the shorter is the time spent in education.