THE EVOLVING PATTERN OF OCCUPATIONAL SEGREGATION BY RACE AND GENDER OF ENLISTED PERSONNEL IN THE US ARMED FORCES, 1984-98

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INTRODUCTION

Several military analysts argue that the US military has been relatively successful in pursuing policies of integration and affirmative action, compared to civilian society.[1] In particular, the Army has been portrayed as a model of racial integration that civilian institutions, including universities and corporations, should follow.[2]

The process of integration began when President Truman signed Executive Order 9981 in 1948 ordering the 'equality of treatment and opportunity for all persons in the armed services' during his re-election campaign. The passing of the Women's Integration Act in the same year enabled women to be mobilised, but they were restricted to 2% of enlisted soldiers and 10% of female enlisted soldiers. In 1967 this restriction was lifted, but female representation in the military did not rise significantly until the 1970's. Women's entry into the military was made easier in 1973 by a change in gender exclusion policies, following concerns about manpower shortages in a voluntary military, after the removal of conscription. Many non-combat jobs became available for women, who are now also allowed to work on combat aircraft and ships but are excluded from front-line infantry, armor and artillery units, and other units and occupations, such as submarines and special forces.

The increased influence of the civil rights movement and the associated demand for equal job opportunities for all groups, including racial minorities and women, have contributed to these changes in employment access,[3] but there have been tensions over female representation and black representation across occupations. The masculine combat warrior culture which is claimed to underpin the functioning of the military[4] has been subject to opposing pressures from proponents of social equality and groups concerned with military effectiveness and morale.[5] The military has no explicit recruiting goals by race, yet some black leaders have advocated a more balanced racial representation of personnel to ensure equity of burden.

In 1998, Hispanic, Black and White female enlisted personnel were under-represented to their shares of the civilian population, labour force and employment in each of the Armed Forces, whereas White and Black males were over-represented. Hispanic males were under-represented relative to civilian numbers in the Air Force and, to a lesser extent, the Army.[6]

There has been a significant contraction and restructuring of military employment due to the end of the Cold War that could have had a significant influence on both the gender and race composition of the enlisted forces.[7] Researchers have tended to focus on changing rates of representation of minority

gender/race groups in the military and the nature of promotion processes and hence the pattern of vertical occupational segregation by race and gender.

The assignment of enlisted personnel to occupations and hence the pattern of horizontal occupational gender/race segregation in the military has been largely ignored,[8] although the skills and experience gained during the period of enlistment are critical to career opportunities and earnings over the lifecycle, part of which may include civilian employment.[9] Occupational segregation is said to exist when gender/race groups are differently distributed across occupations than is consistent with their overall shares of employment, irrespective of the nature of job allocation.[10]

Changes in the pattern of horizontal occupational segregation of enlisted personnel by race and gender across the four branches of the military are explored in this paper for the period 1984-98. A multi-dimensional numerical procedure is used, which was devised by Silber, and extended by Watts in a study of occupational segregation of civilian employment by race and gender in the U.S.A.[11]

The theoretical issues pertaining to race and gender integration in the military are clearly different, with women of all races still being subject to some rules of exclusion with respect to direct combat. On the other hand, from the perspective of measurement, neither concept of integration logically precedes the other. Thus, a documentation of trends that investigates rates of integration of race/gender groups within the US military can be justified, particularly given the limited treatment of this issue in the literature.

Over the sample period only the Navy experienced race/gender integration, as measured by the Composition Effect, and the other 3 Forces experienced higher segregation with the Marines faring the worst. Thus most race/gender groups remain concentrated in a limited number of occupational assignments. These results suggest that the Navy may have undertaken deliberate recruitment practices to promote horizontal integration of minority groups, but it is also possible that fortuitous patterns of enlistment, attrition and failure to re-enlist generated the observed employment outcomes. Further research is required to explore the interaction of practices of recruitment and occupational assignment in the military with the educational attainment and occupational preferences of applicants.

THEORETICAL PERSPECTIVES

Most of the theoretical literature locates discriminatory practices leading to the unequal occupational distributions of employment by race and gender within the dynamics of accumulation and capitalist competition.[12] This work yields limited insights about processes of segregation in the military. First, the command structure of the military precludes the active manifestation of class consciousness in the workplace, say through a strike or work to rule, although it is claimed that cross-race solidarity is achieved within the ranks.[13] Second, equal pay is mandated for US forces and, unlike the private sector, it is difficult to evade. Third, given the personnel requirements, the cost and profit calculus is not relevant to occupational assignment, but perceived military effectiveness and morale are claimed to be important. Moskos argues that the important factors driving formal and actual integration of the Army were manpower shortages in both World War II and the Korean War, and the belated recognition of the military superiority of an integrated force compared to a segregated one. In short, the imperative of military effectiveness led to equal opportunity, rather than the imperative of equal opportunity leading to

greater military effectiveness.[14] Furthermore, policy makers redefined military service as an attractive career option, rather than the fulfilment of an obligation of citizenship.

Thus, the analysis of occupational segregation in the military must be underpinned by a model of occupational assignment by race and gender. The initial choice of occupation by aspiring recruits will reflect social and cultural factors. The military has never tied aptitude tests directly to occupational access, however, although the military claims that suitably qualified applicants can generally be guaranteed their choice of duty assignment.[15] The assignment of recruits to particular occupations is ultimately constrained by personnel requirements.[16] It is possible that recruitment officers can influence the 'choices' of those applicants, who fail to achieve a test score required for entry into their chosen occupation.

The theory of statistical discrimination is relevant here.[17] The occupational assignment of enlisted personnel may be conditioned by the perceived characteristics of the race/gender group to which they belong, in addition to their own attributes. The latter include age, scores in aptitude tests, past experience and training. The former could include performance in the workplace that reflects in part the capacity to operate as a member of a team. The perceived characteristics of the individual do not necessarily conform to the average characteristics of the group. Such assignment practises constitute statistical discrimination but are efficient in a cost minimising sense because more intensive screening of candidates becomes increasingly costly. The stereotyping of these groups underpinning statistical discrimination may be founded on incorrect statistical evidence.

Extreme horizontal occupational segregation enhances identification according to ethnic/gender origins, thereby dividing workers into sub-groups, which can undermine their military effectiveness. It also unifies the dominant group, typically white males, and insulates them from job competition.

MEASUREMENT OF OCCUPATIONAL SEGREGATION

Introduction

Researchers in economics and sociology continue to debate which measurement procedures are appropriate for the analysis of occupational segregation. Indexes remain the favoured form of measurement (see below), although the use of log-linear models in the cross-country and time series analysis of gender segregation has been advocated.[18] These models do not provide an independent test of the log indexes that are calculated and these indexes have undesirable properties.[19]

Index of Dissimilarity

In US studies, the Index of Dissimilarity (ID) has been used to measure both gender and race segregation in civilian employment.[20] Many authors misrepresent the interpretation of the ID index.[21] The magnitude of the Index of Dissimilarity is sensitive to the occupational structure of employment and attempts to decompose it to overcome this problem have been flawed.[22] The standardized ID Index is invariant to the relative size of occupations, but is no longer independent of the overall gender shares of employment.[23]

The Index of Dissimilarity and other indexes, including the Karmel and Maclachlan index, are less useful in the examination of occupational inequality by race and gender. The researcher is confined to partial, pair wise comparisons of employment distributions, such as those of white and black women, and is unable to measure segregation within the context of the overall distribution of employment by occupation and race/gender shares of employment.[24]

Karmel and Maclachlan Index

Watts favours the Karmel and Maclachlan (KM) index to measure gender segregation.[25] The index is

$$IP = (1/T)\sum_i |F_i - a(M_i + F_i)| = (1/T)\sum_i |(1-a)F_i - aM_i| \quad (1)$$

where T, a, F_i, M_i are defined as total employment, the overall female share of employment and female and male employment in the ith occupation, respectively.[26]

This index denotes the fraction of total employment that would have to be relocated between occupations to achieve zero gender segregation, while maintaining both the structure of employment by occupations and the overall gender shares of total employment. Thus the index is a measure of the difference between the integrated and actual distributions of employment by gender.

Over time both the occupational shares of employment (occupational structure) and the overall gender shares of employment typically change. The KM index is sensitive to these interrelated changes. Karmel and Maclachlan show how a change in their index over time can be decomposed into a margin-free Composition and Mix Effects where the latter can be broken up into Occupation, Gender and Interaction Effects.[27] The former represents the change in segregation, after changes in the occupational structure of employment and the overall gender shares have been purged.

Silber's Multi-Dimensional Generalization

Silber generalizes the KM index to the multi-dimensional case, enabling the simultaneous analysis of distributions of employment by gender and race within the overall occupational structure of employment.[28] This form of measurement is used in this paper. The index, which enables the identification of the contributions of the different race/gender (RG) groups, both to the overall level of segregation at a point of time and its rate of net change over time,[29] can be written as follows:

$$IS = (1/2T)\sum_{j=1}^{m}\sum_{i=1}^{n}\left|T_{ij} - (T_{i0}/T)T_{0j}\right|$$

$$= \sum_{j=1}^{m}(T_{0j}/T)\sum_{i=1}^{n}\left|T_{ij} - (T_{i0}/T)T_{0j}\right| / 2T_{0j} = \sum_{j=1}^{m} w_j IS_j \quad (2)$$

Where T_{ij}, T_{i0}, T_{0j}, T are the number of RG group j workers in occupation i; total employees in occupation i; the total number of employees in the jth RG group and total employment, respectively. The computation is based on the premise that, if each RG group were integrated, these employees would be distributed uniformly across the occupational structure within this branch of the military. Thus, in each

occupation, the share of employment corresponding to each RG group would coincide with its overall employment share. The value of the overall index represents a weighted sum of the indices, IS_j across the m RGs, where the weight, w_j is the share of total employment of RG group j.

The normalized index value for each RG group reflects the relative number of employees in that group, *ceteris paribus*. Thus these index values reflect relative population sizes, rates of military enlistment and rates of unemployment, in addition to different patterns of occupational attainment. The index magnitude for white men who predominate in Armed Forces employment would be biased downwards, because their occupational structure of employment is a major influence on the overall occupational structure of employment.[30] This assumes importance with respect to occupational segregation by RG group, because, in principle, absolute comparisons can be made between the normalized index values.

The percentage change through time in the overall index can be decomposed to identify Composition and Mix Effects (Appendix 1). The Composition Effect is the percentage change in the level of segregation that is solely associated with changes in the RG composition of occupations, and is independent of changes in the occupational structure and related changes in the relative numbers of each RG. Composition Effects can be computed for each RG, too.

The Mix Effects can be divided up between the Gender and Occupation Effects and a residual. The Gender Effect is based on the adjustment of the number of personnel in each RG Group in all occupations by the overall increase in the numbers of that Group between periods 1 and 2. Thus in this calculation the overall composition of employment by RG Group corresponds to that of period 2. The comparison of the corresponding index magnitude with the period 1 index value yields the forwards Race/Gender (R/G) Effect. The RG Effect then picks up the impact on the index of a uniform adjustment of the number of RG employees across all occupations, reflecting the changing overall RG shares of employment. Likewise, the Occupation Effect is based on the comparison of the period 1 index with one based on the uniform adjustment of the number of RG employees in each occupation in line with the change in the overall occupational structure. The RG composition of each occupation in period 1 is maintained. Hence the Occupation Effect measures the percentage change in the level of segregation associated with an unchanged occupational structure.

A third distribution of employment by RG Group across occupations is generated by successive transformations of the original distribution of employment by the occupation and RG calculations detailed above. After each iteration, total employment corresponding to period 2 is achieved but, after the odd iterations, individual occupation totals are realized, whereas, after the even iterations, the period 2 RG Group totals are achieved. The numerical adjustments continue until the overall RG group and occupational structure of the transformed (period one) distribution of employment across occupations converges over consecutive iterations. This transformed period one structure of employment has the same occupational shares of total employment and overall RG group shares as the period two distribution, but differs in its RG group shares of employment across individual occupations. The percentage change in the index associated with the transformed (period 1) distribution and the period 2 distribution is defined as the Composition Effect. The two underlying employment distributions only differ in the RG composition of each occupation.

The use of simple aggregate measures of occupational segregation by gender (and race) is based on the dubious premise that 'universal segregative and integrative forces dwarf occupation specific forces'[31] so that changes in the summary measure adequately capture the complexity of changes across groups of occupations. By altering the order of summation in equation 2, index magnitudes can be computed for different occupational groupings within the overall structure of employment.[32] Composition Effects for groups of occupations can also be computed to identify specific trends in segregation (see Appendix 1). The identification of different groups of occupations also overcomes to some degree the problem that measures of segregation, including the Index of Dissimilarity, measure nominal occupational differentiation rather than inequality between RGs.[33]

Researchers have devised other multi-dimensional indexes of segregation, including a complex Gini coefficient.[34] Carlson utilises Goodman and Kruskal's τ_β which is multi-dimensional generalisation of the Variance Ratio Index or Quadratic Loss Function.[35]

EMPLOYMENT OF ENLISTED PERSONNEL IN THE US ARMED FORCES 1984-98

Introduction

The downsizing and restructuring of the Armed Forces, following the end of the Cold War, has now been completed. The Marine Corps experienced a cut in employment of enlisted personnel of nearly 13% over the period 1984-98 across the occupations analysed in this study, and the other branches of the services had cuts in excess of 30% (see Table 1).

The representation of enlisted personnel by race and gender in the four branches of the Armed Services is the outcome of some complicated employment dynamics. The reduced annual flow of gross accessions and changes in the rates of attrition and re-enlistment have been responsible for these changes in employment levels across the Armed Services.

TABLE 1 GROWTH RATES OF ENLISTED PERSONNEL IN TOTAL & BY OCCUPATIONAL GROUP

	AIR FORCE	ARMY	MARINES	NAVY
TOTAL	-35.9	-38.3	-12.8	-34.5
HIGH SKILL	-41.8	-40.9	-13.4	-36.4
MEDIUM SKILL	-31.4	-37.1	-12.3	-32.8
LOW SKILL	-49.9	-38.4	-10.2	-40.6
COMBAT	-28.3	-38.5	-14.8	-25.3

Source: Department of Defense Manpower Data Center.

Accession and Attrition

The accession of enlisted personnel differentiated by race and gender is the outcome of the interaction of the supply of willing applicants and military recruitment and race/gender specific hiring policies. The supply of recruits will be influenced by the underlying labour market conditions and cultural and social

attitudes toward military and civilian employment. These accessions play a major role in the determination of the overall pattern of military representation by race and gender, because the enlisted forces represent 85% of total representation. Also over 50% of enlisted forces serve terms of only three to five years.

Enlistment and training procedures are similar across the branches of the military. High school graduation is emphasised. All applicants must be at least 17 years old and must undertake the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB test scores determine the occupations for which applicants are qualified. The required scores vary by service and have been determined from empirical analysis to yield a high probability of training success.[36]

Qualified applicants are generally guaranteed their choice of training or duty assignment, subject to the availability of vacant positions. The basic training is a rigorous orientation program for the particular military service. Job training follows the basic training and provides the skills in the particular occupational field chosen by the applicant. Further training is available with, for example, airmen undertaking on-the-job training after 3 months at their first permanent duty station. Enlistment lasts for between 2 and 6 years.

Historically blacks have had a greater propensity to seek military enlistment than whites, because the military was one of the first institutions to be integrated and offers better opportunities to blacks than most other sectors of the economy, but the black propensity to enlist has declined.[37]

On the other hand, Black and Hispanic accessions into particular assignments have been limited by the corresponding education and aptitude requirements of the services, because they have a higher rate of high school dropout[38] and score lower on average than Whites and Hispanics in aptitude tests, but there is a wide variation of scores across demographic groups.

The rates of attrition and failure to re-enlist by race and gender reflect the perceived benefits of alternative forms of employment,[39] particularly in the private sector, as compared to the existing assignment. These benefits in turn will reflect rates of pay, conditions of employment, including housing and medical benefits, promotion opportunities and perceptions of discrimination, but will be conditioned by the state of the business cycle.[40]

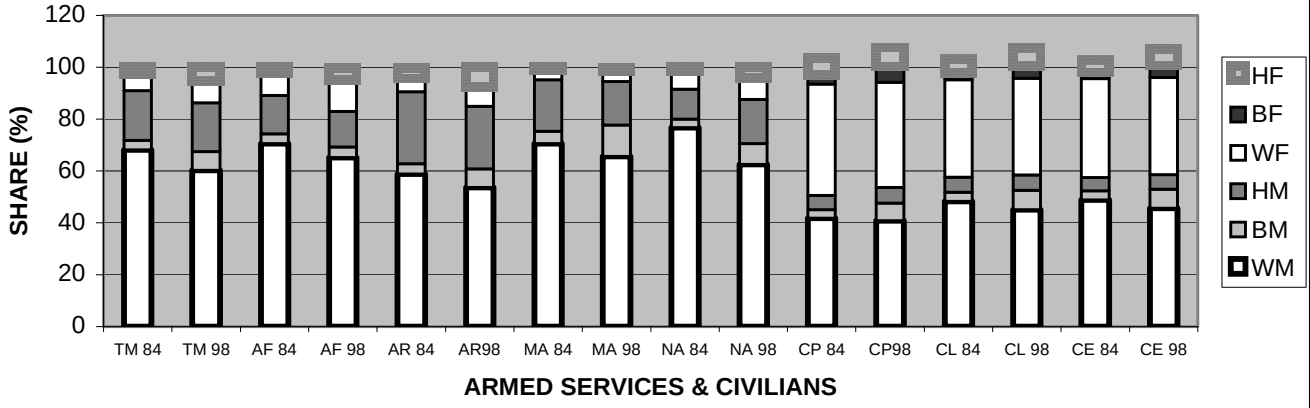
Following the downsizing of the military, the Forces are now struggling to meet enlistment quotas,[41] with the Army being 7,000 recruits short in 1999 and the Navy 2,300. This reflects a growing gap between the civilian culture of personal and financial advancement and the military culture founded on the obligation of citizenship in the context of a booming civilian economy. The current strategy adopted by the military emphasises bonuses and benefits, higher retirement salaries and lower standards.[42]

Employment Shares

The shares of enlisted personnel by race and gender across the military for the years 1984 and 1998 are shown in Figure 1, along with the corresponding shares of the population, labour force and employment of 18-44 year old civilians. The White population shares declined over the 14 years, whereas the Black

and Hispanic shares increased. These changes are mirrored in the trends in the civilian labor force and employment shares.

FIGURE 1 EMPLOYMENT SHARES OF ARMED SERVICES & CIVILIAN SHARES OF POPULATION, LABOUR FORCE & EMPLOYMENT: 1984, 1998



Source: Department of Defense Manpower Data Center (military data)
Employment status of the civilian non-institutional population by sex, age, race, and Hispanic origin, Current Population Survey, Bureau of Labor Statistics 1984, 1998.

Notes: TM, AF, AR, MA & NA denote Total Military, Air Force, Army, Marine Corps and Navy respectively.
CP, CL & CE denote Civilian Population, Civilian Labour Force and Civilian Employment, respectively.
HF, BF, WF, HM, BM & WM stand for Hispanic female, Black female, White Female, Hispanic Male, Black Male and White Male.
All enlisted personnel in the non-Occupational Category or unclassified by occupation or race are excluded from the military data and hence the calculation of employment shares. Also occupations for which there was zero employment for one or both years were deleted.
In the CPS data, 'white' and 'black' are race concepts, so the black and white shares do not sum to 100%, because of the absence of other races. Hispanic is an ethnic concept and is included within both the white and the black measures. Thus the sum of the shares for white, black and hispanic men and women can be greater or less than 100%.

The White male share of employment declined across all the Services, with the sharpest decrease in the Navy. On the other hand, the White female share increased in all Services, except the Marines. The shares of Black females and Hispanic males and females rose across all the Services, whereas Black males experienced a reduced share in all branches, except the Navy. Except for black women in the Navy, female enlisted personnel are significantly under-represented, proportional to their population, and labor force participation, although three of the four services maintain recruiting objectives for women and many jobs in Combat are now available to women. Black and White males are over-represented across all the Armed Forces. Hispanic males are under-represented in the Air Force and the Army, as compared to their civilian averages.

OCCUPATIONAL SEGREGATION BY GENDER AND RACE

Introduction

The reconciliation of the different occupational titles across the Armed Forces by the DMDC has yielded a common three-digit classification, which is available for enlisted personnel for the years since 1984. The occupation data are grouped into 9 major occupations plus a further group consisting of Prisoners, Patients and Students. This final group was eliminated along with employees not classified by occupation.

The numerical procedures adopted in the paper require that the minor occupations in 1984 map into equivalent ones in 1998. Consequently any occupations for which there was zero total employment in one or both of the years were deleted. An alternative procedure would be to amalgamate similar occupations. The first approach was adopted to avoid any ambiguity. Air Force enlisted personnel were defined across 87 minor (three-digit) occupations, the Army had 103, the Marines 88 and the Navy 98.

Overall Movements and Decomposition of the Index

Different rates of race/gender representation across the branches of the military, which could reflect indirect practices of exclusion, are reflected in the gross index values, but do not influence the Composition Effects. In this respect changes in occupational segregation by race and gender are conceptually distinct from changes in their rates of overall representation in the military. Thus increases in the overall employment shares of the minority groups are not necessarily synonymous with their occupational integration, because their increased shares could result from higher employment in occupations that they already dominate.[43]

TABLE 2 DECOMPOSITION OF CHANGE IN RACE/GENDER SEGREGATION ACROSS ENLISTED PERSONNEL IN THE ARMED SERVICES, 1984-98

	INDEX VALUE		INDEX DECOMPOSITION (%)					
	IP84	IP98	TCH	COMP	MIX	R/G	OCC	INT
AIR FORCE	0.121	0.164	30.60	11.11	19.49	21.67	-0.80	-1.38
ARMY	0.155	0.187	18.57	4.31	14.25	14.51	0.35	-0.60
MARINES	0.097	0.147	41.29	38.47	2.82	2.98	-0.53	0.37
NAVY	0.123	0.147	17.25	-17.24	34.49	30.21	2.09	2.19

Source See Table 1.

:Notes: TCH denotes Total % change in the index magnitude:
COMP denotes (%) Composition Effect;
MIX is the (%) Mix Effect, which is subdivided into Race/Gender (R/G), Occupation (OCC) & Interaction (INT) Effects.
The denominator in the calculation of the index decomposition is the average of the two index values, IP84 and IP98, so that the change in the index magnitude is symmetric.

Simple comparisons of index magnitudes across the military must be made with caution because they differ in the minor occupations that are included, the overall RG shares of employment and the distribution of personnel across the occupational structure. Comparisons of rates of integration (resegregation) over the 14 year period can be made, but these rates of change commence from different base levels.

The IP indexes and the decomposition of their changes for the 4 Armed Services are shown in Table 2. The Marines and the Navy had the lowest IP magnitude in 1998, followed by the Air Force and the Army. Overall segregation (TCH) increased between 1984 and 1998 for all branches of the military.

The Mix component of the index decomposition reveals significant Race/Gender effects that reflect the changing RG composition of employment, except for the Marines in which White and Black females remain significantly under-represented. Except for the Navy, the Occupation and Interaction Effects are small.

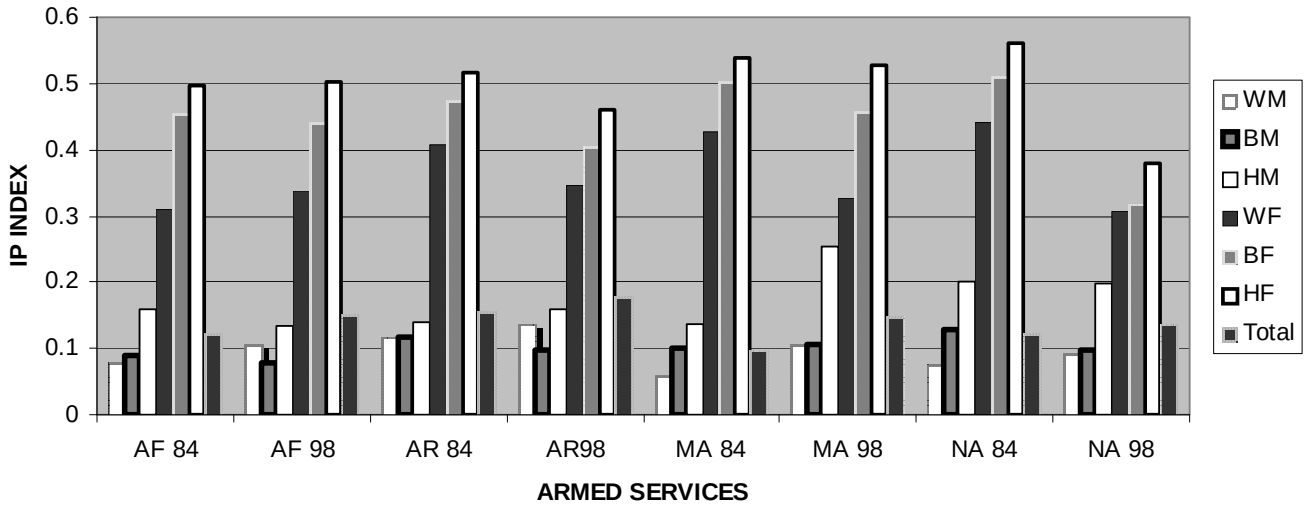
The Navy exhibited a significant rate of integration over the fourteen years, as measured by the Composition Effect, whereas the Marines experienced significantly increased segregation, and the Air Force and Army experienced a slower rate of resegregation.[44]

The failure to re-enlist after the first term of enlistment would have facilitated a change in the RG composition of the Armed Forces, but this has only translated into integration within the Navy.[45] Notwithstanding the resegregation of many occupations since 1984, the military appears to be significantly less segregated than civilian employment.[46]

Occupational Segregation by Race/Gender Group

Figure 2, which shows the IP indexes by RG groups across the branches of the military, reveals that women tend to be concentrated in a limited number of occupations across all branches of the military. Again simple comparisons of the index magnitudes must be undertaken with caution because of the differences in the underlying structures of employment by race/gender and occupation. Women face direct restrictions with respect to occupational assignments in the area of combat, in which Black and Hispanic males are over-represented.

FIGURE 2 IP INDEXES BY ARMED SERVICE AND RACE GENDER GROUP: 1984 & 1998



The Composition Effects indicate the rate of integration or resegregation for the RG group within the context of the overall structure of employment in that branch of the military. The results show that while females and White males became increasingly concentrated in certain occupational assignments in the Air Force, Black and Hispanic males became more integrated. In the Army Hispanic males and females enjoyed increased occupational access, along with Black and White females, but Black males, in particular, and White males experienced increased segregation.

TABLE 3 COMPOSITION EFFECTS BY EMPLOYMENT GROUP, 1984-98

	WHITE		**BLACK**		**HISPANIC**		**TOTAL**
	Male	Female	Male	Female	Male	Female	
AIR FORCE	15.28	16.55	-2.64	8.85	-8.20	6.92	11.11
ARMY	6.50	-11.96	20.14	-5.45	-13.35	-4.31	4.31
MARINES	48.01	-22.89	60.40	1.25	9.87	-5.83	38.47
NAVY	-18.38	-34.87	9.93	-35.06	-3.66	-41.39	-17.24

Source: See Table 1.

In the Marines White females made strong progress and marginal progress was made by Hispanic women, but all males experienced resegregation. In the Navy all female groups had significant rates of

integration. The significant reduction in the White male share of employment was accompanied by a more even distribution of employment and Hispanic males made a marginal improvement. Black males were the only RG group to experience increased segregation.

Segregation by Occupational Group

In studies of civilian gender segregation, four Occupational Groups were defined. Similar patterns in the evolution of gender segregation were found in the UK and the USA.[47] Civilian and military occupations cannot be easily compared, however, because of the more narrowly defined functions of enlisted personnel in the military and the presence of combat troops.

Following the classification used by the Department of Defence,[48] the occupations of enlisted personnel in the Armed Forces were subdivided into 4 skill groups (SGs), namely High Skill, Medium Skill, Low Skill and Combat.

High Skill occupations consist of Communications & Intelligence Specialists and Electronic Equipment Repair. *Medium Skill* occupations are Health Care Specialists & Other Technical and Allied Specialists. Functional Support and Administration and Electrical-Mechanical Equipment Repair. Craftsmen and Service and Supply Handlers are defined as *Low Skilled*. Infantry, Gun Crew and Seamanship Specialists are defined as *Combat*. In contrast to the Department of Defence, *Low Skilled* and *Combat* occupations are separated, so that it is possible to isolate the impact on Combat occupations.

Table 1 shows that the job losses have been distributed fairly evenly across the skill groups, although the High Skill job losses have exceeded the average job loss across all branches of the military. Military affirmative action programs have been designed to improve the access of women and racial minorities to High Skill occupations based on technical and allied skills, in which opportunities are growing due to the increasingly complex military technology and the difficulty of retaining (white) men, in the light of the competition from civilian salaries.[49] The success of these programs can be explored through the comparison of rates of integration across the skill groups.

TABLE 4 COMPOSITION EFFECTS BY OCCUPATIONAL GROUP[50]

	AIR FORCE	ARMY	MARINES	NAVY
TOTAL	11.11	4.31	38.47	-17.24
HIGH SKILL	-11.66	-13.51	3.82	-6.38
MEDIUM SKILL	20.76	-5.32	25.12	-24.82
LOW SKILL	35.14	5.75	53.08	-6.41
COMBAT	-62.53	28.77	83.21	-28.93

Source: See Table 1.

The results were mixed across the skill groups (see Table 4). In general, more highly skilled occupations exhibited a higher rate of integration (lower rate of increase in segregation), than the lower skilled occupations in each branch of the military.[51] The exceptions were the Navy in which all SGs exhibited

integration with Combat exhibiting the greatest rate of change and the Air Force in which High Skilled and Combat integrated. These results reveal that the opening up of Combat positions in these branches of the military have assisted gender/race integration. The Army made progress with respect to High and Medium Skilled occupations, but became more highly segregated with respect to Low Skill and Combat occupations. On the other hand, the Marines failed to exhibit gender/race integration across any of the skill groups.

Comparison between the Services

The branches of the military share 36 common occupations. Pair-wise comparisons can be made between the branches of the military across these occupations in both 1984 and 1998, through the examination of Composition Effects. These effects are independent of differences between gender shares and the occupational structure across the two branches of the Armed Forces.[52]

These cardinal comparisons can be translated into ordinal rankings between the branches across the SGs, the race/gender groups and in aggregate. The relationship appears to be transitive, both in aggregate and across race/gender groups. While these comparative results can not be imputed to all occupations in the Armed Forces, they are worthy of brief examination.

In 1984, the Air Force was least segregated, followed by the Navy, Marines and the Army. Now the order is Navy, Air Force, Army and Marines which is consistent with the rates of integration discussed above. The gross index magnitudes for the services shown in Table 3 reveal a different ordering, but the numbers of occupations differ and the distribution of employment differs across the branches of the Services. Also an examination of the gross index magnitudes for the 36 occupations reveals a different ordering of the Armed Services, which highlights the importance of purging the Mix Effects in making such comparisons.

CONCLUDING COMMENTS

Writers have emphasised that the military model of integrated employment should be adopted by civilian employers, but, in general, their underlying concept of integration is limited to the consideration of rates of representation and promotion of minority groups across the military.

In this paper a multi-dimensional numerical procedure has been adopted to explore the extent to which enlisted personnel differentiated by race and gender have become more occupationally integrated in the military since 1984. Significant cuts to employment have been accompanied by higher segregation by race and gender, except in the Navy, although gender integration occurred in all branches of the Armed Forces over this period, except the Air Force.[53]

These results point to the need to analyse the practices of occupational assignment across the Armed Forces about which the academic literature appears to be largely silent, as well as patterns of attrition and re-enlistment, although the latter are of less quantitative significance. As noted, the ASVAB test scores determine the occupations for which applicants for the military are qualified. The required scores vary by service and have been determined from empirical analysis to yield a high probability of training success.

In general, higher required test scores associated with the higher skilled occupations tends to disadvantage Blacks and Hispanics, who perform less well than whites in aptitude tests.

If we accept that the Navy has a lower level of race/gender segregation, although it cannot be conclusively demonstrated, then one testable hypothesis is that the required test scores in the Navy are systematically lower in occupations in which particular RG groups are under-represented in the other branches of the military. Alternatively the Navy attracts higher quality applicants. In both cases Navy applicants would have greater freedom of choice of assignment.

An alternative hypothesis is that most applicants are able to obtain their preferred assignment, so that the employment outcomes largely reflect the unconstrained choices of applicants. In this case, the occupational preferences of applicants would appear to differ systematically across the services.

One possible policy initiative would be to standardise the levels of minimum achievement required for each occupational assignment across the Armed Forces, unless it is convincingly demonstrated that success in training in similar occupations across the branches of the military warrants different minimum test scores.

The roles played by recruitment personnel in the resolution of constrained occupational choices may be different across the branches of the military. This could reflect practices of statistical discrimination.

Zero occupational segregation by race and gender should not be the objective of affirmative action initiatives in either military or civilian labour markets. Ultimately the assignment of enlisted personnel of different races to occupations in the military should be based on military need and the aptitudes and inclinations of these enlisted personnel, rather than sociopolitical imperatives. At the same time, the design of recruitment policy should reflect the pursuit of efficient and equitable outcomes, so that the setting of required test scores for occupational admission should reflect the demands of those occupations.

Appendix 1

Define the terms with superscripts 1 and 2 as corresponding to periods 1 and 2, then two new indexes can be defined, namely:

$$IS_A = \sum_{j=1}^{m} \sum_{i=1}^{n} \left| T^1_{ij} (T^2_{i0} / T^1_{i0}) - (T^2_{i0} / T^2) \widetilde{T}_{0j} \right| / T^2 \qquad \text{(A1)}$$

where

$$\widetilde{T}_{0j} = \sum_{k=1}^{n} (T^1_{kj} T^2_{k0}) / T^1_{k0} \qquad \text{(A2)}$$

and

$$\widetilde{T}_{i0} = \sum_{p=1}^{m} T^1_{ip} (T^2_{0p} / T^1_{0p}) \qquad \text{(A3)}$$

The index IS_A is obtained by proportionately increasing the number of each category of worker in each occupation by the percentage increase in the employment level in that occupation from period 1 to period 2. The resulting number of RG group j in total is denoted as $\widetilde{T}_{0j}$. The initial Group composition of each occupation is retained but the share of total employment by occupation is adjusted to that prevailing in period 2. Thus the comparison of IS_A with the value of the index in period 1 yields the forwards Occupation Effect (OCC).

The index IS_B is calculated by adjusting the numbers of each Group of worker in all occupations by the overall increase in the numbers of that Group between periods 1 and 2. Thus in the IS_B calculation the overall composition of employment by Group corresponds to that of period 2. Comparison of IS_B with the period 1 index value yields the forwards Race/Gender (R/G) Effect. The derivation of the Composition Effect is described in the text.

The total forward percentage Mix Effect is $100*(IS_C - IS_1)/((IS_1 + IS_2)/2)$, where IS_C denotes the index magnitude based on the third distribution of employment. The forward percentage Composition Effect is $100*(IS_2 - IS_C)/((IS_1 + IS_2)/2)$. By subtraction, the residual Interaction Effect is $((IS_C - IS_1)-(IS_A - IS_1)-(IS_B - IS_1))/((IS_1 + IS_2)/2)$.

These Effects are usually calculated as an average of 'backward' and 'forwards' effects, thereby treating the occupational distributions and overall gender shares for the two periods in turn as given. Thus the effect reflects the prevailing occupational distributions.

The three intermediate indexes can also be disaggregated by RG group (see (2)), since

$$IS_q = \sum_{j=1}^{m} (T^2_{0j} / T^2) IS_{qj} \qquad (q = A,B,C) \qquad \text{(A4)}$$

where the index weights are the employment shares of each EC. The calculation of the Effects across the RGs proceeds in a similar manner to the calculation of the overall Effects.

Under the normalization procedure the terms making up the denominator of the expressions, namely $IS^1_j + IS^2_j$, are measured in comparable units, that is the shares of employment of the particular Employment Group. Because a pure Composition Effect is being computed, the terms in the numerator are measured in comparable units, irrespective of whether normalization is undertaken or not. Consequently the magnitude of the Composition Effect by RG group is relatively insensitive to the way it is calculated, because the normalization procedure affects the terms in the numerator equally.

The calculations across Employment Categories of Total Change and Mix Effects and the components of the latter are sensitive to whether index values are normalized, because of the differential impact on the terms in the numerator by normalization, due to different employment shares of the Economic Categories corresponding to the two time periods. Hence only Composition Effects by RG group should be considered. Composition Effects by SG can be computed in a similar manner.

Appendix 2

The 36 common occupations are 101, Communications Radio; 102, Navigation, Communication and Countermeasure, N.E.C; 104, Surveillance/Target Acquisition and Tracking Radar; 121, Missile Guidance and Control; 150, ADP Computers, General; 160, Teletype and Cryptographic Equipment, General; 198, Electronic Instruments, N.E.C.; 201, Radio Code; 221, Radar; 222, Air Traffic Control; 231, Intercept Operators (Code and Non-Code); 232, Analysis; 242, Image Interpretation; 243, Operational Intelligence; 400, Photography, General; 420, Weather, General; 450, Musicians, General; 510, Administration, General; 512, Legal; 531, Operators/Analysts; 551, Supply Administration; 553, Transportation; 570, Information and Education, General; 600, Aircraft, General; 601, Aircraft Engines; 602, Aircraft Accessories; 603, Aircraft Structures; 612, Construction Equipment; 621, Linemen; 646, Aviation Ordnance; 720, Utilities, General; 721, Electricians; 740, Lithography, General; 800, Food Service, General; 830, Law Enforcement, General; and 860, Forward Area Equipment Support, General.

NOTES

[1] John Sibley Butler, "Affirmative Action in the Military (Affirmative Action Revisited)," *The Annals of the American Academy of Political and Social Science* 523 (Sept 1992): 196-207; Charles C. Moskos and John Sibley Butler, *All That We Can Be: Black Leadership and Integration the Army Way* (New York: Basic Books, 1996); David R. Segal and Naomi Verdugo, "Demographic Trends and Personnel Policies as Determinants of the Racial Composition of the Volunteer Army," *Armed Forces & Society: An Interdisciplinary Journal* 20: 4 (Summer 1994): 619-33; Lorry M. Fenner "Either You Need These Women or You Do Not: Informing the Debate on Military Service and Citizenship," *Gender Issues* 16: 3 (Summer 1998): 5-32.

[2] Moskos and Sibley Butler, *All That We Can Be*.

[3] See David J. Armor, "Race and Gender in the U.S. Military," *Armed Forces & Society: An Interdisciplinary Journal* 23: 1 (Fall 1996): 7-28.

[4] For a contrary view, see Regina F. Titunik, "The First Wave: Gender Integration and Military Culture," *Armed Forces & Society: An Interdisciplinary Journal* 26: 2 (Winter 2000): 229-257.

[5] Karen O. Dunivin, "Military Culture: Change and Continuity," *Armed Forces & Society: An Interdisciplinary Journal* 20:4 (Summer 1994): 531-547.

[6] Department of Defence, "Population Representation in the Military Services: Fiscal Year 1998," 1999, http://dticaw.dtic.mil/prhome/poprep98

[7] Armor, "Race and Gender," 7.

[8] But see Juanita M. Firestone "Occupational Segregation: Comparing the Civilian and Military Work Force," *Armed Forces & Society: An Interdisciplinary Journal* 18: 3 (Spring 1992): 363-82.

[9] Charles C. Moskos "The Army's Racial Success Story: How Do They Do It?" *The New Republic* 205: 6 (August 5 1991): 16-20.

[10] Christine Jonung, "Patterns of Occupational Segregation by Sex in the Labor Market," in *Sex Discrimination and Equal Opportunity: The Labor Market and Employment Policy* (London: Gower Publishing Company, 1984), 45.

[11] Jaques G. Silber "Occupational Segregation Indices in the Multidimensional Case: A Note," *Economic Record* 68: 202 (1992): 276-277; Martin J. Watts "Trends in Occupational Segregation by Race and Gender in the USA, 1983-92: A Multidimensional Approach," *Review of Radical Political Economics* 27: 4 (1995): 1-36.

[12] Patrick L. Mason, "Accumulation, Segmentation and the Discriminatory Process in the Market for Labor Power," *Review of Radical Political Economy* 25: 2 (1993): 1-25; Rhonda Williams "Competition, Discrimination and Differential Wage Rates: On the Continued Relevance of Marxian Theory to the Analysis of Earnings and Employment Inequality," in *New Approaches to the Economic and Social Analysis of Discrimination* (New York: Praeger, 1991).

[13] Moskos, "The Army's Racial Success Story."

[14] Charles C. Moskos "From Citizens' Army to Social Laboratory," *The Wilson Quarterly* 17: 1 (Winter 1993): 83-95.

[15] See, for example, the information on Army Enlistment:
http://www.militarycareers.com/occ/armenlst.htm

[16] Personal correspondence with Juanita Firestone, May 1997.

[17] Edmund S. Phelps, "The Statistical Theory of Racism and Sexism," *American Economic Review* 62 (1972): 659-61.

[18] See the cross-country study by Charles and Grusky "Models for Describing the Underlying Structure," *American Journal of Sociology* 100:4 (1995): 931-971; and a defence of their approach in David B. Grusky and Maria Charles, "The Past, Present and Future of Sex Segregation Methodology," *Demography* 35: 4 (1998): 497-504. See the time series study by Kim A. Weeden, "Revisiting Occupational Sex Segregation in the United States, 1910-1990: Results from a Log-Linear Approach," *Demography* 35: 4 (1998): 475-487.

[19] See Martin J. Watts, "The Analysis of Sex Segregation: When is Index Measurement not Index Measurement?" *Demography* 35: 4 (1998): 505-508 and Martin J. Watts, "Occupational Gender Segregation: Index Measurement and Econometric Modelling," *Demography* 35: 4 (1998): 489-96.

[20] Randy P. Albelda, "Occupational Segregation by Race and Gender," *Industrial and Labor Relations Review* 39: 3 (1986): 404-411; Mary C. King, "Occupational Segregation by Race and Sex: 1940-88," *Monthly Labor Review* (1992): 30-37; Mary C. King, "Black Women's Labor Market Status: Occupational Segregation in the United States and Great Britain," *The Review of Black Political Economy* 24: 1 (1995): 23-43.

[21] For example, White claims that the index, when applied to residential segregation, 'is easily interpreted as the percentage of one group which would have to change residences in order to produce an even distribution.' See Michael J. White, "Segregation and Diversity Measures in Population Distribution," *Population Index* 52: 2 (1985): 198-221. See also Albelda, "Occupational Segregation by Race and Gender," 405; King, "Occupational Segregation by Race and Sex," 31; Charles and Grusky "Models for Describing the Underlying Structure," 933.

[22] See, for example, Andrea H. Beller "Changes in the Sex Composition of U.S. Occupations 1960-81," *Journal of Human Resources* 20: 2 (1985): 235-250; O.E.C.D., *The Integration of Women into the Economy,* (Paris: O.E.C.D., 1985); and the comments of Martin J. Watts "How Should Occupational Sex Segregation be Measured?" *Work, Employment and Society* 6: 3 (1992): 475-487.

[23] Maria Charles and David B. Grusky "Models for Describing the Underlying Structure of Sex Segregation."

[24] King "Black Women's Labor Market Status." King compares the dissimilarity indexes for Black and White women and for Black and White men in Britain and the U.S.A by public and private sector, education and age.

[25] For example, Martin J. Watts, "Explaining Trends in Occupational Segregation: Some Comments," *European Sociological Review* 9: 3 (1993): 315-319 and M.J. Watts, "The Measurement of Occupational Gender Segregation," *Journal of the Royal Statistical Society* (Series A) 160: 1 (1997): 141-145.

[26] Tom Karmel and Maureen Maclachlan "Occupational Sex Segregation - Increasing or Decreasing," *Economic Record* 64 (1988): 187-195.

[27] *Ibid*., 190-91.

[28] Silber, "Occupational Segregation Indices in the Multidimensional Case," 277 (equation 4).

[29] Watts, "Trends in Occupational Segregation," and M.J. Watts, "Multi-Dimensional Indexes of Occupational Segregation: A Critical Assessment," *Evaluation Review* 21: 4 (1997): 461-82.

[30] Watts, "Trends in Occupational Segregation."

[31] Weeden, "Revisiting Occupational Sex Segregation in the United States," 476.

[32] Watts, "Trends in Occupational Segregation."

[33] Mark A. Fossett, Omer R. Galle, and William R. Kelly "Racial Occupational Inequality, 1940-80: National and Regional Trends," *American Sociological Review* 51 (1986): 421-29.

[34] Dale Boisso, Kathy Hayes, Joseph Hirschberg and Jaques Silber "Occupational Segregation in the Multi-Dimensional Case: Decomposition and Tests of Significance," *Journal of Econometrics* 61 (1994):161-171.

[35] Susan M. Carlson "Trends in Race/Sex Occupational Inequality: Conceptual and Measurement Issues," *Social Problems* 39: 3 (1992): 268-290.

[36] Office of Assistant Secretary of Defence

[37] David R. Segal, Jerald G. Bachman, Peter Freedman-Doan and Patrick M. O'Malley "Propensity to Serve in the U.S. Military: Temporal Change and Subgroup Differences," *Armed Forces and Society* 25: 3 (Spring 1999): 407-428.

[38] Hispanics have a rate of high school dropout of 54% compared to the national average (30%). See Sydney J. Freedberg jr., "Not Enough GI Joses," *National Journal* 31:33 (August, 1999): 2366-2368.

[39] In a study of the reenlistment decisions of 402 U.S. Air Force enlistees, a combination of perceptual and objective job availability measures was found to provide the best prediction of the reenlistment criterion.

Robert P. Steel "Labor Market Dimensions as Predictors of the Reenlistment Decisions of Military Personnel," *Journal of Applied Psychology* 81:4 (August, 1996): 421-429.

[40] A detailed analysis of the patterns of recruitment and voluntary and involuntary attrition by race and gender over the intervening years is beyond the scope of this paper.

[41] David R. Segal, Jerald G. Bachman, Peter Freedman-Doan and Patrick M. O'Malley "Propensity to Serve in the U.S. Military."

[42] Mark Pizzo and Philip Gold "Should Congress Reinstate a Peacetime Draft to Fill the Ranks?" *Insight on the News* 15:13 (April, 1999): 24-25.

[43] An occupation in a branch of the Armed Services is said to be dominated by a particular RG Group, if its share of employment exceeds the overall share of employment in the branch of the Armed Services of that RG Group.

[44] Over this period the Navy exhibited the most rapid rate of gender integration, followed by the Marines and the Army. The Air Force became nearly 16% more segregated. See Martin J. Watts, "Enlisted Personnel in the US Armed Forces: The Evolving Pattern of Gender Segregation 1984-98," in *Women in Uniform: Perceptions & Pathways* (Canberra: School of History, University College, UNSW, Australian Defence Force Academy, 2000).

[45] In studies of civilian employment, the rate of gender integration was strongly pro-cyclical which reflects the potential for the gender composition to change in the context of growing employment. See M.J. Watts and J. Rich "Occupational Sex Segregation in Britain, 1979-89: The Persistence of Sexual Stereotyping," *Cambridge Journal of Economics* 17: 2 (1993): 159-177; M.J. Watts "Divergent Trends in Gender Segregation by Occupation in the USA: 1970-92," *Journal of Post Keynesian Economics* 17:3 (1995): 357- 379. See also Martin J. Watts, "Enlisted Personnel in the US Armed Forces."

[46] Across 382 civilian occupations the gross IP index was 0.305 in 1983 and 0.289 in 1992. See Martin J. Watts "Trends in Occupational Segregation by Race and Gender." As noted, these comparisons should be made with caution, given the dependence of the index magnitude on race/gender shares of employment and the number of occupations. The observation that there is an appreciable difference between civilian and military IP indexes would suggest, however, that civilian employment is more segregated. Firestone also argues that the military is less gender segregated. See "Occupational Segregation: Comparing the Civilian and Military Work Force."

[47] In studies of Britain and the USA, it was found that high status, managerial and professional occupations have integrated relatively fast over the past 10 years or so, whereas male dominated Blue Collar occupations and female dominated Sales and Service occupations have exhibited little change. See Watts and Rich, "Occupational Sex in Britain" and Watts, "Divergent Trends in Gender Segregation."

[48] Department of Defence, "Population Representation in the Military Services: Fiscal Year 1998," Executive Summary.

[49] Firestone, "Occupational Segregation," 376.

[50] The change in the RG shares of employment for the RG groups across the SGs provide a rough guide as to the sign of the Composition Effects. These data are available from the author on request.

[51] This pattern of change has some similarity with changes in segregation across civilian occupations, notwithstanding the fall in employment across the military. See fn. 41.

[52] Numerical comparisons and those by the Professional, Skilled and Service SGs are available on request.

[53] Martin J. Watts, "Enlisted Personnel in the US Armed Forces."