

Occupational marriage networks in the USA, 1970-2010

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This paper explores occupational stratification through analysis of the social networks of occupational incumbents. Data is taken from the US Current Population Survey from 1970 to 2010 to explore marriage patterns by occupational position. The paper supports Treiman's (1977) hypothesis that the relative advantage and prestige of occupations remains consistent over time. Through adopting a social network perspective, it is possible to identify changes which are occurring within the occupational structure, particularly regarding educational expansion, and understand how structures remain resilient despite socio-cultural changes. The categorisation of occupations into social classes is also explored, with a case study demonstrating that the aggregation of management roles can produce suboptimal categories.

The study of social interaction patterns to assess relative levels of occupational advantage has been utilised in two, somewhat separate, sociological movements in recent times. Firstly, social interaction distance (SID) analysis has produced scales of the relative advantage of occupations through analysing patterns of friendship or marriage to ascertain which types of workers frequently interact. Secondly, position generator tools have increasingly been used to assess the social capital of individuals by exploring the resources available through social networks. In this paper, we bring together the SID tradition of exploring occupational stratification with social network methods to analyse the underlying patterns of vocational connections. We argue that a network approach provides a robust method which can identify nuances in the occupational structure which can aid our understanding of occupational stratification.

Occupational structure

Social Interaction Distance (SID) methods for constructing scales of occupational advantage have a long sociological tradition (Laumann and Guttman 1966; Blau and Duncan 1967; MacDonald 1972; Stewart et al. 1973). The rationale behind their construction is that it is possible to assess the relative advantage of occupations by analysing the vocations of the people they interact with. Social interaction patterns are assumed to reflect forces of homogamy and homophily which are linked to social inequalities, and therefore maps of the social interaction distance structure can serve to identify occupational structures of stratification and inequality.

As an illustrative example, Tables 1 & 2 show the most common wives of male lawyers and labourers, in the 2010 US Current Population Survey. Lawyers' wives generally hold relatively advantaged positions, such as teachers, accountants, managers and lawyers (as well as representing other common female occupations, such as secretaries and nurses). Labourers' wives, by contrast, often hold some of the least advantaged occupations, such as cleaners and nursing assistants, though they too include many examples of other major female occupations. The CAMSIS scores (see www.camsis.stir.ac.uk), detailed in Tables 1 & 2, are themselves derived from analysis of such patterns of social interaction, and are conventionally interpreted as indicating relative social advantage (scaled to a mean of 50 and standard deviation of 15). The version displayed in Tables 1&2 are derived from the 2000 US Census. Aside from the nurses and secretaries, which are included upon both lists, all the jobs connected to labourers have lower CAMSIS scores than all of those linked to lawyers. In addition, it is notable that labourers have partners from the relatively more advantaged larger occupations (nurses, secretaries and primary school teachers) in lower percentages than the population overall. From this simple vignette the nature of SID classifications can be seen: analysing patterns of which workers are married (or have other social connections) can help understand social inequalities in the occupational structure.

As Table 1 demonstrates, 11.6% of male lawyers are married to lawyers, with a further 2.4% of lawyers are married to paralegals/legal assistants. Since such 'diagonals' (couples with the same occupation) and 'pseudo-diagonals' (couples in workplace-related occupations) are thought to arise for reasons of proximity rather than wider forces of homogamy, SID analysis typically focuses upon the remaining patterns of social interactions between occupations, excluding 'diagonal' and 'pseudo-diagonal' combinations from the analysis.

Rather than grouping occupations in social classes, SID enables a more gradual distinction between occupations to be made. Whilst other occupational scales exist (cf. Ganzeboom and Treiman 1996), SID methodologies can be readily applied to national datasets (such as censuses) and therefore can be used to investigate the empirical nuances of occupational positions within particular countries. The CAMSIS project (Prandy and Jones 2001; www.camsis.stir.ac.uk) includes schemes based upon SID analysis of 27 different countries. Scores are provided which give a measure for assessing the relative advantage typically held by the incumbents of each occupation.

SID approaches provide opportunities to generate new scales for each new national database (such as for different decennial Censuses), although in practice new versions have refined rather than redefined the occupational structure. The so-called 'Treiman constant' reflects the tendency for occupations to preserve their levels of prestige and advantage across different countries and time-points (Treiman, 1977), and SID analyses have generally produced evidence which broadly supports this position (see also Chan, 2010; Lambert et al., 2008). However, SID analysis usually uses all relevant cases within a dataset, regardless of age, and it is possible that such an approach has little chance of identifying up-to-date changes in interaction structures. Whilst marriage patterns for the younger members of an occupation could differ fundamentally to older members, the combination of patterns across the age range should in turn indicate averaged levels of advantage, and therefore we would anticipate seeing, within a SID approach at a national level, at most a gradual shift in the relative advantage of certain occupations rather than fundamental temporal changes.

In contrast to the SID rationale of detailing relative positions of many occupational locations, class theories attempt to aggregate occupations into cohesive nominal groupings. Many 'big class' schemes have sought to identify small numbers of large groups (cf. Grusky and Weeden, 2006). Alternatively, the 'Microclass' approach (e.g. Johnsson et al. 2009; Weeden and Grusky 2005) offers a scheme comprised of many different groups, utilising ideas of cultural and social capital in the classification of occupations to group together those small clusters of occupations which are deemed to share similar traits and knowledge. Office workers, for instance, are grouped by their collective experiences and cultures of performing somewhat different roles within the same overarching set of norms: whereas detailed occupational codes differentiate, for instance, secretaries, payroll assistants and procurement clerks since they perform differing roles (and, presumably, receive differing incomes), the microclass scheme groups them together due to their shared understanding of the cultures of the jobs, alongside the shared social capital due to the social proximity of jobs within the microclass unit.

Whilst not hierarchical, the microclass system is nested within 'mesoclass' and 'macroclass' levels. A simplified six-group coding schematic can be derived from the macroclasses (professionals; proprietors; routine non-manual; manual; farming; and military). A critique of the microclass scheme is that although it attempts to produce a sociologically robust frame for grouping occupations, there

appears little empirical justification of how the categories have been devised. Indeed, we would anticipate the social capital element of grouping occupations by workplace cultures should mirror, in many ways, the social interaction patterns revealed by a SID analysis, and therefore that the micro-class scheme in itself could be sensibly based around an SID analysis. Whilst microclasses show the tendency to form what could be regarded as pseudo-diagonal relationships based around similarity in working locations or practices, mesoclasses and macroclasses provide opportunities to explore wider issues of social inequalities in a similar manner to the 'big class' schemes.

A third sociological system measuring occupational interactions is the position generator method as utilised in the measurement of social capital (cf. Linn & Erikson 2008). Position generators comprise a list generally of 10-15 occupations with respondents asked if they know anyone in those roles. These lists cover a variety of levels of relative advantage. The rationale behind positional generator tools is that they are a proxy for the breadth of an individuals' social capital. They can measure, amongst others, diversity (the gap between the highest and lowest occupation mentioned), or access to the more advantaged roles and, therefore, access to more advantaged individuals (van der Gaag et al. 2008). Such methods generate a proxy of the social capital of an individual by the number, and level, of the occupations they interact with.

The role of social interactions in each of these traditions raises opportunities for combining approaches. SID approaches generate a matrix of the number of occupational interactions present within a community, from which scales of relative advantage can be composed. Microclasses identify occupations which are said to share both workplaces and cultures, thereby demonstrating theoretical closeness between differing types of workers. Position generators assume social capital, and access to individuals at differing levels of stratification can be assessed through occupational linkages and advantages or disadvantages connected to the diversity of the social circles as are indicated. Strong social interaction patterns between microclasses could suggest the shared culture of different occupations leads to similarities in socialisation patterns, whilst connections through macroclasses could suggest stratification effects influence the sharing of knowledge and cultures of specific occupational roles.

The matrix used for an SID analysis could therefore be utilised to harness social network data suited to analysis from the other traditions. Occupations which are shown as being structurally linked could

equally be shown to generate opportunities to utilise the social capital of neighbouring workplaces. In many instances, we could envision such an exercise as replicating the microclasses and detailing occupations with a structural commonality. Instances outwith such considerations could enable us to understand more about the occupational structure and the relative position of certain vocations. This paper examines such patterns of interlocking occupations within the USA from 1970 to 2010.

Methodology

Data has been gathered on both-working married couples from the Current Population Survey (CPS) within the USA every five years from 1970 to 2010. Data has been downloaded from IPUMS, which provides the March data of the monthly survey (<http://cps.ipums.org>). Sample sizes range from 11,389 both-working married couples in 1975 to 23,189 in 2005. We have defined 'working' individuals as people either currently in employment or for whom we know their most recent occupation. Our data consists of nine distinct time points. The design of the CPS effectively includes individuals in March for two consecutive years before they leave the sample, therefore respondents are only included in one of the nine years in this study.

Networks have been generated of the occupations which interact through marriage more commonly than we would otherwise expect. Expected frequencies of marriages between occupations have been generated by multiplying the number of males in each occupational unit group (OUG) by the percentage of females in each OUG, after eliminating all instances of marriages within the same OUG. This provides a matrix of the expected number of directed male-female ties between occupations (i.e. if marriages were produced entirely by chance). This value has been compared to the actual number within the sample. Marriage combinations are deemed to be structurally linked if they occur at least twice as often as would be expected by random chanceⁱ. Combinations fitting this criterion are only analysed if they are found in at least 1 in 5,000 marriages to prevent the over-representation of patterns between sparse occupational groups due to the identification of a very small number of incidental cases. This approach enables consistent criteria to be employed to define network links as connections which occur disproportionately often, despite differences in sample sizesⁱⁱ.

This methodology uncovers the occupations which are most frequently interacting with each other. This data does not emerge in a comparable way from SID approaches (which focus on characterising the average positions of occupations, and do not indicate whether or not occupations with similar scores are actually directly connected). Similarly, whilst the microclass scheme posits the sharing of similar workplace cultures, there is no empirical evaluation of whether interactions take place, nor theoretical model of why this should necessarily occur (for instance, whilst managers in differing industries might perform similar tasks, there is little reason to suspect they share workplaces). The theory behind the position generator implies that connections to other occupations can help utilise the resources available to people in such roles. Networks generated in this study similarly suggest individuals within one role will have access to individuals from those they are connected to, whether personally or through utilising the contacts of colleagues. Our methods therefore enable us to uncover structural links between occupations, based around social interactions, which can help us explore why such connections should be made (the threshold for connectivity having been set at a level which limits the chances of over-representations being generated by chance)..

There are limitations with this approach and dataset. There have been five different occupational coding frames used for the CPS between 1970 and 2010, making direct comparison between years difficult. This is a common problem in detailed occupational research. We have decided against aggregating data, despite translation programmes being available, as doing so can produce other limitations (Weeden 2004)ⁱⁱⁱ. Whilst our methodology for determining over-representation is not overly influenced by small sample sizes, due to the restriction to combinations appearing in at least 1 in 5,000 marriages, OUGs are themselves of considerably different sizes, leading to differing likelihoods of obtaining the thresholds required. For instance, whilst large female occupations, such as teachers and nurses, have the potential to be over-represented in large numbers to many OUGs, for many roles there will be insufficient female workers for any disproportionate linkages to be made. There is also interdependency upon the ability to form relationships. For instance, if we consider the 'pseudo-diagonal' connection between male airline pilots and female air stewardess then if 50% of pilots married stewardess the requirement for over-representation from pilots to other vocations would effectively be four times the expectation after that pseudo-diagonal is excluded. As there are more stewardesses than pilots, the multiplier for stewardesses would be much lower, with the increased number of workers making it more likely that linkages could meet the 1 in 5,000 criterion. We believe that although this approach could systematically remove certain

OUGs from the networks, the representation of the occupational structure is stronger as it avoids identifying connections which are apparently strong but too rare to hold much influence.

We have also assessed the impact of educational expansion through additionally dichotomising occupational units by whether the individual held a degree (we have ignored cases of individuals performing the same role, irrespective of their educational attainment). Again, this leads to questions of some occupation-by-education combinations having too few members to form ties (such as lawyers without degrees), although we suspect that the wider patterns of the occupational structure are not overly affected by infrequent combinations of social interaction patterns.

Data has been processed in Stata and converted to Pajek for the network analysis. The reliability of using such methods are discussed, before exploring their relevance for aggregating occupational groups and exploring the impact of educational expansion upon the occupational structure.

Consistency of network patterns

This paper utilises a novel approach to understanding occupational structure, through identifying which occupations most commonly interact with which others. This approach, whilst loosely associated with SID analysis, ignores relationships which are built infrequently (which we might otherwise argue is noise) to focus solely on over-represented ties. Therefore, in using network techniques we are not examining the full range of alters that members of each occupation hold, as would be the case with a SID approach, but rather we are identifying solely those pairings which hold some sort of underlying connection. Of course, there are multiple plausible reasons why marriages between two occupations are common (Kalmijn, 1998), and this empirical approach cannot determine why such connectivity exists. Social stratification is usually conceived of as the most important influence upon homogenous behaviour, but workplace locations or interactions could be the relevant force (such as marriages between doctors and nurses); Cultural consumption patterns could also determine which types of people will meet (cf. Chan 2000); and educational cohort effects could lead to additional ties between occupations commonly performed by graduates (Schwartz and Mare 2005).

The experimental nature of this research means it is unclear whether the use of network diagrams of the occupational structure, or indeed our methodology for assessing such interactions, is robust. The

CPS has been utilised to test the validity of the methodology. Data is available on the IPUMS website for each year from 1968 to 2010 with individuals only included for two consecutive years, thus giving a large longitudinal database with different cases from which we can test our methods. In this paper we explore the evolution of the structures every five years from 1970 to 2010. Treiman's (1977) hypothesis suggests we would expect to see little change over time, except that some nuanced distinctions may occur. Moreover analysing marriages without age restrictions means we would anticipate any major shifts in occupational interactions at one time point to gradually influence positions within networks, rather than a more dramatic shift (due to the enduring influence of marriages from earlier cohorts).

Figures 1-9 show the networks of occupations at each time point. They have been coloured by the macroclass of the occupation^{iv}. The numbers refer to the occupational units in the surveys, which differ between years, plus an initial digit representing the unit's microclass^v. The network is shown as directed indicating the male occupation linking to the female. Linkages are not necessarily (or ordinarily) replicated (male fire-fighters could commonly marry female nurses without female fire-fighters necessarily heavily marrying male nurses) and the direction chosen could easily have been reserved.

Whilst the sociograms differ radically between time-points, consistencies can be found, with clear evidence in all cases of an impact of social stratification upon the structure of network connections. In each case, the different macroclasses appear to operate differently. Professional occupations tend to form a loosely-connected component, with few ties to manual positions although some to routine non-manual. Similarly, the manual occupations form their own loosely-connected component, with few ties to professional positions although some to routine non-manual. Farming occupations have connections to each other and can loosely form ties with any other occupation. This often produces a path between the professional and routine components, albeit with stratification effects observable between the levels of farming positions connecting to outside jobs. The routine non-manual occupations generally have ties to only one or two occupations, and rarely bridge a connection between a professional and manual role. This demonstrates the strong stratification effect within occupational interactions, with heavily bonded linkages appearing to display attributes of social inequality and stratification homogamy, and this seems to be much more influential than

patterns arising from other structural sources, such as commonalities of workplaces producing interactions.

These levels of consistency suggest this methodology is robust for generating an overview of occupational structure. The only diagram which fails to produce this pattern occurs in 2000, which produces multiple paths between the two groups which elsewhere are stratified. This is due to a higher than usual number of pseudo-diagonal relationships between managers and their employees, which is possibly due to sampling error within the year rather than a temporal shift and readjustment. This unusual pattern in 2000 demonstrates the methodology of network analysis should not be used as proof of the relative size of stratification in all instances, but rather should be viewed as a tool for exploring structures and contributing towards wider arguments.

The lack of certainty in specific positions can also be viewed when looking at the positions of particular occupations and their linkages. We may make the argument that farming occupations are heavily connected across time, but could not assert which non-farming workers they hold connections to given the variety between time-points. Similarly, we could assert that health professions tend to be heavily connected given their ties across time-points, but again could not discuss the specific non-health industries workers have ties to given their changes. This demonstrates the limitations of this type of work; we cannot make assumptions from any specific combination which is observed, but can make claims from the profiles of those alters' occupations which egos are consistently linked to.

The dislocation of the routine non-manual workers is interesting. Strong interaction patterns from such roles tend to be to either professional or manual occupations rather than within their own macroclass. This demonstrates that the shared cultural knowledge of working practices is not replicated within the interaction patterns. For instance, we might anticipate that sales workers possessing similar skills but we would not necessarily expect workplace interactions between OUGs such as car salespersons, retail workers and door-to-door salespersons. We could, however, expect workplace interactions amongst office workers to form their own cliques within the data. This absence, and the large number of ties regularly made to secretaries across the years, might demonstrate that relationships are built within workplaces but outwith workspaces.

Within many of the sociograms it is possible to identify OUGs which are apparently within the 'wrong' macroclass category, given the pattern and expectation for macroclass homogeneity of bonded linkages. Analysis of these cases demonstrates these are often due to two themes. Firstly, it appears the mesoclass and macroclasses systems produce some inconsistencies. Hospital, medical and dental aides are coded as health semi-professionals or hospital attendants, placing them within the professional macroclass, and associate professional mesoclass, despite holding interaction positions alongside manual workers. The same can be said of childcare workers and teachers aides, who are positioned closely within the mesoclass scheme to social workers and teachers despite following different interaction patterns. Police officers and detectives are positioned as manual workers, despite holding interaction patterns most commonly with professional public servants, such as teachers and medical workers. These discrepancies provide many of the linkages identified between the professional and manual classes, demonstrating ambiguities in the coding of occupations and reinforcing evidence of stratification effects rather than identifying asymmetric partnerships. This is, perhaps, unproblematic regarding the nature of microclasses. They were initially designed to trace levels of immobility into similar positions as parents, rather than intended as more global measures of relative social mobility (Grusky and Weeden 2001). Therefore, critique of the positioning of certain occupations in terms of interpreting social stratification is concerned more with their use in assessing inequalities, than in undermining their underlying sociological function.

Pseudo-diagonals are also identifiable in cross-macroclass combinations. Managers are often linked to their workers, often placing the employees close to other prestigious occupations. This is particularly a feature of the 'managers n.e.c.' ('not elsewhere classified') category which often produces ties to multiple OUGs. Perhaps the most interesting types of managers are food service/lodging managers, who frequently appear within the less advantaged component, holding ties, for instance, to waitresses (1995-2010), cooks (1995-2005) and food supervisors (2010) whilst holding no ties to more advantaged occupations. This could be due to the working hours and locations of food service establishments (for example with evening workers holding socialisation and cultural consumption patterns more attuned to their colleagues than people within similarly as advantaged roles). We can be unsure from the sociograms whether food service managers generate their social interactions from their professional relationships or whether they differ to other managers upon appointment, but we can conclude they often tend to be married outside of their occupation's typical stratification position. Construction managers are also shown in 2005 and 2010

to associate more commonly with other workers in their industry, and therefore with less advantaged occupations, than with managers or professionals in other sector. This raises questions about the potential for downward mobility for certain managerial roles, through the strong bonds being made to less advantaged occupations.

Outside of these two classifications, there were relatively few identifiable instances of professional and manual workers holding bonded social interactions. Whilst there are multiple instances of workers marrying varied occupations within their macroclass, there was rarely bonding across the social divide which cannot be explained by questions of coding or structured workplace interactions. Contemporary US society, therefore, can be shown to be heavily stratified regarding occupations. Whilst professionals appear to produce networks of heavily bonded relationships, as do manual workers, there are few linkages across the social groupings. This enables the more advantaged occupations to maintain and control access to the knowledge and cultures of their roles, at the exclusion of less advantaged occupations who find fewer marriage relationships to advantaged roles.

Changes in marriage patterns

Networks of apparently structured occupational marriages exclude much data on the composition of partnerships. Through focusing solely on linkages which appear most commonly, information regarding the patterns of many incumbents of occupations is ignored. Therefore, we cannot conclude from the network analysis that there are distinctions in marriage partnerships between professional and manual workers, but merely that differences occur within the most heavily bonded ties.

Figure 10 shows the distribution of homogenous marriages within the USA from 1970-2010. Starting at the top left, we can see the sample sizes differ largely over time. The top right shows the percentage of marriages occurring within the same OUG has remained relatively consistent at around 5% of all linkages over time. The bottom left shows the percentage within the same microclass has similarly remained consistent at around 10%. The bottom right shows the percentage within the same macroclass is also consistent at around 40%. This continuity over time shows the proportion of marriages within OUGs, microclasses and macroclasses is remaining consistent, without any signs of increases or decreases gradually being incorporated.

Such a finding of stability, rather than change, could be viewed against the 'Bowling Alone' thesis proposed by Putnam (2000). Putnam asserts that US society changed over the latter half of the 20th century with people increasingly spending time working rather than socialising within their community. Based upon such assumptions, it could be hypothesised marriage patterns could alter due to increases in the proportions of couples meeting through workplaces. There is no evidence to support such an argument from this data, which suggests continuity rather than change. The network diagrams similarly show little signs of increased partnerships through workplaces.

Educational homogamy has been shown to gradually increase within the USA during the period of this study (Blackwell 1998; Schwartz and Mare 2004). According to our data, the number of graduates amongst both-working married couples increased from 13% in 1970 to 38% in 2010. Changes in educational homogamy are evident. The percentage of non-graduates marrying other non-graduates has declined from 95% in 1970 to 79% in 2010 (see Figure 11), perhaps due to the lower numbers of non-graduates. The percentage of graduates marrying other graduates has increased from 48% in 1970 to 72% in 2010. However, the percentage of educationally homogenous marriages overall has been gradually increasing slightly, suggesting people are becoming more likely to marry people with a similar level of education.

Figure 12 demonstrates the rise in degree levels by mesoclass. For the traditional professional occupations there has been a relatively steady increase of from 60% to 80% of workers holding degrees. Associate professionals have seen a more stable rise, with just over 60% of workers obtaining degrees. For managers the rise is the steepest, with routine non-manual workers seeing their percentage rise from around 6% in 1970 to 33% in 2010. Manual workers with degrees increased from less than 1% to over 10%, with a strong rise for farming communities also. This demonstrates the near trebling of graduates is not confined to making professionals and managers, traditionally graduate jobs, more educated, but rather also demonstrates a rise in graduates in non-graduate jobs. Accordingly, the types of occupations being undertaken by graduates appear to have changed substantially.

Analysing the networks of linked occupations after dichotomising OUGs by educational attainment, however, shows a strong pattern of educational homogamy, with relatively few instances of

graduate/non-graduate linkages being common outside of an OUG. Those which were identified have been listed in Table 3. It is apparent the number of such ties has declined over time, with nine identified in 1970 and 1975 dropping to just one in 2005 and two in 2010. The more recent linkages are arguably pseudo-diagonal, or might reflect graduates within temporary non-graduate jobs such as maids. The linkages in 2000 between lawyers and non-graduate designers could demonstrate social status or cultural consumption ties, whilst that between social workers and hairdressers appears more difficult to explain. There were multiple instances in the early years of unexpected connections, such as those between accountants and hucksters/peddlers (1970, 1975); artists and farmers (1970); public administrators and craftsmen (1975); electrical engineers and teacher aides (1975); and kindergarten teachers and retail sales representatives (1980). This variation in both the depth of graduate non-graduate linkages, and the exploratory narratives of their construction, demonstrates how heavily bonded connections are becoming more educationally homogenous as the expansion of higher education develops. These subtleties can be uncovered by network exploration of occupational structures and develop more substantial questions for understanding the impact of such expansion.

Managers

Table 3 shows the relatively high frequency with which managers appear within bonded marriages crossing educational boundaries. The 'managers n.e.c' category appears each year from 1970 until 2000 (with a more detailed managerial coding list provided from 2005 onwards), with construction managers also included for 2010. Whilst we can speculate this is largely managers being married to their employees, we could question this for the relationships to primary school teachers (1970) and dentists (1985), amongst others, in addition to the dislocation identified of food service/lodging managers discussed earlier. This analysis questions the degree to which managerial roles are usefully regarded as homogenous (cf. Oesch, 2006). The microclass system groups managers together, believing the similarities within their working practices are weightier than the differences caused by industrial sectors. Managers are often coded together, irrespective of sector, in many more aggregate occupation-based class schemes... The network analysis within this paper, however, suggests differences in interaction patterns exist.

Table 4 displays the levels of graduates within various managerial roles between 1985 and 2010^{vi}. The CAMSIS scores for 2010 are also displayed. Based upon educational attainment, it appears there

are three times of manager. Firstly, the public section managers, whether in public administration or education, appear to hold higher levels of educational attainment than managers within business. The microclass scheme makes this distinction, placing public sector managers in the same mesoclass, but different microclass, to private sector bosses. What we might term office based managers appear to have similar levels of educational attainment, in 2000 varying between those in personnel and labour relations (69%) to those in purchasing (55%). This tendency for over half, but at most two-thirds, to hold degrees is reasonably consistent across time points^{vii}. Non-office based managers, such as those in charge of properties, construction, food service and gaming, shows much lower levels of educational attainment, commonly less than a third with over 90% of gaming managers non-graduates in 2010. An interpretation of managerial positions based solely on educational attainment levels would appear to demonstrate differences between office-based and non-office-based private sector managers, although aggregated coding schemes including the microclass system often group them together. A three-tier system rather than private-public dichotomy would be more appropriate given the interaction networks discussed earlier.

SID analysis does not ordinarily distinguish between different types of manager in as fine a level of detail as this educational interpretation, or network approach, would. The version of CAMSIS from the 2000 US Census used here provides a similar score to personnel and labour relation managers as attributed to gaming and construction managers, despite the differences in educational attainment and bonded social interaction patterns. Food service managers hold a lower than average score, possibly due to their differing socialisation patterns and working hours. Such distinctions between types of managerial role, and potential explanatory power, could not necessarily be obtained from a SID analysis of occupational interactions, illustrating the advantages SNA approaches can play in understanding particular nuances.

Conclusions

This paper has utilised a new methodology for exploring occupational structure. Tests have been performed to ascertain the degree to which claims can be made, which shows that patterns and trends amongst sets of linked occupations can be deduced and provisionally interpreted. These methods have been used to show that whilst individuals are continuing to marry without their own stratification levels, and occupational categories, in similar numbers over 40 years in the contemporary USA, expansion of the education system is leading to alterations in educational

homogamy patterns and a growing distance between graduates and non-graduates. Whilst non-graduates are increasingly likely to marry graduates, as the proportion of fellow non-graduates decreases, there appears to be little strategic linkages of the types of occupations such relationships involve. This is an area which requires further investigation.

The methods are also shown to be an effective way of appraising occupational aggregation schemes. The microclass system is particularly discussed within this paper. We find instances of occupations which appear to be placed within the 'wrong' macroclass, forming part of a stratified wider network of linked occupations based along social advantage levels rather than nature of work. We also find the aggregation of certain groups, such as private sector managers, can provide too wide a construction and include occupations which socially interact, in both SNA and SID terms, differently to other managerial roles. As mentioned earlier, this could be due to the sociological rationale behind their construction, and the desire to see if children utilise the cultural norms and knowledge of their parental occupations in their own career choices. We demonstrate macroclasses are not ideal for assessing differences regarding the stratification effects of big classes, although a stronger classification system could be produced. Utilising SNA techniques to compare the social interactions of occupations to produce a class-type scheme could be a future area of study.

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Tables and figures

	% of Lawyers married to..	% of all husbands married to..	CAMSIS score (US 2000)
Lawyers	11.6%	0.6%	81.5
Primary school teachers	7.2%	4.5%	66.2
Registered nurses	4.4%	4.5%	56.8
Secretaries	3.8%	5.3%	55.5
Preschool and kindergarten teachers	2.8%	1.2%	62.7
Accountants and auditors	2.4%	1.8%	65.2
Counsellors	2.4%	0.8%	65.0
Paralegals and legal assistants	2.4%	0.5%	64.2
Postsecondary teachers	2.4%	1.0%	79.8
Managers	2.1%	1.8%	62.2
Bookkeepers	2.1%	2.5%	53.1

Table 1: Most common wives of male lawyers (CPS 2010)

	% of Labourers married to...	% of all husbands married to..	CAMSIS score (US 2000)
Registered nurses	3.9%	4.5%	56.8
Nursing, psychiatric and home healing assistants	3.9%	1.9%	42.6
Secretaries	3.9%	5.3%	55.5
Customer service representatives	3.6%	1.7%	51.8
Receptionists	3.2%	1.6%	53.2
Cashiers	3.2%	1.8%	41.3
Labourers	2.9%	0.4%	32.0
Janitors and building cleaners	2.5%	1.7%	32.5
Maids and housekeeping cleaners	2.2%	0.3%	27.4
Retail salespersons	2.2%	1.9%	51.9
Tellers	2.2%	0.6%	46.3

Table 2: Most common wives of male labourers (CPS 2010)

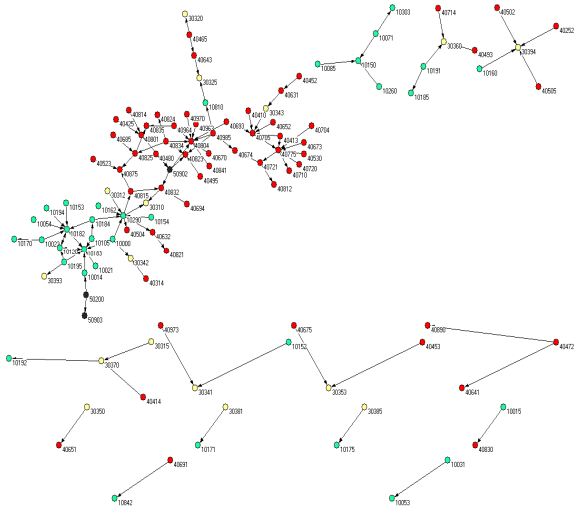


Figure 1: 1970 US occupational structure
Source Current Population Survey

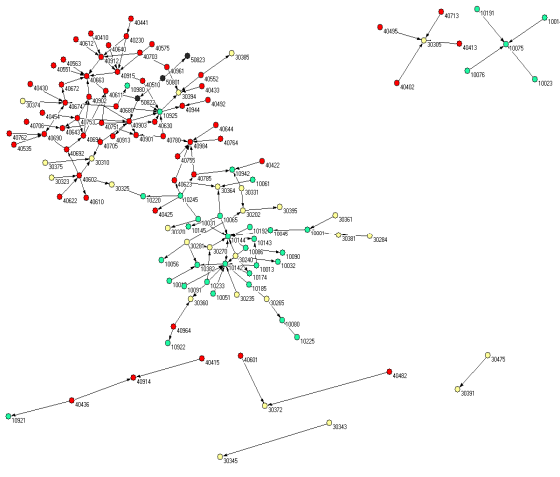


Figure 2: 1975 US occupational structure
Source Current Population Survey

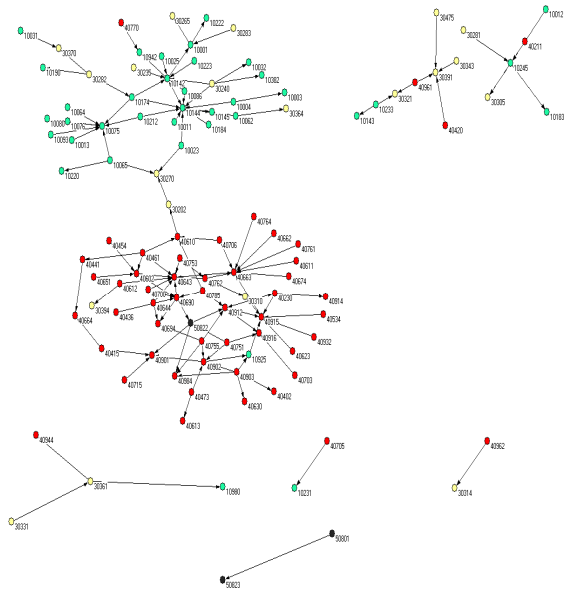


Figure 3: 1980 US occupational structure
Source Current Population Survey

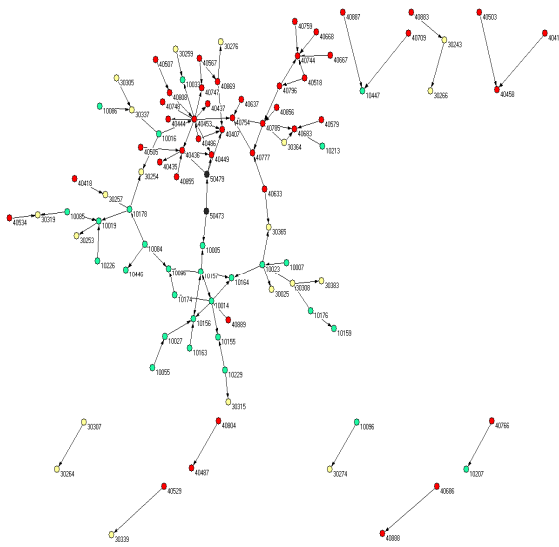


Figure 4: 1985 US occupational structure
Source Current Population Survey

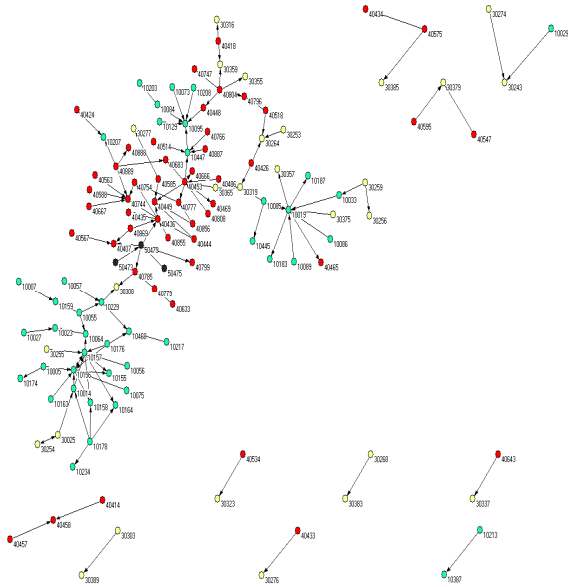


Figure 5: 1990 US occupational structure
Source Current Population Survey

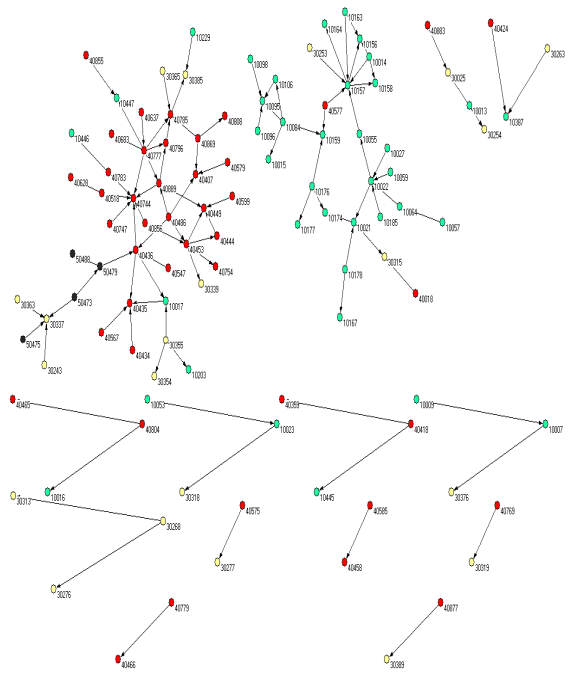


Figure 6: 1995 US occupational structure
Source Current Population Survey

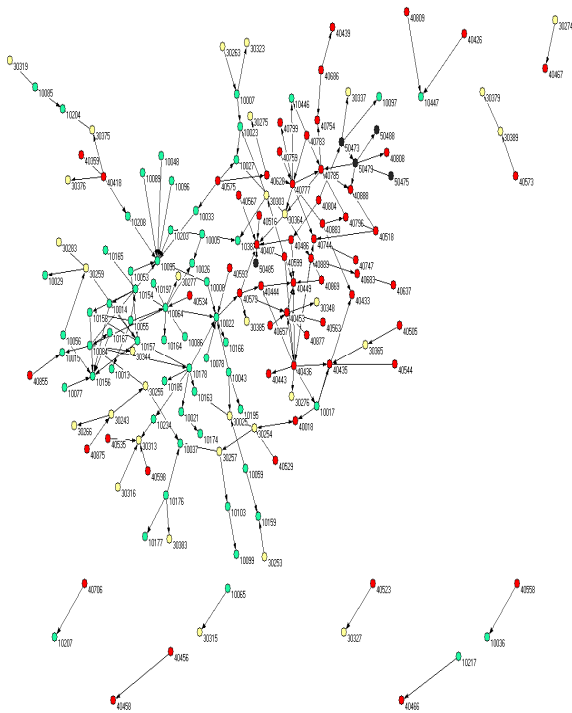


Figure 7: 2000 US occupational structure
Source Current Population Survey

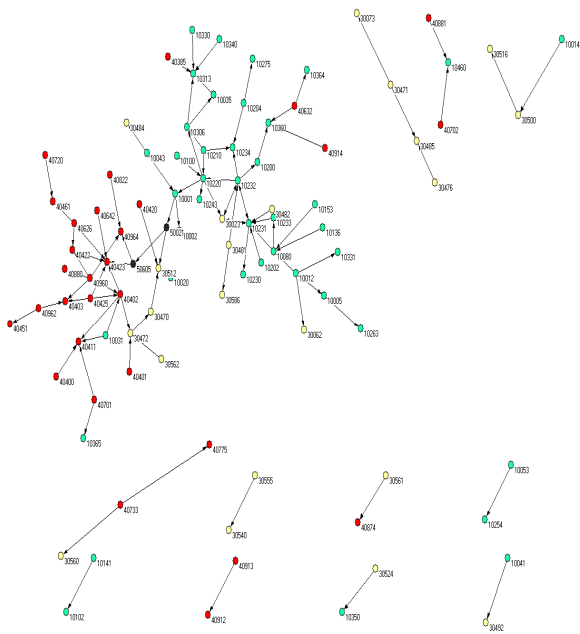


Figure 8: 2005 US occupational structure
Source Current Population Survey

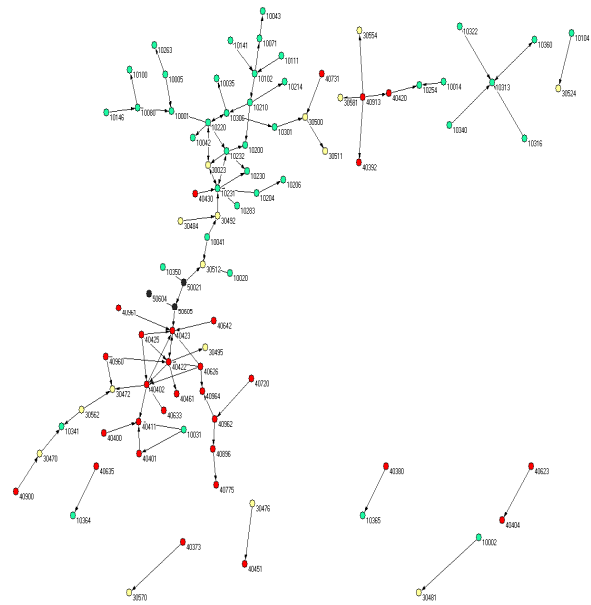


Figure 9: 2010 US occupational structure
Source Current Population Survey

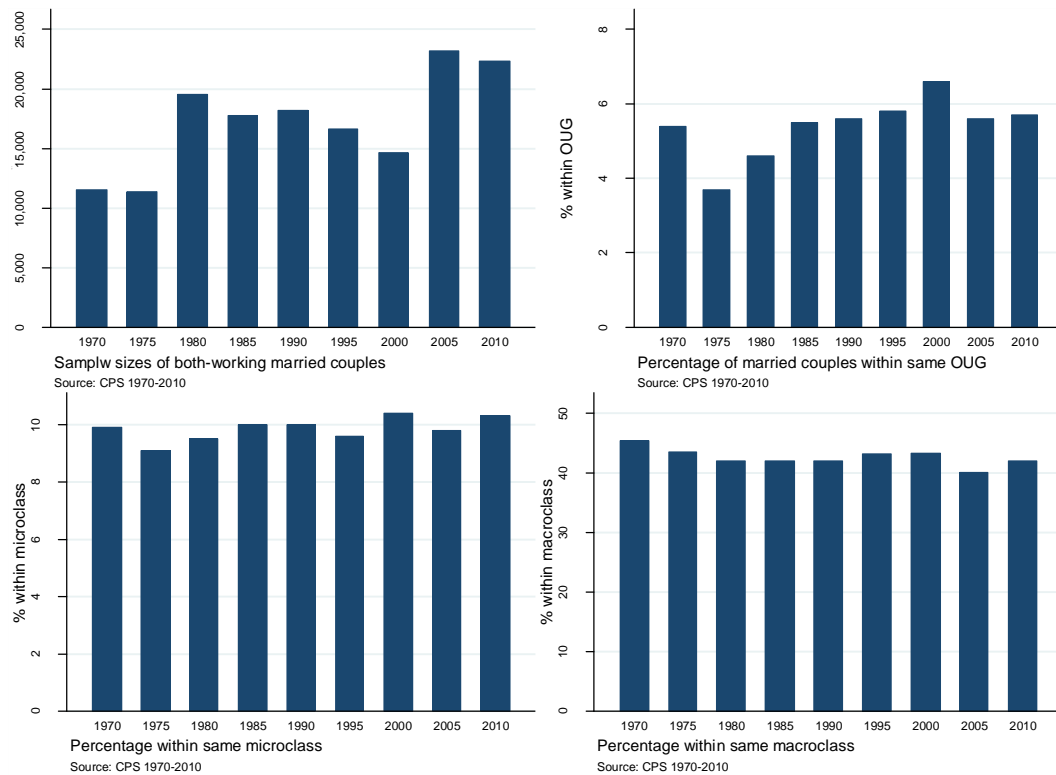


Figure 10: Sample distributions - CPS 1970-2010
Clockwise from top left: number of cases; % marrying within own OUG; % within own macroclass; % within own microclass.

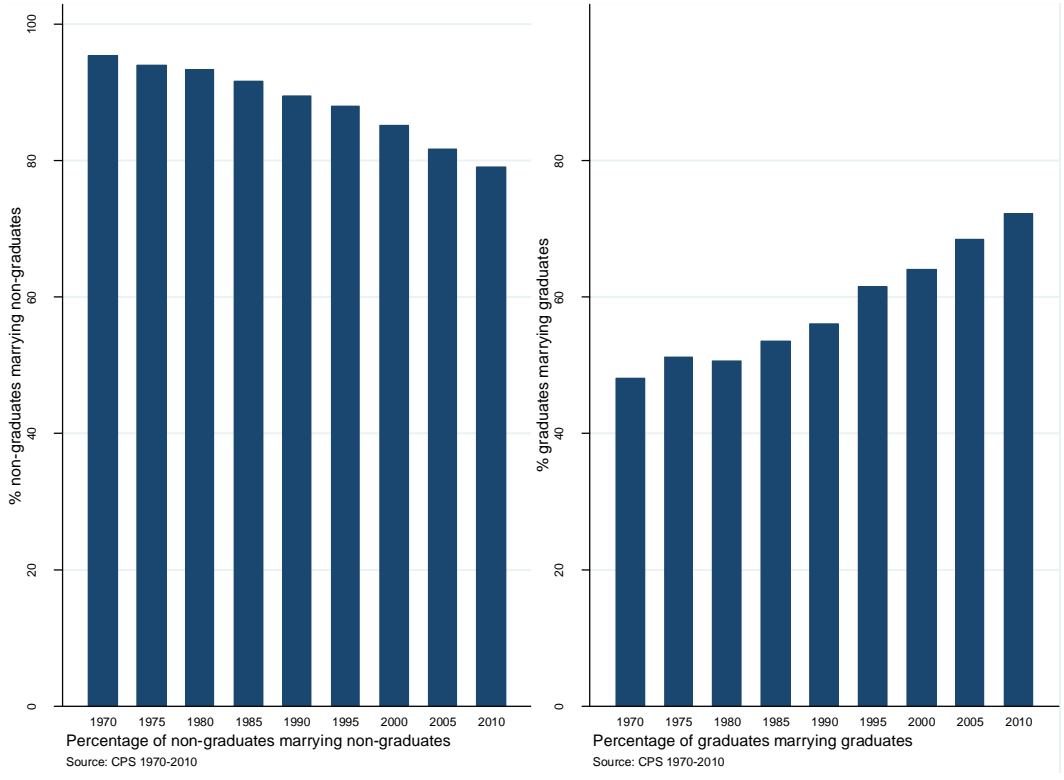


Figure 11: Graduate and non-graduate homogamy in USA 1970-2010
 Source: Current Population Survey

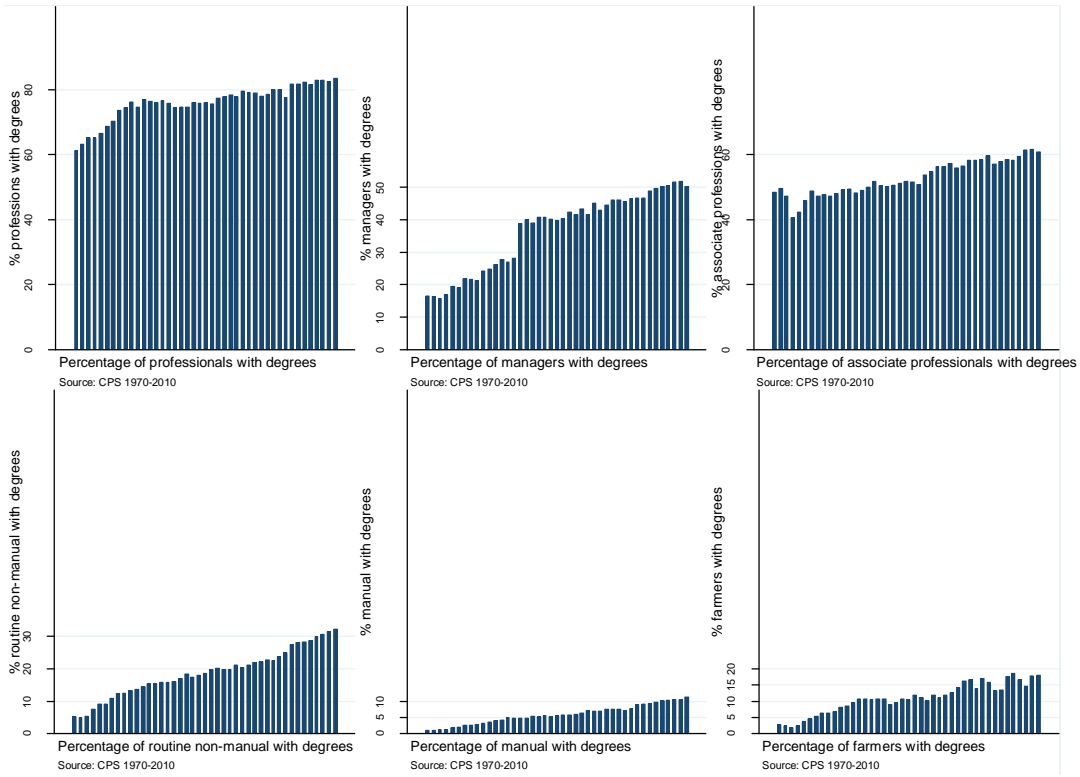


Figure 12: Educational cohort effect for the USA, 1970-2010. Clockwise from top left: Professionals; Managers; Associate Professionals; Farmers; Manual; Routine non-manual.

	Graduate	Non-graduate
1970	Mechanical engineer	<i>Nurses</i>
	Buyers and department heads	<i>Clerical and kindred workers</i>
	Pharmacists	<i>Salespersons</i>
	Managers n.e.c	<i>Personal and labour relations</i> <i>Primary school teachers</i> <i>Real estate agents</i>
	Accountants	<i>Hucksters and peddlers</i>
	<i>Artists and art teachers</i>	Farmers
	<i>Social workers</i>	Auctioneers
1975	Managers n.e.c	<i>Dental assistants</i>
	Accountants	<i>Hucksters and peddlers</i>
	Health advisors	<i>Secretaries</i>
	<i>Public administrators</i> <i>Industrial engineers</i>	Craftsmen
	Secondary school teachers	<i>Cafeteria workers</i>
	Farmers	<i>Farm Labourers</i>
	Electrical engineers	<i>Teacher aides</i> <i>Misc. electrical workers</i>
1980	Physicians and surgeons	<i>Nurses</i>
	Public administrators School administrators	<i>Teacher aides</i>
	Secondary school teachers	<i>Primary school teachers</i>
	Managers n.e.c.	<i>Health advisors</i>
	Kindergarten teachers	<i>Sales representatives (retail, n.e.c)</i>
	<i>Sales representatives (Manufacturing)</i>	Managers n.e.c.
	Cafeteria workers	<i>Waitresses</i>
1985	Sales representatives Secondary school teachers Physicians and surgeons Public administrators Other financial workers	<i>Nurses</i>
	Sales representatives Dentists	<i>Receptionists</i>
	Dentists	<i>Managers n.e.c</i>
	Veterinaries	<i>Bookkeepers</i>
	Purchasing agents	<i>Secretaries</i>
	1990	Health diagnosing professionals
1995	Accountants and auditors	<i>Public administrators</i>
	<i>Secondary school teachers</i>	Electrical power installers
2000	Clergy	<i>Managers n.e.c.</i>
	Social workers	<i>Hairdressers</i>
	Lawyers	<i>Designers</i> <i>Legal assistants</i>
	Data processing repairers	<i>Secretaries</i>
2005	<i>Maids</i>	Janitors
2010	<i>Bookkeepers</i>	Construction managers
	Dentists	<i>Office supervisors</i>

Table 3: Over-represented graduate - non-graduate marriages in USA (1970-2010)

Source: Current Population Survey (<http://cps.ipums.org/cps>). Note: Italics indicate the female occupation.

Managers in...	1985	1990	1995	2000	2005	2010	2010 CAMSIS
Public Administration/education	81.7	74.9	74.5	80.7	80.1	83.8	71.2
Personnel and labour relations	46.0	57.1	47.6	51.9	60.2	68.9	55.7
Chief Executives	37.5	14.3	40.0	37.5	67.5	67.0	70.7
Business and promotions			52.0	58.8	63.6	66.7	70.6
Medicine and health	62.5	66.2	47.5	50.2	62.9	66.8	66.6
Marketing	45.8	52.3	62.8	65.3	56.4	65.8	65.3
Financial managers	50.0	56.9	63.0	53.6	60.0	62.8	66.8
Purchasing	65.4	43.2	61.7	46.2	55.6	54.6	60.5
Properties	33.6	31.0	36.0	40.1	38.6	37.4	59.8
Construction					23.5	29.1	57.8
Food service			20.5	23.6	22.0	26.0	47.9
Gaming					22.2	9.1	55.7
n.e.c.	33.9	35.2	41.5	42.0	51.3	48.7	62.2

Table 4: Percentage of graduates in managerial roles in USA, 1985-2010

Source: Current Population Survey (<http://cps.ipums.org/cps>).

ⁱ A 95% confidence interval, based on the proportion of ties formed, is fitted to the value. Combinations are only accepted if the lower value of the interval suggests the linkage is two or more times common than would be anticipated.

ⁱⁱ A Stata .do file to generate these networks is available at: <http://www.camsis.stir.ac.uk/sonocs/do/pajek.do>

ⁱⁱⁱ We have, however, converted each coding scheme into the Microclass system which is intended to achieve consistent aggregation over time. These conversion files can be downloaded from:

<http://www.geode.stir.ac.uk>

^{iv} The colour scheme is: green: professional; yellow: routine non-manual; red: manual; black: farming. Proprietors and military do not appear due to forming no linkages.

^v The list of OUGs used in this survey can be viewed from:

http://cps.ipums.org/cps-action/variables/OCC#codes_section

^{vi} Detailed managerial categories were not available prior to 1985. There are three different occupational coding schemes used during the 1985-2010 period, hence the absence of data on some OUGs. Coding schemes relate to 1985-1990; 1995-2000; 2005-2010. It is possible managerial positions appear within one category in one year and another in a different year.

^{vii} The unusual distribution of chief executives, ranging from 14% to 68%, most probably demonstrates differing definitions within surveys, such as the potential to name the owner of a small shop or cafeteria as a chief executive.