Wage Growth, Human Capital Investment and Risk Preference

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Abstract: The aim of this paper is to explore how interpersonal variation in risk preference affects human capital investment and wage growth. To date, there has been a distinct lack of empirical research in this area despite the fact that the risk preference of individuals plays a key role in the theory of human capital accumulation. We investigate the link between risk preference, human capital investment and wage growth using data from five waves of the *British Household Panel Survey*. We exploit panel data enabling us to determine the change in real wages experienced by individuals across four different time horizons, 1995-96, 1995-98, 1995-2000 and 2000-2001. Our empirical analysis is based on a theoretical framework, which explicitly allows the risk preferences of individuals to influence human capital accumulation and, consequently, wage growth. Our findings support a positive relationship between less risk averse behaviour and wage growth with the relationship becoming more pronounced over time. In addition, our results suggest that less risk averse behaviour impacts positively on the returns to human capital investment.

Keywords: Human capital; Risk Aversion; Wage Growth

JEL Classification: J24; J30.

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I. Introduction

Given the uncertainty surrounding the returns to investments in human capital, it is not surprising that the risk preference of individuals plays a key role in the theory of human capital accumulation.[1] By definition, any investment in human capital can be considered as risky, since the return is unknown and uncertain. Recent evidence for the U.S. suggests that, due to the degree of risk associated with human capital investments, the actual gains from higher education per unit of risk are in the region of 5 to 20 per cent higher than that from risky financial assets, Palacios-Huerta (2003). The problem is exacerbated, as it is not clear how one can reduce the degree of risk associated with human capital investment. As pointed out by Shaw (1996), the standard approach to reducing risk in financial investment, namely diversification, is often not available in the context of human capital. Typically, an individual holds one job with his/her human capital investments tailored accordingly.

Given the obvious problems in measuring risk preference, it is not surprising, that attitudes towards risk have attracted very little attention in the empirical literature.[2] In some empirical models of human capital accumulation, a parameter of constant risk aversion has been included,[3] but such an approach clearly does not allow variation in risk aversion across individuals to play a role in the investment decision-making process. One important exception in the literature is Shaw (1996) who jointly models investment in risky human capital and financial wealth allowing for interpersonal differences in risk preference. The theoretical framework predicts an inverse relationship between an individual's degree of risk aversion and investment in risky human capital,

[1] See, for example, Johnson (1978), Levhari and Weiss (1974) and Gibbons and Murphy (1992).

[2] Some attempts have been made to adjust the returns to schooling for individual risk by estimating Mincerian wage equations allowing for random coefficients, which yields dispersion (i.e. risk) in the returns to schooling by assigning individual specific returns, Harmon *et al*. (2003).

[3] Such studies include Brown and Rosen (1987), Moore (1987) and Murphy and Topel (1987) whilst Belzil and Hansen (2002) dispense with this assumption.

which, in turn, impacts upon wage growth. Using U.S. data, Shaw finds that wage growth is positively correlated with willingness to invest in risky financial assets such as stocks and shares.

In this paper, we test the theoretical predictions from Shaw's model using data derived from the British Household Panel Survey (*BHPS*), as well as extending her empirical analysis in a number of important ways. We concentrate upon the 1995 wave of the *BHPS* since there are only two years, 1995 and 2000, when individuals are asked detailed questions pertaining to investments held in risky assets such as shares and unit trusts. We focus on the information derived from the 1995 wave in order to determine how risk preference in 1995 affects estimated returns to human capital and, hence, wage growth over three time periods – 1995 to 1996, 1995 to 1998 and 1995 to 2000. We also investigate the determinants of wage growth between 2000 and 2001 exploring how risk preference in 2000 affects returns to human capital over a one-year time horizon – data availability limits the length of time horizon analysed in this case. Our findings suggest that less risk averse behaviour impacts positively on the returns to human capital investment thereby enhancing wage growth.

The paper is set out as follows: Section II summarises the theoretical underpinnings to our thesis whilst Section III describes the data and methodology. Our empirical findings are presented in Section IV whilst final comments and policy implications are collected in Section V.

II. Theoretical Considerations

In order to place our empirical analysis into context, this section summarises the theoretical framework developed by Shaw (1996) [see Shaw, 1996, for full details]. The model is based on a portfolio allocation model extended to incorporate an individual's decision to invest in risky human capital. The share of current human capital allocated to producing new human capital is given by:

$$s_t = \frac{\mu_h - \eta}{\sigma_h^2 R} \tag{1}$$

where $(\mu_h - \eta)$ denotes the net return to risky human capital investment, σ_h^2 represents the variance of its return and R denotes the Pratt-Arrow index of constant relative risk aversion.[4] Hence, Equation 1 predicts an inverse relationship between risk aversion and investment in risky human capital. Similarly, the share of financial wealth invested in risky financial assets is given by:

$$\alpha_t = \frac{\mu - r}{\sigma_f^2 R} \tag{2}$$

where the net return to risky financial investment is given by $(\mu - r)$ and σ_f^2 denotes the variance of the return.[5]

In order to derive an expression for wage growth, wages at time *t* are defined as:

$$w_t = (1 - s_t)K_t = (1 - s_t)(1 + \gamma_t s_{t-1})K_{t-1} \tag{3}$$

where K_t denotes human capital at time t and γ_t represents the productivity of s_{t-1}. Hence, wage growth can be expressed as:

$$\Delta \ln w_t \approx \ln(1 + \gamma_t s_{t-1}) \tag{4}$$

Assuming $s_t \approx s_{t-1}$, small $\gamma_t s_{t-1}$ and that each investor has the same perceptions of returns to risky financial investments,[6] wage growth can be expressed as:

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[4] In Equation 1, μ_h denotes the mean return to human capital investment and η denotes the marginal rate of substitution between financial wealth and human capital.

[5] In Equation 2, μ represents the expected return on the risky asset portfolio whilst *r* represents the risk free return.

[6] This is a standard assumption in portfolio theory – in a well-diversified portfolio, the return would be the same as that of the market portfolio [see Elton *et al.*, 2003].

$$\Delta \ln w = b\alpha \left(\frac{\gamma(\mu_h - \eta)}{\sigma_h^2} \right) \tag{5}$$

where $b = \sigma_f^2 / \mu - r$. The term $\gamma(\mu_h - \eta)$ represents the productivity of human capital and can be proxied by $\boldsymbol{X}_i \beta + u_i$ where $\boldsymbol{X}_i$ is an observed matrix of human capital for individual *i* and u_i represents measurement error. Hence, a wage growth model can be estimated as follows:

$$\Delta \ln w_i = \frac{b\alpha_i}{\sigma_{hi}^2} (\boldsymbol{X}_i \beta) + \varepsilon_i \tag{6}$$

where the error term is defined as $\varepsilon_i = (b\alpha_i / \sigma_{hi}^2) u_i$ and so may not be homoscedastic. The intuition underlying Equation 6 is that those individuals who hold large shares of risky assets, α_i, will also invest in greater amounts of risky human capital.[7,8] It is apparent from Equation 6 that risk-taking as measured by α_i will augment all estimated returns to human capital in the matrix $\boldsymbol{X}$ by the amount (b / σ_{hi}^2). Furthermore, risk preferences may also influence the returns to human capital indirectly through $(b / \sigma_{hi}^2)\beta$. We therefore aim to explore the determinants of real wage growth focusing on the direct and indirect effect of risk preferences via non-linear least squares estimation given the nature of the functional form underlying Equation 6.

III. Data and Methodology

Given that the aim of this paper is to explore how interpersonal variation in risk preference affects human capital investment, we require panel data whereby the same

[7] Similarly, Guiso *et al.* (1996) recognise the influence of earnings risk on a household's demand for risky assets and report an inverse relationship between investment in risky assets and income risk. Moreover, it is apparent that income risk may be influenced by investment in human capital.

[8] Although the theoretical model predicts a positive association between less risk averse behaviour and human capital investment, it is clearly important to explore the empirical validity of this ascertain. It may be the case, for example, that individuals who are risk averse are more likely to invest in human capital in order to safeguard their future, this provides some intuition to explain an inverse relationship.

individuals are tracked across time enabling us to determine the change in real wages experienced by individuals over time and, hence, wage growth at the individual level. Our data set is derived from five waves of the *BHPS* – 1995, 1996, 1998, 2000 and 2001. This is a random sample survey of each adult member of a nationally representative sample of more than 5,000 private households (yielding approximately 10,000 individual interviews). For Wave one, interviews were conducted during the autumn of 1991. The same individuals are re-interviewed in successive waves – the latest available being wave twelve in 2002.

In contrast to Shaw (1996) who is limited to exploring wage growth over a single time period, 1983-1986, the *BHPS* allows us to explore wage growth over different time horizons in terms of both the length of time horizon and in terms of different base years (i.e. 1995 and 2000). The fact that we can explore the relationship between risk preferences, human capital investment and wage growth over different time periods and time horizons is particularly important due to a number of reasons. It may be the case, for example, that risk preferences vary over time or the impact of risk preferences may not be time invariant. On the other hand, both the propensity and the opportunity to invest in human capital or risky financial capital may be sensitive to particular time periods. This may be due to changes in individuals' circumstances relating to, for example, marital or employment status. Hence, the *BHPS* is well-suited to our purposes as, in contrast to the data set analysed by Shaw (1996), it provides us with an opportunity to explore the importance of the time dimension in the relationship between risk preference, human capital accumulation and wage growth.

We initially concentrate upon the 1995 wave since there are only two years in which individuals are asked detailed questions pertaining to investments held in risky assets such as shares and unit trusts – 1995 and 2000.[9] We use information derived from the 1995 wave in order to determine how investments held in risky assets in 1995 affect estimated returns to human capital and, hence, wage growth over the periods 1995 to 1996 (first difference), 1995-1998 (third difference) and 1995-2000 (fifth difference). To evaluate the impact of risk preference upon human capital investment we only require information on risk preference in the base year, 1995. Although, Equation 6 is a growth equation and so wages are differenced, all explanatory variables relate to the base year. We explore wage growth over different time horizons in order to ascertain the robustness of our findings and, in addition, to determine their stability over different wage growth horizons. We also explore the implications of specifying a different base year – namely 2000 – although we restricted our analysis to a one-year growth horizon in this case, with all explanatory variables pertaining to the base year, 2000.

Our sample consists of individuals in employment aged between 16 and 65. We exclude the self-employed, agricultural workers and individuals with more than one job. After conditioning on individuals who have data responses on the investment questions which are of key interest to our study, the sample sizes for the three growth periods with the 1995 base year are 3,105 for the first difference sample, 2,441 for the third difference sample and 2,294 for the fifth difference sample, whilst the sample size is 2,170 in the case of the first difference sample with the 2000 base year.

The empirical counterpart to Equation 6, which forms the basis of our empirical investigations, is as follows:

$$\Delta^d \ln w_i = [\pi(Asset\ Share_i)]\boldsymbol{X}_i\beta + \gamma'\boldsymbol{H}_i + \varepsilon_i \qquad (7)$$

[9] Banks *et al.* (2002) use the 1995 and 2000 waves from the *BHPS* to provide a descriptive investigation of the distribution of financial wealth over the period.

where $d=1,3,5$ represents the length of the difference, so, $\Delta^1 \ln w_i = \ln w_{i,1996} - \ln w_{i,1995}$, $\Delta^3 \ln w_i = \ln w_{i,1998} - \ln w_{i,1995}$, $\Delta^5 \ln w_i = \ln w_{i,2000} - \ln w_{i,1995}$ and, finally, for the 2000 base year, $\Delta^1 \ln w_i = \ln w_{i,2001} - \ln w_{i,2000}$. The impact of risk preferences upon human capital, thus, stems from a direct effect π, where $\pi = \left(b / \sigma_{hi}^2\right)$, and an indirect effect, $\pi \times \beta$.

The dependant variable, the relevant difference in log real hourly wages according to the time period under investigation, is derived from usual gross pay per month from current job divided by usual monthly hours. We replace α_i in Equation 6 with the variable $Asset\ Share_i$, which represents the proportion of net wealth held in investments which, according to the theoretical framework, is inversely related to risk aversion.[10,11] Our measure of risk aversion, $Asset\ Share_i$, is defined as follows:[12]

$$Asset\ Share_i = \frac{Investments_i}{Investments_i + Savings_i} \tag{8}$$

Figures 1 to 8 present the distribution of $Asset\ Share_i$ across our four growth samples as well as for only those employees reporting positive asset shares.

<<FIGURES 1 TO 8 HERE>>

It is apparent from Figures 1, 2, 3 and 7 that the large majority of employees have zero asset shares in accordance with the findings of Shaw (1996) for the U.S. In the following section, we explore whether the skewness of $Asset\ Share_i$ towards a uniform mass point of zero impinges on our results.

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[10] Shaw (1996) also measures risk aversion via survey information whereby individuals were asked about their attitudes towards financial risk. Such information however is not available in the *BHPS*.

[11] Investments comprises of shares, personal equity plans, unit trusts and other investments such as government and company securities.

[12] We have experimented with various definitions of the asset share variable including definitions incorporating housing wealth and debt. Our findings, which are available from the authors on request, are robust to such changes.

Turning to the measures of human capital specified in the matrix, ***X***, the *BHPS*, in contrast to the data set exploited by Shaw (1996), provides information on highest education qualifications rather than relying on a simple years of school index. We also control for labour market experience entered in a quadratic form as well as the extent of job turnover within the relevant sample period.

Also included in the model apart from human capital variables are other controls, given in the matrix ***H***, which are likely to influence wage growth such as occupation, industrial affiliation and regional location (with 8, 8 and 10 categories respectively), as well as demographic characteristics such as gender, marital status and ethnicity. We also control for other factors related to employment such as trade union membership and the type of employment contract held by the individual. The inclusion of contract type captures the effects of other types of risk akin to the theoretical model of Caroli and Garcia-Peñalosa (2002). To summarise, the ***H*** matrix contains a much richer array of control variables than that specified by Shaw (1996).

Full summary statistics for all of the variables used in our empirical analysis are presented in Tables 1A, for the different time horizons and base years with information in the first column stating where each variable is assigned in terms of the ***X*** or ***H*** matrix. Clearly across the different samples the average share of investments is around 25 per cent. Table 1B presents summary statistics of the asset share variable by educational attainment for 1995 and 2000.

<<TABLES 1A & 1B HERE>>

Across each of the three time horizons for the 1995 sample, it is apparent that those individuals with higher educational qualifications are characterised by a larger asset share suggesting a positive correlation between investment in human capital and investment in risky financial assets. For example, those individuals with A levels or

GCSE grades A-C have asset shares similar to the overall mean, whilst the asset share rises to 33% for those individuals who possess a degree. The figures for 2000 follow a similar pattern with the asset share variable being positively correlated with educational attainment.

IV. Results

In the following discussion, we focus on the key results of interest, which are shown in the shaded areas of Tables 2 to 5.[13] Table 2 below presents the results of estimating Equation 7 across the three different wage growth horizons with a base year of 1995 in the first three columns and a base year of 2000 in the final column allowing for heterogeneity in risk aversion at the individual level.[14,15]

<<TABLE 2 HERE>>

The estimated coefficient on the asset share variable, our measure of risk preference is statistically significant and positive across each period. The sign of the estimated coefficient of the asset share variable suggests that those individuals who are willing to make greater financial investments experience higher rates of wage growth. Furthermore, it is apparent that the return to risk-taking increases monotonically across the growth horizons.[16]

The estimated coefficients on the educational attainment variables represent the second indirect effect stemming from interactions between risk preference and the returns to human capital. A striking feature from the results reported in Table 2 is that

[13] The controls in Tables 2, 4 and 5 consist of industry, occupational and regional dummy variables, each jointly significant at the 1 per cent level.

[14] In order to allow for identification of the π and β 's, we normalise on the 'no education' category.

[15] For all of the results which follow, the error term $\varepsilon_i = \left(b\alpha_i / \sigma_{hi}^2\right)u_i$ (see Section II) has to be tested for heteroscedasticity where throughout the null hypothesis of homoscedasticity cannot be rejected at the 1 per cent level.

[16] The coefficients on the asset share variable are significantly different between the first and third difference samples and the first and fifth difference samples with F-Statistics, F(1, 3059)=4.74 and F(1, 3059)=21.60, respectively suggesting that there is an important time dimension to the analysis.

the returns to low education are generally larger than the returns to high education, although the returns to education are positive for all levels of educational attainment. For example, the return to a degree and GCSE grades below C are significantly different at the 1 per cent level. When interpreting the results, it is important to acknowledge that this is not a wage equation but a wage growth model and also that the returns to education are in effect non-linear interactions with the individual risk preference variable. The returns from human capital investment for risk lovers who initially have relatively low levels of educational attainment are greater than that for those with relatively high levels of educational attainment, for instance GCSE versus degree. This may reflect the fact that those with low educational attainment are willing to take greater risks or that they have greater scope for investment in human capital.[17]

Similarly, when one interprets the experience terms, which are interacted with risk preference, it is important to acknowledge that we are estimating a wage growth model. Hence, our results imply that the returns to risk-taking diminish as experience increases. It is surprising to note that the estimated coefficient on the turnover variable which captures the effect of job moving on wage growth, is positive yet insignificant.[18]

Turning to the variables entering the ***H*** matrix, males appear to experience higher wage growth than females. Immigrants have significantly greater wage growth in the

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[17] To explore these issues more fully, we split our sample into a high education group (degree and further education only) and a low education group (A level and below), yielding sample sizes of 877 and 1,417 respectively. We then estimate Equation 7 for the fifth difference wage growth period for each sample separately. To allow identification the omitted categories are ‘further’ and ‘no education’ respectively.

	Degree		A level		GCSE A-C		GCSE <C	
High	1.019	*13%*	–		–		–	
Low	–		1.078	*11%*	1.227	*15%*	1.428	*16%*

The results, along with the percentage change in coefficient compared to column 1 in Table 2, are summarised above, with all the coefficients shown above significant at the 5 per cent level or above. It is apparent that the greatest percentage change is for the lower education group, thus confirming our *a priori* expectations that those with the lower levels of educational attainment are faced with greater scope for investment in human capital.

[18] We have also explored the proposition that individuals with positive turnover, i.e. job-movers, are relatively more risk loving than those who stay in the same firm, as asserted by Shaw (1996). The findings suggested that the risk preferences of those individuals who move are biased in favour of risk-loving behaviour in terms of the intercept effect, in accordance with Shaw’s findings.

first and third difference models whilst married individuals experience lower wage growth, which is significant across third and fifth difference time horizons. In accordance with Shaw (1996), trade union membership impacts negatively on wage growth. We also investigate whether having a permanent contract impinges upon wage growth. This variable may also be capturing attitudes towards risk following the argument put forward by Caroli and Garcia-Peñalosa (2002). We discover, however, that this variable only exerts a significant negative effect in the third difference specification, which may reflect the length of fixed term contracts. Finally, our results suggest that firm size impacts in a positive yet diminishing fashion on wage growth.

Turning to the first difference sample for 2000-2001, in the final column of Table 2, we explore how investments held in risky financial assets in 2000 affect estimated returns to human capital and, hence, wage growth over this period. It is apparent that the findings tie in with those for the 1995 base year – although the estimated coefficient on the asset share variable is much more pronounced for this more recent growth period.

Extensions

We attempt to address three shortcomings with the Shaw (1996) analysis by extending the empirical analysis in three distinct ways. Firstly, we endogenise the asset share variable in order to control for potential income effects. Secondly, we restrict our analysis to those with a positive asset share only controlling for sample selection bias. Finally, we incorporate recent investments in human capital into the framework. In each extension, for reasons of brevity we restrict our analysis to the fifth difference sample only.

A potential problem with the empirical analysis so far is that one could argue that we are simply picking up an income effect. That is, those individuals who hold risky financial assets have higher wages and so experience greater wage growth. For instance, if wage growth is correlated with high levels of income, and high-income individuals are risk takers, then the impact of risk attitudes upon wage growth could simply imply a wage-income correlation rather than a relationship between risk preference and wage growth. This is essentially a problem of endogeneity bias. We would argue against this, however, on the grounds that we enter risk-preferences in levels into a wage growth, i.e. differenced, equation. Hence we are not estimating a relationship between the change in asset share (potentially an income effect) and wage growth. Although such issues are not explicitly discussed by Shaw (1996), we subject our analysis to further scrutiny by instrumenting the asset share variable.

Following Guiso *et al.* (1996), we regress asset share upon a quadratic in age, income and other controls given in the matrix $\boldsymbol{Z}$ - the results are shown in Table 3.[19] We then take the predicted values from this model, $\hat{A}_i = \boldsymbol{Z}_i\hat{\phi}$, and estimate the wage growth equation in fifth differences:

$$Asset\ Share_i^* = \boldsymbol{Z}_i\phi + \omega_i \tag{9a}$$

$$Asset\ Share_i = \begin{cases} 0 \quad if \quad Asset\ Share_i^* \leq 0 \\ Asset\ Share_i^* \quad if \quad Asset\ Share_i^* > 0 \end{cases} \tag{9b}$$

$$\Delta^5 \ln w_i = \left[\pi\left(\hat{A}_i\right)\right]\boldsymbol{X}_i\beta + \gamma'\boldsymbol{H}_i + \varepsilon_i \tag{9c}$$

The results of estimating Equation 9a are shown in Table 3 whilst the estimates from Equation 9c are shown in Table 4. The specification we report in Table 3 is similar in design to that of Guiso *et al.* (1996, 2003). The results from estimating Equation 9c are shown in the first column of Table 4 and demonstrate that the asset share variable again

[19] We specify a tobit model given the truncated nature of the asset share variable.

has a positive and significant estimated coefficient – although its magnitude is much more pronounced. In terms of the human capital interactions, our findings suggest that there are positive indirect effects from risk taking behaviour. In addition, there is still evidence of lower returns for high educational attainment *vis à vis* low educational attainment – for instance degree versus GCSE grades below C, which are significantly different at the 1 per cent level.

<<TABLES 3 AND 4 HERE>>

Our next extension concerns the fact that, in accordance with Shaw (1996), we find that the large majority of employees in our sample have zero asset shares. In contrast to Shaw (1996), however, we explore whether this skewness towards the uniform mass point of zero for assets impinges upon our findings. Restricting our sample to those employees reporting positive asset shares only yields a sample size of 667. The distributions of the asset share variable across each of the three time horizons are depicted in Figures 4, 5, 6 and 8.

We replicate the fifth difference results presented in Table 2 for those individuals reporting positive asset shares controlling for sample selection by incorporating an inverse mills ratio into our analysis, which controls for the probability of having a positive asset share.[20] The positive estimated coefficient on the asset share variable remains albeit at a lower level of significance and magnitude. Interestingly, the interactions with the educational attainment variables are now relatively larger with the exception of the 'other' category. Finally, the estimated coefficient on the sample

[20] In order to control for sample selection bias, we specify a probit model with the dependant indicating whether an individual has a strictly positive asset share – the explanatory variables include a combination of personal and job characteristics. In general, the sample selection equation is well-specified with a chi-squared statistic of 282 (degrees of freedom 44). The full results of the sample selection equation are available from the authors on request.

selection term is positive and significant indicating that its exclusion would bias our results downwards.

The final issue that we address concerns a key assumption underlying the theoretical model of Section II where attitudes towards risk in period *t* (1995) are assumed to reflect an individual's preferences at the time of human capital accumulation which may have occurred at some period *t-h*. It is surprising that Shaw (1996) does not allude to this concern. The problem is exacerbated as our risk measure in 1995, akin to that of Shaw, coincides with human capital already accumulated. However, this is not an issue if risk preference is time invariant.

Our results from instrumenting the asset share (see Table 3) indicate that the age terms have a significant effect suggesting that risk preferences may not be time invariant. It is apparent, however, from the size of the estimated coefficients that the marginal effects are relatively small indicating that the extent to which preferences vary over time may not be particularly important.[21] For example, for every additional ten years of age, the asset share increases by 0.74%, where the mean asset share is 25% suggesting that the impact of age is somewhat limited.[22] Although these findings may justify our methodology, we subject our analysis to further scrutiny in two ways. Firstly, if risk preferences are time invariant then there should be a relationship between asset share in 1995 and wage growth in periods prior to 1995. Similarly, such a relationship should exist between the asset share variable in 2000 and wage growth in periods prior to 2000. Secondly, we explore the influence of recent investments in human capital upon wage growth.

[21] Using data for the USA, Haliassos and Bertaut (1995) found risk preferences to be time invariant. More recently, Guiso *et al.* (2003) have also found risk preferences, measured by asset share, to be time invariant in a number of countries.
[22] We have also estimated an asset share equation based upon data from 2000. Interestingly, the age coefficients were insignificant again suggesting time invariance of risk preferences.

In the first column of Table 5, we report the results of estimating Equation 7 for wage growth between 1991 and 1995.[23] It is evident that both the direct and indirect effects of risk preference are significant lending further support for the proposition that risk preferences are relatively stable across time. Similarly, we estimate Equation 7 for the period 1995-2000 with 2000 set as the base year. The findings, which are presented in the second column of Table 5, indicate that the direct effect of risk preferences is remarkably similar to that presented in Table 2 for the fifth difference sample when 1995 is set as the base year, although the returns to education are more pronounced in Table 5. Thus, our findings suggest that risk preferences may be time invariant.

<<TABLE 5 HERE>>

Turning to current investments in human capital, our proxy for risk preference relates to investment in risky financial assets in 1995, hence we explore the effect of recent human capital investment. This is particularly important as educational attainment may reflect human capital investments made sometime ago. To do this, we include a set of dummy variables to capture whether an individual reports additional educational qualifications between 1995 and 2000 in terms of GCSEs (grades < C and grades A-C), A levels, further education, degree level education or vocational qualifications. We also control for whether the individual reports that they have received during this time period either employer training or non-employer training. Finally, we control for whether the individual or his/her family incurred the financial costs of any training courses.

The results are shown in the last column in Table 5. Once again, our findings with respect to the asset share and educational variables are largely unchanged. In addition, the variables capturing additional investments in human capital are insignificant with the exception of the recent acquisition of a degree. Thus, our findings

[23] This is a fourth difference specification, because 1991 was the first year of the *BHPS* so a fifth difference horizon was not possible.

appear to be robust to controlling for recent investments in human capital in terms of both educational qualifications and job training.

V. Conclusion

In this paper, we have explored how interpersonal variation in risk preference affects human capital investment and, hence, wage growth. We have investigated the link between risk preference and wage growth using data from five waves of the *BHPS*. In general, our findings suggest that those individuals who are willing to take greater risks experience higher rates of wage growth. Moreover, we have found that this result is particularly robust in terms of both changes to the underlying empirical specification as well as changes to the sample of individuals analysed. Furthermore, in contrast to the previous work in this area, the *BHPS* has enabled us to explore the relationship between human capital, risk preference and wage growth over different time horizons as well as at different points in time. The time dimension to our analysis is particularly important as individuals' circumstances clearly may be subject to change over time, which may impact upon risk preferences as well as opportunities to invest in risky human or financial capital.

To date, there has been a distinct lack of empirical research in this area in spite of the fact that any link between risk aversion and wage growth should be of key interest to policy makers - especially if the presence of risk aversion deters individuals from investing in risky human capital. The existence of such a deterrent to investing in human capital may serve to erode productivity and hence may exert adverse effects on economic growth. This would be akin to the argument put forward by Lucas (1988) who linked human capital accumulation to productivity and economic growth.

In addition, our findings may have implications for income distribution – if risk preference and wage growth are correlated, then the variability of risk preference and changes in the composition of assets over time (see Banks *et al.*, 2002) should impact upon the distribution of income. Moreover, our results suggest that risk preference influences the returns to human capital across different educational groups, hence risk preferences and how they affect human capital accumulation may be important in explaining recent increases in international wage inequality, Machin and Van Reenen (1998).

Finally, our findings should add to the current debate on the funding and access to higher education especially in the context of the proposed reforms to the funding for higher education in the U.K. which have been designed to alter the social mix of students to encourage participation amongst lower socio economics groups, Greenaway and Haynes (2000). If it is the case that risk-aversion is concentrated amongst the lower socio-economic groups, then our framework predicts that such individuals may be unlikely to invest in human capital given the current funding system. Interestingly, recent evidence for the U.S. suggests that the losses to lower education (high school) per unit of risk relative to risky financial returns are in excess of 15 per cent, Palacios-Huerta (2003). Thus, such findings suggest that frictions may be present at lower levels of education.

If there is an association between risk-aversion and human capital accumulation then ways in which individuals' risk preferences could be influenced may have wide reaching effects. For example, if risk-aversion is due to information asymmetries, or in the case of higher education varies by socio-economic group, it may be reduced through specific training or education. Moreover, such training or education could directly affect productivity as well as exerting an indirect influence on an individual's willingness to take risks.

Given the importance of such findings for policymaking, it is surprising that there is a distinct lack of research in this area. Hopefully our findings may serve to stimulate further research on the relationship between risk preference, human capital accumulation and wage growth.

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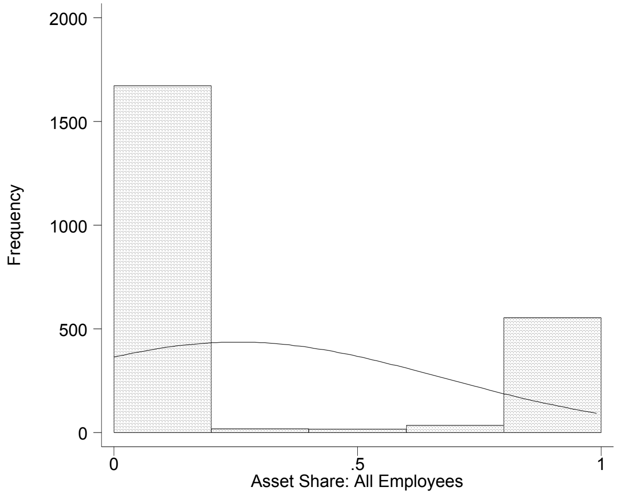

Figure 1: Asset Distribution: 5th Difference

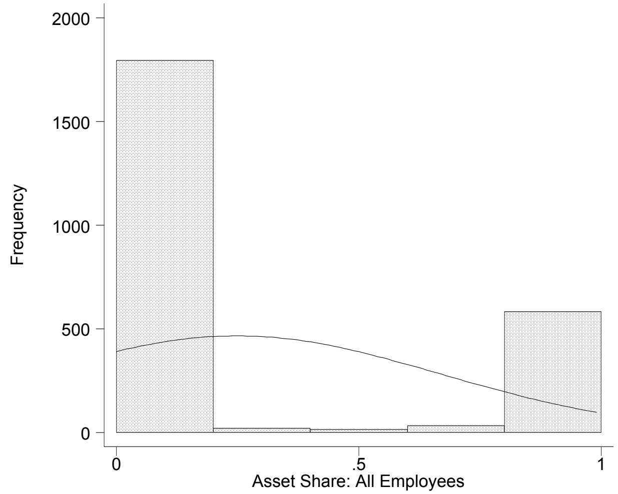

Figure 2: Asset Distribution: 3rd Difference

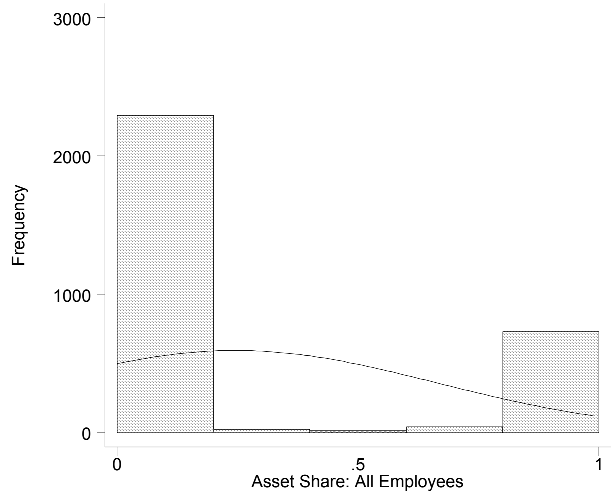

Figure 3: Asset Distribution: 1st Difference

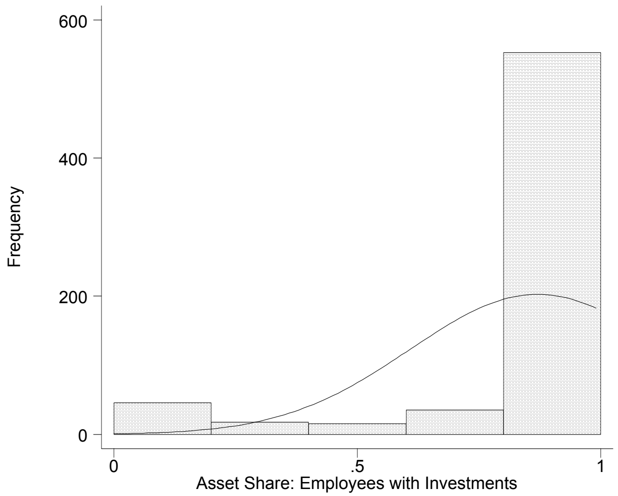

Figure 4: Asset Distribution: 5th Difference

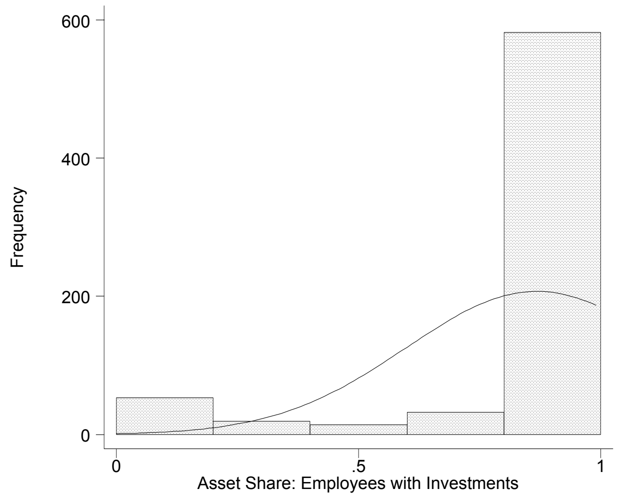

Figure 5: Asset Distribution: 3rd Difference

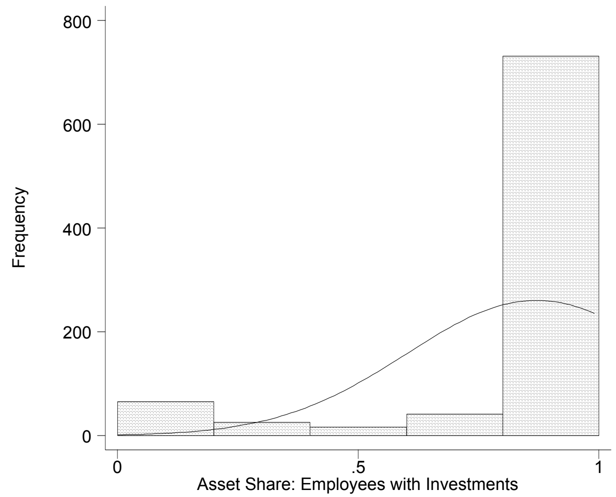

Figure 6: Asset Distribution: 1st Difference

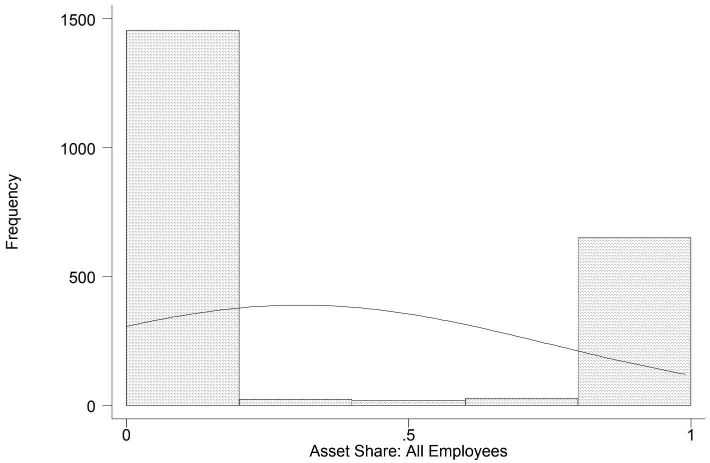

Figure 7: Asset Distribution: 1st Difference 2001-2000

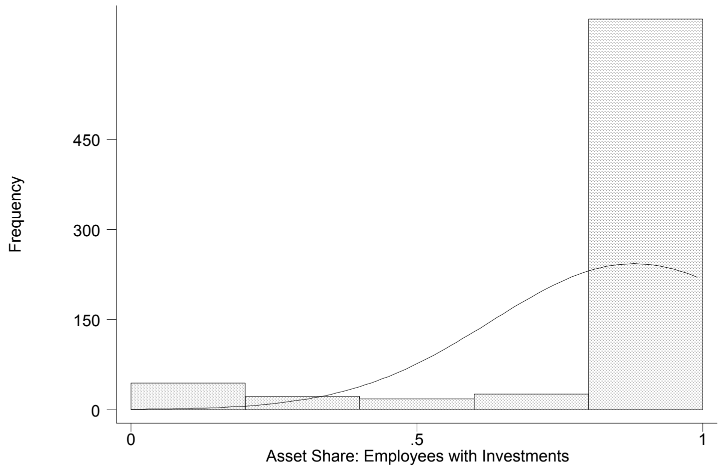

Figure 8: Asset Distribution: 1st Difference 2001-2000

TABLE 1A: Summary Statistics

		BASE YEAR = 1995									BASE YEAR = 2000		
		5TH DIFFERENCE			3RD DIFFERENCE			1ST DIFFERENCE			1ST DIFFERENCE		
		Mean	*Min*	*Max*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
ΔW	Log Wage Growth	0.1437	-2.1707	2.3493	0.0811	-2.1655	3.3347	0.0337	-2.2742	2.669	0.1436	-2.1707	2.3493
X	Asset Share	0.2530	0	1	0.2489	0	1	0.2459	0	1	0.3081	0	1
X	Experience	23.9425	2	50	24.444	2	57	24.728	3	57	23.9880	2	50
X	Experience Squared/10	69.1342	1	250	72.826	1	325	75.318	1	325	69.2001	0.4	250
X	Turnover	1.3001	0	6	1.5422	0	5	0.3449	0	1	1.3991	1	5
X	Degree	0.1622	0	1	0.1536	0	1	0.1623	0	1	0.1760	0	1
X	Further Education	0.2201	0	1	0.2204	0	1	0.2113	0	1	0.3124	0	1
X	A Level	0.1417	0	1	0.1381	0	1	0.1356	0	1	0.1175	0	1
X	GCSE Grades A-C	0.2419	0	1	0.2392	0	1	0.2351	0	1	0.1945	0	1
X	GCSE Grades <C	0.0488	0	1	0.0537	0	1	0.0473	0	1	0.0419	0	1
X	Other Qualification	0.0497	0	1	0.0442	0	1	0.0489	0	1	0.0406	0	1
X	No Qualifications	0.1356	0	1	0.1487	0	1	0.1568	0	1	0.1171	0	1
X	Recent Degree	–	–	–	–	–	–	–	–	–	0.0244	0	1
X	Recent Further Education	–	–	–	–	–	–	–	–	–	0.2507	0	1
X	Recent A Level	–	–	–	–	–	–	–	–	–	0.0955	0	1
X	Recent GCSE A-C	–	–	–	–	–	–	–	–	–	0.0074	0	1
X	Recent GCSE <C	–	–	–	–	–	–	–	–	–	0.0017	0	1
X	Recent Vocational	–	–	–	–	–	–	–	–	–	0.0227	0	1
X	Recent On- Job Training	–	–	–	–	–	–	–	–	–	0.5915	0	1
X	Recent Off-Job Training	–	–	–	–	–	–	–	–	–	0.1482	0	1
X	Paid for Recent Education	–	–	–	–	–	–	–	–	–	0.1007	0	1
H	Male	0.5078	0	1	0.5031	0	1	0.4969	0	1	0.5088	0	1
H	White	0.9690	0	1	0.9644	0	1	0.9701	0	1	0.9705	0	1
H	Immigrant	0.0462	0	1	0.0537	0	1	0.0493	0	1	0.0452	0	1
H	Married	0.7576	0	1	0.7587	0	1	0.7424	0	1	0.8009	0	1
H	Trade Union	0.3418	0	1	0.3449	0	1	0.3339	0	1	0.3576	0	1
H	Firm Size 1-24	0.2847	0	1	0.2868	0	1	0.2937	0	1	0.2912	0	1
H	Firm Size 25-99	0.2650	0	1	0.2642	0	1	0.2612	0	1	0.2424	0	1
H	Firm Size 100-499	0.2668	0	1	0.2671	0	1	0.2651	0	1	0.2654	0	1
H	Permanent Contract	0.9477	0	1	0.9501	0	1	0.9485	0	1	0.9493	0	1
	Observations	*2,294*			*2,441*			*3,105*			*2,170*		

TABLE 1B: Summary Statistics: Asset Share by Education

	BASE YEAR =1995						BASE YEAR = 2000	
	5TH DIFFERENCE		3RD DIFFERENCE		1ST DIFFERENCE		1ST DIFFERENCE	
	Obs	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*
Degree	372	0.3338	375	0.3205	504	0.3319	382	0.4221
Further Education	505	0.2727	538	0.2792	656	0.2502	678	0.3166
A Level	325	0.2508	337	0.2361	421	0.2263	255	0.2822
GCSE grades A-C	555	0.2581	584	0.2532	730	0.2552	422	0.3216
GCSE grades <C	112	0.1429	131	0.1281	147	0.1403	91	0.1863
Other Qualification	114	0.2318	108	0.2966	152	0.2646	88	0.1992
No Qualifications	311	0.1649	368	0.1679	495	0.1841	254	0.1986
Observations	*2,294*		*2,441*		*3,105*		*2,170*	

TABLE 2: Wage Growth across Different Time Horizons and Base Years

	BASE YEAR = 1995									BASE YEAR = 2000		
	5TH DIFFERENCE			3RD DIFFERENCE			1ST DIFFERENCE			1ST DIFFERENCE		
$\hat{\pi}$												
Asset Share	0.4645	***	*(3.83)*	0.2928	***	*(2.96)*	0.1416	**	*(2.04)*	0.5033	***	*(4.32)*
$\hat{\pi} \times \hat{\beta}$												
Experience	-0.0709	***	*(6.36)*	-0.0433	***	*(3.26)*	-0.0723	***	*(3.33)*	-0.0738	***	*(6.29)*
Experience Squared	0.0099	***	*(4.25)*	0.0044		*(1.49)*	0.0113	***	*(2.59)*	0.0103	***	*(4.61)*
Turnover	0.0004		*(0.04)*	0.0528		*(0.83)*	0.2978		*(1.20)*	-0.0133		*(0.27)*
Degree	0.8993	***	*(6.32)*	0.5663	***	*(2.96)*	0.7915	***	*(2.93)*	0.9677	***	*(7.21)*
Further	0.8790	***	*(6.53)*	0.5881	***	*(3.17)*	1.0559	***	*(3.55)*	0.9798	***	*(7.79)*
A level	0.9674	***	*(6.37)*	0.7974	***	*(4.03)*	0.8837	***	*(2.93)*	1.0905	***	*(6.88)*
GCSE Grades A-C	1.0659	***	*(7.15)*	0.9405	***	*(5.21)*	1.1037	***	*(3.68)*	1.0362	***	*(7.66)*
GCSE Grades <C	1.2313	***	*(4.66)*	0.5319		*(1.59)*	0.9359	*	*(1.85)*	1.2469	***	*(5.13)*
Other Qualification	0.9745	***	*(4.90)*	0.8227	***	*(3.27)*	0.9975	***	*(2.58)*	0.8428	***	*(3.95)*
$\hat{\gamma}$												
Male	0.0375		*(2.03)*	0.0037		*(0.23)*	0.0242		*(2.06)*	-0.0159		*(0.84)*
White	0.0939		*(2.32)*	0.1123		*(3.33)*	-0.0009		*(0.03)*	0.1058		*(2.51)*
Immigrant	0.0268		*(0.65)*	0.0689		*(2.07)*	0.0532		*(2.11)*	0.0115		*(0.27)*
Married	-0.0860		*(4.57)*	-0.0363		*(2.22)*	-0.0058		*(0.49)*	-0.0533		*(2.62)*
Trade Union	-0.0883		*(4.65)*	-0.0581		*(3.52)*	-0.0138		*(1.14)*	-0.0179		*(0.96)*
Firm Size 1-24	0.0939		*(3.80)*	0.0812		*(3.78)*	0.0198		*(1.26)*	-0.0480		*(1.99)*
Firm Size 25-99	0.0673		*(2.78)*	0.0595		*(2.82)*	0.0080		*(0.51)*	0.0267		*(1.09)*
Firm Size 100-499	0.0467		*(1.95)*	0.0442		*(2.11)*	-0.0021		*(0.14)*	0.0206		*(0.86)*
Permanent Contract	-0.0102		*(0.30)*	-0.0665		*(2.28)*	-0.0244		*(1.13)*	-0.0161		*(0.47)*
Controls	*yes*			*yes*			*yes*			*yes*		
Observations	2,294			2,441			3,105			2,170		
Adjusted R squared	0.1675			0.0869			0.0213			0.1658		

***, **,* denotes 1, 5 and 10 per cent significance respectively shown only for key coefficients. $\hat{\pi}$ and $\hat{\pi} \times \hat{\beta}$ show the direct and indirect impact of risk preference upon wage growth.

TABLE 3: Asset Share Model, 1995

	COEFFICIENT		T STATISTIC
Intercept	-2.9314	***	*(5.93)*
Age	0.0739	***	*(3.16)*
Age Squared	-0.0008	**	*(2.55)*
Male	0.0899		*(1.34)*
White	0.0633		*(0.32)*
Immigrant	0.0449		*(0.29)*
Married	-0.1407	**	*(1.96)*
Permanent Contract	0.0415		*(0.30)*
Log Real Wage	0.1957	***	*(2.64)*
Log Unearned Income	0.0188	***	*(5.44)*
Firm Size 1-24	-0.0645		*(0.83)*
Firm Size 25-99	-0.0057		*(0.07)*
Firm Size 100-499	-0.0226		*(0.25)*
Log Windfalls	0.0372	***	*(3.89)*
Own Home	0.1224		*(1.46)*
Controls			
Occupation		yes [8] ***	
Region		yes [10] ***	
Expectations#		yes [6] ***	
Observations		2,294	
Left Censored		1,627	
Adjusted R squared		0.0696	

***, ** denotes 1 and 5 per cent significance respectively.
expectations dummy variables capture individuals' expectations regarding their future financial situation

TABLE 4: Instrumentation and Positive Asset Share Restriction (Base Year = 1995) 5th Difference

	INSTRUMENTED ASSET			POSITIVE ASSET SHARE		
$\hat{\pi}$						
Asset Share	1.0323	***	*(4.63)*	0.2519	*	*(1.65)*
$\hat{\pi} \times \hat{\beta}$						
Experience	-0.0674	***	*(5.45)*	-0.1014	**	*(2.53)*
Experience Squared	0.0089	***	*(4.74)*	0.0137	**	*(2.31)*
Turnover	0.0177		*(0.35)*	0.0625		*(0.33)*
Degree	0.8864	***	*(11.01)*	1.2915	***	*(2.86)*
Further	0.9173	***	*(13.40)*	1.0681	***	*(3.33)*
A level	0.9051	***	*(12.42)*	1.1328	***	*(3.19)*
GCSE Grades A-C	0.9058	***	*(14.03)*	1.2779	***	*(3.28)*
GCSE Grades <C	0.9209	***	*(9.28)*	1.5849	**	*(2.54)*
Other Qualification	0.7485	***	*(7.20)*	0.7895	**	*(2.18)*
$\hat{\gamma}$						
Male	0.0168		*(0.92)*	0.0235		*(0.67)*
White	0.0881		*(1.71)*	0.0406		*(0.41)*
Immigrant	0.0272		*(0.64)*	0.0421		*(0.52)*
Married	-0.0190		*(0.99)*	-0.0459		*(1.24)*
Trade Union	-0.0752		*(4.05)*	-0.0661		*(1.90)*
Firm Size 1-24	0.0898		*(3.71)*	0.0068		*(0.15)*
Firm Size 25-99	0.0664		*(2.81)*	0.0024		*(0.05)*
Firm Size 100-499	0.0467		*(1.98)*	0.0353		*(0.83)*
Permanent Contract	0.0151		*(0.43)*	0.1371		*(1.83)*
Inverse Mills Ratio	–			0.4628		*(2.34)*
Controls	*yes*			*yes*		
Observations	2,294			667		
Adjusted R squared	0.2161			0.1587		

***, **,* denotes 1, 5 and 10 per cent significance respectively shown only for key coefficients. $\hat{\pi}$ and $\hat{\pi} \times \hat{\beta}$ show the direct and indirect impact of risk preference upon wage growth.

TABLE 5: Time Invariant Risk Preferences and Recent Human capital Investment

	TIME INVARIANT RISK PREFERENCES						RECENT HUMAN CAPITAL		
	4^{TH} DIFFERENCE: 1991-1995 (BASE YEAR = 1995)			5^{TH} DIFFERENCE: 1995-2000 (BASE YEAR = 2000)			5^{TH} DIFFERENCE: 1995-2000 (BASE YEAR =1995)		
$\hat{\pi}$									
Asset Share	0.2547	***	*(2.71)*	0.4493	***	*(3.95)*	0.4059	***	*(3.08)*
$\hat{\pi} \times \hat{\beta}$									
Experience	-0.0638	***	*(3.78)*	-0.0754	***	*(5.75)*	-0.0764	***	*(4.96)*
Experience Squared	0.0007	**	*(1.96)*	0.0104	***	*(4.18)*	0.0106	***	*(3.66)*
Turnover	-0.2816	*	*(1.78)*	-0.0014		*(0.03)*	0.0062		*(0.09)*
Degree	0.7562	***	*(3.38)*	0.9491	***	*(6.47)*	0.8106	***	*(4.98)*
Further	0.8998	***	*(4.15)*	0.9671	***	*(7.02)*	0.7891	***	*(5.04)*
A level	1.1515	***	*(4.05)*	1.0892	***	*(6.20)*	0.9506	***	*(5.49)*
GCSE Grades A-C	1.0506	***	*(4.50)*	1.0259	***	*(6.89)*	1.0769	***	*(6.18)*
GCSE Grades <C	0.5835		*(1.30)*	1.2685	***	*(4.62)*	1.2609	***	*(4.08)*
Other Qualification	0.8547	***	*(2.71)*	0.8286	***	*(3.72)*	0.9788	***	*(4.28)*
Recent Degree	–			–			-1.7394		*(1.23)*
Recent Further Education	–			–			-0.0262		*(0.06)*
Recent A Level	–			–			0.1186		*(0.77)*
Recent GCSE A-C	–			–			0.4599		*(1.19)*
Recent GCSE <C	–			–			0.0697		*(0.66)*
Recent Vocational	–			–			0.7571	**	*(2.01)*
Recent On- Job Training	–			–			0.1531		*(1.33)*
Recent Off-Job Training	–			–			-0.1544		*(1.20)*
Paid for Recent Education/Training	–			–			-0.2104		*(1.35)*
$\hat{\gamma}$									
Male	-0.0529	***	*(2.85)*	-0.0101		*(0.54)*	0.0375		*(2.03)*
White	0.1090		*(2.42)*	0.0988		*(2.41)*	0.1005		*(2.48)*
Immigrant	0.0403		*(0.94)*	0.0076		*(0.18)*	0.0294		*(0.72)*
Married	-0.0435		*(2.28)*	-0.0504		*(2.53)*	-0.0873		*(4.64)*
Trade Union	-0.0013		*(0.07)*	-0.0157		*(0.85)*	-0.0899		*(4.73)*
Firm Size 1-24	-0.0232		*(0.99)*	-0.0364		*(1.53)*	0.0968		*(3.93)*
Firm Size 25-99	-0.0491		*(2.05)*	0.0302		*(1.25)*	0.0700		*(2.89)*
Firm Size 100-499	-0.0179		*(0.76)*	0.0183		*(0.78)*	0.0471		*(1.97)*
Permanent Contract	0.0301		*(0.73)*	-0.0333		*(1.00)*	-0.0161		*(0.48)*
Controls	*yes*			*yes*			*yes*		
Observations	1,982			2,258			2,294		
Adjusted R squared	0.1635			0.1662			0.1710		

***, **,* denotes 1, 5 and 10 per cent significance respectively shown only for key coefficients. $\hat{\pi}$ and $\hat{\pi} \times \hat{\beta}$ show the direct and indirect impact of risk preference upon wage growth.