Abstract

Using data from three British birth cohort studies, we examine the patterns of social mobility over three generations of family members. For both men and women, absolute mobility rates (i.e. total, upward, downward and outflow mobility rates) in the partial parents–children mobility tables vary substantially by grandparents' social class. As regards relative mobility patterns, there is a statistically significant association between grandparents' and grandchildren's class positions, after parents' social class has been taken into account. The net grandparents–grandchildren association can be summarised by a single uniform association parameter. Net of parents' social class, the odds of grandchildren entering the professional–managerial class rather than the unskilled manual class are at least two and a half times better if the grandparents were themselves in professional–managerial rather than unskilled manual class positions. This grandparents effect in social mobility persists even when parents' education, income and wealth are taken into account.

1 Introduction

Social mobility research has a long and esteemed history (e.g. Glass, 1954; Blau and Duncan, 1967; Goldthorpe, 1980). Without exception, numerous empirical studies demonstrate that social origins are strong predictors of social destinations. Surveying this voluminous literature, it is remarkable that almost all mobility studies make use of data for just two generations of family members: parents and children. Only a handful of studies have explored mobility patterns over three generations (Mukherjee, 1954; Ridge, 1973; Goyder and Curtis, 1977; Beck, 1983; Warren and Hauser, 1997; Erola and Moisio, 2007).

This two-generation focus is partly a matter of practical constraint, as three-generation social mobility data are less commonly available. But it has been argued, with some empirical support, that there is no direct grandparents effect on grandchildren's mobility outcomes once parents' characteristics have been taken into account (e.g. Hodge, 1966; Ridge, 1973; Warren and Hauser, 1997; Erola and Moisio, 2007).

But there are good reasons to expect the opposite. To begin with, it is reasonable to think that grandparents have strong interests in promoting the socio-economic success of their grandchildren. And grandparents who have been socio-economically successful themselves are well-placed to pass this success onto their grandchildren given that, as Mare (2011) argues, many (though not all) mobility-relevant resources, e.g. financial wealth, are quite durable and directly transmissible across multiple generations. Furthermore, there are many social institutions, such as the legacy admission system of Ivy League colleges, generation-skipping trusts, which could contribute to 'status inheritance' over multiple generations, especially at the top and the bottom of the hierarchy. As Mare (2011, p.7) puts it, 'the usual models of two-

generation association may apply to families in the middle of the socioeconomic distribution, but at the extremes, an individual's fortune may depend on the actions and experiences of a more distant ancestor who was lucky or unlucky enough to achieve great wealth or abject poverty.'

In addition, as Bengtson (2001) observes, one implication of population ageing is that there are the 'longer years of shared lives between generations.' Today's grandparents are often healthier, more active and financially more secure than grandparents in the past. Also, there is now greater diversity of family forms and conditions. These social changes might imply a greater role for grandparents in the lives of grandchildren, especially for those with divorced parents (Bengtson et al., 2002, pp.161–162).

If grandparents live with or close to grandchildren, they might be directly involved in childrearing (for the Chinese case, see Zeng and Xie, 2011). Where multigenerational co-residence is rare, grandparents often still play a significant role in grandchildren's lives. For example, in Britain around half of all grandparents of very young grandchildren see them at least once a week (Hawkes and Joshi, 2007); and around one third of all families with working mothers rely on grandparents for informal childcare (Office for National Statistics, 2011). Beyond the grandchildren's formative years, wealthy grandparents might make monetary transfers to help finance grandchildren's education. For example, Arrondel and Masson (2001, Table 2) estimate that in France 22% of grandchildren receive direct financial transfer from grandparents. Well-connected grandparents could also use their social contacts to help grandchildren with job search.

Systematic survey evidence on the mechanisms of the grandparents effect is scant. But suggestive ideas can be gleaned from case studies. For example,

Bertaux and Bertaux-Wiame (1997, p.86) describe the social mobility experience of a French family over five generations: although this is not a straightforward story of dynastic inheritance of a family business, there is a 'connection between the accumulation of a heritage of real estate over three generations ... and the profession of the great-grandson ... through a series of metamorphoses of the heritage.'

Secondly, parents' social class might not fully capture all of the advantages and disadvantages that are transmitted between generations. That is, there might be considerable heterogeneity in how much mobility-relevant resources are available to people from the same class origin. A likely source of such within-class-origin heterogeneity is parents' own mobility experiences. Compared to parents who achieved upward mobility into professional–managerial occupations, those who were intergenerationally stable in advantaged class positions might have more resources (e.g. financial wealth, social contacts) to pass on to their children. Similarly, compared to second generation working class parents, those who have experienced downward mobility to the working class might be better positioned, or perhaps more motivated, to help their children to achieve counter upward mobility (Girod et al., 1972). Congruent with this, Jackson and Marsden's study of children attending academically selective grammar schools in early postwar Britain found that more than a quarter of those from nominally working class background were in fact from families better described as 'sunken middle class', possessing notably higher than average material and cultural resources (Jackson and Marsden, 1962).

The intergenerational counter-mobility experience of an Hungarian family is vividly discussed by Andorka (1997). The grandparents of this Jewish professional/bourgeois family had become *déclassée* during the Second World War and the Stalinist period of the postwar communist regime. But their grandchildren

‘were able—mostly thanks to their knowledge of foreign languages and other cultural resources—to come back to their class of origin at the top of Hungarian society’ (Andorka, 1997, p.269).

Whether grandparents have direct effects on grandchildren’s social mobility outcomes is of course a matter for empirical investigation. But the results of the limited research in this area are mixed. Supporting evidence has been reported for Australia (Allingham, 1967), Canada (Goyder and Curtis, 1977), France (Pohl and Soleihavoup, 1982), and the US (Beck, 1983). In a recent paper, Lindahl et al. (2012, p.20) use linked Swedish survey and register data on education and earnings from multiple years, and report a ‘surprisingly strong association between grandparental education/earnings and education/earnings of grandchildren ...’ To elaborate, their estimate of the earnings elasticity between the first and second generations is 0.356 and that between the second and third generations is 0.303. If earnings mobility follows a Markovian process,[i] the earnings elasticity between the first and third generations should be 0.108, which is ‘substantially lower than the estimate of 0.184 obtained from [the] data.’ Overall, their conclusion is that ‘two-generation studies ... severely under-predict intergenerational persistence in earnings and educational attainment over three generations.’ However, they also note that a ‘*t*-test of equality between the predicted and the estimated three-generation mobility measure gives a *t*-statistic between 1.47 and 1.58, i.e., indicating a marginally significant difference.’

Other researchers have reported different findings. For example, Warren and Hauser (1997, p.561) have analysed data from the Wisconsin Longitudinal Survey, and their conclusion is that ‘the schooling, occupational status, and income of grandparents have few significant effects on the educational attainment or occupational status of their grandchildren when parents’ characteristics are

controlled.' Similarly, Erola and Moisio (2007, p.169) have analysed Finnish mobility data with loglinear models, and they maintain that '[a]fter controlling for parents' social class, ... grandchildren's social class is almost conditionally independent from ... grandparents' social class.' These findings need to be taken seriously. It is certainly possible that a two-generation, Markovian mobility process operates in some contexts but not in others. As Mare (2011, p.16) points out, 'mid-twentieth century Wisconsin families may be a population in which multigenerational effects are unusually weak.' As regards the Finnish paper, Erola and Moisio's conclusion of 'almost conditional independence' belies the fact that their own results reveal a very large and significant improvement in model fit when grandparents–grandchildren association is taken into account (for further details see Chan and Boliver, 2012).

In this paper, we bring fresh empirical evidence to the debate on the grandparents effect in social mobility. We draw on data from three British birth cohort studies and establish that there is indeed a net association between grandparents' and grandchildren's class positions in contemporary Britain. Further, by comparing the fit of several loglinear and related models, we are able to describe the nature of this net association in some detail. To test the robustness of our loglinear results, we then shift our analysis to the individual level. Importantly, we introduce several key covariates and explore the grandparents effect in an ordered logit framework. We show that the grandparents effect remains significant and substantial even when parental education, wealth and income have been taken into account. In the final section, we discuss the implications of our results for further research in social mobility over three generations.

2 Data, class scheme and analytical strategy

2.1 Data and the Registrar General class scheme

The three birth cohort studies that we use have followed large and nationally representative samples of British-born men and women from birth into adulthood. The first of these, the National Study of Health and Development (NSHD), follows a sample of those born in one week in March 1946. The second study, the National Child Development Study (NCDS), follows all those born in one week in March 1958. And the third, the British Cohort Study (BCS), follows all those born in one week in April 1970. (See Appendix A for a discussion of sample attrition and missing data issues of the three studies.)

All three studies have collected a wealth of information about cohort members, including their occupation as adults.[ii] And in interviews with cohort members' mothers in early sweeps, occupational information about cohort members' fathers was collected.[iii] Furthermore, cohort member's mothers also answered questions about the occupation of their father and father-in-law (i.e. cohort members' maternal and paternal grandfathers) when cohort members were 8 years old in the case of NSHD, or as they and their husband were leaving school in the case of NCDS and BCS. There is no reason to think that in contemporary Britain social advantages and disadvantages are transmitted on either patrilineal line or matrilineal line alone. But since it was cohort member's mother who answered the questions about grandparents' occupation, measurement error should be smaller for maternal grandfathers' class position. In addition, evolutionary theory predicts that, because of paternity uncertainty and sex-specific reproductive strategies, maternal grandparents invest more in grandchildren than do paternal grandparents (Coall and Hertwig, 2010,

pp.5–6). Given these considerations, we use maternal grandparents' social class in the following analyses.[iv]

These occupational data have been coded according to the UK Register General (RG) social class scheme. The RG class scheme is based on the notion of occupational skills, such that '[o]ccupations are allocated to social classes commensurate with the degree of expertise involved in carrying out their associated tasks' (Marshall et al., 1989, p.18). There are six RG classes. But because of cell size considerations, they are combined to form the following four categories: class I+II, representing professional and managerial occupations; class IIIn, skilled non-manual occupations; class IIIm, skilled manual occupations; and class IV+V, unskilled manual occupations.[v]

To illustrate some properties of the RG classes, Figure 1 shows its association with home ownership (left panel) and educational attainment (right panel) among cohort members' parents. It can be seen from the left panel that home ownership has become more common between cohorts (especially for BCS). But within each cohort, there is a fairly linear relationship between home ownership rate and the four RG classes. Since, for most individuals, home ownership is the main vehicle of wealth accumulation, this is preliminary evidence that household wealth is rather well ordered by RG classes. The same applies to educational attainment. The right panel of Figure 1 shows fairly linear class gradients in educational attainment, as indexed by the proportion of fathers staying-on beyond the minimum school-leaving age.[vi]

[Figure 1 about here]

2.2 Analytical strategy

Our analytical strategy is as follows. In Sections 3.1 to 3.4, we explore the association between grandparents' class (G), parents' class (P) and children's class

(C) with loglinear and related models. Because separate analyses of the three surveys yield very similar results, the loglinear analyses that we report below are based on pooled data.[vii] However, given the long-standing debate on gender and class analysis (Sørensen, 1994; Beller, 2009), we analyse and report men's and women's three-generation mobility experiences separately.

Our mobility table analysis shows that, for both men and women, there is a strong and statistically significant net association between the class positions of grandparents and grandchildren. But since the four RG classes are rather broad groupings, it could be argued that the net GC association is largely due to measurement error, and could be accounted for with more detailed parental information. To address this concern, in Section 3.5 we regress grandchildren's class position on grandparents' class, while controlling for not only parents' social class, but also their educational attainment, wealth and income.

3 Results

3.1 Marginal distributions

The top panel of Table 1 shows the marginal distributions of respondents by grandparents' class (G), parents' class (P), and their own class (C). It can be seen that there is a general trend for the professional and managerial class (class I+II) to expand across generations. Averaging over the three surveys, 52% of male cohort members are found in class I+II, as compared to 33% of their parents, and 20% of their grandparents. As the 'room at the top' expanded, the manual classes have shrunk: 28% of the grandparents of male cohort members held semi-skilled or unskilled manual occupations, as compared to 14% of the parents and 9% of male cohort members themselves.[viii] The upgrading of the occupational structure in Britain

(and in other industrial societies) over the twentieth century, and its implications for generating upward structural mobility are well understood (Goldthorpe, 1980).

[Table 1 about here]

Occupational upgrading also affects women. But since, for both male and female cohort members, the grandparents and parents that are referred to are maternal grandfathers and fathers, there is very little between-gender difference in the marginal distributions of G and P, as can be seen from the relevant indices of dissimilarity (see the last column of Table 1). However, because of occupational sex segregation, the marginal distribution of C for women is quite different to that for men. In particular, averaged over the three surveys, 34% of women, but only 9% of men, are found in skilled non-manual occupations (class IIIn).[ix]

The bottom panel of Table 1 reports the marginal distributions of parents' social class given grandparents' class position. Not surprisingly, those with advantaged grandparents also tend to have advantaged parents. For example, 58% of those with professional and managerial grandparents, as compared to 19% of those with unskilled manual grandparents, have parents in class I+II.

3.2 Absolute mobility rates

Well over half of all cohort members are intergenerationally mobile. Specifically, 57% of men and 69% of women are found in cells that are off the main diagonal of the marginal parents–children (PC) mobility table.[x] And consistent with the trend of the upgrading of the occupational structure, much of the overall mobility is due to upward mobility rather than downward mobility: 39% men and 46% of women achieve upward mobility (i.e. found in cells that are below the main diagonal of the PC table), as compared to 17% of men and 23% of women who experience downward mobility (found above the main diagonal).

Figure 2 shows how total, upward and downward mobility rates in the partial PC tables vary by grandparent's class position. Three points are notable here. First, women are invariably more mobile than men. Indeed, total mobility rates are 11 to 15 percentage points higher for women. Secondly, for both men and women, total and upward mobility rates are higher for those with less advantaged grandparents. Thus, 32% of women with class I+II grandparents, but 54% of those with class IV+V grandparents, achieve upward mobility. This is partly due to a ceiling effect. As noted above, those with advantaged grandparents are more likely to have parents in advantaged social class too. As a result, they have less room for further upward mobility. Thirdly, there is an opposite (though weaker) gradient in downward mobility rates by grandparents' class which to some degree can be attributed to a floor effect.

[Figure 2 about here]

Some indicative outflow mobility rates in partial PC mobility tables (i.e. distribution of cohort members by their own social class given parents' class) are shown graphically in Figure 3. To elaborate, the cohort members in Figure 3 all have parents in class I+II. The four rows within each panel refer to grandparents' social class, and the four blocks within each row refer to class destination (i.e. children's class). Among men with intergenerationally stable class I+II background (i.e. both parents and grandparents were in class I+II), 80% stayed in class I+II, and only 3% slid down to class IV+V. In contrast, among those with long-range upwardly mobile parents (i.e. class IV+V grandparents and class I+II parents), 61% stayed in class I+II; and 5% experienced what can be called downward counter-mobility and returned to class IV+V. A very similar pattern of outflow rates by parents' and grandparents' class holds for women. One notable feature of the right panel of Figure 3 is that many more women are found in class IIIn. This is expected, as this class contains

many female-dominated occupations. Overall, it is clear that outflow rates in the partial PC tables depend on grandparents' class.[xi]

[Figure 3 about here]

3.3 Relative mobility rates

Having seen evidence that grandparents' social class matters for absolute mobility rates, we now turn to examine relative mobility patterns using loglinear and related models.[xii] We start with the conditional independence model:

$$\log F_{ijk} = \lambda + \lambda^{G}_{i} + \lambda^{P}_{j} + \lambda^{C}_{k} + \lambda^{GP}_{ij} + \lambda^{PC}_{ik}, \qquad (1)$$

where F_{ijk} is the expected frequency of the ijk-th cell; λ is the grand mean; λ^{G}_{i}, λ^{P}_{j} and λ^{C}_{k} are the main effects for grandparents', parents' and children's class respectively; and λ^{GP}_{ij} and λ^{PC}_{jk} refer to the two-way associations between grandparents' and parents' class, and between parents' and children's class.[xiii] Because model 1 does not contain the λ^{GC}_{ik} term, it posits that there is no net GC association once the GP and PC associations are taken into account. If this model fits the data, there would be support for the Markovian view of social mobility. Table 2 shows that the deviance (G^2) of model 1 is 147.28 for men and 113.39 for women. Given that model 1 has 36 degrees of freedom, it clearly fails to fit the data.[xiv]

$$\log F_{ijk} = \lambda + \lambda^{G}_{i} + \lambda^{P}_{j} + \lambda^{C}_{k} + \lambda^{GP}_{ij} + \lambda^{PC}_{ik} + \lambda^{GC}_{ik} \qquad (2)$$

We then add to model 1 the term representing net GC association (λ^{GC}_{ik}). Table 2 shows that the resulting model 2 fits the data well by the conventional criterion of 5% type I error. Moreover, because models 1 and 2 are nested, we can compare their fit to the data using the likelihood ratio test. For 9 degrees of freedom, model 2 reduces the deviance of model 1 by 115.24 for men and 90 for women, which are both large and statistically significant improvements in model fit. Furthermore, the percentage of

cases that are misclassified (Δ) under model 2 is only about a third of that under model 1. Finally, BIC would also suggest choosing model 2 over model 1.[xv] Overall, then, there is quite strong evidence against the null hypothesis of no net GC association. Put differently, grandparents' class does have direct net effects on grandchildren's mobility outcome.

[Table 2 about here]

Model 2 does not constrain the net GC association at all. To find out in what ways grandparents' class matters, we explore the net GC association further. Our goal is to find a model which is more parsimonious than model 2, but which would still fit the data. With this in mind, we first explore the quasi-independence (QI) model. QI posits that, net of other factors, there is a tendency for grandchildren to stay in their grandparents' class, but otherwise C is independent of G. Formally, this can be represented as follows:

$$\log F_{ijk} = \lambda + \lambda^{G}_{i} + \lambda^{P}_{j} + \lambda^{C}_{k} + \lambda^{GP}_{ij} + \lambda^{PC}_{ik} + \lambda^{GC}_{ik}\,\delta \qquad (3)$$

where δ=1 if i=k, otherwise δ=0. Table 2 shows that QI cannot be rejected for women (p=.15), but its fit for men is rather marginal (p=.06). Using the likelihood ratio test to compare QI with model 1, we see that QI significantly improves on the conditional independence model (for 4 degrees of freedom, QI reduces the G^2 of model 1 by 102.26 for men and 72.99 for women, which are both statistically significant, see the '1 v 3' contrast). But the full GC interaction model also fits the data better than QI (see the '3 v 2' contrast). This means that QI, which posits that the grandparents effect takes place on the main diagonal only, fails to capture all of the net GC association in the data.[xvi]

Next, we consider the uniform association (UA) model (Goodman, 1979; Duncan, 1979). UA is a linear-by-linear model. It assumes that the class categories are

ordered and evenly spaced (which are reasonable assumptions for RG classes given Figure 1). Given these assumptions, UA posits that the GC association can be summarised as the product of a uniform association parameter (β^{GC}) and the scale scores of the class categories:[xvii]

$$\log F_{ijk} = \lambda + \lambda^{G}_{i} + \lambda^{P}_{j} + \lambda^{C}_{k} + \lambda^{GP}_{ij} + \lambda^{PC}_{ik} + \beta^{GC}ik \qquad (4)$$

Thus, compared to the conditional independence model, UA uses just one extra parameter, namely, β^{GC}. Table 2 shows that UA also fits the data well. Although QI and UA both fit the data, the interpretation they give of the GC association is very different. QI suggests that the net GC association is found on the main diagonal only. By comparison, UA gives no special status to the main diagonal. Instead, it suggests that the same social force, scaled by the distance between class categories, operates throughout the partial GC table. Because UA and QI are not nested models, we cannot compare their fit to the data formally. Nevertheless, for the following reasons, we prefer UA to QI. First, the deviance of UA is actually smaller than that of QI, despite UA's greater parsimony.[xviii] Secondly, while the full GC association model improves on QI (cf. the '3 v 2' contrast noted above), it does not improve on UA (see the '4 v 2' contrast). Finally, inspection of the residuals of the UA model does not suggest any particular lack of fit along the main diagonal.

It is quite remarkable that a simple model such as UA could provide a satisfactory description of net GC association, especially since UA and QI, suitably modified, fail to describe the net GP association or the net PC association (see models 3 and 4 in Table 3). Table 3 also shows that a 'QI plus UA' model fits the data for the net PC association for women, but not for the other cases. It is beyond the scope of this paper to find the best fitting model for the net PC association or the net GP association. Suffice it to say that the manner in which grandparents directly affect

grandchildren's mobility outcome is quite different from the relative mobility pattern found in parents–children mobility tables.

[Table 3 about here]

3.4 Substantive magnitude of the grandparents effect

How strong is the grandparents effect in social mobility? The point estimate of β^{GC} is .111 for men and .102 for women (with *s.e.*=.011 in both cases). Thus, for men, under the UA model, the local odds ratio for the four cells formed by any adjacent rows and any adjacent columns in the partial GC table is 1.12 ($e^{.111}$) and the odds ratio for the four corner cells is 2.72 ($e^{.111(4-1)(4-1)}$). For women, the corresponding odds ratios are 1.11 ($e^{.102}$) and 2.50 ($e^{.102(4-1)(4-1)}$) respectively. That is, controlling for parents' social class, the odds of cohort members entering class I+II rather than class IV+V are at least two and a half times better if their grandparents were in class I+II rather than class IV+V.

Some counterfactual comparisons would also illustrate the magnitude and the pattern of the grandparents effect in social mobility. In particular, we are interested in the contrast between the UA model which fits the data and the conditional independence model which posits no grandparents effect. Figure 4 reports some indicative outflow rates in partial PC tables. The left panel of Figure 4 concerns class immobility over three generations. For those with class I+II grandparents and parents, the UA model predicts that 77% of men and 65% of women would end up in class I+II themselves. But under the conditional independence model, these percentages would be slightly lower at 71% and 60% respectively.

[Figure 4 about here]

At the other end of the class hierarchy, for those with class IV+V grandparents and parents, the UA model predicts that 19% of men and 28% of women would stay in class IV+V. Under the conditional independence model, three-generation immobility in class IV+V would again be slightly lower at 16% for men and 25% for women.

The right panel of Figure 4 concerns counter-mobility over three generations between class I+II and class IV+V. It can be seen that, under the UA model, 47% of men and 41% of women move from class IV+V (P) to class I+II (C), if they have class I+II grandparents. Under the conditional independence model, the corresponding figures are 35% and 32%. As regards counter-downward-mobility, i.e. moving from class IV+V (G) to I+II (P) and then back to class IV+V (C), the rates under the UA model are 6% for men and 10% for women. Had conditional independence prevailed, these rates would be about a third lower at 4% and 7% respectively.

Overall, the grandparents effect seems to operate as follows. The conditional independence model consistently underpredicts the outflow rates considered above. Where grandparents and parents are in the same social class, the grandparents effect would lead us to expect slightly more three-generational class immobility. But in cases where grandparents and parents are in different social classes, the grandparents effect is often larger, in proportional if not in absolute terms, and would lead to a higher level of counter-mobility, as though grandparents' class background is correcting the 'mobility mistake' made by the parents.[xix]

3.5 Ordered logit analyses

In Figure 5, we plot home ownership rates (left panel) and staying-on rates (right panel) by parents' class and grandparents' class. Within each panel, the line for parents in class I+II is above that for parents in class IIIn which, in turn, is above the line of class IIIm, and so on. This is, of course, consistent with what we saw in

Figure 1. But the slope of the lines in Figure 5 further suggests that parents of the same social class have available to them different amount of resources, depending on grandparents' class. For example, 87% of parents who are intergenerationally stable in class I+II are home-owners, compared to 73% of those who have achieved upward mobility from class IV+V to class I+II.[xx]

[Figure 5 about here]

This is prima facie evidence for one of the motivations of this paper: the availability of mobility-relevant resources to parents is related to their own mobility experiences. But, equally, one might turn the argument around and suggest that the net grandparents–grandchildren association reported above is an artifact. That is, once more detailed parental characteristics are brought into the analysis, the grandparents effect might be explained away.

To address this concern, we shift our analysis from the aggregate level to the individual level, and regress grandchildren's class on grandparents' class. The question is whether the grandparents effect remains statistically significant after we have controlled for, not only parents' social class, but also the following parental characteristics: (1) educational attainment, as measured by the schooling-leaving age of cohort members' fathers and mothers, (2) parental wealth as proxied by whether cohort members' parents were home-owner when cohort members were 15 (NSHD) or 16 (NCDS and BCS), and (3) family income. Since the UA model fits the data well in the loglinear analysis, we use the ordered logistic regression,[xxi] and all class variables are entered as interval level measures.[xxii]

[Table 4 about here]

Unfortunately, parental income data are not available in NSHD. Also, income is measured in very different ways in NCDS and BCS. In BCS, there is a single question on gross household income. In NCDS, there are separate questions on net income from father, mother and other sources. We combine these information and derive a variable of annual net household income for NCDS.[xxiii] Given the divergent income measures, separate models are fitted to the three studies. Table 4 reports some basic descriptive statistics of the covariates. The most notable thing here is that there is a fair amount of missing data, especially for income. So, for each survey, we have carried out multiple imputation. Twenty data sets are imputed for each of the birth cohort studies based on known covariates. The ordered logit results from these imputed data are then aggregated and reported in Table 5.

[Table 5 about here]

It can be seen that mother's education and home ownership are statistically significant predictors, in the expected direction, of children's class attainment in all six cases. For example, other things being equal, at each of the three contrasts implied by the fourfold class scheme,[xxiv] the odds of male NSHD cohort members reaching the higher rather than the lower set of class destinations are 1.7 ($e^{.542}$) times better if their parents are home-owners. And if their mothers stay in school for one further year, the odds would increase by 24% ($e^{.213}$ -1). Father's education and family income also predict children's class attainment in the expected direction. But father's education is insignificant for female cohort members of NSHD (p=.10) and BCS (p=.13), and income is insignificant for female cohort members of NCDS (p=.13) and BCS (p=.07). As expected, parents' social class is a strong predictor of children's class attainment. For example, the odds of male NSHD cohort members reaching the

higher rather than than lower set of class destinations are 2.9 times ($e^{.353 \times 3}$) better if their parents are in class I+II rather than class IV+V.

Net of parents' social class and other parental characteristics, the grandparents' effect remains statistically significant, except for female NSHD cohort members where it is marginally insignificant (p=.09).[xxv] The absolute magnitude of the parameter for grandparents' class is smaller than that for parent's class, but it is nevertheless substantial. For example, net of other predictors that are included in the model, the odds of male NSHD cohort members reaching the higher rather than the lower set of class destination are 48% ($e^{.129 \times 3}$) better if they have class I+II rather than class IV+V grandparents. Overall, then, the net GC association reported in our loglinear analysis cannot be explained away by including further parental characteristics.

4 Summary and discussion

In this paper, we use data from three British birth cohort studies to investigate the patterns of social mobility over three generations of family members. We report quite substantial change in the class structure over generations, and clear evidence of the dependence of absolute mobility rates in the parents–children mobility tables on grandparents' social class. In particular, respondents with more advantaged grandparents have lower rates of total and upward mobility, in the absolute sense. There are also clear gradients in outflow mobility rates by grandparents' social class.

As regards relative mobility patterns, there is consistent and strong evidence that, net of parents' social class, grandparents' class position has a direct effect on grandchildren's mobility outcomes. This net grandparents–grandchildren association can be summarised by a single uniform association parameter, suggesting that the grandparents effect in social mobility is quite a general social force, operating throughout the class hierarchy, and is not restricted to the two ends, as Mare (2011)

suggests. However, it should be noted that most members of RG class I+II do not have 'great wealth'. Likewise, most of those in RG class IV+V are not in 'abject poverty'. In other words, our data are not best suited to testing Mare's argument, and it is possible that, say, at the top 1% and bottom 1% of the population, even stronger and qualitatively different multigenerational effects are at work. Finally, we show that this net association between grandparents' and grandchildren's class positions remains even after other parental characteristics, such as parental wealth, years of schooling and, in the case of NCDS and BCS, household income, have been taken into account.

The grandparents effects in social mobility is most striking in cases of counter upward mobility. While it is possible, as one reviewer suggests, to interpret these as examples of 'regression to the mean', our view is that the grandparents effect reported above is too large and systematic to be attributed entirely to random processes. Afterall, the improvement in fit of the uniform association model over the conditional independence model goes well beyond what one would expect from chance difference alone. Having said that, further data, perhaps involving social mobility over four generations, would help us resolve this issue with even greater confidence.

The results reported in this paper are consistent with those reported for Finland by Erola and Moisio (2007). But, as noted above, we do not agree with the conclusion that they draw. As regards the findings of Warren and Hauser (1997), it is indeed possible that while a three-generation mobility process applies in Britain, a two-generation Markovian mobility process operated in Wisconsin in the mid-twentieth century (Mare, 2011). Clearly, we need evidence from more countries in order to form a view on just how common is the grandparents effect in social mobility.

Finally, it should be noted the grandparents effect reported in this paper is a weighted average of such effects found in different types of household. The strength of the grandparents effect will probably vary by other socio-demographic variables. For example, Zeng and Xie (2011) show that in rural China grandparents affect grandchildren's schooling only when they live together. Their argument is that with multigenerational coresidence, grandparents are more likely to be involved in childrearing, in supervising grandchildren's schoolwork, and in other household activities that would benefit the grandchildren. Multigenerational coresidence is very rare in Britain and many other Western societies. But it is likely that the nature and strength of the grandparents effect depend on the relationship within the extended family. There is some information on intergenerational contact and support in the British Household Panel Survey. In future work, we intend to exploit such information in order to explore the three-generation mobility process further.

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Appendix A Data and sample attrition

Sample attrition and non-response are potentially important issues for the cohort studies that we analyse, just as they are for any longitudinal survey. Wadsworth et al. (1992, p.301, Table 1) have examined the pattern of non-response of the NSHD, and show that 74% of the target sample were interviewed after 43 years. (The target sample refers to all members of the original longitudinal sample until they die or permanently emigrate from Britain.) Given that the '[r]esponse rates from the population resident in Britain have remained high, and the responding population is in most respects representative of the native population born in the early postwar years' (p.300 Wadsworth et al., 1992), it would seem that sample attrition is not a serious problem for NSHD.

Broadly the same can be said of the NCDS: 71% of the target sample were interviewed after 42 years (p.480, Table 1 Hawkes and Plewis, 2006). And although there are 'systematic differences between respondents and non-respondents at every sweep' (p.489 Hawkes and Plewis, 2006), such differences tend to be small. Further, 'the propensity not to respond at sweep 6 [2000] is not strongly related to social class'. Overall, Hawkes and Plewis (2006, p.489) conclude that there is 'support for [treating the missing data] as ignorable non-response'.

By comparison, sample attrition is a more serious problem for BCS. Ketende et al. (2010, p.5, Table 1) estimate that only 61% of the target sample were interviewed after 34 years. The higher sample attrition rate is due to a number of factors, including (1) the fieldwork of sweep 3, which was partly school-based, was hampered by the national teachers' strike of 1986, (2) a lengthy gap of 10 years between sweep 3 and sweep 4 when for the first time cohort members became primary respondents and had to opt into the survey, and (3) that sweep 4 was a postal survey. We would

argue that because some of these factors, especially the teachers' strike, are orthogonal to the social processes under investigation, the resulting attrition, though regrettable, might be less serious in terms of bias. Indeed, contact rates in sweep 5 (2000) and sweep 6 (2004) have improved, and refusal rates in the face-to-face interviews at these two sweeps are at a modest level of 7.3% and 7.6% respectively (Elliott and Shepherd, 2006, p.838).

Table 1 Marginal distribution of respondents by grandparents' social class (G), parents' social class (P) and their own social class (C); and marginal distribution of respondents by parent's class given grandparent's social class}

	male				female				
	I+II	IIIn	IIIm	IV+V	I+II	IIIn	IIIm	IV+V	Δ
G	19.5	7.5	45.2	27.8	18.9	8.3	44.8	28.0	1.0
P	32.9	11.5	41.7	13.9	33.1	11.2	41.8	13.9	0.3
C	51.9	9.3	30.0	8.8	44.5	33.8	6.6	15.1	30.8
P | G=I+II	57.5	10.6	24.0	7.9	57.8	10.9	23.5	7.8	0.6
P | G=IIIn	50.1	15.3	28.8	5.9	45.8	16.7	27.9	9.6	5.2
P | G=IIIm	28.0	12.5	46.0	13.5	29.4	11.3	46.4	12.8	1.9
P | G=IV+V	19.1	9.5	50.6	20.9	18.8	9.4	50.8	21.0	0.4

Δ: index of dissimilarity between gender

Table 2 Goodness of fit statistics of models to explore net GC association

model comparison									
model	G^2	df	p	Δ	BIC		rG^2	rdf	p
male									
1 con. independence	147.28	36	.000	4.6	-179.17				
2 full GC association	32.04	27	.231	1.8	-212.80	1 v 2	115.24	9	.000
3 quasi-independence	45.02	32	.063	2.1	-245.16	1 v 3	102.26	4	.000
						3 v 2	12.98	5	.024
4 uniform association	42.67	35	.175	2.1	-274.72	1 v 4	104.61	1	.000
						4 v 2	10.63	8	.223
female									
1 con. independence	113.39	36	.000	4.4	-211.94				
2 full GC association	23.39	27	.664	1.6	-220.61	1 v 2	90.00	9	.000
3 quasi-independence	40.40	32	.146	2.5	-248.78	1 v 3	72.99	4	.000
						3 v 2	17.02	5	.004
4 uniform association	31.91	35	.618	2.1	-284.38	1 v 4	81.48	1	.000
						4 v 2	8.53	8	.384

Table 3 Goodness of fit statistics of models to explore the net GP and PC associations for men and women

		GP association			PC association		
		G^2	df	p	G^2	df	p
male	1 con. independence	717.22	36	.000	730.54	36	.000
	2 full GP/PC association	32.04	27	.231	32.04	27	.231
	3 quasi-independence	260.69	32	.000	210.13	32	.000
	4 uniform association	109.69	35	.000	92.56	35	.000
	5 QI+UA	91.93	31	.000	47.25	31	.031
female	1 con. independence	730.89	36	.000	426.30	36	.000
	2 full GP/PC association	23.39	27	.664	23.39	27	.664
	3 quasi-independence	244.82	32	.000	118.91	32	.000
	4 uniform association	88.61	35	.000	54.01	35	.021
	5 QI+UA	61.72	31	.001	29.80	31	.528

Table 4 Descriptive statistics of covariates in ordered logit regression}

		male	female	male	female	male	female
N in mobility table		1304	1248	4411	4329	2960	2831
father's school leaving age	mean	14.6	14.7	15.9	16.0	15.5	15.5
	s.d.	1.3	1.3	1.6	1.6	1.1	1.2
	N	1223	1170	3370	3294	2882	2751
mother's school leaving age	mean	14.6	14.5	15.9	16.0	15.5	15.5
	s.d.	1.2	1.2	1.3	1.4	1.1	1.2
	N	1242	1175	3400	3362	2947	2825
annual household income*	mean			2.4	2.4	12.9	12.7
	s.d.			1.2	1.2	8.2	8.1
	N			3129	3068	1601	1573
home-owner	%	40.8	40.0	54.0	52.2	81.6	80.2
	N	1228	1186	3463	3419	2071	2099

* Household income (in thousands of pounds) refers to net household income in NCDS, but gross household income in BCS. See text for details.

Table 5 Ordered logit regression predicting class destination of grandchildren

	NSHD		NCDS		BCS	
male	β	s.e.	β	s.e.	β	s.e.
G	.130*	.060	.171**	.032	.109**	.039
P	.353**	.062	.408**	.034	.311**	.043
father's edu	.212**	.063	.082**	.028	.141**	.042
mother's edu	.213**	.072	.094**	.034	.158**	.043
income			.069*	.033	.014*	.007
home owner	.542**	.133	.259**	.068	.344**	.104
cut 1	4.757	1.094	2.126	.514	3.607	.713
cut 2	6.997	1.097	4.141	.515	5.575	.714
cut 3	7.383	1.099	4.554	.516	6.051	.715
female	β	s.e.	β	s.e.	β	s.e.
G	.096	.056	.124**	.031	.138**	.038
P	.315**	.060	.254**	.032	.184**	.043
father's edu	.089	.054	.075**	.026	.058	.039
mother's edu	.239**	.062	.081**	.030	.138**	.038
income			.044	.029	.013	.007
home owner	.288*	.123	.352**	.071	.300**	.101
cut 1	4.168	.879	1.986	.434	2.245	.642
cut 2	4.589	.879	2.432	.434	2.770	.642
cut 3	6.464	.888	4.080	.436	4.220	.644

* $p<.05$, ** $p<.01$

Figure 1 Home ownership and educational attainment of parents of cohort members by Registrar General social class.

Figure 2 Total, upward and downward mobility rates in partial parents--children mobility tables by gender and grandparents' Class

Figure 3 Outflow rates from class I+II (P) in partial parents--children mobility tables by grandparents' class and gender

Figure 4 Expected three-generation immobility rates (left panel) and expected counter-upward and counter-downward mobility rates (right panel) under conditional independence and uniform association models

Figure 5 Home ownership and educational attainment of parents of cohort members by parents and grandparents' social class

[i] If mobility follows a first-order Markovian process, then grandparents would still matter for grandchildren's outcome, but all such effects would be mediated by parents' class.

[ii] To minimise missing data, we extract occupational data of cohort members from two sweeps of each survey. For NSHD, we refer to the occupation when cohort members were aged 36 or 43; for NCDS respondents, aged 33 or 37; and for BCS respondents, aged 34 or 38. Where two different occupations are reported, we refer to the higher occupation.

[iii] Specifically, we refer to father's occupation when cohort members were 10–11 and 15–16 years old, whichever was higher.

[iv] We have repeated our analyses using paternal grandfathers' class, or the higher of paternal and maternal social classes. These choices do not affect the results of our loglinear analyses, although there is evidence that measurement error is indeed smaller for maternal grandfathers' class (see footnote 14 below).

[v] The RG class scheme was replaced in 2001 by the National Statistics Socio-Economic Classification (NS-SEC) as the UK official social classification. NS-SEC is, in turn, based on the Goldthorpe class scheme. We regard NS-SEC as superior to the RG class scheme. But, unfortunately, grandparents' social class data in publicly available versions of the cohort surveys data sets are coded to the RG class scheme only.

[vi] Between-cohort comparison of staying-on rate is difficult, partly because the minimum school leaving age has changed over time: from 14 in 1921 (which was the regime most NSHD fathers faced), to 15 in 1944 (for NCDS and BCS fathers) and then 16 in 1972. Further, there is much variation in child-bearing age over time and within cohort.

[vii]We obtain the same results by modelling a 4-way G x P x C x S table, where S refers to the three studies. Details of the analysis of this 4-way table can be found in the online supplement on the *ASR* website.

[viii]Because the oldest and the youngest cohorts were born only 24 years apart, there is relatively little between-cohort difference in the marginal distributions, except for the C distribution for women (see footnote 9). Details are available on request. Furthermore, note that, strictly speaking, the marginal distributions of G and P do not represent the class structure of British society at a particular time in the past (see Duncan, 1966). There are various reasons for this, including the fact that childless people in the grandparental and parental generations are not represented in the cohort studies. Also, as members of our three birth cohorts reached their mid-thirties at different historical time, the marginal distribution of C in Table 1 does not represent the class structure at a particular time either. Having stated these caveats, the change in the marginal distributions of Table 1 does broadly reflect historical change in the occupational structure over time.

[ix]As more women enter professional and managerial occupations (class I+II), the level of occupational sex segregation among cohort members (i.e. the C marginal) has declined between surveys: from 41 (NSHD) to 33 (NCDS) and 23 (BCS). Note that cohort-specific Tables and Figures are not shown here, but are available from the authors on request.

[x]The marginal parents–children table is the PC table summed over all grandparents' class categories. The partial parent–children tables are those stratified by grandparents' class, i.e. there is one partial table for each grandparents' class.

[xi]Inflow mobility rates in partial PC tables also vary substantially by grandparents' class. Details are available on request.

[xii]All models are fitted with R package gnm (Turner and Firth, 2011). The observed cell count of the mobility tables and the R codes that we use to analyse these tables are available in the online supplement.

[xiii]We use the ANOVA identifying convention, i.e. $\Sigma_i\lambda^G_i=\Sigma_j\lambda^P_j=\Sigma_k\lambda^C_k=0$; $\Sigma_i\lambda^{GP}_{ij}=\Sigma_j\lambda^{GP}_{ij}=\Sigma_j\lambda^{PC}_{jk}=\Sigma_k\lambda^{PC}_{jk}=0$.

[xiv]If we use paternal grandfathers' class (rather than maternal grandfathers' class) in the construction of the three-way mobility tables, the G^2 for model 1 are 92.84 for men and 53.00 for women, which are still large enough for model 1 to be rejected. But the smaller G^2 returned is consistent with our argument that there is more measurement error for paternal grandfathers' class.

[xv]BIC stands for the Bayesian Information Criterion, and is given by the following expression: BIC = G^2 – *df* x log *N* (see e.g. Raftery, 1986).

[xvi]We have also considered a variant of QI which we call the 'corners model'. This model is the same as QI, but d=1 if i=k=1 or i=k=4, otherwise d=0. Thus, the corners model corresponds to Mare's suggestion that net grandparents' effect is most likely found at the top and the bottom of the class hierarchy. It turns out that the deviance of this model (df=34) is 52.04 for men (p=.025) and 41.04 for women (p=.189). When compared to the corners model, QI uses two more parameters, but the deviance of QI is also smaller, with rG^2=7.02 for men and rG^2=0.63 for women. For two degrees of freedom, only the former is a statistically significant change. In other words, we would prefer the corners model to QI for women, but not for men.

[xvii]We use the simplest integer scoring for i and k, i.e. the scale scores for the four RG classes are entered as 1, 2, 3 and 4 respectively.

[xviii]This also holds when UA is compared to the corners model.

[xix]Neither UA nor the conditional independence model contains the three-way GPC interaction term. The outflow rates discussed here are calculated from the expected frequencies of these models.

[xx]Consistent with the rest of this paper, Figure 5 refers to maternal grandparents. But we obtain a very similar picture if we use paternal grandparents.

[xxi]Brant tests suggest that the proportional odds assumption of the ordered logit models reported in Table 5 cannot, in most cases, be rejected. The exceptions are for the covariate of parents' class for male cohort members of NCDS and BCS.

[xxii]To aid interpretation, we reverse the coding of the class categories, i.e. class I+II is coded 4; class IIIn, 3; class IIIm, 2; and class IV+V, 1.

[xxiii]The income data for both NCDS and BCS come from their respective sweep 3, when cohort members were aged 16. The answer categories to the income questions in both studies were banded. To compute an interval-level income variable, we assign all individuals in each band to the mid-point of the respective band or, for the top category, 1.5 times of its lower limit.

[xxiv]The three contrasts are (1) class I+II v the rest, (2) class I+II or class IIIn v class IIIm or class IV+V, and (3) the rest v class IV+V.

[xxv]If parents' schooling-leaving age, home-ownership status and income are dropped from the model, the magnitude of the grandparents effect in Table 5 would increase by between 44% to 97%, and that for parents' class would increase by between 32% to 70%. For details, see the online supplement.