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Snakes or Ladders? Skill Upgrading and Occupational Mobility in the US and the UK during the 1990s

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Abstract

It is frequently argued that the process of skill upgrading has both worsened the employment prospects and decreased the relative wages of unskilled workers. However, workers are not immutably either low skill or high skill, and skill upgrading may offer the opportunity for workers to move up the 'skill ladder'. In this paper we examine the balance of these two effects. We use comparable individual-level panel data from the US and the UK to relate the probability of individual occupational movement to the extent of skill upgrading at the industry level. We find that whilst skill upgrading does indeed have a positive impact on the probability of moving up the job ladder, this is insufficient to outweigh the increased probability of unemployment. We also find that workers moving down or off the ladder suffer large wage penalties.

JEL classification: J24, J62

Keywords: Skill upgrading, occupational mobility, promotions and demotions

Outline

Non-Technical Summary

The fortunes of low-skilled workers have declined in almost all OECD countries since the 1970s. Relative to more highly-skilled workers, their wages have declined and they are more likely to be unemployed. Most economists think that this is probably because technological change has made skills more valuable, and so firms need to employ more skilled workers. Another plausible hypothesis is that globalisation has increased the demand for highly-skilled workers because the output that they produce can now be traded internationally.

In most of the economic models which analyse these issues, workers are classified as being “fixed” in a particular skill group, as defined by their educational attainment or occupation. Although a workers’ formal education may be largely fixed by the time they enter the labour market, most workers continue to gain knowledge and experience from their jobs, and many are promoted from less-skilled to more-skilled occupations. Thus, if a firm wants to increase the number of skilled workers it employs, it has two options. It can either hire a new skilled worker from the external labour market, or it can train and promote a low-skilled worker inside the firm. In turn, this implies that technological change which increases the demand for high-skilled workers may in part benefit workers who are not initially high-skilled, because it increases the chances that they can be promoted.

In this paper we follow about 10,000 American and 5,000 British workers over course of the 1990s. We track their wages and occupational levels, and we examine how they fare when the industry in which they work changes its demand for skilled workers. We find that low-skill workers in industries which increase the demand for skilled workers do have a higher probability of promotion. However, we also find that low-skill workers in these industries are more likely to be laid off. Unfortunately, the layoff effect is larger than the promotion effect, so, on balance, low-skilled workers do lose out from a faster growth in the demand for skilled workers.

1 Introduction

It is widely agreed that there has been a dramatic shift in demand away from unskilled toward skilled workers in many OECD countries.[1] This has manifested itself both in terms of deteriorating employment prospects and worsening wage outcomes for low-skilled workers. The balance of opinion relates this demand shift to changes in the technology of production which has led to "skill upgrading" within firms and industries.

However, workers are not immutably either low skill or high skill. When firms change their desired skill mix of workers, they can do so either by hiring new workers, or by retraining their existing workforce. If the second method is quantitatively important, then the impact of a change in demand for skilled and unskilled workers may be less harmful for unskilled workers because new opportunities for better jobs become available within the firm.

Hence, it is possible that skill upgrading might confer some benefits to those previously in low skill occupations, and the existing literature may overstate the deleterious impact on those at the bottom of the skill distribution. Of course, it is also possible that the costs of adjustment are high and that the negative effects of job loss greatly outweigh the potential availability of new high-skill jobs.

This paper directly addresses this issue by examining how the changing patterns of aggregate employment have impacted both on the employment prospects and on the occupational mobility patterns of individual workers. We do this by using individual-level panel data from the United States and the United Kingdom from 1991-2001 to examine movements up, down and off the 'occupational ladder'. This enables us to quantify the extent of occupational mobility in both countries and to estimate the relationship between occupational movement and the rate of change of skill intensity.

[1]See, for example, Murphy & Welch (1993) and Berman, Bound & Griliches (1994) for US evidence; Berman, Bound & Machin (1998) for international evidence.

This analysis serves to fill a number of gaps in our knowledge of the skill upgrading process. First, it allows us to address the question "what is the impact of skill upgrading on individual workers?" We examine the characteristics of those workers who have improved employment prospects and the characteristics of those whose job prospects worsen. By focusing on individual workers, we are also able to assess the extent of individual wage gains and losses for those who move job as a result of changes in the skill structure. Second, the paper sheds light on the mechanism by which firms upgrade the skill composition of their workforce. For example, do they retrain and promote individuals already working within the firm or do they layoff low skill workers and recruit external high skill workers?

The analysis which we conduct in this paper bridges two existing literatures — that relating to skill upgrading, and that relating to occupational mobility. Studies of skill upgrading have tended to be at the industry level (Berman *et al.* 1994, Berman *et al.* 1998), although there is some evidence from plant-level studies e.g. Dunne, Haltiwanger & Troske (1997) for the US and Haskel & Heden (1999) for the UK. Industry- and plant-level studies, however, cannot tell us whether within-plant skill upgrading occurs via the reallocation of existing workers or by laying off unskilled workers and hiring new workers.

The literature on the occupational mobility of individual workers falls into two broad areas. A large literature, following Burdett (1978) and Jovanovic (1979), stresses the role of imperfect information and the arrival of shocks in determining the nature of job separations. In contrast, Sicherman & Galor (1990) consider workers as forward-looking agents who invest in human capital and maximise lifetime income by choosing a feasible career path which involves movements up or across occupational "ladders". An empirical literature, starting with Wise (1975), and including Sicherman & Galor, has estimated the probability of different types of occupational movement.

In general, the literature on the occupational mobility of workers takes the demand side as given.[2] In this paper we explicitly consider the relationship between the demand for jobs of different skill levels and the probability of occupational mobility of workers.

A paper which tangentially addresses this issue is Mortensen & Pissarides (1998). In their model they consider a stylised firm that employs a single worker. The arrival of a new technology then causes some matches between workers and firms to become unprofitable. Firms must then choose whether to dissolve the match, causing the worker to lose their job, or to incur a "renovation" cost to retrain the worker to use the new technology. If they dissolve a match they fill it from elsewhere. The consequence of skill upgrading to an individual worker differ dramatically in these two cases. In the first, the process of skill upgrading is associated with greater rates of job loss (or enforced moves to lower skill levels). In the second, with greater rates of movement up the occupational ladder.

A closely related empirical paper is Bartel & Sicherman (1998), who measure the relationship between industry-level measures of technological change and rates of training provision. They find that higher rates of technological change are associated with *greater* training provision for production workers and for less-skilled non-production workers. This accords with our earlier intuition that technological change may not necessarily harm less-skilled workers. Instead of focusing on training, in this paper we examine whether industries which demand more highly-skilled workers do so by upgrading their existing workforce, or by laying-off low-skilled workers.

The paper is organised as follows. We start in Sections 2 and 3 by laying out the patterns of employment by skill-level and the patterns of worker movement up and down those skill-levels. We then outline a simple empirical framework in Section 4, and our results are presented in Section 5. Section 6 then examines the wage effects of occupational mobility. Finally, Section 7 concludes.

[2]Siow (1994) is an exception.

2 Skill Upgrading in the US and UK

How has the skill structure of employment changed in the US and the UK? To answer this question we need to quantify the skill composition of the labour force. A number of alternative measures have been used in the existing literature.[3] We use the ISCO-88 occupational classification to define a 'skill ladder'. This has a number of advantages. It allows us to examine changes in the composition of the skill structure in a less crude way than does the white collar-blue collar distinction. This method also allows us to make comparisons across countries in the nature and extent of skill upgrading. The ISCO88 classification defines four broad levels of skill, based on the level of general education and the amount of job-related formal training required to perform a job. These skill groups are defined in Table 1.[4]

[Table 1 here]

Table 2 provides a comparison of the skill composition of the labour force in the United States and the United Kingdom using two comparable large-scale surveys, the Current Population Survey (US) and the Labour Force Survey (UK).[5] Both the composition of the workforce and the changes in the proportions in each skill group are very similar across countries. The two lower skill groups have declined in size, while the top two skill groups have expanded.

[Table 2 here]

[3]These include the balance between production and non-production workers, the use of within-firm grading scales and a variety of esteem indicators relating to different occupations.

[4]See Table A1 for a detailed composition of each skill group, and how they compare across countries.

[5]See also Figure B.1 for estimates of employment by skill group using the panel data used in the remainder of this paper.

3 Patterns of worker movement

Having established the pattern of skill upgrading in aggregate, we now examine the pattern of individual worker movements associated with these broad changes. To do this we require micro-data which tracks individual workers over time. We use the Panel Study of Income Dynamics (PSID) for the US and the British Household Panel Study (BHPS) for the UK. To ensure maximum comparability of the results for the two countries, we use a common data period from 1991 to 2001 (Waves 24-32 of the PSID and waves 1-10 of the BHPS). We also apply identical sample selection criteria and data construction methods to both datasets.[6]

Table 3 shows the basic patterns of individual mobility up and down the job ladder, and between employment and non-employment for the two countries.[7] We break down movements into those that occur within firms and between firms. The majority of individuals remain within the same broad skill-level from one year to the next: 82% in the US and 86% in the UK. Table 3 confirms the greater fluidity of the US labour market: there is more mobility both up and down between skill groups in the US relative to the UK. Workers in the US are also more likely to change between employers, whether or not they move up and down the skill ladder.

[Table 3 here]

In both countries the top skill group is the most stable. This is partly because the top skill group, by definition, cannot move further up, but also because this group has lower exit rates to non-employment. The bottom skill group is the most fluid, with the highest rates of

[6] In both datasets, we select only heads and wives of adult core sample members; we keep only individuals who are present in at least two consecutive years and initially in employment; finally we keep only individuals who have non-missing information on a full set of covariates required for estimating the relevant models. This results in a sample of 9,880 individuals from the PSID and 5,437 individuals from the BHPS.

[7] See also Table B.1 for estimates based on the March CPS (US) and the Spring LFS (UK).

promotion (12.9% in the US and 9.3% in the UK) and the highest rates of exit (11.2% and 8%). Level 3 jobs have higher rates of promotion and demotion than those at Level 2.

40% of movements up the ladder in the US are within-firm, compared to 48% in the UK. As we would expect, movements down the ladder are less likely to occur within firms. In the US nearly three-quarters of downward movements involve a change of employer. Finally, the transition rate to non-employment is also higher in the US, but in both countries it is declining in skill level.

4 The relationship between skill upgrading and occupational mobility

What role does structural change, and in particular the speed of skill upgrading, have on patterns of individual mobility? Does the speed of skill upgrading in an industry lead to greater upward mobility of workers, or does it lead to a greater rate of job loss and downward mobility, with skilled workers being drawn from non-employment? To answer these questions we outline a simple empirical framework which draws on Mortensen & Pissarides (1998).

4.1 A simple framework

Consider an economy with two types of job, low skill (1), and high skill (2). Given the current state of technology, firms decide on their optimal mix of jobs. In aggregate, there are initially N_1 workers employed in low skilled jobs and N_2 workers employed in high skilled jobs.

We suppose that firms are then potentially subject to two types of shock. First, technology shocks, which occur with probability λ per period per job, cause firms to change their optimal mix of jobs. More precisely, a technology shock causes an unskilled job to become unprofitable, but at the same time opens up a new profitable opportunity for a skilled job. A technology shock therefore causes firms to destroy low-skill jobs and create high-skill jobs. In aggregate, this causes the destruction of λN_1 low skill jobs and the creation of λN_1 high-skill jobs.

Second, in the absence of a technology shock any particular job may be subject to an idiosyncratic shock, which occurs with probability τ per period per job. These occur when either a firm or a worker decides to end a particular worker-firm match. These shocks leave the profitability of high- and low-skill jobs unchanged, and so the firm replaces the worker who leaves with another worker of the same skill-level.

When faced with a technology shock, a firm can either replace their existing worker with a new worker, or they can retrain an existing worker. In the first case the firm must pay a search and recruitment cost. In the second case, the firm must pay the cost of retraining the worker. The relative cost of each strategy differs across firms, so not all firms adopt the same response to a technological shock.[8] A firm chooses to 'renovate' the match (and retrain its worker) with probability π, and to destroy the match and search for a new worker with probability $1 - \pi$.

Given this setup, four different outcomes are possible for workers in the low skill group. Firstly, an individual who is subject neither to a technology shock nor an idiosyncratic shock will stay at the same skill level within the same firm:

$$s' = (1 - \lambda)(1 - \tau). \tag{1}$$

Secondly, if they are subject to a technology shock but their job is renovated then they will

[8]Mortensen & Pissarides (1998) suggest that "For example, if implementing the latest technology requires that the job move to a new location, then the implementation [renovation] cost would include the cost of moving as well as retraining the worker. These could well exceed the cost of recruiting and training a new worker already located in the appropriate place. Alternatively, a different type or level of education may be needed by the new technology. In this case it may be cheaper to destroy the current job rather than retrain a current employee." (p.745)

move up the job ladder but stay in the same firm:

$$v' = \pi\lambda. \tag{2}$$

If, on the other hand, the worker is laid off, with probability $(1-\pi)\lambda$, or they are subject to an idiosyncratic shock, with probability $(1-\lambda)\tau$, then the individual will seek employment in another firm. Define θ_1 as the probability of finding a new low-skilled job, and θ_2 as the probability of finding a new high-skilled job. Then the probability of moving to another job at the same skill-level in a new firm is

$$s'' = (1-\pi)\lambda\theta_1 + \tau(1-\lambda)\theta_1, \tag{3}$$

and the probability of moving to a high-skill job in a new firm is

$$v'' = (1-\pi)\lambda\theta_2 + \tau(1-\lambda)\theta_2. \tag{4}$$

If individuals fail to find either a low skilled or a high skilled job then they become unemployed.

$$u = (1-\pi)\lambda(1-\theta_1-\theta_2) + \tau(1-\lambda)(1-\theta_1-\theta_2). \tag{5}$$

Our estimates may be viewed as an attempt to recover the underlying parameters which determine probabilities (1) to (5) above. This procedure would directly answer the question that we initially posed: if there is a technology shock, what are the relative chances of being upgraded and of being made unemployed?[9]

In this framework, the only reason for a change in the skill structure of the labour market is a technology shock. Thus, the percentage change in low skill employment is a perfect proxy

[9] An equivalent set of movement probabilities can be derived for someone in the high skill group.

for the probability that a job is affected by a technology shock. That is, since

$$\Delta N_1 = N_{1,t+1} - N_{1,t} = -\lambda N_{1,t}, \tag{6}$$

then the probability of a technology shock is given by:

$$\lambda = -\frac{\Delta N_1}{N_{1,t}} \tag{7}$$

This suggests that once we have estimated the probability of a shock by observing the percentage change in unskilled employment, equation (2) would allow us to obtain an estimate of π. We could similarly extract the value for the remaining parameters. This is largely the strategy that we adopt in this paper. We relate the probability of movement up the 'occupational ladder' to the percentage change of employment in the skill group in the industry i in which the individual works at time $t-1$. For example:

$$v'_{it} = \Phi\left(\beta\frac{-\Delta N_{it}}{N_{it}} + \gamma\mathbf{x}_{i,t-1} + \delta_j\right). \tag{8}$$

Each movement probability (1) to (5) has an empirical counterpart of the form given by (8), estimated using a Probit model. We include in these regressions a vector of individual characteristics $\mathbf{x}$ to control for other factors which might influence the probability of movement. The δ_j are a set of industry dummies to allow for the possibility that turnover rates differ across industries for other reasons.

4.2 Extensions

Firstly, it is straightforward to allow for more than two skill groups. Secondly, we have so far assumed that technology shocks are purely 'skill upgrading' in the sense that they destroy low-skill jobs but create high skill jobs. However, Davis, Haltiwanger & Schuh (1996) show that, in reality, we observe simultaneous job creation and destruction within skill groups. A simple way to accommodate this feature is to extend the framework to allow for the possibility of shocks arriving at both low-skill and high-skill jobs. This modification allows for the possibility that technological change can cause movements both up and down the job ladder.

To illustrate this, let λ_s be the shock to skill group $s = 1, 2, 3$. The mobility equations are now modified to allow for the possibility of both upgrading and downgrading. Hence, for those in skill group 2:

$$s' = (1 - \lambda_2)(1 - \tau) \tag{9}$$

$$s'' = (1 - \pi)\lambda_2\theta_2 + \tau(1 - \lambda_2)\theta_2 \tag{10}$$

$$v' = \pi\lambda_2 \tag{11}$$

$$v'' = (1 - \pi)\lambda_2\theta_3 + \tau(1 - \lambda_2)\theta_3 \tag{12}$$

$$d'' = (1 - \pi)\lambda_2\theta_1 + \tau(1 - \lambda_2)\theta_1 \tag{13}$$

$$u = [(1 - \pi)\lambda_2 + \tau(1 - \lambda_2)](1 - \theta_1 - \theta_2 - \theta_3) \tag{14}$$

We now have an additional term d'', which represents the probability of losing a skill-group 2 job and finding a new skill-group 1 job in a new firm.

Once technology shocks are allowed to destroy not only low skill but also high skill jobs, then the percentage change in employment ($\Delta N/N$) is no longer a perfect proxy for λ. Since workers may now be downgraded, the percentage change in employment of the low skilled group understates the true likelihood of the probability of a technology shock to the extent to which there is a 'reverse' flow of workers from higher skill groups into skill group 1:

$$-\left(\frac{\Delta N_1}{N_{1,t}}\right) = \lambda_1 - \lambda_2\left(\frac{N_{2,t}}{N_{1,t}}\right) \tag{15}$$

The extent to which the percentage change in employment is subject to measurement error in this way clearly depends on the extent to which the destruction of high skill jobs are destroyed as a result of technological change relative to low skill jobs.[10]

5 Results

Table 4 reports estimates of the relationship between skill upgrading and the probability of each type of movement.[11] Our proxy for λ is

$$-\frac{N_{sj,t+1} - N_{sj,t}}{N_{sjt}}$$

where s denotes skill group $1, 2, 3, 4$, j denotes industry and t denotes time.[12] Thus, for example, we regress the probability of movement between t and $t+1$ for a worker in skill group s and industry k on the proportionate change in the size of skill group s in industry k between t and $t+1$. Recall that λ_s represents a shock which destroys jobs in skill group s and which creates jobs in another skill group, so λ is only synonymous with "skill upgrading" in the bottom skill group. All estimates come from a Probit model of the form given in (8), and include a set of individual characteristics and a full set of industry dummies.[13]

[Table 4 here]

The first row in Table 4 verifies that increased skill upgrading (i.e. a reduction in the size of each skill group) reduces the probability of staying in the same skill group in the same firm. It is noticeable that this effect is larger in the US than in the UK. The estimated effect

[10]A better proxy for λ would be the 'job destruction' rate. However, job destruction rates are not available disaggregated by occupational group or skill-level.

[11]We have investigated numerous departures from our basic specification in order to test the robustness of our findings. These are reported in Table B.2.

[12]The industry definitions and concordance we use is given in detail in Table A2.

[13]Coefficient estimates on all other covariates are reported in Table 5.

is negative in all skill groups, and tends to be larger in lower skill groups. This effect is, of course, essentially tautological: a reduction in the size of a worker's skill group in their industry *must* reduce the probability that a worker can stay in that skill group in that industry.

What is of more interest is where these workers go. In a framework where workers' skills are fixed, then a reduction in the number of jobs of a certain skill will always harm workers of that type. But in our framework, even low-skill workers may benefit from skill upgrading because they may be promoted.

The final row of Table 4 shows that in almost every case, a reduction in the size of a skill group does increase the probability of entering unemployment, and that this effect is slightly larger in the US. In the UK there is also evidence that the probability of demotion within the firm is increased, although the size of the marginal effect is smaller. This effect is not significant in the US; nor is it significant for between-firm moves.

Workers can also benefit from this process of skill upgrading. For both countries we see evidence of an increased probability of upward movement. For workers in the US, the probability of moving up the skill ladder is increased both within and between firms. This effect is also evident in the UK, though only the between firm component is statistically significant.

What is the overall balance of these effects on individual workers? We may interpret the results obtained in relation to the framework of the previous section. A parameter of particular interest is π, which indicates the extent to which technology shocks cause within firm skill upgrading. For the US, the estimate of π is 0.0173, which represents the technologically induced promotion rate within the firm. Our estimate of π for the UK is much smaller, and statistically insignificant.[14] This is of clear interest to workers. However workers are not only concerned about the value of π, but also about with the probability of re-employment should

[14] Our estimates of π are accurate only if $-\Delta N/N$ is a perfect proxy for λ. For the reasons discussed in Section 4.2, this is not the case if shocks also destroy high-tech jobs, and we would expect our estimate of π to be biased toward zero.

they be laid off as a result of technological change. In this regard θ_1 and θ_2 are crucial. To assess whether technology shocks are beneficial or harmful to a worker's career prospects we therefore need to ask whether an increase in λ increases the probability of upgrading within and between firms more than it increases the likelihood of downgrading and unemployment. Table 4 shows that in both countries, whilst the probability of movement up the job ladder goes some way to offset the increased probability of unemployment, the average overall impact is negative because the increased probability of unemployment is greater.

Variations across skill groups and skill upgrading

Table 4 also shows how the impact of structural change affects the movement probabilities of workers in different skill groups. If we think of the process of upgrading as a relative decline in lower skill groups and an expansion of the higher groups, then this table allows us to make some judgement about how this change comes about. In both the US and the UK, our estimate of π is actually largest for skill group 1, and declines as we move up the skill ladder, suggesting that the beneficial effect of skill upgrading is stronger for lower skill groups.[15] Interestingly, those on the lower rungs are *not* necessarily more likely to exit to unemployment as a result of greater skill upgrading. Expansion of the upper skill groups is therefore achieved via a number of sources. First, job stability in the higher skill groups is increased, with the probability of remaining in this group rising and the probability of moving into unemployment from this group falling. Second, there is significant movement from the lower skill groups with promotion playing a role.

[15] This may also reflect the fact that $\Delta N/N$ is a better proxy for λ in lower skill groups.

The impact of other covariates on mobility

The estimates in Table 4 are obtained controlling for a range of other individual characteristics. A useful question we can ask is whether the impact of skill upgrading is important compared to these individual characteristics. Table 5 reports the marginal effects of these characteristics for all seven types of worker mobility.

[Table 5 here]

Strong regularities are again observed across the two countries. The young are less likely to stay on the same rung of the job ladder than are older workers. However this is largely due to higher entry rates into unemployment rather than due to any greater mobility up the job ladder. Females also face greater job instability than males, again reflecting higher rates of movement into unemployment. Bad health also reduces job stability in both countries. By contrast, those with higher levels of education have relatively favourable movement patterns, as would be expected. In the US, those with more years of education have greater levels of job stability, and are less likely to move into unemployment.

The family circumstances of the individual also prove to be important. Those who are married show more stable employment patterns, though those with more children are more likely to exit employment in both countries.

The working environment also determines an individual's mobility patterns. In both countries unions serve to stabilise employment relationships. The employment tenure of workers is also crucial. As we might expect from matching arguments, those with higher levels of tenure are more likely to remain in their current job. It is also the case that, in the UK, those with a high current wage, who are presumably also well matched with their current employer, are less likely to move from their current position.

How important are industry skill-upgrading effects relative to individual characteristics? Consider the third column of Table 5, which shows the impact on the probability of promotion. The largest marginal effects are associated with education: workers with 13-15 years of education have a significantly higher probability of promotion with a marginal effect of 0.007 in the US and 0.006 in the UK. In contrast, the marginal effect of skill-upgrading on the probability of promotion was 0.0173 in the US. The difference in λ between a fast-changing and a slow-changing industry in the US is about 0.4, so the difference in the probability of promotion between these two industries is approximately 0.007, very similar in magnitude to the effect of education. If we were to look only at the lower skill groups, which have larger marginal effects on λ, the importance of skill upgrading would be relatively even more important. Thus, we can claim that a significant component of whether an individual is promoted is related to the rate of skill upgrading in their industry.

6 Wage effects of occupational mobility

Thus far we have implicitly made the assumption that movement up the skill ladder is preferable to movements down or off. In this section we examine this contention in more detail, and seek to document the changes in individual wages associated with mobility.[16] Table 6 shows the raw wage effects associated with movements up and down the skill ladder, as well as the proportion experiencing real wage falls. For instance, in the US, those remaining at skill level 2 with the same employer experience mean wage increases of \$$0.74$ and 18% experience real wage falls.

[Table 6 here]

[16]Evidence on the effect of internal promotions within the firm can also be found in, for example, Baker, Gibbs & Holmstrom (1994) (US) and Treble, van Gameren, Bridges & Barmby (2001) (UK). McCue (1996) also investigates the impact of promotions on wages. Fewer studies have considered the impact of movements down the occupational ladder.

As we would expect, those moving up the skill ladder experience much greater wage growth than those remaining on the same rung, while those moving down the ladder experience either much smaller wage increases or actual wage decreases. The proportion experiencing wage cuts is also higher for those moving down. For example, of those moving from level 2 to level 1 and changing employer, *average* wages reduce by 51 cents in the US and increase by only 7 pence in the UK. 42% report a reduction in pay in the US and 47% in the UK. Reductions in pay are also observed for those moving down from level 3 (65 cents/23 pence) and level 4 (7 cents/62 pence).

There are clear differences between workers who remain at the same firm and those that change employer. In almost every case, across both countries, individuals who change employer are more likely to experience wage cuts. But at the same time those who change employer and remain in the same skill group experience *larger* positive changes in wages. This suggests that those who change employer comprise two distinct groups: those who move voluntarily to better jobs; and those whose movement is enforced. The latter group often end up in lower paying jobs.

We observe significant increases in mean pay for those who move up the skill ladder. In the US, this effect is especially beneficial for those that move up within their existing firm, who obtain higher wage increases than those that move firm. Again, this is likely to reflect the fact that some of those who move to new firms are not doing so voluntarily and so may suffer wage falls despite moving to a higher skill level. In the UK, the rewards to internal promotion are not so pronounced, and the biggest gainers are those that move employers.

Downward movement within firms is, as noted in the previous section, much less common than downward movement between firms. The pattern of wage penalties is therefore less clearly defined. However wage penalties are observed, if somewhat smaller than those suffered from those that move between firms.

These raw wage changes might be misleading if those who move up and those that move down have different characteristics. To examine this we estimate wage-change regressions which control for those individual characteristics which might impact on wage changes independently of movement. These results are presented in Table 7 where, once again, we split movement according to whether the movement is within- or between-firms.

[Table 7 here]

The results indicate that the raw wage effects in Table 6 are robust to the inclusion of individual characteristics. The measured impact in the US ranges from 11% for those moving down from level 2 to 17% for those moving from level 3. In the UK the equivalent impacts range from 4% to 14%. There is no evidence of a wage penalty for downward movement within firms.

Table 7 also emphasises the benefit of upward movement within a current employer, both for the US and the UK. By contrast, only in the UK, when moving from skill group 2 to skill group 3, is there a mean pecuniary advantage to an individual of changing firm.

Tables 6 and 7 indicate that movements up and down the skill ladder have significant impacts on wages. Those who move down the ladder, especially if this also entails a movement to another firm, face a particularly large wage fall. Movement up the ladder has a correspondingly beneficial impact, with promotion within firms having a larger impact than promotion between firms.

7 Conclusions

In this paper we have investigated a very simple idea. When firms change their desired skill mix of workers, they can do so either by hiring new workers, or by retraining their existing workforce. If the second method is quantitatively important, then the impact of a change in demand for skilled and unskilled workers may be less harmful for unskilled workers because new opportunities for better jobs become available within the firm.

To measure this process we regress the probability of various worker movements on the change in employment of the skill group in which the individual works. We find that workers in low skill groups whose industries skill-upgrading faster have a higher probability of being promoted to a higher skill group. This effect is less important for higher skill groups, partly because the opportunities for promotion are less. The size of the "promotion" effect is always smaller than the size of the "exit" effect. Skill upgrading does help some unskilled workers climb the ladder, but it pushes more down or off the ladder altogether.

We estimate the model using similar data for both the US and the UK, and find qualitatively similar results, although the size of the effects tends to be larger in the US. In the US the importance of skill upgrading in determining the probability of promotion is of a similar magnitude to the effect of higher educational qualifications. In the UK, the probability of promotion is much less strongly associated with the pattern of skill upgrading.

The wage implications of these occupational movements are considerable and statistically significant. Those who move down the ladder, especially if this also entails a movement to another firm, face a particularly large wage fall. Movement up the ladder has a correspondingly beneficial impact, with promotion within firms having a larger impact than promotion between firms.

As noted earlier, our measure of changing skill requirements is rather noisy because we cannot measure job creation and job destruction of specific skill groups within industries or within firms. The availability of linked employer-employee datasets would allow future researchers to investigate the relationship between the availability of different jobs within the firm and the probability of promotion in that firm.

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Tables

Table 1: Definition of skill groups

ISCO skill-level	*Description*	*ISCO Major Group*
First skill level	Competence associated with general education usually acquired by completion of compulsory education	(9) Elementary occupations
Second skill level	Requires knowledge as for first skill level, but in addition typically have a longer period of worker-related training or work experience	(4) Clerks (5) Service, shop and market sales workers (6) Skilled agriculture and fishery workers (7) Craft and related workers (8) Plant and machine operators and assemblers
Third skill level	Requires a body of knowledge associated with a period of post-compulsory education but not to degree level	(3) Technicians and associate professionals
Fourth skill level	Normally requires a degree or an equivalent period of relevant work experience	(1) Legislators, senior officials and managers (2) Professionals

Source: International Labour Office (1990, pp.2–3) and Elias, McKnight & Kingshott (1999).

Table 2: Employment by skill group

	(a) March CPS 1991-2001				*(b) Spring LFS 1991-2000*			
	Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 1*	*Level 2*	*Level 3*	*Level 4*
1991	0.093	0.533	0.114	0.260	0.092	0.542	0.102	0.265
1992	0.090	0.534	0.117	0.259	0.090	0.531	0.102	0.277
1993	0.091	0.528	0.114	0.267	0.090	0.525	0.103	0.282
1994	0.087	0.525	0.113	0.275	0.088	0.522	0.105	0.285
1995	0.086	0.516	0.116	0.283	0.085	0.524	0.103	0.288
1996	0.089	0.511	0.116	0.285	0.084	0.523	0.104	0.289
1997	0.085	0.510	0.115	0.290	0.080	0.524	0.107	0.289
1998	0.085	0.508	0.116	0.291	0.081	0.523	0.103	0.293
1999	0.084	0.502	0.114	0.300	0.077	0.521	0.106	0.296
2000	0.087	0.500	0.115	0.299	0.078	0.515	0.107	0.300
2001[a]	0.084	0.497	0.119	0.300				

[a] Concordance between occupation codes used in the LFS in 2001 and ISCO-88 not available.

Table 3: Probability of movement up and down the skill ladder

	All skill groups	*Level 1*	*Level 2*	*Level 3*	*Level 4*
(a) PSID					
Same level	0.818	0.705	0.819	0.804	0.861
Same employer	0.738	0.652	0.721	0.753	0.791
New employer	0.080	0.053	0.097	0.051	0.070
Higher level	0.040	0.129	0.044	0.047	0.000
Same employer	0.016	0.041	0.020	0.021	0.000
New employer	0.023	0.088	0.024	0.026	0.000
Lower level	0.030	0.000	0.017	0.051	0.054
Same employer	0.008	0.000	0.003	0.013	0.016
New employer	0.022	0.000	0.014	0.038	0.038
Non-employment	0.112	0.166	0.120	0.098	0.085
(b) BHPS					
Same level	0.863	0.778	0.869	0.832	0.888
Same employer	0.793	0.738	0.789	0.778	0.822
New employer	0.069	0.040	0.080	0.054	0.066
Higher level	0.031	0.093	0.033	0.052	0.000
Same employer	0.015	0.027	0.017	0.030	0.000
New employer	0.016	0.066	0.016	0.023	0.000
Lower level	0.026	0.000	0.011	0.048	0.051
Same employer	0.010	0.000	0.003	0.021	0.020
New employer	0.016	0.000	0.008	0.028	0.030
Non-employment	0.080	0.128	0.087	0.067	0.061

Table 4: Probit results: impact of $\Delta N/N$ on movement probabilities[ab]

	All skill groups	*Level 1*	*Level 2*	*Level 3*	*Level 4*
(a) PSID					
s'	-0.1016	-0.0981	-0.1305	-0.0614	-0.0527
	[0.000]	[0.024]	[0.001]	[0.143]	[0.163]
s''	0.0026	0.0111	0.028	0.0137	-0.0205
	[0.763]	[0.456]	[0.158]	[0.398]	[0.291]
v'	0.0173	0.0296	0.0187	0.0015	
	[0.001]	[0.021]	[0.051]	[0.847]	
v''	0.0126	-0.001	-0.0008	0.016	
	[0.008]	[0.953]	[0.977]	[0.076]	
d'	-0.0009		0.0026	0.004	0.0029
	[0.776]		[0.603]	[0.280]	[0.692]
d''	-0.0064		0.0061	0.0107	0.0027
	[0.170]		[0.987]	[0.349]	[0.796]
u	0.0517	0.0479	0.0446	-0.0027	0.065
	[0.000]	[0.120]	[0.139]	[0.919]	[0.011]
(b) BHPS					
s'	-0.0646	-0.0629	-0.0646	-0.0066	-0.0639
	[0.0001]	[0.1037]	[0.0001]	[0.8291]	[0.0415]
s''	-0.0138	-0.0202	-0.0099	-0.0168	0.0011
	[0.1109]	[0.0633]	[0.6120]	[0.2497]	[0.9447]
v'	0.0038	0.0219	0.0015	-0.0082	
	[0.3511]	[0.0152]	[0.8104]	[0.1135]	
v''	0.0094	0.0201	0.0017	-0.0018	
	[0.0503]	[0.1994]	[0.8382]	[0.7354]	
d'	0.0082		0.0045	0.009	0.008
	[0.0017]		[0.0719]	[0.0225]	[0.2522]
d''	0.0028		0.0148	-0.0011	0.0069
	[0.4943]		[0.0109]	[0.8181]	[0.4849]
u	0.0455	0.0433	0.0862	0.0132	0.0387
	[0.0000]	[0.1100]	[0.0001]	[0.4978]	[0.0464]

[a] Table reports marginal effects or $\partial\Phi/\partial x$.
[b] p-values in square brackets.

Table 5: Probit estimates: impact of other covariates on movement probabilities

(a) PSID	s'		s''		v'		v''		d'		d''		u	
Age	0.0214	[0.000]	−0.0007	[0.361]	0.0013	[0.001]	0.0001	[0.630]	0.0004	[0.092]	0.0000	[0.919]	−0.0110	[0.000]
Age$^2 x100$	−0.0002	[0.000]	0.0000	[0.371]	0.0000	[0.000]	0.0000	[0.061]	0.0000	[0.018]	0.0000	[0.353]	0.0002	[0.000]
Female	−0.0255	[0.000]	−0.0062	[0.016]	0.0009	[0.420]	−0.0012	[0.228]	0.0002	[0.833]	−0.0025	[0.043]	0.0310	[0.000]
12 years of education	0.0410	[0.000]	0.0012	[0.756]	0.0048	[0.016]	0.0014	[0.338]	0.0013	[0.329]	0.0048	[0.013]	−0.0387	[0.000]
13-15 years of education	0.0369	[0.000]	−0.0009	[0.830]	0.0066	[0.003]	0.0051	[0.003]	0.0035	[0.026]	0.0049	[0.022]	−0.0375	[0.000]
$>$15 years of education	0.0533	[0.000]	0.0039	[0.393]	0.0050	[0.056]	0.0023	[0.262]	0.0018	[0.292]	0.0017	[0.511]	−0.0405	[0.000]
Married	0.0305	[0.000]	−0.0083	[0.002]	0.0010	[0.404]	−0.0004	[0.661]	0.0000	[0.968]	−0.0035	[0.006]	−0.0098	[0.006]
Number of children	−0.0014	[0.562]	−0.0003	[0.780]	−0.0016	[0.005]	−0.0009	[0.053]	−0.0004	[0.315]	−0.0004	[0.503]	0.0041	[0.013]
Health limits work	−0.0634	[0.000]	0.0079	[0.063]	−0.0015	[0.435]	0.0009	[0.593]	0.0015	[0.281]	−0.0034	[0.105]	0.0467	[0.000]
Tenure with current employer	0.0325	[0.000]	−0.0115	[0.000]	−0.0002	[0.479]	−0.0028	[0.000]	0.0003	[0.051]	−0.0021	[0.000]	−0.0114	[0.000]
Tenure$^2 x100$	−0.0009	[0.000]	0.0003	[0.000]	0.0000	[0.738]	0.0001	[0.000]	0.0000	[0.102]	0.0001	[0.000]	0.0003	[0.000]
Represented by a union	0.0062	[0.641]	−0.0008	[0.910]	0.0024	[0.448]	0.0027	[0.303]	0.0006	[0.784]	−0.0065	[0.058]	−0.0058	[0.540]
Union member	0.0514	[0.000]	−0.0196	[0.005]	−0.0011	[0.728]	−0.0063	[0.009]	−0.0010	[0.649]	−0.0048	[0.218]	−0.0110	[0.269]
Hourly wage	0.0007	[0.122]	0.0000	[0.510]	−0.0004	[0.000]	−0.0006	[0.000]	0.0000	[0.404]	−0.0004	[0.002]	−0.0002	[0.452]
(b) BHPS	s'		s''		v'		v''		d'		d''		u	
Age	0.0225	[0.000]	0.0012	[0.313]	0.0003	[0.515]	0.0009	[0.089]	0.0001	[0.812]	0.0004	[0.343]	−0.0161	[0.000]
Age$^2 x100$	−0.0003	[0.000]	0.0000	[0.041]	0.0000	[0.472]	0.0000	[0.029]	0.0000	[0.949]	0.0000	[0.086]	0.0002	[0.000]
Female	−0.0297	[0.000]	−0.0027	[0.439]	0.0002	[0.854]	−0.0022	[0.144]	−0.0005	[0.542]	−0.0014	[0.302]	0.0355	[0.000]
12 years of education	0.0024	[0.781]	−0.0097	[0.043]	0.0032	[0.113]	0.0000	[0.994]	0.0004	[0.777]	−0.0009	[0.638]	0.0032	[0.533]
13-15 years of education	0.0019	[0.835]	−0.0151	[0.002]	0.0057	[0.008]	0.0006	[0.771]	0.0035	[0.016]	−0.0012	[0.539]	0.0038	[0.485]
$>$15 years of education	−0.0052	[0.582]	−0.0079	[0.121]	0.0036	[0.088]	0.0019	[0.369]	0.0027	[0.062]	−0.0012	[0.543]	0.0040	[0.482]
Married	0.0071	[0.265]	−0.0037	[0.286]	−0.0013	[0.288]	−0.0012	[0.388]	0.0009	[0.296]	−0.0026	[0.076]	0.0037	[0.346]
Number of children	−0.0137	[0.000]	0.0012	[0.472]	0.0002	[0.732]	0.0006	[0.324]	−0.0001	[0.843]	−0.0005	[0.414]	0.0084	[0.000]
Health limits work	−0.0910	[0.000]	0.0126	[0.028]	−0.0017	[0.380]	−0.0014	[0.503]	−0.0012	[0.400]	0.0015	[0.512]	0.0735	[0.000]
Tenure with current employer	0.0232	[0.000]	−0.0099	[0.000]	−0.0017	[0.000]	−0.0019	[0.000]	−0.0012	[0.000]	−0.0018	[0.000]	−0.0042	[0.000]
Tenure$^2 x100$	−0.0006	[0.000]	0.0002	[0.000]	0.0000	[0.000]	0.0000	[0.000]	0.0000	[0.000]	0.0000	[0.000]	0.0001	[0.000]
Represented by a union	0.0200	[0.015]	−0.0131	[0.004]	0.0047	[0.002]	−0.0016	[0.367]	0.0036	[0.001]	−0.0023	[0.210]	−0.0112	[0.035]
Union member	0.0311	[0.000]	−0.0055	[0.268]	−0.0030	[0.044]	−0.0041	[0.035]	−0.0017	[0.087]	−0.0045	[0.031]	−0.0057	[0.301]
Hourly wage	0.0020	[0.002]	−0.0010	[0.007]	−0.0001	[0.461]	−0.0012	[0.000]	0.0000	[0.733]	−0.0002	[0.145]	0.0002	[0.544]

Table 6: Raw wage effects[a]

(a) PSID	*Same employer at t*			*New employer at t*		
	Down	*Same*	*Up*	*Down*	*Same*	*Up*
Level 1		$0.52	$0.90		$0.36	$0.83
		0.18	0.14		0.34	0.32
Level 2	$0.36	$0.74	$2.00	−$0.51	$0.80	$1.91
	0.26	0.18	0.13	0.42	0.33	0.26
Level 3	$1.49	$1.00	$2.26	−$0.65	$1.30	$2.01
	0.14	0.19	0.13	0.45	0.28	0.22
Level 4	$1.21	$1.55		−$0.07	$2.91	
	0.19	0.16		0.46	0.24	

(b) BHPS	*Same employer at t*			*New employer at t*		
	Down	*Same*	*Up*	*Down*	*Same*	*Up*
Level 1		£0.18	£0.93		£0.54	£0.67
		0.32	0.13		0.35	0.33
Level 2	£0.40	£0.27	£0.87	£0.07	£0.38	£1.13
	0.29	0.33	0.25	0.47	0.4	0.32
Level 3	−£0.09	£0.43	£0.36	−£0.23	£0.84	£1.34
	0.36	0.31	0.36	0.41	0.29	0.21
Level 4	£0.50	£0.51		−£0.62	£0.92	
	0.25	0.3		0.48	0.31	

[a] Each cell reports the average wage change (per hour) and the proportion of the sample reporting a cut in hourly wages.

Table 7: Conditional wage effects[a][b]

(a) PSID	*Sample employer*		*New employer*	
	Coeff.	p-value	Coeff.	p-value
level 2	0.003	$[0.457]$	0.031	$[0.318]$
level 3	0.006	$[0.265]$	0.056	$[0.114]$
level 4	0.020	$[0.000]$	0.116	$[0.001]$
level 2 (down)	-0.014	$[0.411]$	-0.108	$[0.000]$
level 3 (down)	0.055	$[0.019]$	-0.156	$[0.000]$
level 4 (down)	-0.009	$[0.628]$	-0.172	$[0.000]$
level 1 (up)	0.030	$[0.115]$	0.048	$[0.201]$
level 2 (up)	0.102	$[0.000]$	0.091	$[0.000]$
level 3 (up)	0.086	$[0.002]$	0.031	$[0.417]$
(a) BHPS	*Sample employer*		*New employer*	
	Coeff.	p-value	Coeff.	p-value
level 2	0.005	$[0.451]$	-0.026	$[0.620]$
level 3	0.010	$[0.164]$	-0.007	$[0.909]$
level 4	0.015	$[0.029]$	-0.026	$[0.632]$
level 2 (down)	0.043	$[0.406]$	-0.043	$[0.363]$
level 3 (down)	-0.035	$[0.156]$	-0.123	$[0.035]$
level 4 (down)	-0.016	$[0.407]$	-0.136	$[0.000]$
level 1 (up)	0.107	$[0.000]$	0.039	$[0.543]$
level 2 (up)	0.055	$[0.001]$	0.071	$[0.028]$
level 3 (up)	-0.032	$[0.127]$	0.068	$[0.245]$

[a] Coefficients are the percentage change in wages associated with each movement

[b] Equations include controls for age, sex and educational level.

A Skill definitions

Table A.1: Composition of ISCO major groups

UK SOC 1980 Description (BHPS)	*US SOC 1970 Description (PSID)*
ISCO Major group 1: Legislators, senior officials and managers	
Managers & proprietors in service industries nec	Managers & administrators, nec
Other managers & administrators nec	Restaurant, cafeteria, & bar managers
Marketing & sales managers	Bank officers & financial managers
Other financial institution & office managers nec	Office managers, nec
Production, works & maintenance managers	Sales managers & department heads, retail trade
Restaurant & catering managers	Farmers (owners & tenants)
Farm owners & managers, horticulturists	Sales managers, except retail trade
Builders, building contractors	
Computer systems & data processing managers	
Managers in building & contracting	
Publicans, innkeepers & club stewards	
Personnel, training & industrial relations managers	
Bank, Building Society & Post Office managers (except self-employed)	
Treasurers & company financial managers	
Hotel & accommodation managers	
Transport managers	
Advertising & public relations managers	
Primary (& middle school deemed primary) & nursery education teaching profession	
Managers in warehousing & other materials handling	
Entertainment & sports managers	
Secondary (& middle school deemed secondary) education teaching professionals	
Civil Service executive officers	
Garage managers & proprietors	
Hairdressers' & barbers' managers & proprietors	
General administrators; national government (HEO to Senior Principal/Grade 6)	
Stores controllers	
ISCO major group 2: Professionals	
Secondary (& middle school deemed secondary) education teaching professionals	Elementary school teachers
Primary (& middle school deemed primary) & nursery education teaching profession	Accountants
Computer analyst/programmers	Secondary school teachers
Social workers, probation officers	Personnel & labor relations workers
Authors, writers, journalists	Social workers
Chartered & certified accountants	Computer systems analysts
Vocational & industrial trainers	Lawyers
Higher & further education teaching professionals	Computer specialists, nec
University & polytechnic teaching professionals	Physicians, medical & osteopathic
Solicitors	Electrical & electronic engineers
Medical practitioners	Computer programmers
Design & development engineers	Industrial engineers
Planning & quality control engineers	Teachers, except college & university, nec
Other teaching professionals nec	Vocational & educational counselors
Management consultants, business analysts	Mechanical engineers
Clergy	Painters & sculptors
Software engineers	Engineers, nec
Personnel & industrial relations officers	Economists
Artists, commercial artists, graphic designers	Clergymen
Special education teaching professionals	Research workers, not specified

Table A.1: Composition of ISCO major groups

UK SOC 1980 Description (BHPS)	*US SOC 1970 Description (PSID)*
Civil, structural, municipal, mining & quarry engineers	Editors & reporters
Other engineers & technologists nec	Psychologists
Biological scientists & biochemists	Chemists
Quantity surveyors	Civil engineers
Building, land, mining & 'general practice' surveyors	Librarians
Architects	Pharmacists
Pharmacists/pharmacologists	Adult education teachers
mechanical engineers	Writers, artists, & entertainers, nec
Management accountants	Architects
	Recreation workers
	Public relations men & publicity writers
	Musicians & composers
	Operations & systems researchers & analysts
ISCO major group 3: technicians and associate professionals	
Nurses	Registered nurses
Welfare, community & youth workers	Bookkeepers
Technical & wholesale sales representatives	Sales representatives, wholesale trade (Industries 017-058, 507-599)
Accounts & wages clerks, book-keepers, other financial clerks	Insurance agents, brokers, & underwriters
Underwriters, claims assessors, brokers, investment analysts	Teacher aides, except school monitors
Other sales representatives nec	Prekindergarten & kindergarten teachers
Computer operators, data processing operators, other office machine operators	Electrical & electronic engineering technicians
Laboratory technicians	Clinical laboratory technologists & technicians
Civil Service administrative officers & assistants	Therapists
Occupational & speech therapists, psychotherapists, therapists nec	Health technologists & technicians, nec
Organisation & methods & work study officers	Health administrators
Matrons, houseparents	Sales representatives, manufacturing industries (Industries 107-399)
Draughtspersons	Real estate agents & brokers
Other scientific technicians nec	Secretaries, legal
Local government officers (administrative & executive functions)	Purchasing agents & buyers, nec
Engineering technicians	Insurance adjusters, examiners, & investigators
Buyers & purchasing officers (not retail)	Stock & bond salesmen
Occupational hygienists & safety officers (health & safety)	Designers
Medical secretaries	Engineering & science technicians, nec
Photographers, camera, sound and video equipment operators	Welfare service aides
Artists, commercial artists, graphic designers	Dental assistants
Medical technicians, dental auxiliaries	Airplane pilots
Legal secretaries	Draftsmen
Midwives	Inspectors, except construction, public administration
Estimators, valuers	Radiologic technologists & technicians
Filing, computer & other records clerks (inc. legal conveyancing)	Advertising agents & salesmen
Actors, entertainers, stage managers, producers & directors	Secretaries, medical
Physiotherapists	Real estate appraisers
Taxation experts	Officials of lodges, societies, & unions
Other associate professional & technical occupations nec	
Electrical/electronic technicians	
Driving instructors (excluding HGV)	
Professional athletes, sports officials	
Ship & hovercraft officers	
Radio & telegraph operators, other office communication system operators	
Other health associate professionals nec	
Window dressers, floral arrangers	
Architectural & town planning technicians	
Police officers (sergeant & below)	
ISCO major group 4: clerks	
Clerks (nec)	Secretaries, nec

Table A.1: Composition of ISCO major groups

UK SOC 1980 Description (BHPS)	*US SOC 1970 Description (PSID)*
Accounts & wages clerks, book-keepers, other financial clerks	Miscellaneous clerical workers
Other secretaries, personal assistants, typists, word processor operators nec	Sales clerks, retail trade (Industries 608-699 except 618, 639, 649,
Filing, computer & other records clerks (inc. legal conveyancing)	Cashiers
Storekeepers & warehousemen/women	Estimators & investigators, nec
Counter clerks & cashiers	Receptionists
Retail cash desk & check-out operators	Computer & peripheral equipment operators
Civil Service administrative officers & assistants	Bank tellers
Local government clerical officers & assistants	Shipping & receiving clerks
Receptionists	Stock clerks & storekeepers
	Postal clerks
	Typists
	Clerical supervisors, nec
	Counter clerks, except food
	Mail carriers, post office
	Not specified clerical workers
	Statistical clerks
	Billing clerks
	Expediters & production controllers
ISCO major group 5: service workers, shop and market sales workers	
Sales assistants	Nursing aides, orderlies, & attendants
Care assistants & attendants	Cooks, except private household
Other childcare & related occupations nec	Child care workers, except private household
Counterhands, catering assistants	Waiters
Chefs, cooks	Guards & watchmen
Bar staff	Policemen & detectives
Waiters, waitresses	Hairdressers & cosmetologists
Hairdressers, barbers	Practical nurses
Educational assistants	Food service workers, nec, except private household
Police officers (sergeant & below)	Salesmen, retail trade (Industries 607, 618, 639, 649, 667, 668, 688)
Assistant nurses, nursing auxiliaries	Salesmen of services & construction (Industries 067-078, 407-499,
Nursery nurses	Health aides, except nursing
Security guards & related occupations	Bartenders
Shelf fillers	Housekeepers, except private household
Fire service officers (leading fire officer & below)	Firemen, fire protection
	Child care workers, private household
ISCO major group 7: craft and related trades workers	
Metal working production & maintenance fitters	Foremen, nec
Electricians, electrical maintenance fitters	Automobile mechanics
Carpenters & joiners	Carpenters
Motor mechanics, auto engineers (inc. road patrol engineers)	Heavy equipment mechanics, including diesel
Plumbers, heating & ventilating engineers & related trades	Electricians
Painters & decorators	Painters, construction & maintenance
Welding trades	Plumbers & pipe fitters
Bricklayers, masons	Miscellaneous mechanics & repairmen
Other electrical/electronic trades nec	Air conditioning, heating, & refrigeration
Butchers, meat cutters	Stationary engineers
Construction & related operatives	Aircraft
Roofers, slaters, tilers, sheeters, cladders	Brickmasons & stonemasons
Other construction trades nec	Roofers & slaters
Telephone fitters	Telephone installers & repairmen
Other plant & machine operatives nec	Automobile body repairmen
Computer engineers, installation & maintenance	Bakers
Other machine tool setters & setter-operators nec (inc CNC setter-operators)	Sheetmetal workers & tinsmiths
Precision instrument makers & repairers	Pressmen & plate printers, printing
Fishmongers, poultry dressers	Household appliance & accessory installers & mechanics

Table A.1: Composition of ISCO major groups

UK SOC 1980 Description (BHPS)	*US SOC 1970 Description (PSID)*
Inspectors, viewers & testers (metal & electrical goods)	Electric power linemen & cablemen
Glass product & ceramics makers	Compositors & typesetters
Bakers, flour confectioners	Tool & die makers
Coach trimmers, upholsterers & mattress makers	Painters, manufactured articles
Cabinet makers	Telephone linemen & splicers
Printers	Structural metal craftsmen
Tool makers, tool fitters & markers-out	Cabinetmakers
Plasterers	Decorators & window dressers
Vehicle body repairers, panel beaters	Craftsmen & kindred workers, nec
Shoe repairers, leather cutters & sewers, footwear lasters, makers & finishers,	
Coach & vehicle body builders	
Glass product & ceramics finishers & decorators	
Other craft & related occupations nec	
Floorers, floor coverers, carpet fitters & planners, floor & wall tilers	
Other woodworking trades nec	
Tyre & exhaust fitters	
Sheet metal workers	
Scaffolders, stagers, steeplejacks, riggers	
Originators, compositors & print preparers	
Radio, TV & video engineers	
Glaziers	
Bookbinders & print finishers	
Electrical engineers (not professional)	
ISCO major group 8: plant and machine operators and assemblers	
Drivers of road goods vehicles	Truck drivers
Assemblers/lineworkers (electrical/electronic goods)	Machine operatives, miscellaneous specified
Taxi, cab drivers & chauffeurs	Assemblers
Bus & coach drivers	Fork lift & tow motor operatives
Sewing machinists, menders, darners & embroiderers	Sewers & stitchers
Other plant & machine operatives nec	Checkers, examiners, & inspectors; manufacturing
Other food, drink & tobacco process operatives nec	Miscellaneous operatives
Plastics process operatives,moulders & extruders	Bus drivers
Chemical, gas & petroleum process plant operatives	Machinists
Fork lift & mechanical truck drivers	Welders & flame-cutters
Assemblers/lineworkers (vehicles & other metal goods)	Machine operatives, not specified
Other printing & related trades nec	Excavating, grading, & road machine operators, except bulldozer
Printing machine minders & assistants	Not specified operatives
Inspectors, viewers, testers & examiners (other manufactured goods)	Cutting operatives, nec
Machine tool operatives (inc CNC machine tool operatives)	Meat cutters & butchers, except manufacturing
Other assemblers/lineworkers nec	Laundry & dry cleaning operatives, nec
Launderers, dry cleaners, pressers	Cranemen, derrickmen, & hoistmen
Woodworking machine operatives	Inspectors, nec
Mechanical plant drivers & operatives (earth moving & civil engineering)	Mixing operatives
Press stamping & automatic machine operatives	Taxicab drivers & chauffeurs
Paper, wood & related process plant operatives	Bulldozer operators
Other metal making & treating process operatives nec	Textile operatives, nec
Bakery & confectionery process operatives	Spinners, twisters, & winders
Rubber process operatives, moulding machine operatives, tyre builders	Meat cutters & butchers, manufacturing
Other craft & related occupations nec	Grinding machine operatives
Rail engine drivers & assistants	Punch & stamping press operatives
Coach painters, other spray painters	Millwrights
Other textiles processing operatives	Clothing ironers & pressers
ISCO major group 9: elementary occupations	
Cleaners, domestics	Janitors & sextons

Table A.1: Composition of ISCO major groups

UK SOC 1980 Description (BHPS)	*US SOC 1970 Description (PSID)*
Packers, bottlers, canners, fillers	Cleaners & charwomen
Kitchen porters, hands	Deliverymen & routemen
Other building & civil engineering labourers nec	Freight & material handlers
Messengers, couriers	Construction laborers, except carpenters' helpers
Farm workers	Stock handlers
Caretakers	Gardeners & groundskeepers, except farm
All other labourers & related workers	Packers & wrappers, except meat & produce
Telephone salespersons	Maids & servants, private household
Other personal & protective service occupations nec	Farm laborers, wage workers
Roundsmen/women & van salespersons	Vehicle washers & equipment cleaners
Goods porters	Chambermaids & maids, except private household
Other labourers in making & processing industries nec	Miscellaneous laborers
Collector salespersons & credit agents	Warehousemen, nec
Other transport & machinery operatives nec	Lumbermen, raftsmen, & woodchoppers
Other security & protective service occupations nec	
Road construction & maintenance workers	

Table A.2: Concordance between US and UK 2-digit industries

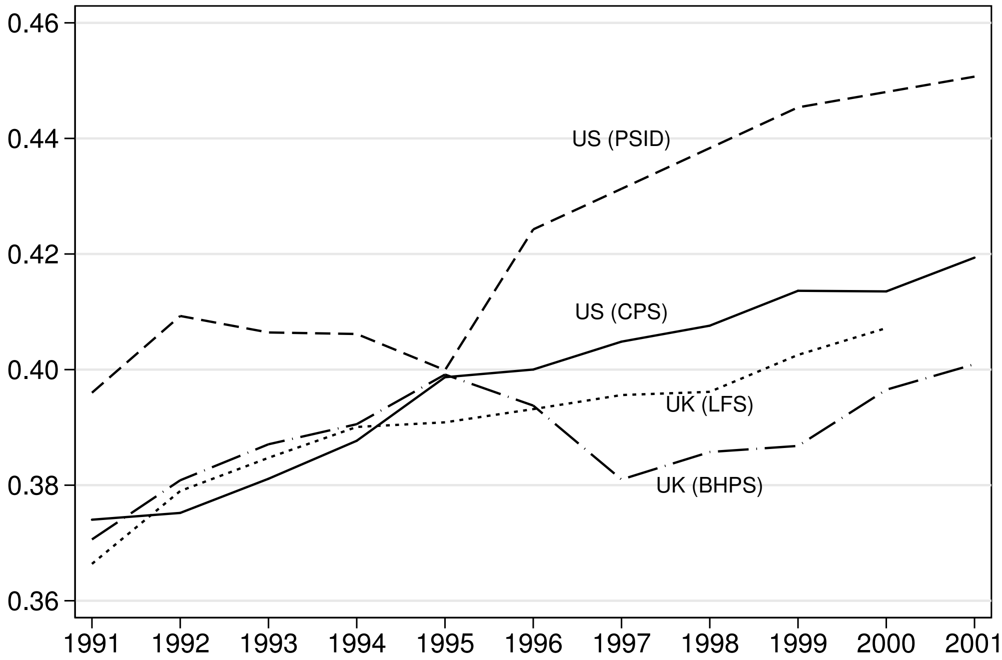
Concordance	*UK 1980 2-digit*		*US 1987 2-digit*	
Agriculture	01	Agriculture and horticulture	1	Agricultural production crops
			2	Agricultural production livestock and animal specialties
			7	Agricultural services
	02	Forestry	8	Forestry
	03	Fishing	9	Fishing, hunting & trapping
Energy & water	11	Coal extraction & manufacture of solid fuels	12	Coal mining
	12	Coke ovens		
	13	Extraction of mineral oil & natural gas	13	Oil & gas extraction
	14	Mineral oil processing	29	Petroleum refining & related industries
	15	Nuclear fuel production		
	16	Production & distribution of electricity, gas & other forms of energy	49	Electric, gas & sanitary services
	92	Sanitary services		
	17	Water supply industry	46	Pipelines, except natural gas
Mining & heavy manufacturing	21	Extraction & preparation of metalliferous ores	10	Metal mining
	23	Extraction of minerals not elsewhere specified	14	Mining & quarrying of nonmetallic minerals, except fuels
	25	Chemical industry	28	Chemical & allied products
	26	Production of man-made fibres		
	24	Manufacture of non-metallic mineral products	32	Stone, clay, glass & concrete
	22	Metal manufacturing	33	Primary metal
Metal goods manufacturing	31	Manufacture of metal goods not elsewhere specified	34	Fabricated metal
	32	Mechanical engineering	35	Industrial & commercial machinery
	33	Manufacture of office machinery & data processing equipment	36	Electronic & other electrical equipment
	34	Electrical & electronic engineering		
	35	Manufacture of motor vehicles & parts thereof	37	Transportation equipment
	36	Manufacture of other transport equipment		
	37	Instrument engineering	38	Measuring, analysing and controlling instruments; photographic, medical & optical
Other manufacturing	41	Food, drink & tobacco manufacturing	20	Food and kindred products
	42	Food, drink & tobacco manufacturing	21	Tobacco products
	43	Textiles	22	Textile mill products
	44	Manufacture of leather & leather goods	31	Leather & leather products
	45	Footwear & clothing industries	23	Apparel
	46	Timber & wooden furniture industries	24	Lumber & wood products
	47	Manufacture of paper & paper products; printing & publishing	25	Furniture & fixtures
			26	Paper
			27	Printing & publishing
	48	Processing of rubber & plastics	30	Rubber & plastics
	49	Other manufacturing industries	39	Miscellaneous manufacturing
Construction	50	Construction	15	Building construction
			16	Heavy construction
			17	Construction
Distribution & repairs	61	Wholesale distribution	50	Wholesale trade - durable goods
	62	Dealing in scrap & waste materials	51	Wholesale trade - non-durable goods
	63	Commission agents		
	67	Repair of consumer goods & vehicles	753	Automotive repair and related services
			754	Automotive repair and related services
			76	Miscellaneous Repair Services
Retail distribution	64	Retail distribution	52	Retail trade
	65	Retail distribution	53	Retail trade
			54	Retail trade
			55	Retail trade
			56	Retail trade
			57	Retail trade

Table A.2: Concordance between US and UK 2-digit industries

Concordance		*UK 1980 2-digit*		*US 1987 2-digit*
			59	Retail trade
Hotels & catering	66	Hotels & catering	58	Eating & drinking places
			70	Hotels etc.
Transport & communications	71	Railways	40	Railroad transportation
	72	Other inland transport	41	Local & suburban transit
			42	Motor freight transportation
	74	Sea transport	44	Water transportation
	75	Air transport	45	Transportation by air
	76	Supporting services to transport	47	Transportation services
	79	Postal services & telecommunications	43	United States Postal Service
			48	Communications
	77	Miscellaneous transport services & storage nec		
Banking	81	Banking & finance	60	Depository institutions
			61	Non-depository credit institutions
			62	Security & commodity brokers, dealers, exchanges
			67	Holding & other investment offices
Insurance	82	Insurance, except for compulsory social security	63	Insurance carriers
			64	Insurance agents, brokers & service
Business services	85	Owning & dealing in real estate	65	Real estate
	83	Business services	73	Business services
			89	Miscellaneous professional and related services
			81	Legal services
	94	Research & development	87	Engineering, accounting, research, management and related services
Other services	84	Renting of movables	751	Automotive rental & leasing
			752	Automotive parking and car washes
	97	Recreational and other cultural services	78	Motion pictures
			79	Amusement & recreation services
			84	Museums, art galleries, zoos
	98	Personal services	72	Personal services
	99	Domestic services	88	Private households
	96	Other services provided to the general public	83	Social services
			86	Membership organisations
Public administration	91	Public administration, national defence & compulsory social security	91	Executive, legislative and general government
			92	Justice, public order and safety
			93	Public finance, taxation and monetary policy
			94	Administration of human resource programmes
			95	Administration of environmental and housing programs
			96	Administration of economic programs
			97	National security and international affairs
Education services	93	Education	82	Educational services
Health services	95	Medical and other health services: veterinary services	80	Health services

B Robustness checks

In this section we report alternative estimates of some of the key parameters. We first verify that the changes in skill composition of the workforce observed in the CPS and the LFS (Table 2) are also observed in the panel data we use to estimate movement probabilities. Figure B.1 shows that the proportion of employment in the top two skill groups is very similar across all four datasets and shows a similar increasing trend over the sample period.



Notes
See Tables 2 and A1 for definitions of skill groups

Figure B.1: Proportion of employment in ISCO skill groups 3 and 4

In Table B.1 we report alternative estimates of the probability of moving between skill groups using the larger samples available from the March CPS and the Spring LFS. These estimates of movement are based on retrospective information rather than contemporaneous, and do not allow us to distinguish between within- and between-firm moves. Comparing with Table 3, these estimates show rather lower probabilities of moving up and down the ladder in both countries, but qualitatively similar patterns across skill groups: stability is generally increasing with skill level, mainly because of declining exit rates to unemployment.

Finally, in Table B.2 we estimate our basic model on a large number of alternative specifications to see how robust the basic results are. In columns 1-3 we report the raw correlations, the raw correlations conditional on industry fixed-effects and our preferred specification. We then report the results of using an alternative econometric model which estimates simultaneously the probability of movement using a multinomial Logit (Column 4). In Columns 5 and

Table B.1: Movement probabilities: alternative data

	All skill groups	*Level 1*	*Level 2*	*Level 3*	*Level 4*
(a) March CPS 1991–2001					
$s' + s''$	0.833	0.687	0.814	0.861	0.904
$v' + v''$	0.020	0.078	0.020	0.022	0.000
$d' + d''$	0.018	0.000	0.011	0.036	0.030
u	0.129	0.235	0.155	0.080	0.067
(b) Spring LFS 1991–2000					
$s' + s''$	0.883	0.801	0.881	0.887	0.911
$v' + v''$	0.020	0.072	0.021	0.024	0.000
$d' + d''$	0.015	0.000	0.009	0.026	0.027
u	0.083	0.126	0.090	0.063	0.062

6 we investigate whether our result is dependent on the particular definition of skill group or industry. We report estimates based on a simple binary high-skill/low-skill split, and based on a simplified 1-digit industrial classification. Next, in Column 7, we use the PSID to see whether the same result holds over a longer time period from 1981-2001 (US only). In Column 8 we vary the definition of "movement" used, basing it only on a comparison of reported occupation. Finally, in Columns 9 and 10 we investigate whether the reported correlations might be the result of small-cell sizes. This is potentially a problem because we use the same data to construct our measure of skill-upgrading as our measure of movement. In Column 9 we exclude any industry-year cell with less than 10 observations, and in Column 10 we exclude any with less than 50 observations.

Our key result is that skill upgrading has a significant and positive effect on the probability of promotion, so we focus on the row labelled v'. In the US, the estimated marginal effect is significantly different from zero in every single specification, varying in size from 0.0942 to 0.0078. In fact, the single biggest impact comes from changing the definition of movement (Column 8) which substantially increases the size of the effect. In our preferred specification our definition of occupational mobility is much "tougher". We require not only that an individual reports a different skill group at $t + 1$ as at t, but also, for those individuals that remain in the same firm, that the individual reports that their position within the firm changed. Relaxing the second requirement increases the number of workers who apparently move up and down within the firm, and increases the importance of the skill upgrading effect reported here. In the UK, the key result is that skill upgrading has a much smaller and generally insignificant effect on promotion. This result too is robust across almost every specification.

Table B.2: Departures from the preferred specification

	Raw effect (no covariates)	*Industry fixed-effects only*	*Preferred specification*	*Multinomial Logit (preferred specification)*	*Alternative skill measure*	*Alternative industry measure*	*Longer time-period*	*Alternative definition of movers*	*Ignoring small cell sizes* < 10	*Ignoring small cell sizes* < 50
(a) PSID										
s'	-0.0260	-0.0082	-0.1016	-0.0922	-0.1101	-0.0334	-0.0958	-0.1583	-0.1009	-0.1467
	[0.0772]	[0.5769]	[0.0000]	[0.0000]	[0.0001]	[0.0295]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
s''	-0.0159	-0.0199	0.0026	0.0088	0.0113	0.0095	-0.0001	0.0026	0.0022	0.0110
	[0.0676]	[0.0184]	[0.7626]	[0.2552]	[0.4665]	[0.2843]	[0.9816]	[0.7626]	[0.8211]	[0.4015]
v'	0.0158	0.0129	0.0173	0.0187	0.0211	0.0078	0.0099	0.0942	0.0194	0.0288
	[0.0005]	[0.0028]	[0.0008]	[0.0004]	[0.0000]	[0.0390]	[0.0082]	[0.0000]	[0.0004]	[0.0000]
v'’	0.0047	0.0022	0.0126	0.0130	0.0107	0.0044	0.0122	0.0126	0.0091	0.0175
	[0.4322]	[0.6871]	[0.0083]	[0.0038]	[0.0042]	[0.0685]	[0.0001]	[0.0083]	[0.0690]	[0.0009]
d'	0.0013	0.0002	-0.0009	-0.0004	-0.0050	-0.0009	-0.0014	-0.0255	-0.0012	-0.0064
	[0.6821]	[0.9536]	[0.7757]	[0.8821]	[0.0571]	[0.2676]	[0.5172]	[0.0119]	[0.7099]	[0.1638]
d''	-0.0040	-0.0061	-0.0064	-0.0047	-0.0199	-0.0079	-0.0020	0.0444	-0.0083	-0.0188
	[0.4274]	[0.2069]	[0.1702]	[0.2833]	[0.0002]	[0.0001]	[0.4994]	[0.0024]	[0.1011]	[0.0077]
u'	0.0234	0.0168	0.0517	0.0568	0.0741	0.0123	0.0542	0.0517	0.0573	0.0841
	[0.0286]	[0.1130]	[0.0002]	[0.0001]	[0.0002]	[0.2518]	[0.0000]	[0.0002]	[0.0001]	[0.0000]
(b) BHPS										
s'	-0.0649	-0.0781	-0.0647	-0.0576	-0.1110	-0.0534	na	na	-0.0743	-0.0563
	[0.0001]	[0.0000]	[0.0001]	[0.0001]	[0.0000]	[0.0214]			[0.0001]	[0.0747]
s''	-0.0206	-0.0139	-0.0139	-0.0108	0.0109	-0.0304			-0.0099	-0.0065
	[0.0285]	[0.1432]	[0.1060]	[0.1669]	[0.4315]	[0.0128]			[0.3320]	[0.7171]
v'	0.0061	0.0058	0.0039	0.0038	0.0031	0.0156			0.0002	-0.0058
	[0.2939]	[0.2913]	[0.3486]	[0.3646]	[0.4205]	[0.0213]			[0.9697]	[0.3143]
v'’	0.0151	0.016	0.0101	0.0101	0.0063	0.0165			0.0083	-0.0021
	[0.0201]	[0.0135]	[0.0429]	[0.0415]	[0.1283]	[0.0076]			[0.1247]	[0.7548]
d'	0.0135	0.0157	0.0081	0.0042	0.0061	0.0021			0.0085	0.0077
	[0.0006]	[0.0001]	[0.0018]	[0.0014]	[0.0083]	[0.4648]			[0.0053]	[0.0910]
d''	0.0035	0.0036	0.0027	0.0026	-0.0043	0.0046			0.0003	0.0046
	[0.5256]	[0.4498]	[0.5009]	[0.5247]	[0.2318]	[0.4443]			[0.9549]	[0.5390]
u'	0.0498	0.0533	0.0453	0.0477	0.0817	0.0353			0.057	0.0612
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0170]			[0.0000]	[0.0027]