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Microclass immobility during industrialisation in the USA and Norway

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Abstract

The 'microclass' approach advocated by Grusky, Weeden and colleagues emphasises fine-grained occupational differences and their relevance to social reproduction and social mobility. Using recent developments in historical occupational classifications, we adopted a microclass approach to the analysis of intergenerational social mobility using linked census data for Norway and the USA in the late 19th and early 20th century (1850–1910). We describe a procedure that offers an operationalisation of microclass units for these datasets, and show how its application enables us to disentangle different forms of immobility which would not be distinguished in other approaches. Results suggest that microclass immobility is an important part of social reproduction in both Norway and the United States during the era of industrialisation. Both countries reveal a similar balance between 'big class' and 'microclass' immobility patterns. In Norway, the relative importance of microclasses in social reproduction regimes, when compared to the role of 'big class' structures, seems to decline very slightly over the course of industrialisation; but in the USA the relative importance of microclasses seems if anything to increase over the period.

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Introduction

A presumption of any measure of social class is that there are clear boundaries between classes that reflect important differences in social resources and in social outcomes, whilst there are few social differences between people who are within the same class. However, 'big class' schemes (i.e. those which define a small number of large social class categories) have been shown to depart from this presumption across a range of relevant measures (e.g. Prandy, 1990). Grusky and colleagues argue for a 'new class map', claiming that much smaller class categories are better able to effectively define shared and distinctive social experiences (Grusky et al., 2008; Jonsson et al., 2009; Weeden and Grusky, 2005, 2012). Their 'microclass' approach is designed to recognise large numbers of small social classes, the boundaries of which are largely defined by occupational institutionalisation. According to their advocates, the sociological theories and patterns that can be linked to microclasses are at least as substantial and interesting as are those linked to 'big classes'. Microclasses are likely to be empirically relevant to the analysis of a wide range of social processes; but hereinafter we focus on research on intergenerational social mobility, and we assess whether the characterisation of social mobility patterns in two nations in the nineteenth century is changed if we take account of microclass categories.

Grusky et al. (2008) and Jonsson et al. (2009) demonstrate how the analysis of microclasses is of particular relevance to understanding the intergenerational transmission of social inequality. They argue that occupations themselves form part of the reproduction process and, therefore, it is useful to establish whether meaningful intergenerational changes in social positions (i.e. social mobility) occur mostly between, or within, 'big classes'. In the microclass approach, different types of social mobility can be differentiated by assessing the relative influence of aggregate units that subsume the (typically 100 or so) different microclasses. Grusky and colleagues explore such aggregate units that they label mesoclasses (around 12), macroclasses (around 6), the manual/non-manual sectoral division (a dichotomy), and 'gradational exchange' (a unidimensional scale by which microclasses are arranged based on relative socio-economic advantage). For example, individuals could experience intergenerational social mobility between microclasses, but such mobility may or may not also involve a change in mesoclass category, in macroclass, in manual/non-manual status, or in relative position in the gradational hierarchy. Grusky et al. (2008) and Jonsson et al. (2009) specify log–linear statistical models that are designed to assess the relative magnitudes of social mobility at these different levels for a number of contemporary societies. Broadly speaking, this is achieved by assessing how much of the statistical association between the microclass positions of parents and children can be attributed to intergenerational inheritance or 'immobility' at each of the different aggregate categories, and/or to relative associations in gradational positions.

Our study applies the framework used by Jonsson et al. (2009) and Grusky et al. (2008) to data from the late 19th century in Norway and the United States. Hitherto, literature on microclasses has focused on 'industrialised' societies, often with the specific acknowledgement that the approach may not translate to non-industrialised societies (Erikson et al., 2012; Grusky et al., 2008; Jonsson et al., 2009; Weeden and Grusky, 2005, 2012). However, there is reason to think that the microclass approach might be an especially useful means of analysing social reproduction in societies at earlier stages of economic development. Social reproduction may have been much stronger in pre-industrial societies (e.g. Blau and Duncan, 1967; Kerr et al., 1973[1960]; Treiman, 1970), because many children learned their occupational skills from their father. This mechanism constitutes a transmission of human capital at the microclass level, which could be identified empirically through the relative importance of microclass transmission when compared to other forms of 'big class' transmission.

The aim of this article is twofold: to present a historical microclass scheme; and to explore its contribution to analysing different forms of men's social reproduction in two industrialising countries. The operationalisation of microclass measures is not trivial, but secondary census data for both Norway and the USA includes suitably standardised and detailed occupational information to allocate occupations to microclasses consistently. Moreover, linked census data from these two countries are available in a manner that facilities the analysis of intergenerational social reproduction in terms of occupational titles (cf. Long and Ferrie 2013; Modalsli 2017).

Previous studies portray high levels of social mobility in the USA in the 19th century, an era which has been described as the golden age of the American Dream (Grusky, 1986; Guest et al., 1989; Long and Ferrie, 2013; Thernstorm, 1973). For its part, Norway had moderate and probably increasing levels of intergenerational vertical mobility during the 19th century (Torvanger, 2000), most noticeably in non-farming occupations (Modalsli, 2017). Previous studies in these societies, however, have used 'big class' schemes and/or gradational measures rather than detailed 'microclass' data. A key empirical question in our analysis is whether intergenerational mobility patterns in either country might change substantially when microclass patterns are incorporated in the analysis.

We draw upon datasets from the USA and Norway spanning the period 1850–1910 because they are amongst the first such resources from this era to feature linked census records that are conveniently available for secondary re-use: we benefitted greatly from the work of the North Atlantic Population Project in providing access to this data – see Minnesota Population Center (2008). During our own analysis we found empirical differences (and similarities) in results for the two countries, but it is difficult to draw authoritative comparative conclusions because there are several concurrent differences between the two societies in the era of our analysis (cf. Kim, 2005; Ljungberg and Schön, 2013). Industrialisation proceeded in similar ways in both countries around this era, but also took different forms and is associated with slightly different time periods. Both countries had very large agricultural sectors, but farm sizes tended to be smaller in Norway (Modalsli, 2017). During the era, both countries also experienced considerable structural changes which may have affected social mobility patterns, but these played out in different ways and for different reasons in each society: the USA, for instance, was greatly affected by its civil war, political and geographical restructuring, and by high volumes of inward migration; Norway was politically more stable in the era, but experienced very high levels of outward migration, particularly across the Atlantic (Semmingsen, 1960). For such reasons we can at best speculate on the origins of differences and similarities in empirical patterns of social mobility in both societies, and we do not attempt to provide comprehensive comparative results.

Trends in social reproduction during industrialisation

Across societies it is plausible that microclass measures add a level of insight into the analysis of intergenerational mobility. Grusky et al. (2008: 986) argue that parents may transmit skills, aptitudes, cultures and resources to children both within occupation-specific contexts and in a broader manner that is not occupationally specific. The expectation is that the former patterns should influence a propensity for exact reproduction within microclasses, whilst the latter should also influence a propensity to reproduction, but in broader categories such as 'big classes' and not necessarily within microclasses. A hierarchical microclass scheme can therefore be used to disentangle those types of reproduction that are empirically linked to microclasses, and those more generic patterns that will be linked, for example, to 'big class' categories net of microclass reproduction. More generally, when considering historical trends in social reproduction, we can also examine and compare trends in both occupation-specific reproduction patterns, as well as those of a broader 'big class' nature, recognising that the two trends need not be completely related.

Most perspectives on intergenerational mobility during the era of industrialisation anticipate a decline in the specific experience of individuals following their father's work (Featherman and Hauser, 1978; Furstenberg, 1966; Grusky, 1983; Grusky, 1986; Treiman, 1970;). This is partly driven by a decline in the relative size of the agricultural sector (reducing the frequency of father–son inheritance of farming occupations), but occupational specialisation and the appearance of new occupations might also make occupational inheritance outside of the agricultural sector increasingly uncommon over time (e.g. Treiman, 1970). Accordingly, most arguments suggest that social reproduction (within microclasses) should be expected to decline with industrialisation.

During industrialisation the growing complexity of occupations and the need for specialist skills increased the importance of education and training and decreased opportunities for non-meritocratic job selection. In addition, during the 19th century the development of railways, telephones, telegrams and a postal service in many countries increased opportunities for people to find out about, and travel towards, new positions in more distant locations (Knigge et al., 2014; Maas and van Leeuwen, 2016; Schulz et al., 2014; van Leeuwen et al., 2016; Zijdeman, 2009, 2010). These diminishing ascriptive, geographical and network constraints on seeking employment might provide for individuals not only to acquire an occupation different from their father's, but also, with some luck and skills, to enter a higher relative position such as in a different meso- or macroclass. This 'big class' social reproduction (net of microclass reproduction) might also be expected to decline as industrialisation expands. However, there are also reasons why industrialisation might not lead to a reduction in the influence of parents upon broader patterns of attainment. The growing importance of education, for instance, may simply mean that parents with more resources seek to provide their children with favourable support during, and outcomes from, education (e.g. Bowles and Gintis, 1976). Indeed, social reproduction theories suggest that those who hold the most advantageous positions are generally the best placed to adapt to new social patterns (e.g. Bourdieu, 1998; Pareto, 1991 [1901]). In this scenario, whilst microclass immobility might be declining with industrialisation, 'big class' immobility might concomitantly persevere.

Data

We obtained census data from the 19th and early 20th centuries for Norway and the United States from the North Atlantic Population Project (NAPP) (see Minnesota Population Center, 2008). These data include identifiers that enable linkage over time between randomly selected records for the same people from different census years (see NAPP, 2018). Because the censuses contain information on all household members, this supports intergenerational mobility analysis because we can link data from adults in one year to records on their parents (with whom they lived at an earlier point in time), or their children (with whom they live at present and who will be recorded as adults in a later census record). Previous research on intergenerational social mobility from the 19th century has often exploited register data such as for marriages and births (e.g. Maas and van Leeuwen, 2002; Miles, 1999), or genealogical data (e.g. Prandy and Bottero, 2000). The emergence of services supporting secondary access to census datasets from the 19th century offers an important new data source.

The NAPP data provide, for the United States, information on individuals from the full 1880 census linked to 1% samples of the censuses for 1850, 1860, 1870, 1900, and 1910 (Ruggles et al., 2010). The Norwegian data links individuals from 1865 (Digital Archive et al., 2008a), 1875 (Norwegian Historical Data Center and Minnesota Population Center, 2008) and 1900 (Digital Archive et al., 2008b). In our analysis, for the USA we have taken either the son's occupation in 1880 and connected it to his father's occupation for the period of 1850–1870; or we have linked a father's occupation in 1880 to a son's occupation in the period 1900–1910. For the Norwegian data, we began with samples of fathers in 1865, and sons in 1900, and connected these to the respective relatives from 1875 or the corresponding other time-point. When we have split our data by era we have regarded those cases where the son's occupation was taken from 1880 or earlier as the earlier era, and those cases where the son's occupation was obtained in 1900 or 1910 as the later period. For operational and theoretical reasons, our analysis focuses only on the male population. Coverage and quality of data on female employment in the 19th century are both limited, and we would anticipate very different social mechanisms to be involved in class reproduction involving women's occupations.

Table 1. Number of father–son combinations used from the historical censuses for the USA and Norway.

USA	1880 sons	1880 fathers
1850 fathers	1990	
1860 fathers	4093	
1870 fathers	6835	
1900 sons		9628
1910 sons		6432
Total	12,918	16,060
Norway	**1875 sons**	**1900 sons**
1865 fathers	10,113	14,663
1875 fathers		17,062
Total	10,113	31,725

Linked census data have two major attractions for intergenerational mobility research: first, a large volume of respondents can be easily studied; and, second, the occupations of both the parent and the child can be measured at an age of 'occupational maturity'. 'Occupational maturity' refers to the ages during which an adult would usually be in the principal and most important occupation of their life course (e.g. Goldthorpe, 1980). In contemporary analysis the age of occupational maturity is often suggested to lie between around 35 and 60 years old. In the 19th century, adults probably reached occupational maturity at a younger age, such as 25 or 30 (cf. Miles, 1999; Schulz, 2013). However, if records from only a single census are used, most intergenerational father–son combinations that can be identified (i.e. fathers and sons living in the same household) will feature one or both adults outside of the age of occupational maturity (the same problem can also apply to intergenerational records derived from marriage registers: cf. Miles, 1999: 16–17). In contrast, the use of linked census data ensures that records can be extracted for both fathers and sons from a time point when both are in their occupational maturity (see also Long and Ferrie, 2013; Modalsli, 2017).

Our primary analytical sample is summarised in Table 1. It reports the number of males of occupational maturity in each linked census for whom there is occupational information on both themselves and their father/son. The data in Table 1 also refer only to those occupations from neither the military nor agricultural sectors. Most of our results apply only to occupations outside these sectors. People in military positions often have atypical intergenerational profiles, and comparisons over time can be conflated with temporal variation in military recruitment. There are substantive differences between immobility in agriculture and other sectors, particularly within the period studied. For instance, immobility is usually much higher in agriculture, where resources (such as farms) and skills (such as sheep shearing) are often passed directly from parents to children. The very large size of the agricultural sector can also mean that the patterns of this sector would otherwise dominate statistical results, whilst subtle differences within the sector are not recognised in occupational categories; in terms of social mobility, for instance, fathers and sons might appear stable, with the same occupational titles, when in fact there could have been a considerable change in the economic size of their farms (e.g. Modalsli, 2017). For such reasons it is a common practice in historical social mobility research to exclude occupations from the agricultural and military sectors from analysis, albeit this is an approach that is subject to debate, and which might have important implications for results (cf. Long and Ferrie, 2013; Xie and Killewald, 2013). Later, we also discuss sensitivity analysis that does include these categories: doing so increases the sample sizes, for instance to 44,976 cases (late USA) and 149,057 cases (late Norway).

Linked censuses have been criticised for being potentially biased (Xie and Killewald, 2013). In the NAPP data linkage project (NAPP, 2018) a statistically random criterion is used to determine whether a case might potentially be linked, but only a subset of those are successfully linked, and there may be biases in successful linkage. There could, for example, be an impact of literacy and wealth upon the accuracy and consistency of census records for individuals in different years, and all linkages necessarily apply to combinations of fathers and sons who live in the country in the relevant years (i.e. restricting coverage of families of immigrants and emigrants). We identified some small, albeit non-trivial, biases within the data: in the USA there is a small under-representation of non-white respondents and immigrants in our data; and in Norway married people were more likely to be linked, especially as fathers, whilst people who had servants were under-represented. We operationalised a sensitivity analysis that sought to test for biases in the selection of cases (see online Appendix) but this did not reveal any issues which would affect substantive results.

Creating a historical microclass scheme

Microclass schemes usually feature about 100 different occupation-based categories. Microclass categories do still amalgamate occupations, but they are designed so that their incumbent occupations are very similar, share a number of important resources and circumstances, and will be likely to exhibit social closure. As mentioned above, a microclass scheme is hierarchically organised into aggregate units. Grusky et al. (2008) defined ‘macroclasses’ as aggregations of microclasses into six categories associated with major differences in occupational rewards, similar in character to classes in most existing ‘big class’ schemes. They also defined ‘mesoclasses’ as aggregations of around 12 categories, which can be understood as divisions within macroclasses according to industry groups and other features of employment relations.

In our analysis we sought to develop a historical microclass scheme that would have a similar structural framework to those used for contemporary societies, and could be applied to the occupational data held on the datasets available from NAPP (see Minnesota Population Centre, 2008). Occupations in the NAPP data for the USA are coded to the 1950 US census code in all years. For Norway, occupations are coded into the NAPP–HISCO scheme. Using algorithms developed in previous research (Zijdeman, 2011), we recoded these into the five-digit occupational categories of the Historical International Standard Classification of Occupations (HISCO) (van Leeuwen et al., 2004). HISCO units were then used to derive a gradational measure of occupational advantage called HISCAM (Lambert et al., 2013), and the historical class measure HISCLASS (van Leeuwen and Maas, 2011). Both of these standardised measures informed decisions in defining the microclass scheme, and the HISCLASS measure was used as the foundation of ‘macroclass’ and ‘mesoclass’ schemes that are used in analysis below.

Our procedure for constructing microclasses, based on the HISCO codes for occupations, is documented in full online (Griffiths, 2012). Table 2 summarises the microclasses that we defined, as well as indicating macroclass, mesoclass and HISCLASS categories into which the microclasses fall, and giving further summary data about the microclasses, such as the mean HISCAM score for occupations within the category.[1] The scheme shown is based upon a mapping between HISCO and microclass units (published as Griffiths, 2014) that is designed to optimise the relevance of microclass units for the time period covered by the NAPP datasets.

The last important step in defining the scheme is specifying ‘macroclass’ and ‘mesoclass’ categories that constitute aggregations of the microclass units. The 12 HISCLASSes were used as the foundation of a ‘macroclass’ aggregation that resembles the macroclass categories used by Jonsson et al. (2009). Categories were defined for agricultural and military workers, and the remaining HISCLASS categories were then collapsed into a five-class structure by merging together professionals and managers of a similar level, and merging the semi- and unskilled manual workers (see Table 3). Merging semi- and unskilled manual workers may lead to a very broad aggregation; however, this is comparable to other macroclass schemes (e.g. Jonsson et al., 2009), and, in the case of historical data coded to HISCO, it may in any case be a sensible strategy because many occupational descriptions for workers in these categories do not feature details that enable a better disaggregation on the basis of skill level (for instance they are often labelled as ‘labourers’ with no further information). Finally, ‘mesoclasses’ are usually

Table 2. The historical microclass scheme.

Macroclass *(HISCLASS categories in parentheses)*	Mesoclass	Microclass	Mean HISCAM	Cases (Norway)	Cases (USA)
Professionals (1,2)	Higher professionals	Lawyers	99	1206	1269
		Health professionals	97	1431	2777
		Teachers	80	3203	2086
		Architects and engineers	86	647	252
		Other higher	88	369	241
	Higher managers	Government managers	93	128	918
		Business managers	84	1416	350
Lower professionals (3,4)	Lower professionals	Artists	61	797	637
		Bookkeepers	71	576	896
		Sales professionals	73	1541	208
		Proprietors	64	11588	13,575
		Workers in religion	97	1361	1301
		Police officers	52	1036	2656
		Other lower professionals	69	758	178
	Lower managers	Government lower managers	74	1364	1155
		Business lower managers and supervisors	71	2040	754
		Ship's officers	66	8016	410
Lower non-manual workers (5)	Clerks	Clerks	71	3407	882
		Stock clerks	67	413	3436
	Other non-manual	Watchmen and janitors	62	905	212
		Other non-manual workers	60	2542	433
Skilled manual (6,7)	Makers and operators	Plumbers	56	182	235
		Joiners	55	13,996	6330
		Sheet metal workers	54	1056	572
		Other makers and operators	64	4866	1788
	Artisans	Printers	59	944	591
		Tailors	55	5017	1633
		Shoemakers	53	6564	943
		Cabinetmakers	55	243	482
		Cartwrights	55	240	556
		Coopers	51	1634	1257
		Blacksmiths	52	3646	2469
		Stonemasons	55	404	1338
		Other artisans	67	640	326
	Food producers	Bakers	57	1938	295
		Butchers	59	593	759
		Other food producers	58	71	719
Semi- and unskilled manual (9,11)	Construction semi-skilled	Stone cutters	60	899	248
		Metal processors	60	501	626
		Construction	54	4280	442
		Miners	47	1299	2255
		Sawyers	50	4851	261
		Painters	53	1643	1425
	Personal or Service	Barbers	55	140	449
		Domestic servants	58	3496	925
		Messengers	54	845	112
		Other service	70	420	731

(continued)

Table 2. (continued)

Macroclass *(HISCLASS categories in parentheses)*	Mesoclass	Microclass	Mean HISCAM	Cases (Norway)	Cases (USA)
	Transport	Brakemen	49	91	301
		Seaman	53	6020	578
		Train guards	61	161	217
		Motor vehicle drivers	61	3017	1974
	Other semi-skilled	Stationary engine operators	60	362	129
		Textile workers	56	2802	219
		Other lower	60	2795	10,402
	Unskilled	Labourers	47	7087	6112
		Other unskilled	55	6716	565
Working in agriculture (8,10,12)	Farmers and fishermen	Farmers, including managers	52	238,774	83,899
		Farm workers	50	11,911	9914
		Fishermen	52	32,497	471
	Non-farming agricultural workers	Loggers	55	3829	390
		Gardeners	55	285	340
		Other agricultural workers	59	596	
Military	Military	Officers	95	948	
		Other ranks	52	1311	205

characterised as divisions within macroclasses by industrial sector (e.g. Gusky et al., 2008; Jonsson et al., 2009). Accordingly, we defined mesoclasses for this exercise by identifying what we judged to be consequential divisions within macroclasses by the industry associated with the microclass. Our final scheme (see Table 3) comprises 64 microclasses, nested within 17 mesoclasses and seven macroclasses. As mentioned elsewhere, most of our analysis proceeds on the population excluding agricultural and military workers – namely 56 microclasses, nested within 14 mesoclasses and five macroclasses.

Patterns of social reproduction during industrialisation in Norway and the USA

Table 3 shows selected 'total mobility' percentages; that is, the percentage of sons in a different category to that of their fathers. For example, in Norway in the early period (1865–1875), 15% of all adult males were in a different manual/non-manual category to that of their fathers, whilst a further 19% were in a different macroclass but were in the same manual/non-manual category. In both Norway and the USA there is evidence of more intergenerational mobility in the later than the earlier period.[2] This growth in total mobility in both societies (for non-agricultural jobs) is consistent with evidence reported by other studies. These figures suggest somewhat higher volumes of total mobility in these periods than would be found in contemporary societies (cf. Breen and Luijkx, 2004; Ringdal, 2004). Arguably, however, it is equally interesting to reflect upon the broad similarity in the absolute mobility trend of slowly increasing 'big class' mobility, both between the societies and time periods, and between 19th century and contemporary societies. Whilst the figures do change, at a very broad level the scale of intergenerational mobility at the 'big class' level is surprisingly similar, ranging from 34% to 52% in these societies, compared to around 60% to 70% which is typical of evidence using comparable class categories in late 20th century societies (e.g. Breen and Luijkx, 2004).

Three further points are notable from Table 3. First, a large proportion of 'immobility' in all samples is at the microclass level. Second, there is a spread of experiences across the samples in the extent or 'range' of mobility: some combinations involve a long range transition such as between manual and non-manual sectors, whilst other combinations involve mobility in a smaller scale, such as mobility

Table 3. Intergenerational patterns (%) for adult men in Norway (1865–1875; 1865/75–1900) and the USA (1850–1880; 1880–1910)

	Norway		USA	
	Early	Later	Early	Later
Intergenerational mobility across				
(1) Manual/non-manual division	15	22	21	29
(2) Macroclass but not (1)	19	25	21	23
(3) Mesoclass but not (2)	12	14	9	11
(4) Microclass but not (3)	5	6	4	5
No mobility				
(5) Intergenerationally stable	50	33	46	32
N	10,113	31,725	12,918	16,060

Source: NAPP linked datasets, excluding combinations where the father or son worked in agriculture or the military.

between different microclasses whilst staying within the same mesoclasses. Third, there are variations over time and between societies in the relative volumes of mobility at different levels, suggesting that a microclass analysis that disaggregates mobility patterns might reveal interesting variations over the course of industrialisation and between the two countries.

Table 3 takes no account of changes in the 'marginal' distribution of jobs between the fathers' and sons' generations, and between countries and time periods. Log–linear models are widely used to address this challenge in intergenerational social mobility research (Grusky, 1986; Guest et al., 1989; Long and Ferrie, 2013; van Leeuwen and Maas, 1991). Conveniently, these also provide for the estimation of parameters that describe the distinctive influence upon reproduction associated with micro-, meso- and macroclasses (e.g. Jonsson et al., 2009). We estimated and compared different log–linear models with LEM (Vermunt, 1997), using a similar range of models as reported by Jonsson et al. (2009).

Equations (1), (2) and (3) show depictions of relevant log–linear models (following the style of Jonsson et al., 2009). In broad terms we start with a mobility table that relates the father's (i) and son's (j) occupational microclass, and then evaluate different models which predict the number of occurrences in each cell of the table (F_{ij}). We compare the improvements in model fit (the differences between model predictions and actual cell counts from the table) as is achieved by models which allow for different parameters to contribute to the prediction (e.g. Breen and Luijkx, 2004; Jonsson et al., 2009). Comparisons can be made by using several alternative model fit statistics, but most often in the field we use the BIC statistic, which assesses both overall model fit and the parsimony of the model (e.g. Breen and Luijkx, 2004). Equations (1), (2) and (3) correspond to the specifications that are used in models (1), (2) and (3) from Table 4 (the other models in the Table occupy intermediate positions between these examples).

$$F_{ij} = \alpha\beta_i\gamma_j \tag{1}$$

$$F_{ij} = \alpha\beta_i\gamma_j M_{ij} \tag{2}$$

$$F_{ij} = \alpha\beta_i\gamma_j\phi^{\mu1\mu2}A_{ij}B_{ij}C_{ij}M_{ij} \tag{3}$$

Equation (1) represents the 'independence' model, which controls only for row and column totals or marginals (terms β_i and γ_j) and the total number of cases (α), and otherwise predicts cases as if there was no other relationship between row and column categories. Equation (2) controls additionally for microclass immobility: specific parameters (M_{ij}) are fit for every cell where the father and son are in the same microclass. The difference in model fit, between models (1) and (2), can therefore be used to tell us how much of the patterns in the father–son mobility table can be associated with microclass immobility.

Table 4. Model fit statistics for log–linear models of father–son microclasses (Norway 1900 linked censuses). N=31725.

Model used, and its immobility parameters	L2	df	Δ	BIC L2
1. Independence model	48,286	3025	0.416	16,933
2. (1) + microclass	12,459	2969	0.192	−18,314
3. (1) + microclass, mesoclass	11,817	2955	0.185	−18,812
4. (1) + microclass, mesoclass, macroclass	11,342	2950	0.179	−19,235
5. (1) + microclass, mesoclass, macroclass, manual	8262	2948	0.148	−22,294
6. (1) + manual	37,167	3023	0.375	5834
7. (1) + manual, macroclass	32,492	3018	0.371	1211
8. (1) + manual, macroclass, mesoclass	22,731	3004	0.312	−8405
9. (1) + manual, microclass	10,465	2967	0.155	−22,002
10. (1) + manual, macroclass, microclass	8450	2962	0.151	−22,251
11. (1) + manual, mesoclass, microclass	8514	2953	0.151	−22,093
12. Full model = (1) + HISCAM, manual, macroclass, mescoclass and microclass	7502	2947	0.141	−23,043

L2 = Likelihood ratio chi-squared statistic; df = model degrees of freedom; Δ = dissimilarity index; BIC L2 = Bayesian Information Criteria based upon L2 statistic.
All models feature main effects for the father or son microclass category totals.

Equation (3) controls additionally for several other forms of father–son relationship: for fathers and sons being from the same 'mesoclass' (C_{ij}), 'macroclass' (B_{ij}) and the same category in the manual/non-manual division (A_{ij}), and also for a gradational inequality relationship that is fit in our analyses using the HISCAM scale that assigns row and column scores (μ1 and μ2 respectively) to the corresponding row and column occupations for each cell (represented by the term $\phi^{\mu 1 \mu 2}$).

Table 4 shows the results of log–linear models for father–son occupational combinations in the later period for Norway.[3] By comparing the fit of the different models, it is possible to draw conclusions about the relative influence of the different 'types' of intergenerational (im)mobility (e.g. macroclass, microclass, etc.) that are allowed for in alternative models. The fit of the different models can be described by several different statistics. The likelihood ratio statistic (L2) is a direct measure of the extent to which the model accurately predicts the occurrence of cases (the smaller the value the better the prediction). The 'dissimilarity index' (Δ) reports the percentage of cases in a table which would need to be reassigned to equal the model's expected number of cases for each cell: it can also be read as a summary of the extent to which the father–son distribution is empirically associated net of the forms of mobility that are allowed for in the parameters of any given model. The Bayesian Information Criterion (BIC) assesses the 'parsimony' of each model – that is, the extent to which the model explains patterns in the data without using an excessive number of extra model parameters: a lower value of BIC usually indicates a more parsimonious model (e.g. Raftery, 1995). Table 4 also reports the 'degrees of freedom' (df) for each model – this is a number of relevance to further statistical calculations that reduces by one for every additional parameter that it estimated in the corresponding model.

Table 4 begins with the independence model (1). Subsequent models introduce parameters that represent different types of immobility, and it can be seen that every alternative model is a better fit to the data than model (1), the evidence for which is lower BIC values and smaller likelihood ratio statistics. Models (2) to (5) add 'immobility' parameters, building from the microclass level through the more aggregated categorisations. The model fit (as measured by BIC) is improved each time. This suggests that immobilities with regard to microclasses, mesoclasses and macroclasses are all independently influential parts of the social reproduction regimes within the data.

Models (6), (7) and (8) summarise the improvements to fit, starting with manual/non-manual parameters then adding terms for the two other 'big class' schemes. The improvements in fit suggest that each of these structures makes a distinctive contribution to social reproduction, though it is evident that

Table 5. Model fit statistics (BIC L2) for selected models*, by nation and time period.

	Norway early	Norway late	USA early	USA late
1. Independence model (excluding all controls)	–715	16,933	–1790	–8,198
12. Full model	–23,982	–23,043	–24,428	–25,066
Percent of the BIC reduction between (1) and (12) that is achieved by this model				
2. (1) + microclass	93.8%	88.2%	95.7%	93.9%
3. (1) + microclass, mesoclass	93.9%	89.4%	95.6%	93.7%
4. (1) + microclass, mesoclass, macroclass	94.4%	90.5%	95.6%	94.3%
5. (1) + microclass, mesoclass, macroclass, manual	99.7%	98.1%	99.9%	99.7%
Sample size	*10,113*	*31,725*	*12,918*	*16,060*

*Data and model numbers as per Table 4.

the total model fit is not as favourable as when microclass immobility is explicitly modelled. Stated differently, to ignore fine-grained occupational-level immobility patterns (as social mobility studies have often done in the past) would be to neglect a substantial part of the father–son reproduction regime in the late nineteenth century.

Finally, models (9), (10) and (11) are similar to models (6), (7) and (8) but include microclass immobility parameters. In each case this leads to a large increase in fit. Model (12) allows for every single type of measured class immobility, including the gradational parameter (HISCAM), and provides the best fitting statistical model. This model is also evaluated as the most parsimonious model according to the BIC statistic. Conventionally, we would take model (12) as evidence that every single parameter included in the model is worth taking account of – the gradational parameter, microclass immobility parameters, and further parameters for immobility in mesoclasses, macroclasses, and the manual/non-manual division. There is nevertheless a slight nuance to the results from models (9)–(12); figures such as the likelihood ratio statistic and the dissimilarity index help us to see that the lion's share in improvement in model fit is achieved by model (9). Adding the further parameters for macroclass, mesoclass, and gradation in models (10), (11) and (12) does bring an improvement in fit over model (9), but we could argue that the scale of improvement is quite slight. Again, expressed differently, additional macroclass, mesoclass and gradational parameters do improve the model fit, but their relative importance to the mobility regime (net of the effects of microclasses and the manual/non-manual division) is minimal.

Table 5 provides comparisons between some of the same models as described in Table 4, but now across countries and time periods, and focusing only on BIC, the parsimony statistic. As a heuristic we present percentages that emphasise the relative reduction in the BIC value between the independence model (with no controls) and the full model (with all possible parameters available to us). The three key points here are, first, that in all situations, the microclass parameter in model (2) captures the lion's share of the model improvement, with the next largest increase for the manual/non-manual divide (5). Second, in both Norway and the USA there is a slight reduction in the relative explanatory influence of microclass mobility in the later period compared to the earlier period – although microclasses are an important part of the story in both time periods. Third, there are small variations over time and between the two countries in the extent to which adding mesoclass and/or macroclass terms further reduces the BIC statistic (over-and-above controls for microclass immobility). In Norway there is a pattern whereby modelling 'big class' structures improves model parsimony – just as it is reported to do in contemporary microclass studies in other societies, for example as reported by Jonsson et al. (2009) – but at slightly different scales in the two periods. This pattern of change over time in Norway suggests that, net of the declining role of microclass inheritance during industrialisation, the influence of inheritance at the 'big class' level might have actually increased slightly in the period. In the USA, by contrast, mesoclasses (3) reduced fit at both periods (taking parsimony into account), and including macroclasses (4) only

Table 6. Model fit statistics for selected models (as Table 5) with additional gradational parameters (upper panel) and for the whole population including farmers and military (lower panel).

	Norway early	Norway late	USA early	USA late
Percent of the BIC reduction between (1) and (12) that is achieved by this model				
Including HISCAM in selected explanatory models				
2. (1) + HISCAM, microclass	93.8%	95.5%	97.5%	97.1%
3. (1) + HISCAM, microclass, mesoclass	93.9%	95.9%	97.2%	96.5%
4. (1) + HISCAM, microclass, mesoclass, macroclass	94.4%	96.5%	97.1%	96.6%
Including agricultural and military workers (*N*)	55,844	149,057	41,680	44,976
2. (1) + microclass	86.8%	78.8%	92.4%	87.1%
3. (1) + microclass, mesoclass	93.9%	91.5%	97.2%	90.0%
4. (1) + microclass, mesoclass, macroclass	94.3%	92.7%	97.3%	96.0%
5. (1) + microclass, mesoclass, macroclass, manual	99.4%	98.2%	99.9%	99.7%

improved fit for the later time point. In summary, this evidence suggests that in the later 19th century social reproduction processes were mainly about occupations, rather than 'big classes', and that the separable influence of 'big class' boundaries (as also reported for contemporary data) may have developed at different points in different Western nations.

As sensitivity checks we repeated the comparisons shown in Table 5 in two other scenarios: for the same range of models but with the gradational parameter HISCAM being fitted in all exploratory models; and for the same range of models whilst including occupations in farming and the military (see Table 6). The gradational parameter is used throughout the comparisons presented by Jonsson et al. (2009), and there is a compelling argument that social reproduction is more appropriately accounted for by allowing for general hierarchical inequality structures over and above patterns of similarity within both 'big class' and microclass categories (e.g. Lambert et al., 2013). However, the use of the gradational parameter seems to have minimal consequences for our conclusions about the separable use of microclass mobility parameters in studying social reproduction. For Norway, similar patterns of model fit were observed irrespective of when the gradational effect was applied (evident from comparing the corresponding cells from Tables 5 with those in the upper panel of Table 6). However, the relative improvement in model fit from adding the gradational parameter in the Norwegian data was larger for the later than for the earlier period. This suggests that the gradational structure may have become relatively more influential in more recent times in Norway. In the USA, the comparison of relevant fit statistics suggests a slightly greater relative improvement from modelling the gradational position, which changes little between the time periods.

The lower section of Table 6 shows the model for all workers, including the agricultural and military sectors. For all societies the percentage of model improvement associated with microclasses (2), without any gradational effect, is lower than that reported for the subset of the population in Table 5. This difference is larger in Norway than the USA, and in both countries it is more pronounced in the later period. This implies that relatively smaller occupational effects on social reproduction are charted when agricultural jobs are included; and this might suggest in turn that microclass effects become more important as the agricultural sector declines. Importantly however, when we move through different models with different additional mobility parameters, we do not see important differences in the progression through models, compared with the account garnered from Table 5 which focusses only on the non-agricultural and non-military occupations. Because we are aware of common but relatively trivial occurrences of non-microclass 'inheritance' in the farming and military sectors (for example, a father-to-son transition from 'small farmer' to 'farm worker', which involves microclass mobility but mesoclass immobility), we can argue that whilst a microclass analysis of intergenerational mobility can be fit to samples that include large volumes of farmers and workers in agriculture, this is perhaps a less compelling strategy.

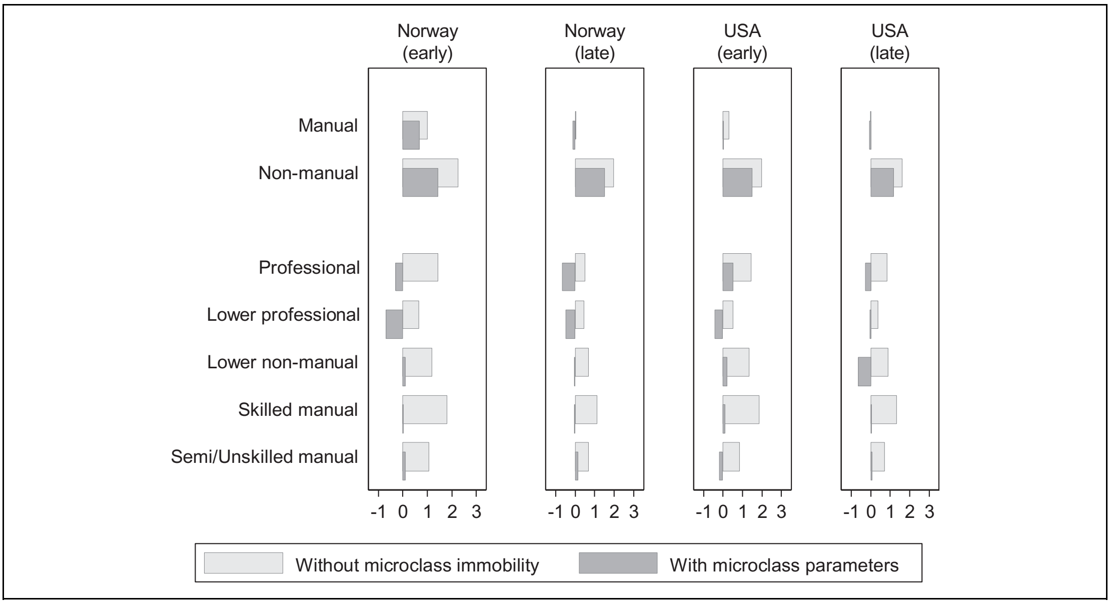

Figure 1. Immobility parameters for 'big class' categories with and without controlling for microclass mobility.
Figures show the log-odds parameter for immobility within the category. Top panel: log-odds for immobility in manual or in non-manual status; lower panel: immobility in macroclass net of manual/non-manual immobility.

Jonsson et al. (2009) highlight that, because microclass immobility is an important aspect of intergenerational associations, it is possible that estimates of 'big class' influences that ignore microclasses are misleading because they may be very different from the equivalent effects if microclass immobility were controlled for: that is, without controls, they may just be '. . . microclass inheritance in disguise' (Jonsson et al., 2009: 1007). In Figure 1 we summarise the extent of the difference between various 'big class' parameters (for non-agricultural and non-military occupations) with and without controlling for microclass structures, also incorporating an evaluation of change over time and between countries.

The bars in Figure 1 show the model based log-odds parameters for remaining in the appropriate 'big class' category: first, when we do not control for microclass inheritance; then, second, when we do. Just as Jonsson et al. (2009) reported for contemporary societies, we see that for the USA and Norway in the nineteenth century the odds ratios are much bigger without microclass controls. Furthermore, in many instances the log-odds of remaining in the 'big class' category are even reversed after microclass controls. In those cases with negative values, it is actually less likely that a father and son will share the same big class position, after controlling for the microclass immobility propensity (in contrast, the model without microclass controls always shows an increased probability). Our conclusion here is that microclass inheritance matters across all the societies, with immobility at the 'big class' level often demonstrating little more than 'small class' reproduction patterns.

Discussion

This paper presents an exploration of a microclass analysis of 19th century social mobility data. Such an analysis has only become plausible in recent years, as a result of the development of historical occupational unit groups (van Leeuwen et al., 2004), stratification scales (Lambert et al., 2013), and big class schemes (van Leeuwen and Maas, 2011), and has been aided by the development of linked census datasets (Norwegian Historical Data Centre and the Minnesota Population Center, 2008; Ruggles et al., 2010). We have demonstrated that it is feasible to construct a microclass scheme for historical societies, and have identified ways in which such a scheme can aid our understanding of late 19th century mobility patterns. Just as has been shown in studies using data from the 20th century, our empirical results show that patterns of immobility linked to microclasses are a substantial part of the social reproduction regime in the period 1850–1910, and that accounting for microclasses leads to different conclusions about social reproduction patterns than when they are not used. In addition, we have demonstrated that the level at which occupations are aggregated can have an important independent influence upon characterisations of immobility.

Substantially, we have shown that social reproduction regimes seem to have changed very slowly over the course of the industrialisation period in both Norway and the USA. Whilst the theories discussed might anticipate a decline in occupation-specific inheritance, microclass immobility was strong throughout the period. The total volume of microclass immobility does decline over time – as predicted by theories of modernisation – but the relative importance of microclass immobility to social reproduction regimes is only fractionally diminished over the period concerned. Previous research into these societies (e.g., Modalsli, 2017; Xie and Killewald, 2013) has involved analyses at the 'big class' level; however, our results suggest that these studies might not have incorporated substantial empirical patterns associated with more disaggregated occupational categories, and that interesting stories can be told about intergenerational association by modelling different forms of immobility and gradational inequality. A microclass approach to analysing social mobility cannot eliminate the risk of artefactual errors that could arise due to changes in occupational distributions over time (for instance, if some occupations decline in volume over time, or are coded differently in more recent datasets). However the relatively more fine-grained information recorded by microclass schemes could be more likely to identify such dangers when compared to using a 'big class' approach.

Our analysis focused strategically on non-agricultural (and non-military) occupations, and addressed the relatively late stages of industrialisation. Stronger patterns of change over time are evident if agricultural groups are included; however, the integration of agricultural jobs in stratification analyses is challenging, because only broad characterisations are available for different jobs that involve very large numbers of people (e.g., 'farmers' versus 'farm workers'). Previous discussions of the trade-off between 'big class' and microclass patterns in social reproduction concentrate on modern societies with smaller agricultural sectors, and analysis of the non-agricultural 19th century population seems a fairer and more interesting point of comparison. It is also plausible that an extension of our analysis to earlier time periods may reveal even stronger microclass inheritance patterns in non-farming occupations, given the even smaller proportions in non-agricultural work.

There are other specificities in our approach which need not necessarily apply to further analyses using microclasses. Our analysis was restricted to male employment; it would be interesting to look at the microclass mobility of women (cf. van Leeuwen and Zijdeman, 2014). We would also emphasise that the microclass scheme that we generated for this analysis, and make available for others to use, is itself only one plausible realisation in the microclass research agenda. Our scheme still includes some very small, and some very large, microclasses, and alternative researchers might produce refined or alternative microclass schemes for comparable periods. Nevertheless, it is apparent to us that adding microclass schemes and model parameters to the analysis of data from industrial societies may lead to interesting and consequential alternative insights into social reproduction in the era.

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Supplemental material

Supplemental material for this article is available online.

Notes

1. In summary, the microclasses were calculated iteratively. We initially used an algorithm (Griffiths, 2012) to assign HISCO categories into an existing contemporary microclass scheme. On inspection, we judged that there were anomalies in the relation between some HISCO units, their microclasses, and their HISCLASS categories; and we also noted that many of the microclasses were either very small (with few incumbents) or very large (combining several very populous occupations). The initial allocation was subsequently reviewed. We created some separate or 'miscellaneous' categories designed to accommodate those cases that we felt were anomalous after the initial algorithm. In addition, we used the principle of aggregating categories which had fewer than 300 cases overall or fewer than 30 cases in either period for either nation; and disaggregated categories (if plausible) if there were over 10,000 cases in the microclass.
2. There was a small number of cases which changed the HISCO occupational category, but remained within the same microclass. This was around 5% of cases in the USA and 1% in Norway.
3. Table 4 summarises 12 statistical models and presents four commonly used statistics for summarising the results. For ease of comparison, in Tables 5 and 6 we have shown only the BIC parameter, and only a subset of the range of models, although the same set of results were originally generated.

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