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A Stratification Scale Based on Social Interactions for Historical Comparative Research

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Abstract. A new occupational stratification scale, "HISCAM" (historical CAMSIS), has been developed to facilitate the analysis of data coded to the Historical International Standard Classification of Occupations. This article describes the derivation and properties of the HISCAM measure. The scale was derived using patterns of inter-generational occupational connections, replicating a method of "social interaction distance" analysis which is widely used in contemporary sociology. Analysis was performed on data for the period of 1800–1938, principally derived from marriage registers covering Belgium, Britain, Canada, France, Germany, the Netherlands, and Sweden, and encompassing over two million inter-generational relationships. Researchers report how several different HISCAM scales were evaluated and show how this approach can explain social stratification and inequality in the past.

Keywords: HISCO, HISCAM, occupations, social interactions, social stratification

Occupational Data and Historical Sources

Using large-scale survey datasets, sociologists are able to carry out empirical analyses of individual level data on features of, or attitudes about, occupations. Examples include prestige studies that ask people for their own ideas on how occupations are ranked (e.g., Van Tulder 1962; Treiman 1977; Sixma and Ultee 1983); analysis of subjective ratings of job satisfaction and desirability (e.g., Mills 2007); and profiles of occupations in terms of their incumbents' average income and educational levels (e.g., Ganzeboom and Treiman 1996), employment relations and conditions (e.g., Rose and Harrison 2010), or skill levels (e.g., Tahlin 2007). Schemes and scales derived from such reviews are widely exploited in contemporary research, where it has been suggested that occupation-based indicators out-perform any other measureable variable in explaining people's position in the social structure (e.g., Treiman 1977).

In historical research which pre-dates the era of large and complex social survey data collections, detailed data about occupations and their incumbents is not generally available on a large scale. Until recently, historical datasets with occupational data were often limited in their geographical, temporal, or socioeconomic coverage due to the labor intensive nature of gathering occupational records (cf. Miles and Vincent 1993). Digitization of historical documents, such as census records, parish records, and birth, marriage, and death certificates, now provides access to wider-ranging data on occupations (cf. NAPP 2008), but such records are often limited to the occupational title and lack systematic information about the features of occupations which might be used to explain the social position of occupations and their incumbents.

However, one means of positioning occupations within the social structure, developed in contemporary research, is well suited to applications using historical data resources. The "CAMSIS" approach to studying the relative stratification position of the incumbents of occupations ("Cambridge

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Social Interaction and Stratification" Scales; see Stewart, Prandy, and Blackburn 1973, 1980; Prandy and Lambert 2003) exploits data on social connections between the incumbents of occupations. According to the principles of homophily, it can be assumed in general that people interact more often the closer they are in terms of social position (e.g., Bogardus 1925, 1933; Park 1926; Weber 1968 [1922]). While other characteristics of occupations (e.g., whether they share a work place such as physicians and nurses, and farmers and farm workers) will affect interaction as well, previous research indicates that a major feature of the empirical structure behind interactions is "social stratification" (Stewart et al. 1980; Prandy 1999; Prandy and Lambert 2003; Bottero 2005). CAMSIS scales are scores given to occupations which indicate their position in the social stratification structure as revealed through social interaction patterns, and CAMSIS scales have been calculated for many contemporary countries (see www.camsis.stir.ac.uk for full details of contemporary CAMSIS scales and information on their derivation and exploitation). A number of other sociologists have also undertaken similar analyses of the social interaction distance structure, reaching similar conclusions (e.g., Laumann and Guttman 1966; Bakker 1993; Chan and Goldthorpe 2004; Chan 2010).

This article describes the application of the CAMSIS methodology to data on social interactions between the incumbents of occupations in the period 1800–1938. The application generated a new occupation-based stratification scale through the analysis of social interaction distance: the HISCAM (HIStorical CAMsis) scale (see www.camsis.stir.ac.uk/hiscam). A first version of the HISCAM scale was released in 2006, but the scale has been subject to several refinements and expansions in its scope since that point (see also Lambert, Zijdeman et al. 2006, 2008; Zijdeman and Lambert 2010). In this article, we provide a description of the social interaction distance analysis used to generate HISCAM, alongside comments serving to introduce HISCAM as a new tool available to historians for exploring or analyzing the occupational structure in the past.

Other Historical Occupational Measures

To our knowledge, HISCAM is the first attempt to provide an internationally comparable stratification scale for occupations in the past, but various other historical studies have calculated occupation-based social classifications. Kenneth Prandy and Wendy Bottero (1998, 2000) conducted a comparable analysis of social interaction data to the HISCAM scale reported herein. Prandy and Bottero used British data from the "Family History Study" (a genealogical database) to construct a scale for British occupational codes in two time periods (1750–1840 and 1841–1938). The current article broadens the scope of this analysis, using data from more countries and different studies and analyzing occupations at a finer level of detail than was feasible in Prandy and Bottero's analysis.

Elsewhere, many researchers have sought to replicate versions of contemporary occupational class schemes on earlier data (e.g., Miles 1999) or to codify divisions between occupational positions in a particular national context using theoretical and empirical criteria (cf. Royle 1987, ch. 3). To improve the comparability of such efforts, two categorical schemes, SOCPO (Van De Putte and Miles 2005) and HISCLASS (Van Leeuwen and Maas 2011), have recently been developed using the Historical International Standard Classification of Occupations (HISCO; Van Leeuwen, Maas, and Miles 2002, 2004). Both schemes start from a theoretical model of the social class structure and derive their measures by linking occupations with positions within that theoretical structure, though in both instances alterations are made in response to empirical analysis of the patterns revealed. HISCAM offers a natural alternative to these categorical comparative schemes, in its case placing occupations in a single continuous dimension of social stratification difference on a strictly empirical, rather than a theoretical basis.

Derivation and Use of the HISCAM Scales

The CAMSIS Approach

CAMSIS measures can be constructed by using data on pairs of occupations linked by a social interaction, such as marriage, friendship, or parent-child relationships. First, a two-way cross-tabulation of the occupations for the first and second members of the pair is prepared, and then the frequency of occurrence of all particular combinations is modelled (e.g., how many bakers are friends of bakers, but also how many bakers are friends of butchers, secretaries, majors, etc.). Correspondence analysis (e.g., Greenacre and Blasius 1994) and Goodman's RC-II Association Models (e.g., Goodman 1979; Wong 2010) can be used to develop statistical models which seek to find one or more dimensional structures behind patterns of interactions between occupations. A score is assigned to each occupation to indicate its position within the empirical dimension(s) of social interaction. It transpires, with remarkable consistency across societies and across different types of social interaction measure (cf. Prandy and Lambert 2003), that a principal dimension of the social interaction structure emerges which can be presented as a hierarchical dimension of social stratification. The relevant dimension score is then saved and is conventionally rescaled (to a mean of 50 and standard deviation of 10, with higher scores indicating a more advantaged position in society).

The name "CAMSIS" refers to a project initiated in 1999 which sought to generalize previous work on the UK-based "Cambridge Scale" of occupations (see Stewart et al. 1973, 1980; Prandy 1990, 1999; http://www.camsis.stir.ac.uk) to other countries and time periods. CAMSIS scales for the period 1960 to the present are now available for 32 countries, and there are several ongoing academic investigations exploiting this methodology (e.g., Bottero et al. 2009; Griffiths and Lambert 2012). In addition, several separate sociological projects have recently constructed scales using a similar methodology (e.g., Bessudnov 2009; Chan 2010; De Luca, Meraviglia, and Ganzeboom 2010; Chan et al. 2011). Accordingly, the social interaction distance approach is proving a popular mean of exploring contemporary occupational inequalities and offers a robust, well-documented, and empirically feasible mean for exploring data from earlier time periods.

Deriving the HISCAM Scale

The data we used to derive the HISCAM scale cover the period 1800–1938 and originate from seven countries: Belgium, Britain, Canada, France, Germany, the Netherlands, and Sweden. The first three columns in Table 1 show which datasets we used for each country and the period to which they apply. Further columns show that there were substantial differences in the nature and scale of the data available across countries.

We used marriage records and similar data to gather the occupations of pairs of persons with a social connection. Specifically, we focused upon inter-generational occupational comparisons as recorded at the point of marriage. The entries in columns 4–8 of the table show the comparisons for which we have information. For instance, the column titled "M-M" shows that for the "HSN" dataset, we know the occupations of 10,915 grooms and either their fathers or their brides' fathers. The column titled "M-F" indicates that we know the occupations for the groom and either his mother or his bride's mother for 1,158 pairs of people, and so on.

Using these data, we undertook analyses that yielded 12 different HISCAM scales, which are available on our website (www.camsis.stir.ac.uk/hiscam/). The details of these analyses are described under "Methodological Considerations." Firstly, for each country, a "specific" scale was estimated using the data from that country, leading to seven different scales (labelled as "hiscam_{nl/de/fr/se/gb/ca/be}," for the Netherlands, Germany, France, Sweden, Britain, Canada, and Belgium, respectively). These national-specific scales were based only on male-male records in each country. (This aided comparability since the coverage of female records varied between countries.) In these national-specific scales, the scores assigned to occupations represent the relative positions of those employed in each occupation, as revealed by the social interaction patterns in the country concerned. An occupation's position may well vary from country to country as a result of genuine differences between nations in the character of the stratification structure, but differences in the positions could also arise for more prosaic reasons, such as differences in coding practices.[1]

In addition, we developed "universal" HISCAM scales using combined data from those four countries (Belgium, Britain, France, and the Netherlands) which we considered to be the more reliable datasets on the grounds of the volume of cases and other national features.[2] Several different universal scales reflect varying specifications of time periods and of the gender of the persons whose records were used to form the scale. A scale combining both male and female records was generated ("hiscam_u1"), but we also generated scales restricted to male records only ("hiscam_u2") and another scale restricted to female records only ("hiscam_u3"). This approach, separating male and female samples, is consistent with contemporary CAMSIS scale derivations, where separate scales for men and women are ordinarily generated (see Prandy 1986). Patterns of gender segregation in occupations, the motivation for this approach, were even more pronounced in the past than they are today (e.g., Bradley 1989), so it is particularly appropriate to consider this strategy. Lastly, we also divided the pooled data (for men only) into two time periods and estimated separate "early" ("hiscam_e," for marriages in the approximate period 1800–90) and "late" ("hiscam_l," for the approximate period 1891–1938) scales (see also the section below on "Trends in Occupational Positions Over Time"). These different analyses were undertaken in order to generate scales which would provide users with a number of options for exploring and analyzing occupational positions in the past. In general terms, we believe that the male-only scale covering all time periods ("hiscam_u2") is ordinarily the most appropriate means of depicting and analyzing the stratification structure in Western industrializing countries in the nineteenth and early twentieth century, and we recommend that users work with this scale unless they have a particular interest in the patterns associated with the other analyses.

Obtaining and Using the HISCAM Scales

The 12 HISCAM scales we produced are available online (http://www.camsis.stir.ac.uk/hiscam/).[3] While we expect that most researchers will be interested in the universal scale ("hiscam_u2"), we also want to serve the needs of those who are dependent on context-specific measures of occupational stratification. Indeed, the 12 HISCAM scales published represent a selection from a much larger array of possible derivations represented by different permutations of the data, depending upon the time period, country, gender, and number of occupational categories used to produce the model.

The HISCAM scales are provided in a number of data formats that we believe are most often used by researchers in the field. In addition to a tab-delimited file, all of the scales are available as MS Excel, SPSS, and Stata files. Within each database can be found two columns, "hisco" and "hiscam," which give the HISCO unit and the corresponding HISCAM scores (there are also some further data files,

TABLE 1. Data Sources

			N child-parent relations *(and % of which consanguineous)*				
Study	Year range	Median year	M-M	M-F	F-M	F-F	*% CS*
Netherlands							
HSN	1818–1938	1903	10,915	1,158	2,124	518	*48*
Genlias Zeeland	1800–1923	1874	156,915	70,833	73,060	53,512	*49*
Genlias Limburg	1800–1927	1875	163,022	80,179	58,532	34,347	*48*
Genlias Overijssel	1811–1922	1869	233,874	66,278	82,521	35,238	*49*
Germany							
Knodel/Imhof (regional subsets)	1800–49	1827	372				*47*
	1800–49	1827	2,164				*50*
	1800–49	1826	749				*51*
	1800–49	1829	1,541				*49*
	1800–1938	1880	7,475				*69*
France							
TRA	1803–1938	1876	54,669	18,620	27,420	13,545	*50*
Henry	1800–19	1810	790				*63*
Sweden							
DDB Sundsvall	1803–89	1863	16,169		7,329		*48*
DDB Skelleftea	1800–1901	1869	9,419				*49*
DDB 11 Parishes	1800–1921	1861	5,631		2,831		*50*
Britain							
Miles/Vincent	1839–1914	1874	19,547				*50*
FHS	1800–1938	1873	31,872	689	9,472	394	*51*
Canada (Quebec)							
BALSAC	1800–1938	1895	552,521		12,320		*42*
Belgium							
HMF WFlanders	1800–1900	1859	56,774	29,423			*100*

Notes. Years refer to the year at which the marriage occurred. Cases indicate instances where HISCO occupational data were successfully coded for the relevant persons. The same marriage often contributes more than one child-parent record (in total, we have 2,005,125 inter-generational connections, which arise from 990,493 unique marriages). "%cs" refers to the percent of records within each study where the data refers to a parent and child from the same family (e.g., groom-groom's father, compared to groom-bride's father).

Sources.

HSN: Historical Sample of the Netherlands. International Institute for Social History (IISH). Amsterdam, The Netherlands. We excluded data from provinces overlapping with the Genlias data. http://www.iisg.nl/∼hsn/database/.

Genlias: Civil registration data (marriage records 1796–1922), accessed for Limburg (HSN); Zeeland (Zeeuws Archief and HSN); Overijssel (Historisch Centrum Overijssel and HSN). http://www.genlias.nl.

Knodel/Imhof: Ortssippenbüchern, Germany (supplied on personal arrangement).

TRA: Base TRA Patrimoine. L'institut national de la recherche agronomique (INRA). Paris.

Henry: Survey data collected by Louis Henry, INED (distributed by INED since 1997).

DDB: Demographic Data Base. University of Umeå, Sweden. http://www.ddb.umu.se/.

Miles/Vincent: Marriage records, literacy database (see Vincent 1989, Miles 1999).

FHS: Cambridge Family History Study (genealogical database, see Prandy and Bottero 2000).

BALSAC: BALSAC population register. University of Quebec at Chicoutimi, Quebec, Canada. http://www.uqac.ca/balsac.

HMF WFlanders: Marriage records; Historical Mobility File of West Flanders (supplied on personal arrangement).

labelled "_detail," which give additional diagnostic information about the relevant scales). We anticipate that the most common uses of the HISCAM scale files will be either as a means of looking up particular occupational scores in order to understand that occupation's estimated position in the stratification structure or for merging HISCAM scale scores onto existing micro-data that include HISCO units, thus generating a new variable featuring the HISCAM score for the relevant units of analysis.

Illustrative Properties of the HISCAM Scales

By way of illustration of the character of the HISCAM scales, the bars in Figure 1 show the distribution of values of the universal HISCAM scale ("hiscam_u2") for all 4.5 million occupational records. The smoothed line in the figure shows the best-fitting Gaussian kernel density plot for the data, which suggests that the distribution can be reasonably described as having a normal shape with positive skew. In

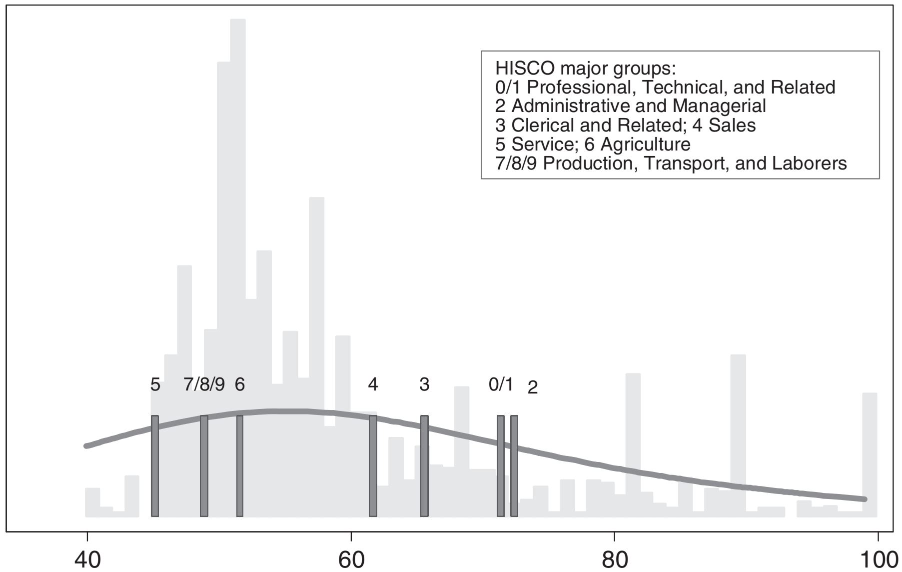

FIGURE 1. Distribution of HISCAM scores across the population (using the universal scale, "hiscam_u2," version 1.3). HISCAM distribution across all adults with occupational records, 1800–1938 (4.5 M total). Bars show number of cases per one-unit band, with best-fitting Gaussian kernel density plot overlaid. Spikes mark the means for the seven HISCO major groups.

addition, "spikes" are shown which highlight the mean scores of each respective HISCO major group. As is evident from the major group profile, the scale depicts an order of differentiation between occupations which appears to map onto a structure of social stratification (higher positive scale scores indicating more advantaged occupational positions). As in all examples, the HISCAM scale is centered around mean 50 with a standard deviation of 10 on the population from which it was derived. In this example, the distribution is represented across the pooled sample of all occupational records available to us (4.5 million records). We see that while most of the people have occupations that are close to the mean, the distribution appears to be positively skewed (a typical result for datasets of this period, where the volume of cases in farming and general laboring jobs, scaled toward the lower end of the distribution, far outweighs those cases in other positions). This skew also means that the distance between the occupations with the lowest HISCAM scores and the average HISCAM score is much smaller than the distance between the average and the highest HISCAM scores (contemporary CAMSIS scales tend to have less marked positive skew, suggesting that "elite" positions were relatively more distant from the rest of the population in the nineteenth century than more recently).

Figure 2 provides an overview of the scale scores of HISCO unit groups. The *y*-axis portrays HISCAM scores on the universal scale ("u2"). The points represent the scores assigned to particular HISCO units, scaled in size according to the number of cases in each occupation, but the *x*-axis does not represent an important dimension and is mainly used as a device to reduce the degree of overlap between the units. (On the *x*-axis, all occupations are placed in rank order of their HISCAM scores; the resultant curvilinear character of the plot reflects the greater distance on the *y*-axis between HISCAM scores at higher rather than lower values of the scale.) The figure depicts the "lumpiness" of the occupational order; many HISCO units feature relatively few cases, but some are disproportionately large (these results are shown for male occupations only, since the female occupational distribution is even more "lumpy"). Labels are also provided for the largest HISCO unit group within each one-digit cluster: At the high end of the distribution, we find the General Physician and General Manager as the largest units in groups 0 and 2, respectively, while Day-Laborers and House-Servants are the most common units in groups 9 and 5 and are found at the opposite end. When comparing the spread of scores of particular occupations (Figure 2) with the average scores of each HISCO major group (Figure 1), we see evidence of internal heterogeneity within major groups. For example, whereas the major group of professionals (0/1) as a whole is to be found at the higher end of the distribution, one of the largest units in this major group, that of first-level education teacher, is given a relatively low rank. Such observations reiterate why it can be undesirable to reduce detailed occupational information into aggregations such as major groups.

As a last illustration of the HISCAM scale properties, in Figure 3 we depict the scale scores for a selection of five occupational groups or clusters (namely Teaching, Working

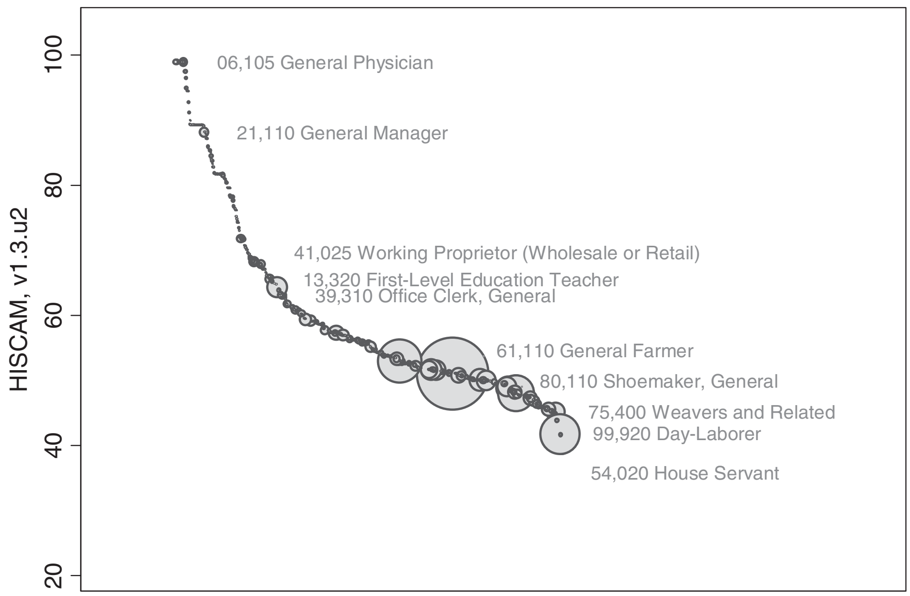

FIGURE 2. Illustrative HISCAM scores for HISCO units. Combined sample (males only, $N = 1.3M$). Symbol size is proportional to number of cases in unit group (labelling largest unit within one-digit clusters).

Proprietors, Shoemakers, Miners, and Agriculture) and show their averages on the universal scale alongside their averages in the relevant national-specific scales for the seven countries. This presentation is typical of the comparisons that many users may wish to make between the scale score of the same occupations across different countries (overall correlations between versions are also discussed further below; see Table 2). In Figure 3, for all five occupational groups, most of the HISCAM scores on the national scales lie within one standard deviation (10 points) of the universal HISCAM

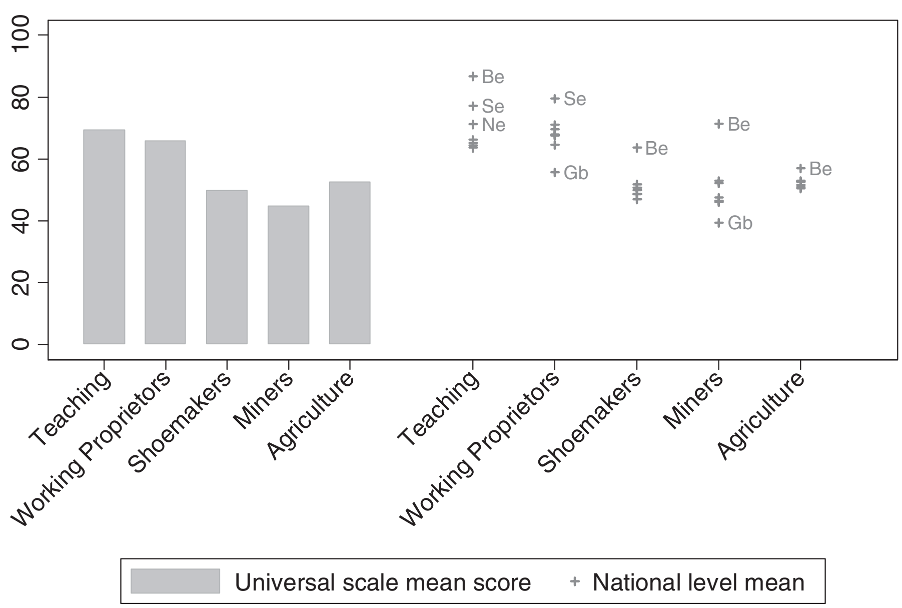

FIGURE 3. HISCAM scores of selected occupational groups (using national scales and the universal scale "hiscam_u2," version 1.3). Data from Belgium, Germany, the Netherlands, France, Canada, Great Britain, and Sweden.

scale. Yet while the differences are relatively small, there are some interesting exceptions, such as that Working Proprietors in Sweden are estimated to be somewhat higher than average and in Britain lower, and in several groups the Belgian scores are unusually high. We emphasize that the differences between scores for the same occupations emerge from empirical differences in the patterns of associations between occupations in the respective samples from each country. Moreover, within any particular scale, an occupation's position is defined in relation to the overall distribution of jobs within the country. The interpretation of national differences in the scores assigned to the same jobs is therefore one of relative rather than absolute differences in position. While this is potentially very helpful, it is also somewhat complex, and we would again stress that in many circumstances, prospective users of HISCAM may prefer to restrict their attention to the properties of the universal scale.

The Derivation of HISCAM: Methodological Considerations

We performed a large number of different scale estimation analyses in preparatory exercises using different software routines and data sources (see Lambert, Zijdeman et al. 2006, 2008; and www.camsis.stir.ac.uk/hiscam for further details). The current version (1.3) of the HISCAM scale was generated using a semi-automated routine for performing correspondence analysis using the Stata software (StataCorp 2009; a sample of our program is available at our website). Various options are available in performing social interaction distance analysis (for further discussion, see www.camsis.stir.ac.uk), and it is important to lay out an account of main steps that we took in our analysis of historical occupational data.

A first consideration concerns the type of social interaction used to generate the HISCAM scales. In social interaction distance analysis, three different types of social associations are commonly modelled: occupational combinations of husbands and wives (as in most contemporary CAMSIS scales), occupational combinations of parents and their adult children (which we used in HISCAM), and occupational combinations of friends (as in the original "Cambridge" scale; see Stewart et al. 1980). Bottero (2005) summarized the reasons why such diverse relations of social interaction should all nevertheless embody the same empirical structure of stratification, and Tak Wing Chan (2010), Prandy and Lambert (2003), and Prandy (1990) presented empirical evidence of the similarity of the social interaction order across different measures of social connection. Our analysis involved modelling the occurrence of intergenerational links between occupations listed on marriage records. As noted above, columns 4–8 in Table 1 show the number of child-parent relations available in our datasets. These relationships are either consanguineous (e.g., father-to-son) or non-consanguineous (e.g., father to son-in-law). Information on consanguinity for the male-male relationships is noted in the last column of Table 1, but in sensitivity analyses we found no significant impact of consanguinity upon social interaction patterns, so all pairs of related occupations were used in relevant analyses.

Secondly, in any social interaction distance analysis, some "recoding" of occupational units is desirable in order to ensure that the unit groups contain sufficient cases for the two-way association model to be estimated successfully. This ordinarily involves merging occupations which are sparsely represented into larger aggregations. A common strategy to avoid low cell sizes is to derive social interaction distance scales for relatively small numbers of different units, such as major groups or sub-major groups (e.g., Chan 2010), but this does risk disregarding interesting empirical heterogeneity. Instead, we sought to maximize the number of different occupational positions used in analysis using a working principle favored in CAMSIS estimations for contemporary populations that representation of an occupational unit group should exceed 30 cases, and if not, that group should be merged with another occupational unit group with similar features (see Prandy and Lambert 2003).[4] This led to our analysis using 536 different occupations in the largest dataset used ("hiscam_u1"), but to code smaller numbers of units in smaller datasets. In the commonly used universal scale "hiscam_u2," 464 different units were scaled; the smallest number of units analyzed, 79, was for the Swedish scale "hiscam_se."

Third, we observed during preparatory analyses that the way in which sparsely represented occupations were merged or recoded could be influential. We often noted, for instance, that certain occupations had substantially different scale scores assigned to them from one version to another, but we sometimes suspected that it was our decisions on how to merge occupations that produced different scores, rather than genuine differences in the way the occupation was located within the stratification order. We believe that while there is always an element of ambiguity over whether the scores generated through the CAMSIS approach are the "right" ones (since it hinges upon the statistical estimation of scale locations on the basis of empirical data), there are circumstances when it is sensible to use *a priori* expectations about plausible scale scores to refine analytical results. Accordingly, we developed a methodological adaptation that had the impact of reducing implausible disparities in the empirical estimates between versions.

In HISCAM version 1.3, we first calculated the scales in the conventional manner for each particular version (known as the "raw scale"). Second, we applied a "smoothing" approach to examine disparities between each "raw scale" and our most robust estimated scale (the "universal" scale "u2"). We then applied a set of criteria under which, if the actual number of cases representing the occupation in the specific version was small, and the disparity between its specific and universal score was large, we replaced the specific score with a weighted average between the two. See www.camsis.stir.ac.uk/hiscam for the full details of the program that we wrote to achieve this. The impact of this adjustment is that well-represented occupations are not altered in their positions, but the more sparsely represented ones may have their scores changed. We felt that this smoothing adjustment led to an improvement in the reliability of the country- and period-specific scale values, since it took advantage of the comparable nature of the different source datasets used for HISCAM scale estimations but came at minimal cost to the general empirical approach (e.g., it did not prevent major differences from one version to another being estimated). In our scale release files for version 1.3, the standard files contain the "smoothed" scores only, which we consider to be the most plausible results, but a supplementary "details" file also provides the interested reader with further technical information including access to both the raw and smoothed scores.

A fourth issue concerns the treatment of occupational combinations that link two equivalent occupations (e.g., son "farmer" to father "farmer," referred to as "diagonals") or two non-equivalent but structurally-related occupations (e.g., son "farm worker" and father "farmer," referred to as "pseudo-diagonals"). Such diagonal and pseudo-diagonal combinations have the capacity to exert a considerable influence upon dimensions that are estimated in an association modelling approach but are thought to be separable from the general structure of social stratification inequality (which drives "non-diagonal" associations). Following a common convention in association modelling of occupational mobility (cf. Luijkx 1994), we excluded diagonal combinations from the modelling analysis, and we also excluded pseudo-diagonals which we identified through a mixture of *a priori* (e.g., all farming-farming pseudo-diagonals were excluded) and *post-hoc* criteria (i.e., inspection of model results was undertaken to diagnose other pseudo-diagonals and exclude them). In practice, excluding diagonal and pseudo-diagonal combinations from analysis leads to substantial reductions of the sample size for datasets from the nineteenth century, and there is an obvious subjective element to the choice over which combinations should be considered as pseudo-diagonals in each model. These are long-running issues in the conduct of social interaction distance analysis, and copies of our derivation files including pseudo-diagonal specifications are available from our website, www.camsis.stir.ac.uk/hiscam, allowing interested readers to study the choices we made.

Fifth, we took specific steps to estimate scale values for farming occupations due to the volume of records coded as farmers in the historical databases (43 percent of all records in our data were farming occupations, though this average drops to 37 percent if the Canadian data are excluded). We often found that the empirical patterns of social association involving farming occupations were so influential that we were unable to estimate models which we were confident had eliminated the influence of the farming sector (even after excluding farming diagonals and pseudo-diagonals). For instance, there were extremely high numbers of certain other combinations with farming, such as with "day labourers," which dominated some estimated patterns but could not easily be removed from analysis without skewing other results. After evaluation of numerous alternatives, we ultimately chose a two-stage operational strategy. Firstly, the HISCAM scales were estimated on the population of all pairs of responses except those involving farming jobs. Secondly, scores for farming occupations were estimated on the basis of calculating the arithmetic average of the scale scores of all other occupations linked to them. We considered this approach preferable to running a single statistical model for all of the population, because it led to much more consistent scoring for farming occupations across different countries and time periods.

Finally, the various steps taken during our extended preparatory analysis help to address a concern sometimes expressed with scales such as HISCAM, that there may be a problem of endogeneity or "circularity" to social interaction distance analysis, on the grounds that scales derived from data on marriage, friendship, or inter-generational mobility ought not to be applied to subsequent analyses involving the same phenomena. This is an important consideration, because such processes are very typical of the mechanisms that HISCAM is designed to explore. Our counter-argument is twofold. First, scales derived from the analysis of social associations correlate strongly with other occupation-based scales such as measures of prestige or socioeconomic status, so this concern might lead to an argument that no occupational scales may ever be used to analyze any phenomena involving marriage, friendship, or intergenerational mobility (see several analyses that correlated scales based on social associations with more conventional occupational scales: Luijkx 1994; Prandy 1998; Lambert, Prandy, and Bottero 2007; Zijdeman 2009). Such a concern is misplaced, however, because all such scales are assigning scores to occupational categories, and in doing so become, by definition, measures of occupations rather than of individual phenomena and therefore are very unlikely to have a problematic level of collinearity with the mechanism of interest. Secondly, the extended preparatory analysis we undertook (generating many hundreds of preliminary versions of HISCAM scales) revealed an underlying robustness to the core social stratification dimension detected through social interaction distance models. This suggests that there are not strong influences of highly-specific (or erroneous) empirical relationships in the HISCAM scale values, implying there is little chance of a "circular" empirical finding in subsequent analysis.

Trends in Occupational Positions Over Time

One of the most interesting contributions that could emerge from the HISCAM approach is to compare estimated scale scores for different HISCO units at earlier and later time periods. Many possible comparisons might be made,

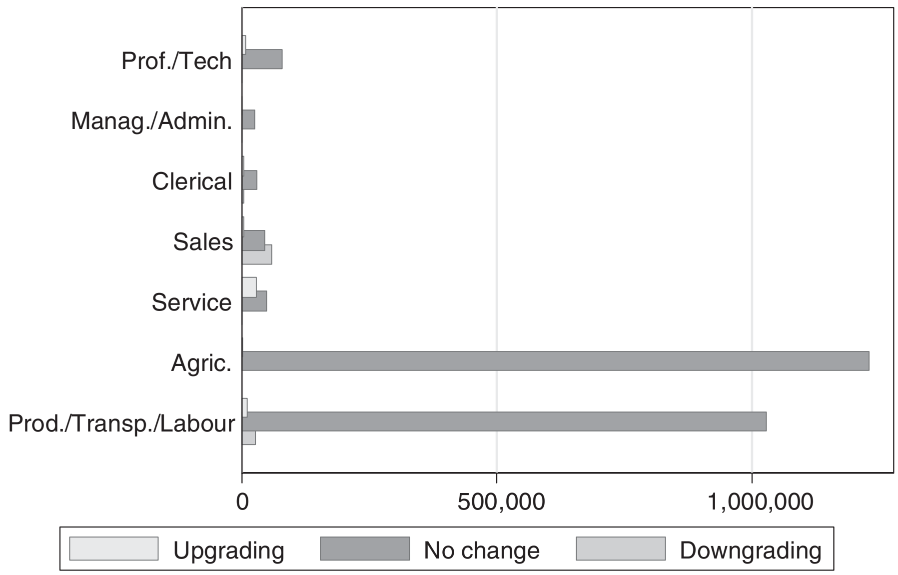

FIGURE 4. Distribution of men in occupations that did or did not experience a substantial change in HISCAM score from the early to late period (comparing "hiscam_e" and "hiscam_l" scales, version 1.3). Sample of all recorded male jobs across period.

but the distributed scales focus on differences associated with the transition to industrialization, namely the derivation of an "early" (1800 until circa 1890) and a "late" (circa 1890 until 1938) universal scale score.[5] Figure 4 depicts the scale of change between HISCAM scores estimated for the same occupations in the early and late periods (across all countries). The actual magnitude of change in the scores varies considerably between HISCO unit groups, but in this image we categorize change into three groups, namely "upgrading" (a gain in relative position of five or more HISCAM units—the equivalent of half a standard deviation—between the periods), "downgrading" (a decline of five or more units), and "stability" (a change of less than five units). We see from the figure that the common pattern across HISCO major groups is of no substantial change, but within major groups 4 (Sales), 5 (Service), and 7/8/9 (Production, Transport, and Laborers), there are moderate volumes of people in occupations that are recorded as experiencing substantial change in their relative positions over time. Such patterns may well help us to explore historical change in stratification relations. As one illustrative example, in the sample of male jobs, we found a correlation of –0.18 between the level of upgrading of occupations (i.e., late scale score – early scale score) and a classification measure for HISCO that indicates whether or not the occupation can be considered "modern" (see http://collab.iisg.nl/hisco for documentation). The correlation suggests that advantages in social position associated with modern occupations decline over time: As more people move into more "modern" occupations, the social advantage associated with those occupations is diluted.

Assessing the Validity of the HISCAM Scales

Evaluations of occupation-based measures for contemporary populations routinely undertake validity testing (see esp. Rose and Harrison 2010). In the previous sections, we have demonstrated that the HISCAM scale has "face validity" insofar as it depicts a structure of occupational inequalities which we argue can readily be interpreted as an order of hierarchical social stratification. In addition, "construct validity" arguably has been demonstrated through several recent analyses which use HISCAM successfully as a means of exploring the relationship between social stratification position and other social inequalities (e.g., Bras, Kok, and Mandemakers 2010; Zijdeman and Maas 2010; Schulz and Maas 2012), although there are relatively few sources of national-level micro-data spanning suitable countries and time periods with variables which can be used for this purpose (see Van De Putte and Miles 2006).

Alternatively, the data used in deriving the HISCAM schemes can themselves be used to help establish "criterion validity" (which is conventionally defined as the circumstance in which a measure is linked in the expected way to separate measures of things with which it is designed to be associated). Writers linked to the CAMSIS project have argued that social reproduction of the stratification order is the primary force that defines the properties of a CAMSIS scale (Stewart et al. 1980; Prandy and Bottero 2000; Bottero 2005), and accordingly, one means of assessing the criterion validity of the HISCAM scales would involve showing that HISCAM does indeed serve to characterize patterns of inter-generational social mobility in the expected way. In Table 2, for instance, we see that the magnitude of inter-generational correlation across countries and time periods is of the order of 0.4–0.5 and somewhat higher when farming occupations are not included in the analysis. These figures are comparable to the magnitude of correlation measured by other available schemes and consistent with expectations arising from other analyses of levels of social mobility in the period (cf. Miles 1999; Prandy and Bottero 2000; Schulz and Maas 2012).

A second demonstration of criterion validity concerns the relationship between the HISCAM scale and other purported measures of occupational stratification (see also Zijdeman and Lambert 2010). It is appropriate to compare HISCAM with the the Standard International Occupational Prestige Scale (SIOPS; see Treiman 1977) since this scale, which was based on data from 60 societies covering the period 1949–71, is claimed to be universal and therefore applicable to all countries and time periods. Indeed, Michael Hout and Thomas DiPrete (2006) named this degree of universality the "Treiman constant" and heralded it as the number one finding in the field of social stratification research. Moreover, since SIOPS and other measures have themselves been subject to extensive validation exercises, the correlation between HISCAM and these validated measures may add credibility to the HISCAM scale.

TABLE 2. Indicators of Criterion Validity of HISCAM Scales

	Whole population		Male non-farming population only	
	Par-child HISCAM	HISCAM/ SIOPS	Par-child HISCAM	HISCAM/ SIOPS
All	0.435	0.653	0.549	0.792
Netherlands	0.454	0.616	0.557	0.764
Germany	0.540	0.777	0.627	0.848
France	0.443	0.653	0.536	0.778
Sweden	0.300	0.634	0.430	0.713
GB	0.465	0.738	0.503	0.755
Canada	0.409	0.763	0.534	0.844
Belgium	0.434	0.631	0.476	0.662

Note. Based on micro-data from the data files described in Table 1. Columns 1 and 3 show inter-generational Pearson correlations between parents and children. Columns 2 and 4 show Pearson correlations between SIOPS and HISCAM (U2 scale) for children.

In Figure 5, we show a scatterplot of the HISCAM scale on the *y*-axis and Donald Treiman's SIOPS on the *x*-axis. The numeric values of SIOPS are in their natural units and ultimately reflect the averages of Likert scale score values from prestige surveys (see Treiman 1977; the values are not mean standardized and are generally lower than those of HISCAM, which is standardized around 50). The dots in the scatterplot represent the occupational unit groups in HISCO and show a strong overall relationship between the scales. The plot also shows the OLS regression line relating the two scales, which confirms the pattern of positive relationship between the scales. In addition, Table 2 summarizes

FIGURE 5. Relationship between HISCAM and SIOPS scores. All available occupations for adult grooms (N = 1.3M, as in Table 1). Plot size proportional to number of cases per HISCO unit group. Line shows OLS fit.

further correlations (Pearson's *r*-values) between HISCAM and SIOPS across different countries. Taken together, these patterns support the criterion-validity of HISCAM since the correlations are relatively high.

The size of the dots in Figure 5 varies according to the number of persons in a given occupational unit group, such that the more people there are in an occupational unit group, the larger the dot (the further the dots are away from the regression line, the larger the discrepancy between the HISCAM and SIOPS scale score). In addition, in Figure 5 we have placed labels for a small number of the larger occupational unit groups. This concerns people working in agriculture as well as those considered to be "workers." While the latter group is more or less given a similar position in HISCAM and SIOPS, the farming occupations are evaluated differently by the two scales. In comparison to SIOPS, farm workers receive a relatively higher position in HISCAM, while general farmers and field crop farmers are rated lower in HISCAM. The different positioning of general farmers and field crop farmers in HISCAM relative to SIOPS might seem worrisome, especially since these are the occupational unit groups occurring most frequently in our data. However, Treiman himself noted on the release of his scale that the positioning of farmers was difficult and noted that the positioning of farmers in SIOPS might be misleading for societies with large proportions of farmers (Treiman 1977, 183). Since most of the data used to derive HISCAM originated from industrializing societies which had large proportions of farmers, the alternative positioning of farmers does not seem to raise too much concern.

Conclusions

In contemporary sociology, occupational data is routinely collected (cf. Ganzeboom 2010) and is seen as central to social theories of stratification and inequality (e.g., Wright 2005) and to the empirical investigation of socioeconomic processes and their many related epiphenomena (e.g., Goldthorpe and McKnight 2006; Elo 2009; Chan 2010; Rose and Harrison 2010). Accordingly, a vast literature examines the features of occupations and their incumbents and questions how best to summarize occupations in terms of their positions within the stratification system (e.g., Treiman 1977; Erikson and Goldthorpe 1992; Ganzeboom and Treiman 1996; Hauser and Warren 1997; Oesch 2006; Güveli 2006; Goldthorpe 2007; Lambert, Tan et al. 2008; Jonsson et al. 2009; Rose and Harrison 2010). Occupational data are equally important to social and economic historians, but there has been far less opportunity for the construction and evaluation of comparative occupation-based measures with historical sources. The application of the CAMSIS methodological approach of social interaction distance analysis provides an opportunity for an extended empirical review of occupational inequality in the past; the HISCAM scale, the product of this exercise, gives illuminating insight into the social stratification of occupations in earlier periods. We hope that the HISCAM scales reported in this article will make a useful contribution to social history, since they provide detailed measures of stratification based upon occupations. The scales described above are a new contribution that can both tell us about occupational positions and provide new tools, in a convenient continuous functional form, for further analyses.

In general, all of the HISCAM scales depict broadly the same structure of social stratification in occupations (summarized in Figures 1 and 2). There are some differences from country to country or over time in scale scores, and these reflect noteworthy differences in occupations, but typically, scores for professional and managerial occupations (particularly those requiring high levels of education or training) are placed toward the top of the scale, and laboring and lower-skilled occupations are placed toward the bottom. The different HISCAM scales correlate highly with each other (see Figure 3), and they have comparable correlations with other occupation-based social classifications including prestige and socioeconomic status scales and class schemes (see "Methodological Considerations," above). We argue that this broad stability in occupational stratification arrangements is no coincidence. On the contrary, our findings constitute evidence from social interaction analysis of the enduring nature of social inequality in occupations. These enduring inequalities are reflected in social interaction patterns, just as they are also reflected in other forms of social recognition such as the "conscience collective" of occupational prestige discussed by Treiman (1977, 1).

HISCAM is not the first endeavor to schematize the occupational stratification structure of the past, but we believe that HISCAM has several attractions. Firstly, the HISCAM approach uses an empirical strategy that requires few initial assumptions on the nature of stratification systems in the past. This means it offers a contribution different from the many occupation-based stratification measures that are derived according to an *a priori* theoretical logic (esp. Rose and Harrison 2010). This empirically neutral strategy means that HISCAM is a relatively flexible approach to studying stratification which is not restricted to revealing the same structures of occupational inequality over time or between countries, nor obliged to group together occupational positions into large aggregate categories, which might elide important stratification differences within the occupational structure. In the derivation of HISCAM, we have largely managed to avoid assumptions about the positions of occupations within the social system. There is only a single pivotal assumption underlying HISCAM—that there is more social interaction between individuals who are, in terms of stratification, closer to each other—after which the occupational scale emergent from the HISCAM approach is obtained entirely from analysis of empirical patterns in the occupational structure in the period and countries at hand.

A second advantage of the HISCAM approach is that it supports comparative analysis between countries and over time. Its linkage to HISCO makes for ready operationalization from occupational description to HISCO codes and HISCAM scale values across countries. Moreover, HISCAM is based upon analysis of occupational titles from more than four million records, from seven different countries, over a period of more than a century (1800–1938). The HISCO scheme itself embraces a wealth of occupational detail, reflecting the methodological principles adopted during its development (Van Leeuwen et al. 2002, 25–9), and the HISCAM approach offers a summarizing device that is able to take account of empirical differences between detailed occupational positions in a way that is often overlooked in other summary approaches. Indeed, using HISCAM, it is possible to estimate a single "universal" scale applied to the full span of data, but it is also possible to estimate HISCAM scales for more specific circumstances, such as a particular country and/or time period. The 12 different HISCAM scales described above, for instance, provide revealing comparative information on the placement of occupations between contexts and satisfy the needs of researchers who desire a more specific approach to historical comparisons. Indeed, HISCAM in many ways represents a dynamic approach where there are opportunities for further scale estimations from new societies or time periods (or indeed for improvements upon the statistical results within the currently released versions). Accordingly, further implementations and evaluations of social interaction distance analysis applied to historical data should, over time, provide further insight into the organization of occupational inequality in the past.

Lastly, for some writers, HISCAM scales represent a particularly important theoretical endeavor (e.g., Stewart et al. 1980; Prandy 1998; Bottero 2005; Bottero et al. 2009). To explain why social interaction patterns are so deeply entwined with social systems of inequality, they have argued that socialization around occupations serves to normalize and especially to regenerate social systems of inequality, and accordingly that societies are characterized by a strong force of social reproduction which acts directly, through processes of social interaction, to define and sustain the very order of social stratification itself. From this perspective, empirically-based depictions of the social structure of social interactions might not simply be a convenient means to describe the occupational structure in the past but may offer a preferable theoretical explanation for social stratification and inequality in occupations in general.

NOTES

1. We note two concerns regarding comparative evaluations between the country-specific scales. First, the uneven historical coverage of the German and Swedish records may conflate the understanding of national and time period differences within these two countries' data resources. Second, there was unusual concentration in the Canadian data into a number of particularly populous occupational categories (especially the agricultural sector), which may skew the relative positioning of all other occupations in Canada.

2. The data on Sweden and Germany cover very specific regions and are relatively sparse, while the data from Canada most of all cover agricultural areas in Quebec (the Canadian data are also unusual in that almost all people working in agriculture are coded as "farmers," while, unlike in other countries, there are hardly any people coded as "farm-workers"). The data from Canada, Germany, and Sweden may thus be representative for the relevant regions in each of the countries but may distort an image of a more general cross-national occupational stratification structure.

3. Duplicated copies of the files also may be obtained from the "GEODE" website for distributing occupational information (http://www.geode.stir.ac.uk) and from the HISCO collaboratory (http://collab.iisg.nl).

4. We used a pre-defined list of recodes which would be applied to an occupation if it was too sparsely represented. Ordinarily, an occupation is merged with the largest occupational unit within the HISCO minor group or if necessary sub-major or major group, although in a few instances different merges are undertaken to preserve important sectoral differences. Details of the recode list are available at www.camsis.stir.ac.uk/hiscam.

5. The time period division tries to approximate a simplified cut-point between pre-industrialized and industrialized economies. It was chosen after review of the changing occupational distributions of the countries over time. We tried to identify a cut-point in each country when a sharp decline of the agricultural sector coincided with a sharp increase in typically industrial occupations, and accordingly we used a different division of periods for different countries: For the Netherlands, Belgium, and Germany, the periods were 1800–90 and 1891–1938; for Sweden, 1800–90 only (there were no more recent data available for Sweden); for France, 1800–1910 and 1911–38; for Britain, 1800–50 and 1851–1938; for Canada, 1800–1900 and 1901–38. We do not wish to claim that these cut-points should be interpreted as definitive cut-points of industrialization for each country, particularly because, for some countries in our analysis, the number of occupational titles is relatively small or stems from a single region. Indeed, our cut-points between "early" and "late" are typically later than reported in other literature, but should provide reasonable indicators for the data at hand.

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