Social Mobility Over Three Generations in Finland: A Critique*

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Abstract

Erola and Moisio (2007) argue that in Finland the class positions of grandparents and grandchildren are almost independent of each other, once parents' social class has been taken into account. We show that this conclusion of 'almost conditional independence' is actually *not* supported by the results reported in their paper. We further show that the strong evidence against conditional independence is not due to the large N of the Finnish mobility table alone, as the same critique applies to much smaller sub-samples drawn randomly from the data. We then demonstrate with some illustrative outflow mobility rates that the grandparents effect in social mobility in Finland is not only statistically significant, but is also of substantive importance. Finally, we discuss the two 'lagged' effects reported in Erola and Moisio (2007), and show that they fail to capture much of the net GC association.

1 Introduction

In a paper published in the *European Sociological Review*, Erola and Moisio (2007, p.169, hereafter as EM) argue that in Finland '[a]fter controlling for parents' social class, the grandchildren's social class is almost conditionally independent from the grandparents' social class.' This is a Markovian view of social mobility: grandparents' class position affects parents' class outcome and, in turn, parents' class position influences grandchildren's class outcome; but there is no direct grandparents effect on grandchildren, once parents' social class has been taken into account.

We make four claims in this paper. First, we argue that EM's conclusion is actually *not* supported by the results reported in their paper. Secondly, we demonstrate that the strong evidence against conditional independence is not due to the large N of the Finnish mobility table alone. Our critique remains valid when the same analysis is applied to much smaller sub-samples drawn randomly from the Finnish data. Thirdly, we show that the net grandparents effect is of substantive importance, as demonstrated by some illustrative outflow mobility rates. Fourthly, we discuss the two 'weak lagged effects' identified by EM. We show that they fail to capture much of the net GC association in the data, and they do not support EM's main claim of 'almost conditional independence.'

2 The evidence against conditional independence

EM base their conclusion on a loglinear analysis of a three-way contingency table cross-classifying the class positions of grandparents (G), parents (P) and children (C).[1] The key evidence that they present (in Table 3 of their paper) is reproduced in Table 1 here. Their model I can be represented by the equation below, where F_{ijk} is the expected frequency of the $ijk-$th cell, λ is the grand mean, and λ_i^G, λ_j^P and λ_k^C are the main effects of grandparents' class, parents' class and children' class respectively. We call this the 'main effects' model (ME). ME precludes all two-way associations, and with a deviance (G^2) of 15,425.7 for 324 degrees of freedom, it clearly fails to fit the data.

$$\log F_{ijk} = \lambda + \lambda_i^G + \lambda_j^P + \lambda_k^C. \tag{ME}$$

Their model IV is the conditional independence model (CI), which takes into account the association between the class positions of grandparents and parents (represented by the λ_{ij}^{GP} term) and the association between the class positions of parents and children (λ_{jk}^{PC}). CI further posits that, conditional on

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[1]EM use the CASMIN class schema (Erikson and Goldthorpe, 2002). In their paper, EM have also modelled a four-way contingency table of grandparents' class (G), parents' class (P), children's class (C) and lineages (L), where L represents the eight combinations of grandparents', parents' and children's gender. As their analysis of this four-way table is very similar to that pertaining to the three-way table, we will not discuss that section of their paper. In addition to loglinear analysis, EM also regress children's ISEI score on those of parents and grandparents. Their OLS regression analysis shows that grandfathers' status is consistently a significant predictor of grandchildren's ISEI score, even when parents' status is controlled for (see Erola and Moisio, 2007, Table 5). They note that 'the [grandfather] effect exists, but it is very small. The result is line with the result achieved with loglinear models' (p.179).

the grandparents–parents association and the parents–children association, there is no net grandparents–grandchildren association. (Note the absence of the λ_{ik}^{GC} term in CI.) This model also fails to fit the data ($G^2 = 750.7$ for 252 degrees of freedom, $p < .001$). But CI accounts for 94% of the deviance under ME, and the index of dissimilarity, Δ (i.e. the percentage of misclassified observations), comes down from 17.1 to 3.8.

$$\log F_{ijk} = \lambda + \lambda_i^G + \lambda_j^P + \lambda_k^C + \lambda_{ij}^{GP} + \lambda_{jk}^{PC}. \qquad \text{(CI)}$$

EM then add the λ_{ik}^{GC} term, representing the grandparents–grandchildren association, to their analysis. The resulting model, which can be called the 'full GC interaction model' or FI, still does not fit the data. But compared to CI, deviance (G^2) is reduced by 454.3 for 36 degrees of freedom, which is actually a highly significant improvement in model fit. In other words, there is very strong evidence against the null hypothesis of no net GC association. Furthermore, BIC would also suggest choosing FI over CI.[2]

$$\log F_{ijk} = \lambda + \lambda_i^G + \lambda_j^P + \lambda_k^C + \lambda_{ij}^{GP} + \lambda_{jk}^{PC} + \lambda_{ik}^{GC}. \qquad \text{(FI)}$$

So how do EM come to the view of 'almost conditional independence'? The discussion in their paper suggests that they have abandoned the likelihood ratio test as a model selection criterion, and have instead relied on the index of dissimilarity and rG^2 (which is simply the proportional reduction in deviance as compared to that of ME).[3] To be clear, EM have reported

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[2]BIC refers to the Bayesian Information Criterion, and is given by the following expression: BIC $= G^2 - df \times \log N$ (see e.g. Raftery, 1986).

[3]Private correspondence between the authors and Jani Erola confirms this.

the deviance, or G^2, of their models, so that the fit of each model with the data can be assessed. But when it comes to comparing nested models, they have not employed the likelihood ratio test. For example, they justify their choice of CI over FI as follows: '[c]ompared to model IV, the dissimilarity index is reduced from 3.8 to 2.0 and rG^2 from .94 to .97. This suggests that GC associations play a rather small role after controlling GP and PC' (Erola and Moisio, 2007, p.177).

EM's model selection strategy seems inappropriate to us. This is so, firstly, because there is no theoretical basis in using rG^2 as a model selection criterion. As regards the index of dissimilarity, although it certainly has its role in the assessment of model fit, it is meant to be used 'as a supplement to, rather than a replacement for, model-selection criteria such as those based on the log likelihood' (Kuha and Firth, 2010, p.375). Furthermore, even if we were to compare CI and FI on EM's terms, it should be noted that λ_{ik}^{GC} accounts for almost half (1.8/3.8) of the misclassified cases of CI, and 60% of its deviance (454.3/750.7). Given these considerations, the conclusion of 'almost conditional independence' seems to us as quite unjustified.

We note that the qualifier 'almost' might provide some room for manoeuvre. This would be the case if the type I error associated with the null hypothesis of conditional independence is close to the conventional 5% cutoff, say, $p \approx .04$. But for 36 degrees of freedom, the probability that a reduction in deviance of 454.3 is due to chance is vanishingly small ($p = 7.7 \times 10^{-74}$), rendering the qualifier unconvincing.[4]

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[4]We are grateful to Bent Nielsen for suggesting an expression to compute this p-value.

3   Large N and model selection criterion

It is not unreasonable to argue that because the Finnish mobility table has a very large number of observations ($N = 57,585$), almost all null hypotheses related to this table would be rejected by conventional statistical criteria, even if they make a lot of sense in substantive sociological terms. It then follows that some other model selection criterion should be employed instead. Indeed, this is the motivation of Kuha and Firth (2010) when they propose the index of dissimilarity as a basis for model selection.

To address this concern, we have randomly drawn 20 sub-samples from the Finnish data, each with 5,000 cases.[5] Table 2 reports the deviance of CI and FI when these two models are applied to the sub-samples.[6] It can be seen that the difference in deviance between CI and FI, i.e. ΔG^2, ranges from 52 to 92. For 36 degrees of freedom, the improvement in fit of FI over CI is statistically significant in all 20 cases. In other words, the likelihood ratio test consistently and often strongly favours FI over CI, even when the sample size is much smaller.[7] The strong evidence against the null hypothesis of conditional independence reported in Section 2 is not due to the large N of the Finnish data alone.

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[5]The Finnish mobility data is taken from The Finnish Longitudinal Census Data file, which was supplied by Statistics Finland to Jani Erola of the Department of Social Research, University of Turku. The three-generation mobility table is available at the Jani Erola's website, see `http://users.utu.fi/japeer/data/`.

[6]All models in this paper are fitted with the R package gnm (Turner and Firth, 2011).

[7]Jani Erola confirmed in private correspondence with us that he obtained very similar results with sub-samples of Finnish data. He has provided some codes to draw sub-samples from the Finnish mobility data, see `http://users.utu/fi/japeer/script-codes`.

4 The strength of net GC association

It could be argued that although the net GC association is statistically significant, it might not matter very much in a substantive sociological sense. To address this question, we need to assess the strength of the net grandparents effect in social mobility. Specifically, we compare the expected outflow mobility rates under CI and FI in partial parents–children tables (stratified by grandparents' class). Outflow mobility rates refer to the distribution of grandchildren according to their own social class given their class of origin (i.e. parents' social class) and, in the present case, also stratified by grandparents' class. In other words, they are the row percentages in partial mobility tables where parents' class is the row variable, children's class is the column variable, and grandparents' class is the stratifying variable. There are many such outflow rates that we could report. But, as illustrations, Figure 1 report the retention or immobility rates (with 95% confidence intervals) of those from salariat (class I+II) or unskilled working class (VIIa) origin.

In Figure 1, expected outflow rates under CI are represented by 'o's, those under FI are represented by '●'s, and the observed outflow rates are represented by '×'s. As CI posits that, controlling for parents' class position, children's class is independent of grandparents', all 'o's are lined up vertically. Specifically, the left panel shows that, under CI, 45% of Finns with salariat parents are expected to be immobile, irrespective of grandparents' social class. But there is actually a good deal of variation in the observed immobility rates: from 50% for those with salariat grandparents to 40% for those with grandparents in the skilled manual class (V+VI). And consistent with the

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fact that FI is a better fitting model than CI, the observed rates tend to be closer to the expected rates under FI than to those under CI. Furthermore, while the observed rates are all within the confidence intervals of the relevant expected rates under FI (see the solid line segments), only three of them, pertaining to individuals with classes III, IVab or VIIa grandparents, are within the confidence intervals of the relevant expected rates under CI.

Turning to the right panel of Figure 1, CI predicts that, regardless of grandparents' class background, 26% of Finns with unskilled working class parents will stay in class VIIa. But actually there is considerable variation in the observed rates: from 22% of those with class IVc grandparents to 34% of those with class III grandparents. Also, the observed rates are closer to the expected rates under FI than to those under CI. Finally, the observed rates are all within the confidence intervals of the relevant expected rates under FI (the solid line segments). But only two observed rates, pertaining to those with class I+II or class VIIb grandparents, are within the confidence intervals of the relevant expected rates under CI.

5 The pattern of the net GC association

Given the strong evidence against conditional independence, there is a need to specify just what the net grandparents effect looks like. To be fair, EM have fitted three further models doing just that. These are topological models, all nested within FI, and each specifies a particular constrained form of the net GC association. EM refer to them as 'quasi-perfect mobility' (QPM), 'immobility due to lagged inheritance' (ILI), and 'lagged barriers of mobility'

(LBM) respectively (see models VI, VII and VIII of their Table 3). Briefly, QPM fits a separate parameter for each of the diagonal cells of the partial GC mobility table; ILI replaces those seven parameters with just one parameter, contrasting the diagonal cells of classes I+II and IVc against the rest of the mobility table; finally, LBM highlights mobility from classes III, V+VI, VIIa and VIIb to classes I+II, IVab and IVc.[8]

Since these three models are nested within FI, their fit with the data could be compared with that of FI using the likelihood ratio test. For example, EM report that their model VIII (i.e. ILI+LBM) has a deviance of 546.8 for 250 degrees of freedom. Compared to FI, $\Delta G^2 = 250.4$, $\Delta df = 34$, $p < .001$. This suggests that although ILI+LBM is a lot more parsimonious than FI, much of the net GC association in the data is not captured by this model. The same is true for their models VI (i.e. QPM) and VII (i.e. ILI).[9] EM maintain that '[a]lmost all (relative) mobility in the three-generation mobility table can be explained as a Markovian process' (Erola and Moisio, 2007, p.178). They also describe the two lagged effects that they identify (i.e. ILI and LBM) as 'weak' (p.169). We note that EM have not reported the magnitude of the ILI and LBM parameters in their paper. But even if they are indeed small effects, this does not support EM's main claim of 'almost conditional independence,' as the ILI+LBM model fails to capture much of the net GC association.

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[8]That is, the following cells of the partial GC table is set at one fluidity level: III–I+II, III–IVab, III–IVc, V+VI–I+II, V+VI–IVab, V+VI–IVc, VIIa–I+II, VIIa–IVab, VIIa–IVc, VIIb–I+II, VIIb–IVab, VIIb–IVc; while the rest of the mobility table is set at another fluidity level, see Appendix 1 in Erola and Moisio (2007).

[9]Comparing QPM with FI, $\Delta G^2 = 344.8$, $\Delta df = 29$, $p < .001$; as regards the comparison between ILI and FI, $\Delta G^2 = 370.6$, $\Delta df = 35$, $p < .001$

6　Conclusion

Erola and Moisio (2007, p.169) argue that in Finland '[a]fter controlling for parents' social class, the grandchildren's social class is almost conditionally independent from the grandparents' social class'. We have shown that this claim is actually *not* supported by the results reported in their own paper. We also demonstrate that the strong evidence against conditional independence is not due to the large N of the Finnish mobility table alone. We then present evidences that the grandparents effect matters for quantities of substantive interest, such as outflow mobility rates. Finally, we show that the 'weak lagged grandparents effects' identified by EM fail to capture much of the net GC association. Thus, their posited 'weakness' does not support EM's main claim. Overall, then, our view is that EM's main conclusion is unwarranted. There is indeed a net grandparents effect in social mobility over three generations in Finland.

References

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Table 1: Goodness of fit statistics of three loglinear models reported in Erola and Moisio (2007, p.176, Table 3)

model		G^2	df	rG^2	Δ	BIC
I (ME)	G, P, C	15425.7	324	—	17.1	11874.3
IV (CI)	GP, PC	750.7	252	.94	3.8	-2011.4
IX (FI)	GP, PC, GC	296.4	216	.97	2.0	-2071.0

Note: Roman numerals refer to model numbers in Erola and Moisio (2007, Table 3); rG^2 refers to proportional reduction in G^2 as compared to model I (ME)

Table 2: Deviance of the conditional independence model and of the full interaction model for 20 random sub-samples ($N = 5,000$ each)

sample	G^2(CI)	G^2(FI)	ΔG^2	p	sample	G^2(CI)	G^2(FI)	ΔG^2	p
1	316.6	235.3	81.4	.000	11	331.3	247.7	83.6	.000
2	283.0	202.0	81.0	.000	12	292.8	219.5	73.3	.000
3	292.9	207.8	85.1	.000	13	268.4	195.0	73.3	.000
4	293.5	235.8	57.6	.012	14	264.8	213.2	51.6	.044
5	255.8	198.3	57.5	.013	15	275.3	197.4	77.8	.000
6	323.9	249.7	74.2	.000	16	296.6	227.5	69.1	.001
7	303.1	246.7	56.5	.016	17	285.1	192.7	92.4	.000
8	321.9	237.4	84.5	.000	18	297.9	209.8	88.1	.000
9	297.7	214.2	83.5	.000	19	262.7	194.2	68.5	.001
10	258.0	183.1	74.9	.000	20	296.9	242.4	54.5	.025

Note: $\Delta G^2 = G^2(CI) - G^2(FI)$

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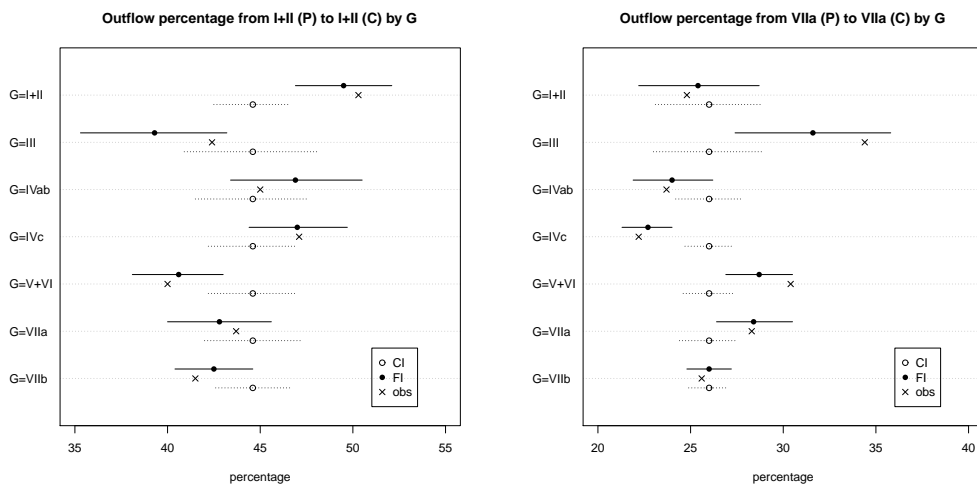
Figure 1: Outflow rates under CI and FI (with 95% confidence intervals) compared with observed rates.