OCCUPATIONAL SEGREGATION BY SEX AND INDUSTRIALIZATION IN CANADA: 1891-1971

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ABSTRACT

Occupational data for industrial labour forces reveal sexual division of labour in the form of occupational segregation by sex (OSS). There are two principal dimensions of this phenomenon. First, male and female workers are distributed differently among occupations, an aspect of OSS referred to as occupational differentiation by sex (ODS). Second, there is considerable variation in the internal sex compositions of occupations, such that women are overrepresented in a few jobs, and underrepresented in others. This dimension of OSS is referred to as occupational sex-typing (OST). Some patterns of OSS suggest that male and female workers are not merely segregated into different jobs, but also stratified into occupations readily ranked according to conventional criteria. Such sexual stratification of the labour force is referred to as sexual inequality of occupational status (SIS).

Although economic, socialization, discrimination, interdisciplinary, and ecological explanations of change in OSS and SIS identify important determinants of these phenomena, none of these perspectives provides an adequate theory of change in OSS and SIS. As well, the various approaches have led to contradictory conclusions about trends in OSS and SIS. Some authors argue that there has been no change in the degree of these phenomena. Others contend that OSS and SIS have grown more

pronounced, while yet others claim declines in these phenomena. Much of the confusion concerning trends in OSS and SIS results from methodological inadequacies, which render inconclusive many of the findings of previous research.

The thesis of this study is that there should be inverse relationships between the level of industrialization and both OSS and SIS. Specifically, it is argued that (1) the development of machine technology tends to eliminate the necessity to select workers for some jobs on the basis of strength, i.e., usually by sex; (2) the commitment to productivity characteristic of industrial societies implies hiring and promoting workers on the basis of their probable contribution to production; (3) the industrial urban milieu is characterized by conditions conducive to the employment and advancement of women (e.g., low birth rate, career opportunities); and (4) the bureaucratization accompanying industrialization ideally implies the selection and promotion of workers on the basis of achieved qualifications, determined by formalized, calculable standards, rather than on such traditional, ascriptive, and often economically irrational, criteria as sex. Accordingly, it is predicted that ODS, OST, and SIS will be inversely related to technological development, productivity, urbanization, and bureaucratization, and that as the levels of the latter dimensions of industrialization increase over time the degree of ODS, OST, and SIS will decline.

Indexes of each dimension of industrialization and of

ODS, OST, and SIS are calculated with official Canadian data for the census years 1891 through 1971. The results are graphed and correlated, and subjected to regression and trend analysis. Generally, the findings are consistent with the thesis of inverse relationships between both OSS and SIS and each dimension of industrialization. Declines in OSS, however, are slight, with considerable sexual division of labour remaining at the end of the period studied. The theoretical and methodological implications of these findings are discussed, and several directions for subsequent research indicated.

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CHAPTER I

INTRODUCTION

A sexual division of labour occurs in all societies. Ethnographic records of nonindustrialized societies show that although most subsistence activities are performed by both sexes, some are performed usually or exclusively by only one sex (Murdock and Provost, 1973:206-207). Brown (1970:1074) suggests that in primitive settings

> the degree to which women participate in subsistence activities depends upon the compatibility of the latter with simultaneous child-care responsibilities. Women are most likely to make a substantial contribution when subsistence activities have the following characteristics: the participant is not obliged to be far from home; the tasks are relatively monotonous and do not require rapt concentration; and the work is not dangerous, can be performed in spite of interruptions, and is easily resumed once interrupted.

Conversely, Murdock and Provost (1973:21) note that periods of absence from the household are required by such typically masculine activities as warfare, hunting, fishing, and herding. These and other masculine tasks usually have features which give a relative advantage to males, who "tend in general to be endowed with greater physical strength than females and probably also a superior capacity for mobilizing it in brief spurts of excessive energy."

Even in nonindustrialized settings, however, tasks performed by men in one society are undertaken by women in another.

The biological factor, then, is not sufficient to explain the sexual allocation of subsistence tasks. Depending on the values of a given society, other determinants, including the "hardness" or "toughness" of raw materials, a tendency for the sex which uses an artifact to be the sex which makes it, complexity of technology, and intensity of agriculture, influence the sexual division of labour (Murdock and Provost, 1973:211-215).

The Sexual Division of Industrial Labour

Occupational data for industrial work forces reveal the persistence of a sexual division of labour outside the home[1] in the form of "occupational segregation by sex" (OSS). There are two principal dimensions of this phenomenon. First, male and female workers are distributed differently among occupational categories, as may be seen in Table 1. The concentration of the majority of the female labour force in a relatively few major occupation groups contrasts sharply with the much greater, though by no means uniform, dispersion of male workers among all occupation groups.

Listing the occupation groups according to the size of their share of the female labour force highlights the degree of concentration of women in a few kinds of work. In 1971, over one-third (36 per cent) of all female workers in Canada were employed in clerical work, while another 17 per cent held

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[1] Inside the home, of course, there is a sexual division of household labour (Meissner et al., 1975; Meissner, 1976; Clark and Harvey, 1976).

Table 1

Occupational Differentiation by Sex: Percentage Distributions of the Female and Male Labour Forces by Major Occupation Group, Canada (1971)[a]

Occupation Group	Female	Male
Clerical	35.9%	8.5%
Service	17.1	10.2
Sales	9.5	11.1
Medicine and health	9.3	1.6
Teaching	8.1	2.7
Fabricating, assembling and repairing	5.7	9.5
Agricultural	4.1	7.9
Processing	2.3	5.4
Managerial and administrative	2.2	6.2
Materials handling	1.5	3.2
Social sciences	1.1	1.0
Artistic, literary and recreational	0.8	1.1
Natural sciences, engineering and maths	0.7	4.3
Machining	0.5	4.5
Other crafts and equipment operating	0.5	1.9
Transport equipment operating	0.3	6.5
Construction trades	0.2	11.0
Religion	0.1	0.4
Forestry and logging	0.1	1.3
Fishing, hunting and trapping	0.0[b]	0.5
Mining and quarrying	0.0[b]	1.2
All occupation groups	100.0%	100.0%
(Number in thousands)	(2,620)	(5,102)

[a]Excluding workers whose occupations were either not classified or not stated.

[b]Less than 0.05 per cent.

Source: Canada. Statistics Canada (1974:Table 2).

service jobs. These two categories together accounted for over half (53 per cent) of all women in the labour force. The sales, medicine and health, and teaching groups each contained nearly 10 per cent of the female labour force. Thus two-thirds of all females were contained in three, over three-quarters in four, and four-fifths in five, of the twenty-one major occupation groups of the 1971 classification scheme. The percentage of the female labour force in the remaining occupation groups dropped off rapidly from 6 per cent in fabricating, assembling, and repairing jobs to virtually none in mining and quarrying.

The distribution of the male labour force shows much less concentration. Each of the five occupation groups with the largest percentage of male workers--clerical, service, and sales, again, as well as construction and fabricating, assembling and repairing--has roughly one-tenth of the male work force. Only two categories (religion and fishing, hunting and trapping) contain less than 1 per cent of the male labour force, contrasting sharply with the distribution of women, where ten occupation groups contain less than 1 per cent of the female work force. This differential distribution of the male and female labour forces among occupational categories is referred to as "occupational differentiation by sex" (ODS) (Martin and Poston, 1972; 1976; Williams, 1976).

The other major dimension of OSS is seen in the internal sex compositions of occupational categories and is usually illustrated by calculating the percentages of men and women within each occupational category. If the latter are listed

down the "stub" of a table, the percentages are run horizontally. This is done in Table 2, which lists the major occupation groups according to the proportion of the workers in each who are women. In only three of the groups--social sciences, sales, and artistic, literary and recreational--are the percentages of workers who are female within ten percentage points of the figure for the labour force as a whole (34 per cent). Of the other occupation groups, women are greatly overrepresented in four: medicine and health, with 74 per cent; clerical, with 68 per cent; teaching, with 60 per cent; and service, with 46 per cent. Men, of course, dominate the remaining fourteen groups, with proportions ranging from 76 per cent in fabricating, assembling and repairing to 99 per cent in mining and quarrying.

The breadth of these categories, however, masks even more extreme variations in the sex compositions of detailed occupations. For, as Gross (1968:207) observes, "the finer the distinctions, the more segregation one will 'catch.'" This is evident in Table 3, which lists the four occupation groups in which the proportion of workers who are female exceeds the figure for the labour force as a whole by more than ten percentage points. In the service group as a whole, for example, women comprise roughly half (46 per cent) of the workers, but chambermaids and housemen consist almost entirely of the former (96 per cent), while virtually all (98 per cent) policemen and detectives are men. Similarly, the clerical group includes secretaries and stenographers, of whom 97 per cent are women, as

Table 2

Occupational Sex-Typing: Sex Compositions of Major Occupation Groups, Canada (1971)[a] (Percentages)

Occupation Group	Women	Men
Medicine and health	74.3	25.7
Clerical	68.4	31.6
Teaching	60.4	39.6
Service	46.2	53.8
Social sciences	37.3	62.7
Sales	30.4	69.6
Artistic, literary and recreational	27.2	72.8
Fabricating, assembling and repair	23.7	76.3
Agricultural	20.9	79.1
Materials handling	19.7	80.3
Processing	17.8	82.2
Managerial and administrative	15.7	84.3
Religion	15.7	84.3
Other crafts and equipment operating	12.4	87.6
Natural science, engineering and maths	7.3	92.7
Machining	5.7	94.3
Transport equipment operating	2.4	97.6
Forestry and logging	2.1	97.9
Fishing, hunting and trapping	1.9	98.1
Construction trades	0.9	99.1
Mining and quarrying	0.6	99.4
All occupation groups	33.9	66.1

[a]Excluding workers whose occupations were either not classified or not stated.

Source: Canada. Statistics Canada (1974:Table 2).

Table 3

Occupational Sex-Typing: Sex Compositions of Leading Female Occupation Groups[a] and Selected Occupations, Canada (1971) (Percentages)

Occupation	Women	Men
Medicine and health	74	26
Physicians and surgeons	10	90
Graduate nurses	96	4
Clerical	68	32
Secretaries and stenographers	97	3
Mail carriers	8	92
Teaching	60	40
University	17	83
Secondary	45	55
Elementary and kindergarten	82	18
Service	46	54
Policemen and detectives	2	98
Chambermaids and housemen	96	4

[a]Major occupation groups in which the percentage of workers who are women exceeds that in the labour force as a whole (34 per cent) by over ten percentage points.

Source: Canada. Statistics Canada (1974:Table 2).

well as mail carriers, of whom 92 per cent are men. Such occupations, in which an overwhelming proportion of the workers are of one sex, are often referred to as being "sex-typed" (Armstrong and Armstrong, 1975). Accordingly, this dimension of OSS is referred to as "occupational sex-typing" (OST).

Some patterns of OST suggest that men and women are not merely segregated into different jobs, but are also stratified into occupations readily ranked by conventional criteria, as may also be seen in Table 3. An extreme example occurs within the medicine and health group, where 96 per cent of nurses are female, but 90 per cent of physicians and surgeons are male. Similarly, 83 per cent of university teachers are men, while a like proportion of elementary and kindergarten teachers are women; high school teaching occupies an intermediary position, for it is practised by nearly as many women (45 per cent) as men (55 per cent).[1] Table 4 presents the percentage distributions of the female and male labour forces according to intervals of the Blishen-McRoberts (1976) socioeconomic index. Greater proportions of the male than the female work forces are found in the top two and the bottom two intervals. Although it would be difficult to determine its extent by mere inspection of the data, the apparent sexual stratification of the labour force may be referred to as "sexual inequality of occupational status" (SIS).

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[1]Such extreme variation in sex compositions tends not to occur within those occupation groups formed almost exclusively of males. For example, in the five occupation groups in which the percentage of workers who are men exceeds 95 per cent (i.e., the last five listed in Table 2), there is not a single specific occupation in which the proportion of workers who are women reaches 10 per cent. ("Specific occupation" here refers to a detailed occupation other than a general designation, such as "foremen . . . ," or a residual category containing workers "not elsewhere classified.")

Table 4

Sexual Inequality of Occupational Status: Percentage Distributions of the Female and Male Labour Forces by Blishen-McRoberts "Class Intervals," Canada (1971)

Socio-economic Index Value	Female	Male
70.0000+	2.7%	3.7%
60.0000-69.9999	8.9	11.8
50.0000-59.9999	23.2	9.8
40.0000-49.9999	22.1	21.2
30.0000-39.9999	20.2	22.7
Below 30.0000	23.0	30.7
Totals[a]	100.1%	99.9%

[a]Do not equal 100.0 per cent due to rounding error.

Source: Based on Canada. Statistics Canada (1974:Table 2) and Blishen and McRoberts (1976).

The purpose of this thesis is to measure and explain long-term changes in the amounts of ODS and OST, as well as in the degree of SIS. The following section contains an evaluation of theories of change in these phenomena. An alternative explanation is then developed to account for change in OSS and SIS. The final section of the chapter outlines the limitations of previous research in this area.

Explanations of Change in OSS and SIS

If biological differences do not account for variation in the sexual division of labour in nonindustrialized societies,

they are utterly inadequate as an explanation of change in occupational segregation by sex (OSS) and in the sexual inequality of occupational status (SIS) in industrial milieux. The various sociological approaches taken in this study of OSS and SIS have led to conflicting views about changes in these phenomena. Some authors argue that there has been no change in the degree of OSS and SIS. Others contend that these phenomena have grown more pronounced, while yet others predict declines in OSS and SIS. This section outlines the theoretical bases for these irreconcilable conclusions. Given the lack of agreement concerning trends in OSS and SIS, it is difficult to evaluate definitively the various theories of change in these phenomena. Accordingly, one of the aims of this study is to establish long-run trends in OSS and SIS in Canada.

Five kinds of explanations have been offered to account for change in OSS and SIS. Although there is considerable overlap among these explanations, they may be distinguished with respect to the weighting given the alleged determinants of change in OSS and SIS. One approach emphasizes financial need, another socialization, as the key independent variable. A third argues that institutionalized sexist discrimination accounts for change in OSS and SIS. A fourth approach to the question utilizes the concepts of several disciplines, while the fifth is anchored in human ecology.

The Economic Need Argument

Armstrong and Armstrong (1975:383) conclude that despite the doubling between 1941 and 1971 of both the female labour

force participation rate[1] in Canada (from 21 to 40 per cent) and the proportion of Canadian workers who were women[2] (from 18 to 35 per cent), most women in the paid labour force remained segregated in a few low skilled, low paid jobs over this thirty-year period. During the same period, however, the proportion of married women in the female work force grew more than fourfold (from 13 to 57 per cent) as a result of a seven-fold increase in the labour force participation rate of married women (from 4.5 to 33 per cent). Armstrong and Armstrong (1975:381-382) explain the enormous increase in the married female labour force participation rate as mainly the result of the rising financial need of families in the middle and lower income ranges. This economic need, it is argued, is brought about by increasing inequities in the distribution of national income, and reflected in [illegible] a shift from typically one income recipient per family, the case for 57 per cent of Canadian families as of 1951, to at least two income recipients per family, the situation of 65 per cent of families in 1971. On this basis, Armstrong and Armstrong (1975:383) conclude that

> some women do work because . . . they find fulfilling and rewarding employment. However, many more women, especially

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[1]The "female labour force participation rate" is the number of women in the labour force (e.g., 3 million, as of 1971), expressed as a percentage of all women, 15 years of age and over (7.6 million in 1971).

[2]That is, the female labour force as a percentage of the entire labour force, male and female workers combined (8.7 million, in 1971).

> in the lower and middle [income ranges], work because they need the money. . . . [Therefore], most women continue to have to take low-skilled, poorly paid jobs.

Although growing financial need may explain in large part the recent increase in married female labour force participation, it does not account for the persistence of OSS and SIS throughout the labour force. Furthermore, even if economic need did influence OSS and SIS as Armstrong and Armstrong argue, then growing financial need should be expected to lead to increasing OSS and SIS. Armstrong and Armstrong, however, do not claim an increase, but refer instead to stability, a trend which, as will be shown later, is unsubstantiated.

The Socialization Approach

An equally unsubstantiated conclusion of stability, or at best "a small, but definite, drop" in OSS has also been construed as "providing support for a functional analysis," which interprets OSS as the inevitable counterpart "of sex role segregation in the [traditional] family" (Gross, 1968:203-205). In this view, a boy is socialized--by the family, school, and church--to be the family breadwinner and hence to give primary attention to finding a full-time, permanent job or career. Girls, on the other hand, must be socialized primarily to traditional marital and maternal roles, and, therefore, are expected to prepare for a limited number of occupational roles (e.g., secretary), which do not involve inordinate investments in training, high geographical mobility, lengthy commitments of time and energy incompatible with the performance of their

familial roles, or direct competition with men in the work place. Nontraditional behaviour, especially that of a woman doing a "man's job," is seen as precipitating "a profound alteration in family structure" (Parsons, 1942:609), thereby threatening the hypothetical integration of not only society itself, but also the "natural" feminine personality (Erikson, 1964:105). Even if such sex-based socialization patterns and the segregation they allegedly engender are a function of "needs," this sort of explanation begs the very question it would be expected to answer: Why have the needs changed, so as to account for trends in OSS and SIS? Like financial need, socialization must be counted among the mechanisms by which change occurs, but it is not sufficient as the key independent variable.[1]

This perspective parallels the views of the nineteenth-century, Cambridge economist, Alfred Marshall. Beatrice Webb (1938:398) reports a conversation with "the dear little professor" in which he argued

> that woman was a subordinate being, and that, if she ceased to be subordinate, there would be no object for a man to marry. . . . Hence the woman must not develop her faculties in a way unpleasant to the man: that strength, courage, independence were not attractive in women; that rivalry in men's pursuits was positively unpleasant. Hence masculine strength and masculine ability in women must be firmly trampled on and boycotted by men. . . .
>
> "If you compete with us we shan't marry you," he summed up with a laugh.

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[1]Not all approaches which emphasize socialization assume these patterns fulfill the "needs" of society and the individual. Some assume, instead, that these "needs" are learned and have a self-fulfilling effect. As general explanations of change in OSS and SIS, however, the same criticism applies.

The Discrimination Argument

Another explanation of change in OSS and SIS (Knudsen, 1969:190-191) acknowledges the influence of both economic need and sex-based socialization patterns, but regards the latter process as having resulted in institutionalized sexist discrimination, another important determinant of OSS and SIS. This approach recognizes that women who conform to normative sex-role definitions will be not only restricted by education and recruitment to a limited number of occupations, but will also experience discriminatory salary scales and promotional practices (Knudsen, 1969:192). Moreover, ambitious or intellectually aggressive women are stigmatized as being "deviant," manifesting "role conflict," or even exhibiting "neurosis" (Rossi, 1964:611).

Both institutionalized inequality and oppression, Knudsen (1969:191) argues, have been reinforced by the postwar social sciences "through the use of an individualistic perspective and the dominance of functionalist interpretations." Rossi (1964:611), too, contends that the conservatism of sociology and psychology has had adverse "effects on the motivation and ability of women to exercise the rights already theirs or to press for an extension of them." Thus, OSS and SIS were allegedly aggravated

> as a result of . . . preconceptions regarding appropriate sex roles, sociologists . . . asserted the value and necessity of certain family structures . . . . justified by appeals to a normative order which defined females as complementary to males. Fulfilling maternal roles is therefore the primary and highest order if not the only appropriate behavior. (Knudsen, 1969:191)

As one might expect, writers who are critical not only of the status quo with reference to the traditional family and the labour market, but also of functionalist social science, reach the most pessimistic conclusion concerning trends in OSS and SIS. Knudsen claims that in the United States between 1940 and 1966, OSS and SIS grew even more pronounced, and he predicts "that women will remain in an inferior position for the next generation" (1969:192). Difficult as it is to specify the effects of factors such as discrimination, it would be much more difficult to document the alleged impact of functionalist social science on behaviour throughout society. Knudsen does not support either claim, much less document the incremental influence of either sexist discrimination or functionalist conservatism logically necessary to account for the alleged increases in OSS and SIS. The discrimination argument, therefore, is also defective. For not only is it logically inadmissible to explain a variable with a constant (Ogburn, 1957: 13), but, as will be shown later, the "increases" are also undocumented.

The Interdisciplinary Approach

In contrast to those who emphasize single determinants of OSS and SIS, Oppenheimer (1970) adopts a comprehensive approach incorporating demographic, economic, and psychological, as well as sociological, variables. Oppenheimer (1970:96-144) argues that OSS and SIS are variously the result of several factors, including the differential cost, availability, quality, and motivation of female, as compared with male, labour;

pre-job training patterns; the inertia of tradition; the conventions and exigencies of careers; and real or presumed difficulties with having mixed work groups and female supervisors; as well as the force of beliefs about sex-linked aptitudes.

Such an explanatory framework, however, is at best a piecemeal, and at worst an ad hoc, selective approach. Tradition, for example, may explain in part why "women . . . made . . . clothes at home, and continued to do so in the factory . . . , nursed the sick at home, and . . . [then] in the hospitals . . . , [and] took care of their own and other people's houses as domestics" (Oppenheimer, 1970:105). Tradition does not account, however, for women outnumbering men nearly three to one in electronics equipment fabricating and assembling jobs. The explanation given for the latter situation is that employers believe that women have greater manual dexterity than men and that they are more tolerant of repetitive, monotonous, and poorly paid work (Oppenheimer, 1970:103).

The problem with the interdisciplinary approach is that it does not specify why a given factor is effective in one instance but not in another; nor does it account for the absence of sex-typing in many of the occupations of an industrial society. In short, the cross-disciplinary approach offers separate and irreconcilable explanations for a relatively few extreme instances of occupational sex-typing, but cannot account for the level of OSS and SIS in the labour force as a whole and, hence, provides no general explanation for changes in these phenomena.

The interdisciplinary approach posits only three determinants of change in OSS: reorganization of the way work is done, technological innovation, and labour shortages. Oppenheimer (1970:116-117) notes that the reorganization of work in the production of boots and shoes resulted in transforming an exclusively male craft into a series of jobs, some of which (stitching and binding) became "women's work" and remained so, despite the shift from home to the factory and the subsequent introduction of machinery.

The development of successively heavier and faster power looms in the cotton industry is cited as the reason female workers were gradually replaced by men, who allegedly could tend the new machines more easily. On the other hand, the introduction of the typewriter, it is noted, marked the influx of women into clerical occupations, once a male preserve; no reasons, however, are offered (Oppenheimer, 1970:117-118).

Labour shortages, Oppenheimer (1970:118-119) argues, resulted in the utilization of women in schoolteaching in the nineteenth century, when cheap native male labour became scarce, as well as an increase in the proportion of male elementary teachers following the Second World War, when a shortage of female teachers occurred. The substitution of female, for male, workers in "men's jobs" due to wartime shortages, however, does not appear to be permanent.

The problem with this approach to change in OSS and SIS is that it does not explain why technological innovation results

in the replacement of men with women in one occupation, and vice versa in another; nor why the reorganization of work overrides tradition in one setting, but not in another. Although the interdisciplinary approach ultimately fails to provide a general explanation for trends in the degree of OSS and SIS in the labour force as a whole, it does provide a post factum account of several changes in sex-typing in specific occupations and industries. Moreover, although Oppenheimer's (1970:77) claim of stability in the overall degree of OSS since the turn of the century remains unsubstantiated, her detailed analysis of OSS and SIS has yet to be surpassed.

The Ecological Approach

There is an approach to the problem of change in OSS, however, which not only uses techniques permitting a more or less reliable measurement of variation in OSS, but also provides a general explanation for trends in OSS and SIS. This approach, the final one to be evaluated in this section, is that of the human ecologists (Poston, 1968; Poston and Johnson, 1971; Martin and Poston, 1976; Williams, 1976). From the ecological perspective, OSS is viewed as a dimension of the more general social division of labour and, as such, is shaped by the process of industrialization (Martin and Poston, 1976: 82). A critical feature of industrial societies, the ecologists argue with Parsons (1960:102), is "a primary orientation to economic productivity" (emphasis in original). It is further argued that as a society industrializes, it becomes

bureaucratized, and hiring practices give preference to those who are likely to contribute most to production; workers are assigned to jobs on the basis of achieved qualifications, rather than on ascribed grounds, such as sex; universalism overrides particularism in the allocation of jobs to prospective workers. Accordingly, the ecologists expect OSS to decrease with advancing industrialization (Poston, 1968:16-17).

Human ecologists (Poston, 1968; Poston and Johnson, 1971; Martin and Poston, 1976) identify several components of industrialization: technology, diversification, efficiency, size, urbanization and level of living. These "component variables" are discussed as interrelated requisites of the industrialization process. Technological development includes the utilization of high-energy sources (e.g., steam, electricity), resulting in increased productivity ("efficiency"), which in turn results in a shift of the working population from agriculture into manufacturing and construction, and hence into services (diversification). The ecologists explicitly specify size as a requisite of industrialization: "Large-scale organizations are certainly necessary for the effective utilization of a [society's] labor force and technology" (Martin and Poston, 1976:85). Urbanization is viewed as a result, as well as a requisite, of industrialization:

> At least until the present time, industrialization has required that populations congregate in cities because of the need for a concentrated labor force to operate the industrial plant; conversely, the increased technology and efficient utilization of manpower and materials in the agricultural sector have resulted in the release of a

> sizable proportion of the workers from agricultural activities. (Martin and Poston, 1976:85)

Ecologists (Martin and Poston, 1976:86) state that "level of living is usually treated as a consequent, rather than a requisite of industrialization, but a certain level of living is needed for continuing industrialization."

Preoccupied with establishing their component variables as requisites of industrialization, the ecologists have neglected to link each of the components to OSS. The relationship said to prevail between industrialization and OSS is apparently assumed to exist as well between the components and OSS. The specific relations between some of the components--technology, size, urbanization, and level of living--are overlooked. The consequences of productivity and efficiency[1] for OSS are mentioned only obliquely in the course of a brief discussion of bureaucratization (Poston, 1968:16). The relationship between the latter process and OSS, moreover, is never hypothesized for testing. This failure to pursue analytically the implications of bureaucracy has been a shortcoming of ecology generally; as a recent assessment (Frisbie and Poston, 1977:18-19) observes: "Ecologists seldom think in terms of bureaucratization when conceptualizing . . . organization, but the concept quite obviously deals with aspects and features of . . . organization." Left unexplored, then, are the

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[1]Ecologists have used the concepts of productivity and efficiency almost synonymously and, as they have recognized recently, "with some inconsistency" (Frisbie and Poston, 1977: 20). The distinction between the two concepts is dealt with in the following section.

mechanisms linking OSS with the components of industrialization--i.e., the core of the phenomenon has yet to be discovered.

In their approach to the sexual division of labour, the ecologists have failed to distinguish ODS and OST as separate dimensions of OSS, and have disregarded SIS altogether. Recent ecological studies have focussed on ODS (Poston and Johnson, 1971; Martin and Poston, 1972; 1976; Williams, 1976), a departure from an earlier study (Poston, 1968), which examined OST, but under the rubric of "ODS." It has not been the intention of the human ecologists, of course, to explore exhaustively the forms of the sexual division of labour itself, but rather to select one dimension (usually ODS) as a manifestation of the more general social division of labour (cf. Martin and Poston, 1976:83), and explain its variation as a result of the level of industrialization. Nevertheless, this failure to appreciate the conceptual distinction to be made between ODS or OST, or to recognize SIS, has resulted in empirical weaknesses in ecological analyses, which are discussed below.

The ecologists' explicit intention (cf. Gibbs and Martin, 1959:36) has been to develop general hypotheses concerning change, and this seems to be precisely what is needed in this area, namely a general explanation of long-term trends in OSS and SIS. Although the ecological expectation of an inverse relationship between OSS and level of industrialization implies an historic decline in the degree of OSS and SIS,

technical difficulties, to be discussed below, have impeded the longitudinal analysis of change in these phenomena.

None of the foregoing approaches to the subject constitutes an adequate explanation of change in OSS and SIS. The economic, socialization, discrimination, and interdisciplinary arguments all identify important determinants of OSS and SIS. The proponents of each have, in Bierstedt's (1960:8) phrase, turned their theoretic bias to good account, but none provides a general explanation of change in these phenomena. As we have seen, the ecological approach offers a good deal of promise in developing hypotheses linking OSS and SIS with industrialization, but this promise has yet to be fulfilled. The following section supplies the clarification and specification absent in the theory thus far.

OSS, SIS and Industrialization

This section develops the thesis that OSS and SIS are inversely related to industrialization, and that this relationship exists concretely in the nature of the effects of four critical dimensions of industrialization. Specifically, it is argued that to understand the relationship of OSS and SIS to industrialization, one must consider the influence of technology, productivity, and urbanization, as well as bureaucratization,[1] recognized by the ecologists as a "logical extension

[1]Although the other components of industrialization identified by the ecologists (size and level of living) remain integral parts of this process, the focus here is confined to the four dimensions with the most predictable effects on the dependent variables.

of an economic system with [a] rational focus on economic productivity" (Poston, 1968:16). In other words, we shall be specifying the basis for the "subrelations" that account for the general relationship of OSS and SIS to industrialization.

The process of industrialization is characterized by technological development and an emphasis on productivity, as well as by urbanization and bureaucratization. Each of these dimensions of industrialization, it is argued, erodes the traditional, ascriptive bases of the social division of labour and the inequality of occupational status, including that of sex.

Technology

While no single factor accounts for the transformation of nonmarket societies whether agricultural or commercial, into industrialized, market societies, there is considerable agreement that the development of machine technology is crucial (Marx, 1906:407; Weber, 1927:174; Polanyi, 1957:40; Fourastie, 1960:17; Williams, 1976:39-41).[1] Industrial machinery differs fundamentally from hand-tool technology in that the former typically involves high-energy converters, delivering many times the power that is at the disposal of nonindustrial societies, including mercantile societies utilizing only the

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[1]Williams (1976:40) has correctly observed that "there is no necessity that members of a society act rationally by choosing to adopt a complex technology and to abandon the principle of ascription." Thus, we eschew any sort of technological fetishism, for such an extreme perspective would itself beg questions concerning the causes of industrial technology.

windmill, waterwheel, and sailing ship (Cottrell, 1955:43-78). Initially based on steam, the development in the West of industrial technology has involved the successive exploitation of other high-yield energy sources, including petroleum, electricity, and nuclear power (Cottrell, 1955:93-99).

In nonindustrialized settings, where sheer physical strength is a requirement for the performance of some tasks, certain subsistence activities must be allocated on the basis of relevant ascribed characteristics, particularly age and sex. In industrialized societies, however, the development of machine technology amplifies human capabilities so as to minimize the importance of brute strength, and hence sex, in the allocation of most jobs. In Canada,

> by 1971 women were employed in virtually every listed occupation. While they were still excluded from some jobs in, for example, stevedoring and the railway running trades, the presence of women in almost every job demonstrated that there was little biological justification for job segregation. (Armstrong and Armstrong, 1973:373).

In light of these considerations, it will be hypothesized that as the level of technological development advances, there will be declines in the degree of OSS and SIS.[1]

Productivity

Technological development, involving the "introduction of new machines, new materials, new sources of power, and new

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[1]It is recognized, of course, that certain areas of work (e.g., stevedoring) are more likely to require strength than others. However, the general thrust of technological development has been to make the consideration of strength decreasingly important in job allocation.

processes," results in increasing productivity or performance,[1] especially that of labour (Higgins, 1968:150). Moreover, the costs and risks of machine production are such that the acquisition and coordination of essential aspects of the production process--raw materials, human labour, and money--are ordinarily undertaken only when the sale of the finished goods or services is not likely to incur a loss (Polanyi, 1957:40). In both modern socialist and capitalist societies, therefore, decisions concerning the disposition of labour, as well as land and money, usually reflect "a primary orientation to economic productivity" (Parsons, 1960:102, emphasis in original). In industrial societies, then, one would expect workers to be hired and promoted on the basis of their expected contribution to production, rather than on ascriptive grounds, such as sex. Accordingly, it is expected that as the level of productivity increases, both OSS and SIS decline.

Urbanization

The development of machine technology and the attendant increase in productivity results in the generation of a surplus (Stein, 1964:48, 51), which in turn leads to exponential

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[1] In ecological studies of OSS, productivity is discussed under the heading of "efficiency," but operationalized with conventional productivity indexes (see p. 20, above). Productivity, or performance, simply refers to a physical or technical relationship, and is expressed as the ratio of output realized to resources used. Efficiency, on the other hand, implies an optimal level of performance of an energy converter, be it a person, a machine, or an entire productive situation, expressed as a proportion of the energy fed into it which is converted into the form desired (Cottrell, 1955:8; Canada. D.B.S., 1965:33).

increases in organizational scale and complexity. Concomitant "improvements in transportation technology," Kuznets (1966:70) observes, "permit the widening of sources of supply." These developments are reflected in the rise of industrial cities and the growth of bureaucracy.

> Urbanization over the last century and a half has been primarily . . . a result of the technological changes that made large-scale operation . . . feasible. A large-scale plant implies a dense . . . community, and a shift of the working, hence total, population to the cities. (Kuznets, 1971:80)

The development of agricultural science and technology reduces the chances of crop failure and raises the level of food production, enabling a minority of the population to provide food for the entire society and, under certain circumstances, to produce foodstuffs for export (Jaffe and Stewart, 1951:23-24; Kuznets, 1966:70). As a result, the rest of the population can concentrate in urban agglomerates, produce nonfoodstuffs, and perform the varied services found in an industrial society (Eldridge, 1942:311; Schnore, 1964:40).

Technological development, Kuznets (1966:276) observes, also increases the variety and volume of consumer goods

> by the creation of new types and by major changes in the old . . . [including] modern canning, freezing . . . , synthetic fiber textiles, household electrical appliances, radio and television sets, passenger cars, airplane transportation, and the like.

Therefore, industrialization, as Stein (1964:6) emphasizes, not only involves mass production, but also implies mass consumption, which often results in the employment of women:

> Workers . . . [are] forced into the scramble for household gadgets . . . children [demand] educational opportunities. . . . Drastic changes in . . . family life,

> including acceptance of the need for wives and mothers to take jobs, [are] justified in terms of the new . . . requirements. (Stein, 1964:52)

The industrial urban milieu has proved especially conducive to gainful employment among women: "The expansion of female job opportunities, and social attitudes in the city have been far more tolerant of working wives than those in the more conservative rural areas" (Ostry and Zaidi, 1972:35).

Urbanization is also accompanied by an early completion of child-bearing and a decline in the birth rate, developments conducive not merely to female labour force participation per se, but also to the employment and advancement of women in occupations characterized by career continuity and, therefore, effectively "off limits" to women bearing and caring for several children over much of their early working lives (Ostry and Zaidi, 1972:36; Oppenheimer, 1970:109-110). Accordingly, inverse relations are expected between urbanization and both OSS and SIS.[1]

Bureaucratization

OSS and SIS, however, cannot be expected to decline merely because of the effects of technological development, a commitment to productivity, and urbanization. For the availability of machinery eliminates only the necessity to select

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[1]Although the growth of the service sector accompanying urbanization (Moore, 1967:107) results in considerably low-grade female employment (Ostry, 1967:7) and, therefore, may mitigate the otherwise inverse relationship expected between urbanization and both OSS and SIS, the hypothesis refers, again, to the general impact of urbanization on OSS and SIS.

workers for some jobs on the basis of strength, i.e., usually by sex. Hiring and promoting workers on the basis of their probable contribution to production is but one strategy consistent with an emphasis on productivity, another of which is taking advantage of existing sex differentials in labour costs. These and other strategies enhancing productivity, however, may be overridden by practices contributing to OSS and SIS. Similarly, the urban milieu and its attendent circumstances (e.g., a low birth rate) are merely conducive to, not determinant of, the employment and advancement of women. Even the combined effects of these three factors, then, will not ensure that workers will be selected and promoted on the basis of achieved qualifications, rather than ascribed characteristics, such as sex. However, one may expect to see the selection and advancement of workers on the basis of their potential contribution to production, rather than on such ascribed characteristics as sex, if technological development, a commitment to productivity, and urbanization are associated with bureaucratization. For this fourth dimension of industrialization ideally maximizes the technical routinization of recruitment and promotion.

The elaboration of machine technology structures the social organization of industrial production and its administration according to a complex technical and professional division of labour. "Technology," observes Galbraith (1971: 31), "means the systematic application of scientific and other organized knowledge to production tasks. Its most important consequence . . . is in forcing the . . . subdivision of any

such task into its component parts." Technological development also increases the elapsed time from the conception, through design and testing, to the emergence, of a marketable product. The increased amount of time, and hence capital, that is committed to production implies the utilization of the diverse talents of many specialists (Galbraith, 1971:32-35). "Mass production," notes Cottrell (1955:207), "requires scheduling that is exact to the fraction of a second and demands controls over . . . temperature, chemical constituents, and other measurements that can be made only by experts." As these experts come to include specialists in planning and coordinating the activities of the experts themselves, industrial enterprises[1]--in order to be efficient and competitive in the world market--must attain a size[2] which calls for management procedures quite different from the personal direction exercised by the early entrepreneurs (Stein, 1964:85-90). In practice, production units become centrally (though not always privately) owned and controlled (Stein, 1964:85) by "some approximation to the model of specialized and hierarchically governed bureaucracy" (Moore, 1974:101, his emphasis).

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[1]Exceptions to this principle include operations which are necessarily geographically dispersed, enterprises specializing either in unstandardized goods or personal services, and firms bound by legal or other constraints on growth (Galbraith, 1973:4-42).

[2]Some firms, of course, exceed the size required for efficiency, the extreme cases resulting in economic concentration--i.e., large size vis-à-vis the market itself (Galbraith, 1971:87-89).

As a dimension of industrialization, bureaucratization involves the substitution of routine procedures for traditional means of control. The tasks once performed by the owner-managers of enterprise have been subdivided into separate functions, including labour management, and the mercantile tasks of purchasing, sales, and finance (Bendix, 1956:211-212). Although notorious for its "impersonality" (Stein, 1964:90), bureaucracy ideally possesses the "special virtue" of "eliminating from official business love, hatred, and all purely personal, irrational, and emotional elements which escape calculation" (Weber, 1958:216).

The rational character of bureaucracy renders it uniquely suited to undertake the planning and coordination of many specialized tasks, so as to maximize productivity. Along with other procedures, in modern industry, recruitment, hiring, and promotion practices are guided in a bureaucratic organization by exhaustive, written rules specifying more or less quantifiable, and hence calculable, standards (e.g., examinations, experience) for the selection and advancement of personnel (Weber, 1958:214-216). Ideally, then, bureaucratization results in workers being hired and promoted on the basis of achieved "technical qualifications which are ascertained through formalized, impersonal procedures" (Merton, 1957:196). It is expected, therefore, that as bureaucratization proceeds, there will be declines in both OSS and SIS (cf. Erickson, 1974: 8). Even bureaucratization, however, should not be expected to eliminate OSS and SIS. The top echelon of organizational

hierarchies, as Weber insisted, cannot be bureaucratized[1] (Parsons, 1960:114).

In this section, we have identified four critical dimensions of industrialization and stated the reasons for expecting each to bear inverse relations to both OSS and SIS. We shall now consider the limitations of the methods used so far in research on OSS and SIS. These techniques will be shown to be unable either to provide support for the explanations with which they are associated or to test the theory developed here.

Research on Change in OSS and SIS

As mentioned earlier, previous investigations of OSS and SIS have led to irreconcilable conclusions about trends in OSS and SIS. Furthermore, as we have seen, none of these conclusions is substantiated. Much of the confusion concerning trends in OSS and SIS undoubtedly stems from technical limitations, which render inconclusive most of the findings. These limitations include the analysis of only part of the labour force, a failure to examine detailed occupational data, a lack of summary measurement, a failure to distinguish SIS from OSS, and OST from ODS, a failure to employ an occupational ranking, and a lack of longitudinal analysis.

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[1]This qualification makes some sense of the fact that women hold less than 1 per cent of both Clement's elite positions (6 out of 946) and Canadian directorships and senior executive positions generally (49 out of 7,358) (Clement, 1975: 266).

One of the most serious shortcomings in investigations of OSS and SIS has been the failure to examine these phenomena throughout the entire labour force. In order to facilitate historical comparison, as well as to make easier the consideration of detailed occupational data, the study of OSS and SIS may be restricted to, say, "the 10 occupations with most female workers" (Armstrong and Armstrong, 1975:372) or, alternatively, to "occupations in which 70 percent or more of the workers [are] women" (Oppenheimer, 1970:76). The extent to which this limits the range of observation, however, is enormous. Armstrong and Armstrong's (1975:372) "leading female occupations," for example, contain less than half (46 per cent) of the female labour force and account for a mere 8 per cent of male workers, as of 1971. Thus the alleged demonstration that "most women in the labour force remain concentrated in a few low-paid and low-skilled women's jobs" (Armstrong and Armstrong, 1975:383) is based on an examination of scarcely one-fifth (22 per cent) of the labour force, a limitation overlooked by the authors.

Other researchers (Knudsen, 1969; Poston, 1968; Martin and Poston, 1972; 1976; Gunderson, 1976) have sought to maximize comparability without sacrificing coverage by analysing labour force data classified according to a few broad, but fairly comparable, categories. As shown earlier, however, broad occupational categories mask enormous amounts of segregation and fail to reveal the inequality actually present in the labour force. Any analysis, therefore, which is confined to broad occupational categories will underestimate the degrees

of OSS and SIS, which are measured more accurately by analysing occupational data at the most detailed level available.

With the exception of Gross (1968), Gunderson (1976), and the human ecologists (Poston, 1968; Poston and Johnson, 1971; Martin and Poston, 1972; 1976; Williams, 1976), none of the investigators of OSS cited above has employed a summary measure of ODS or OST--i.e., a segregation index--with which to specify the amounts of segregation in each of the years, and therewith estimate trends in the phenomenon. The absence of summary measurement is another reason some analyses of OSS and SIS have been limited to inspecting data for a few "leading female occupations" (cf. Armstrong and Armstrong, 1975; Oppenheimer, 1970) or classified according to a few broad categories (cf. Knudsen, 1969). Such analyses inevitably suffer from the limitations we have mentioned.

The application of summary indexes unfortunately has been accompanied by a lack of appreciation for the distinction to be made between ODS and OST. Those employing such measurement examine only one dimension of segregation, usually ODS (Gross, 1968; Poston and Johnson, 1971; Martin and Poston, 1972; 1976). OST has been subjected to summary measurement in one ecological analysis, but under the label of "ODS" (Poston, 1968). In taking up only one dimension of OSS, these studies fail to make the conceptual distinction between ODS and OST that was recognized by Oppenheimer (1970) and by Armstrong and Armstrong (1975), whose respective studies include the examination of both dimensions.

Moreover, none of the studies reviewed here clearly distinguishes SIS from OSS. The human ecologists (Poston, 1968; Poston and Johnson, 1971; Martin and Poston, 1972; 1976; Williams, 1976) make no attempt either to analyse or to predict change in SIS, focussing instead on one dimension of OSS. Although Gross (1968:207) observes that "a major form that segregation takes is stratificational," he neither analyses nor draws conclusions about SIS. Oppenheimer (1970) implicitly considers SIS along with OSS, although she does not sharply distinguish between the two phenomena, neither does she claim to have analysed or discovered trends in SIS. Knudsen's principal concern, of course, is with SIS, which he attempts to infer from OSS: "the majority of the positions filled by women can hardly be classified as creative and intellectually demanding" (1969:185). Similarly, Armstrong and Armstrong assert that their research "demonstrates that most women in the labour force remain concentrated in a few low-skilled, poorly paid jobs" (1975:371, emphasis added). Knudsen and the Armstrongs, however, employ neither an occupational ranking--the sine qua non of any stratification analysis--nor a summary measure of SIS, and are unable, therefore, to provide evidence for the trends they allege.

Their other weaknesses aside, the studies of Armstrong and Armstrong (1976) and of Knudsen (1969) at least encompass several decades, as befits the analysis of change in such phenomena as OSS and SIS. The interdisciplinary study of OSS spans a somewhat longer historical period but it is based on

only two census years: 1900 and 1950 (Oppenheimer, 1970). In contrast to these studies, ecological investigations of OSS are usually confined to cross-sectional analyses of data for only one year (Poston and Johnson, 1971; Martin and Poston, 1972; 1976). In summarizing an ecological analysis involving two successive census years (1950 and 1960), Poston notes that "a time interval greater than ten years in length is probably necessary for an adequate assessment of change in . . . ODS" (1968:199).

In a study of OSS covering a relatively long series of successive census years (1900 through 1960), Gross (1968), in attempting to exploit the advantages afforded by summary measurement, analysed in detail occupational data for the entire labour force. However, Gross used an index which is affected by the number of categories to which it is applied (Blau and Duncan, 1967:69). Since the number of occupations increases decade by decade, conclusions based on the results of such calculations are of questionable validity.

Williams (1976) reports a replication of Gross' study, in which he analysed data classified according to 246 detailed, but "essentially comparable," occupations. The problem with this strategy is that it necessarily excludes workers in relatively new occupations created by technological development and "for which data are unavailable for one or more decade (e.g., airline pilot)" (Williams, 1976:51-52). The exclusion of such occupations from the analysis results in a loss of thirty-eight occupations. This figure represents about 13 per cent of the

occupations and probably a similar proportion of workers.[1] Although Williams overlooks the point, excluding such a proportion of the work force casts doubt upon his conclusion of a decline in ODS.

For one or more of the reasons discussed above, each of the conclusions about trends in OSS and SIS remains unsubstantiated. An adequate test of any theory predicting change in OSS and SIS would involve the application of suitable summary indexes of ODS, OST, and SIS to detailed and ranked occupational data for the entire labour force, over as many years as possible.

Summary

In this chapter we have evaluated various explanations of change in the degree of OSS and SIS in industrial societies and developed an alternative theory of change in OSS and SIS which predicts inverse relations between these phenomena and four aspects of industrialization, namely technology, productivity, urbanization, and bureaucratization. Finally, we examined the methods used in previous studies of OSS and SIS and stated the requirements of a research design that would afford a valid test of a theory predicting change in OSS and SIS.

In the literature reviewed above, too much remains in

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[1] In labour force series for Canada, the percentage of workers excluded by the deletion of such occupations is approximately the same as the proportion of occupations excluded.

the realm of assumption, because of either theoretical bias or methodological inadequacies. Trends in OSS and SIS are assumed, rather than investigated. The situation in a few selected occupations is assumed to exist throughout the labour force. What seems to be the case for one dimension of OSS is assumed to hold for SIS, which is never directly measured. The general relationship between industrialization and OSS is expected to hold for each dimension of industrialization. The reasoning linking OSS with components of industrialization, however, is not provided, nor are dimensions of industrialization linked (either theoretically or empirically) with SIS. The following chapter describes how the theory developed above is tested by an analysis of occupational and other Canadian census data. The results of this analysis are presented in Chapter III and discussed in Chapter IV.

CHAPTER II

METHODOLOGY

This chapter specifies empirical indicators for each dimension of industrialization identified in Chapter I and describes indexes of OSS and SIS. It describes the data to which these measures are applied, restates the hypotheses of inverse relations between the independent and dependent variables, and indicates the analytic techniques used to test these predictions.

Empirical Indicators of the Four Dimensions of Industrialization

In Chapter I it was argued that OSS and SIS are eroded by each of four dimensions of industrialization, namely technological development, increasing productivity, urbanization, and bureaucratization. Available information and techniques do not permit measurement of all elements of any of these complex processes over more than two or three decades, even for a single country, such as Canada, for which data are relatively abundant and of good quality. Accordingly, one empirical indicator is selected for each dimension of industrialization.

Technological development is measured by the number of professional engineers per thousand workers. The selection of this indicator is based on the assumption that technological

development, involving the "introduction of new machines, new materials, new sources of power, and new processes" (Higgins, 1968:150), will be reflected in a greater proportion of specialists concerned with the development and application of industrial technology (Anderson and Wilson, 1974:11-12; cf. Hagedorn et al., 1971:181). More conventional indicators of technology, such as the various energy indexes (Labovitz and Gibbs, 1964:8), would be unfeasible for the early years of the period to be studied. On the other hand, the selection of the number of engineers per thousand workers as an indicator of technological development should reflect technology as involving "the application of knowledge and beliefs in carrying out tasks," including the development of energy sources, machinery, processes, and materials (cf. Gibbs and Martin, 1962:672), a dimension of technology imperfectly measured by energy indexes (Labovitz and Gibbs, 1964:7).

Economic productivity is operationalized as output per man-hour in manufacturing industries. Measurement of productivity is confined to the manufacturing sector[1] to maximize consistency and thereby comparability. Labour is chosen as the single factor in the denominator of this productivity ratio for both conceptual and practical reasons. First, labour is a resource common to all industries. Second, it usually

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[1]Excluded from this productivity measure, therefore, are agriculture; forestry; fishing and trapping; mines, quarries and oil wells; construction; transportation, communication and other utilities; trade; finance, insurance and real estate; community, business and personal service; and public administration and defence (Canada. D.B.S., 1970:17-20).

represents a major part of value added in production. Third, it is relatively easy to measure--in this case, in hours (Canada. D.B.S., 1965:33). The use of man-hours worked, rather than persons employed, avoids the duplication inherent in the latter employment measure, which involves counting multiple job holders twice. The output data represent Real Domestic Product (Canada. Statistics Canada, 1977a:27-28).

The indicator of urbanization is the percentage of the population residing in areas defined as urban by the census. Admittedly a crude measure of the social properties of urbanism, this indicator is the most practicable for the period studied (cf. Labovitz and Gibbs, 1964). Bureaucratization is operationalized as the number of clerical workers per thousand workers, an indicator similar to one used by Blau et al. (1966: 182). Most directly measuring bureaucracy's property of having written rules, records, and communications, requiring "a staff of . . . scribes of all sorts" (Weber, 1958:197), this indicator of bureaucratization necessarily ignores the other dimensions of the process, which are less readily operationalized over the period under consideration. The data for these indicators are described following definition of indexes for the dependent variables.

Indexes of OSS and SIS

In evaluating the methods of previous research, we saw that summary indexes of OSS and SIS are especially appropriate for studying change in these phenomena. Coefficients of

"localization" and "geographic association" have long been used by economists (Hoover, 1936; Florence et al., 1943) and geographers (Wright, 1937). Similar indexes have been used since by sociologists to measure patterns and trends in the residential segregation and relative concentration of racial, ethnic, and socioeconomic-status groups in the United States (Lieberson, 1961; Duncan and Duncan, 1955; Taeuber and Taeuber, 1965; Erbe, 1975), Canada (Marston, 1969; Driedger and Church, 1974; Balakrishnan, 1976), and Sweden (Ramsøy, 1966). Meanwhile, Glenn (1963), Gibbs (1965), Broom and Glenn (1965), and Lieberson and Fuguitt (1967) adapted these measures as indexes of the occupational segregation of whites and blacks in the United States work force. Finally, the sexual division of the labour force was subjected to summary measurement: Gross (1968) measured ODS, and Poston (1968) analysed OST. The human ecologists have continued to employ segregation indexes of ODS (Poston and Johnson, 1971; Williams, 1975; 1976) and in some studies have focussed simultaneously on occupational differentiation by race, sex, and age (Martin, 1972; Martin and Poston, 1972; 1976). As noted in Chapter I, however, SIS has yet to be so measured. This section describes conventional measures of OSS and introduces indexes of ODS, OST, and SIS.

Measurement of ODS

With one exception (Gunderson, 1976), all analyses of ODS employing summary measurement use the dissimilarity index (DI) (Gross, 1968; Poston and Johnston, 1971; Martin, 1972; Martin and Poston, 1972; 1976; Williams, 1975; 1976). Since DI

is used in this study for comparative purposes, its calculation as an index of ODS is illustrated here. The formula for DI is

$$100 \times (\Sigma|X_i - Y_i|)/2$$

where X_i is the proportion of the female labour force in the ith of n occupations, Y_i is the proportion of the male labour force in the ith of n occupations, and the summation is of the absolute differences between the female and male proportions in each occupation over n occupations. DI varies between zero and 100 and may be interpreted as an index of displacement, indicating the percentage of female workers who would have to change occupations for their occupational distribution to be the same as that for male workers, or vice versa. The calculation of DI may be demonstrated by applying it to a simple hypothetical work force (Table 5). As in actual industrial labour forces, the males in the hypothetical work force are more evenly distributed among the three occupations than the women. The concentration of the female labour force is such that most women are in occupation 3, the rest in occupation 2, and none in occupation 1.

Table 5

Numerical Distribution of Hypothetical Labour Force, by Three Occupations and by Sex

Occupation	Male	Female	Total
1	30	0	30
2	20	5	25
3	10	25	35
Totals	60	30	90

To compute DI for the hypothetical work force, we calculate the proportional distributions of the male and female labour forces and take the absolute differences between the female and male proportions in each occupation (Table 6).

Table 6

Proportional Distribution of Hypothetical Labour Force, by Three Occupations and by Sex, Showing Absolute Differences

Occupation	Male Y_i	Female X_i	Absolute Differences $\lvert X_i - Y_i \rvert$
1	0.50	0.00	0.50
2	0.33	0.17	0.16
3	0.17	0.83	0.66
Totals	1.00	1.00	1.32

For this example, then,

$$DI = 100 \times (\Sigma \lvert X_i - Y_i \rvert)/2$$

$$= 100 \times (1.32/2)$$

$$= 100 \times 0.66$$

$$= 66.0 \text{ per cent}$$

The DI value of 66 per cent for this hypothetical work force indicates that the degree of ODS is such that 66 per cent of the female labour force would have to shift from one occupation to another in order for their occupational distribution to be the same as that of the male labour force or vice versa.

This interpretation of DI may be verified by observing that if five women are shifted from occupation 3 and placed in occupation 2, and another fifteen women from occupation 3 are placed in occupation 1, the female labour force would have the same proportional distribution as the male work force (Table 7, cf. Tables 5 and 6). In all, twenty of the thirty women, or 66 per cent of the female labour force (the calculated value of DI), must change occupations in order for the occupational distributions of the sexes to be the same.

Table 7

Numerical and Proportional Distributions of Hypothetical Labour Force, by Three Occupations and by Sex, with Females Redistributed According to Male Distribution

Occupation	Numerical Distribution		Proportional Distribution	
	Male	Female	Male	Female
1	30	15	0.50	0.50
2	20	10	0.33	0.33
3	10	5	0.17	0.17
Totals	60	30	1.00	1.00

One of the advantages of DI is that it may be interpreted from the standpoint of either sex. Shifting 66 per cent of the hypothetical male labour force (forty men) by moving all thirty males from occupation 1, and ten from occupation 2, to occupation 3 also makes the proportional distributions of the

sexes the same (Table 8, cf. Tables 5 and 6). Thus, DI indicates the redistribution of either sex required for the occupational distributions of both to be identical.

Table 8

Numerical and Proportional Distributions of Hypothetical Labour Force, by Three Occupations and by Sex, with Males Redistributed According to Female Distribution

Occupation	Numerical Distribution		Proportional Distribution	
	Male	Female	Male	Female
1	0	0	0.00	0.00
2	10	5	0.17	0.17
3	50	25	0.83	0.83
Totals	60	30	1.00	1.00

Reconsidering the hypothetical work force in Table 5, however, it may be noted that the labour force as a whole is not evenly distributed among the three occupations. This raises the question as to how much of the measured ODS is due to the structural effects of the occupational distribution of the total labour force. These effects can be removed by "standardizing" the work force on occupation (cf. Poston and Johnson, 1971:338-339). This may be done by assigning an equal number of persons to every occupation, maintaining the original sex composition within each occupation. Table 9 contains the hypothetical labour force data from Table 5, standardized on occupation. As may be seen, the standardized labour force

numbers 300, with an equal number of workers (100) in each occupation. The original within-occupation sex composition is maintained: e.g., just as in the original distribution 20 per cent (5/25) of the workers in occupation 2 are women (Table 5), so, too, in the standardized distribution 20 per cent (20/100) of the workers in occupation 2 are female (Table 9). DI may be calculated, interpreted, and verified for the standardized labour force as for the original. The DI value for the standardized data is 64 per cent. Compared with the "crude" value of 66 per cent, calculated for the original distribution, this result indicates that only 3 per cent (2/66) of the ODS measured in the original distribution is due to the structural effects of the occupational distribution of the total labour force. In the examples that follow, as in the analysis reported in the next chapter, all measures of OSS and SIS are calculated with standardized data.

Table 9

Numerical Distribution of Hypothetical Labour Force, by Three Occupations and by Sex, Standardized on Occupation

Occupation	Male	Female	Total
1	100	0	100
2	80	20	100
3	29	71	100
Totals	209	91	300

DI values, however, are affected by the number of

categories (n) to which this index is applied (Blau and Duncan, 1969:69; Martin and Poston, 1972). For measuring change in ODS, therefore, DI is appropriate only for data series in which n is constant, as in the analysis undertaken for comparative purposes in this study. An index independent of n is required wherever n varies, as in the main analysis of this investigation. Gibbs and Poston (1975:473-474) present a measure of differentiation (M4), which they report is virtually independent of the number of categories to which it is applied ($r = 0.13$). M4 measures the degree of concentration of workers in an occupational distribution. Now, the greater concentration of female, than male, workers among occupations is the essential feature of ODS (cf. Tables 1 and 5, above). Applied to the female labour force, therefore, M4 should serve as a satisfactory index of ODS. For this purpose, M4 is obtained by calculating the quantity

$$100 \times \left[\frac{(\Sigma |X_i - \overline{X}|)/2}{\Sigma X_i} \right]$$

where X_i is the standardized frequency of women in the ith of n occupations, $\overline{X}$ is the mean standardized frequency of women per occupation, and the summation in the numerator is of the absolute deviations of the standardized frequencies from the mean standardized frequency over n occupations. The summation in the denominator is the total number of females in the standardized labour force. The calculated values of M4 range between zero and 100 per cent, indicating the percentage of the female labour

force that would have to be shifted from one occupation to another in order to achieve a prefectly even distribution of women in all occupations (Gibbs and Poston, 1975:374). Hence the higher the value of M4, the greater the degree of concentration of the female labour force in a relatively few occupations, and the lower the value, the more even the distribution of women among the occupations.[1]

The calculation of M4 may be illustrated by using the standardized hypothetical labour force (Table 9). To calculate M4 for the female labour force in Table 9, we first obtain the mean number of women per occupation:

$$\bar{X} = \Sigma X_i / n$$
$$= 91/3$$
$$\approx 30$$

The absolute deviations of the standardized frequencies of women in each occupation from the mean number of women per occupation include

occupation 1: $|0 - 30| = 30$

occupation 2: $|20 - 30| = 10$

occupation 3: $|71 - 30| = 41$

For the standardized hypothetical female labour force, then

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[1]This calculation of M4 differs in two minor respects from that of Gibbs and Poston (1975). First, they do not include the multiplication by 100, and hence obtain a proportion rather than a percentage. Second, they subtract the calculated quantity from unity, which merely implies an interpretation which is the converse of that given here: i.e., the lower the value, the greater the concentration, and vice versa.

$$M4 = 100 \times \left[\frac{(\Sigma|X_i - \bar{X}|)/2}{\Sigma X_i}\right]$$

$$= 100 \times \left[\frac{(30 + 10 + 41)/2}{91}\right]$$

$$= 100 \times \left[\frac{81/2}{91}\right]$$

$$= 100 \times (40.5/91)$$

$$= 100 \times 44.5$$

$$= 44.5 \text{ per cent}$$

The M4 value of 44.5 per cent for the standardized hypothetical female labour force indicates that the degree of concentration of women is such that 44.5 per cent of them would have to be shifted from one occupation to another in order for their distribution among all occupations to be perfectly even. This interpretation of M4 may be verified by observing (Table 9) that if ten women are taken from occupation 3 and placed in occupation 2, and another thirty-one from occupation 3 are placed in occupation 1, a perfectly even distribution of thirty women per occupation (with one woman left over) is achieved by shifting forty-one members (or 44.5 per cent) of the 91-member standardized hypothetical female labour force, precisely the value of M4 calculated above.

Although calculating M4 for the female labour force provides a satisfactory measure of the degree of concentration of women, it gives no indication of the concentration of the female labour force relative to that of men. Unlike DI, then,

M4 does not directly measure ODS, which refers to the difference in the occupational distributions of men and women. As evident in Table 9, although male workers are more evenly distributed among the three occupations than women, nearly half of the standardized male labour force is concentrated in occupation 1, and nearly 90 per cent in the first 2 occupations combined. The M4 value for the standardized hypothetical male labour force is 19.4 per cent, indicating less than half the amount of concentration measured in the female labour force (M4 = 44.5).

The information contained in the M4 values for the male and female work forces could be combined by taking the ratio of the latter to the former: 44.5/19.4 = 2.29, which indicates that over twice the proportion of the female labour force would have to change jobs in order to achieve a perfectly even distribution among occupations than would be the case for the male labour force. In the Canadian data, however, M4 values for the female labour force are consistently higher than those for the male labour force. Moreover, the ratios of the former to the latter are almost perfectly correlated with the M4 values for females (r = 0.97). It may be assumed, therefore, that M4 values calculated for the female labour force serve as valid indicators of the degree of ODS.

Measurement of OST

As noted in Chapter I, there is only one analysis of OST involving summary measurement (Poston, 1968). The index used is the coefficient of relative variation (CRV), a general measure of variability consisting of the ratio of the standard deviation

to the mean (Poston, 1968:64-77; Snedecor and Cochrane, 1967: 62-64). Since CRV is used for comparative purposes in this study, its calculation as an index of OST is illustrated here.

Before defining CRV and illustrating its calculation, it would be useful to consider OST in the hypothetical work force used to demonstrate the computation of the measures of ODS. As may be seen in Table 10, women constitute one-third of the total labour force (30/90), yet there are no women in occupation 1, which in this respect is similar to the virtually all-male preserves of the Canadian labour force observed in Chapter I (cf. Tables 2 and 3). In occupation 2 we find that one-fifth, and in occupation 3 over two-thirds, of the workers are female. In none of the three occupations do we observe the number of women we would expect if female workers were represented in each occupation as they are in the total labour force.

Table 10

Numerical Distribution of Hypothetical Labour Force, by Three Occupations and by Sex

Occupation	Male	Female	Total
1	30	0	30
2	20	5	25
3	10	25	35
Totals	60	30	90

Nor is this OST the result of women being outnumbered two to one in the labour force as a whole. For if we remove the

structural effects of the sex composition of the total labour force, by setting the total number of female workers at that of males (i.e., equalizing the proportional representation of men and women in the work force as a whole at 0.50 each) and apportioning them according to the original occupational distribution of women, OST is still evident (Table 11). Occupation 1 remains monopolized by male workers, one-third of all workers in occupation 2 are women, as are over four-fifths in occupation 3. In the standardized, as in the original, hypothetical work force, then, no occupation contains the sex composition one would expect from the now equalized representation of the sexes in the total labour force.

Table 11

Numerical Distribution of Hypothetical Labour Force, by Three Occupations and by Sex, Standardized on Sex

Occupation	Male	Female	Total
1	30	0	30
2	20	10	30
3	10	50	60
Totals	60	60	120

The calculation of CRV as an index of OST may be illustrated with the standardized data in Table 11. The first step in obtaining CRV is to calculate the ratio (R_i) of the observed to the expected (E_i) number of women for each occupation. This is done by dividing the number of women observed in each occupation

(O_i) by the number we would expect (E_i) if the sexes were represented in each occupation as in the labour force as a whole. The expected frequencies are obtained by multiplying the total number of workers in each occupation (T_i) by the proportion of women in the total labour force (P). Thus,

$$R_i = O_i/E$$
$$= O_i/(T_i \times P)$$

Since the hypothetical work force is standardized on sex, with the porportions of the sexes in the total labour force equalized, P = 0.50. The ratios (R_i) are calculated in Table 12.

Table 12

Calculation of Ratios of Observed to Expected Frequencies of Females in Hypothetical Labour Force, Standardized on Sex

Occupation	O_i	T_i	P	E_i ($T_i \times P$)	R_i (O_i/E_i)
1	0	30	0.50	15	0.000
2	10	30	0.50	15	0.667
3	50	60	0.50	30	1.667
Total					2.334

The calculations in Table 12 show that an underrepresentation of women in an occupation ($O_i < E_i$) results in a ratio less than 1.00 (e.g., occupation 2) and that an overrepresentation ($O_i > E_i$) produces a ratio greater than 1.00 (e.g., occupation 3). Where the number of women observed in an occupation is what one would expect from their representation in the labour force as a

whole ($O_i = E_i$), the ratio would be 1.00, an event which does not occur in the hypothetical labour force. In other words, OST in the form of discrepancies between the sex compositions of occupations and that of the total labour force results in observed-to-expected ratios greater or less than, but not equal to, 1.00. Thus, the greater the extent of OST--i.e., the more instances of, and the more extreme, such departures from the overall sex composition of the labour force--the greater the dispersion of ratios about 1.00.

One way to measure OST with the information obtained so far would be to calculate the standard deviation (σ) of the ratios (R_i), which measures their dispersion about their mean ($\bar{R}$):

$$\sigma = \sqrt{\Sigma (R_i - \bar{R})^2 / n}$$

With the information in Table 12 the mean ($\bar{R}$) is calculated as follows:

$$\bar{R} = \Sigma R_i / n$$
$$= (0.000 = 0.667 = 1.667)/3$$
$$= 2.334/3$$
$$= 0.778$$

The deviations of the ratios from the mean ($R_i - \bar{R}$) and their squared values $(R_i - \bar{R})^2$ are presented in Table 13.

Table 13

Calculation of Deviations of Ratios from Mean Ratio ($R_i - \bar{R}$) and Squared Deviations $(R_i - \bar{R})^2$

Occupation	R_i	$\bar{R}$	$(R_i - \bar{R})$	$(R_i - \bar{R})^2$
1	0.000	0.778	-0.778	0.605
2	0.667	0.778	-0.111	0.012
3	1.667	0.778	-0.889	0.790

The standard deviation (σ) may be calculated using the information from Table 13:

$$\sigma = \sqrt{\Sigma(R_i - \bar{R})^2/n}$$

$$= \sqrt{(0.605 + 0.012 + 0.790)/n}$$

$$= \sqrt{1.407/3}$$

$$= \sqrt{0.469}$$

$$= 0.685$$

As a basic measure of variation, the standard deviation would summarize the extent of OST present in a labour force: the greater the standard deviation, the greater the degree of OST.

The standard deviation, however, is inappropriate for comparing OST in one work force with that in another. For, as Poston (1968:70) notes, the mean, as well as the standard deviation, may vary among labour forces (cf. Snedecor and Cochrane, 1967:62). For comparative purposes, therefore, Poston (1968: 70-71) calculated CRV as a normal measure of dispersion,

$$CRV = 100 \times (\sigma/\bar{R}),$$

which also reflects the degree of OST: the larger the value of CRV, the greater the extent of OST. Now, CRV differs from both DI and M4 in two important respects. First, CRV values are not readily interpreted with reference to the redistribution required to achieve evenness. Second, CRV lacks an upper limit: given sufficient dispersion (i.e., $\sigma > \bar{R}$), CRV exceeds 100. Martin and Gray (1971:497) present a corrected CRV (CRVc), obtained through division by $\sqrt{n - 1}$, the theoretical maximum value of CRV:

$$CRVc = 100 \times (\sigma/\bar{R})/\sqrt{n - 1}$$

Substituting the data for the hypothetical labour force, we have

$$\begin{aligned} CRVc &= 100 \times (p.685/0.778)/(\sqrt{n - 1}) \\ &= 100 \times (0.880/\sqrt{3 - 1}) \\ &= 100 \times (0.880/\sqrt{2}) \\ &= 100 \times (0.880/1.414) \\ &= 100 \times (0.622) \\ &= 62.2 \text{ per cent} \end{aligned}$$

Although CRVc does not vary above 100, it remains dependent on n: the larger the n, the smaller the CRVc value (cf. Smith and Snow, 1976:527). As an index of OST, therefore, CRVc is appropriate only if applied to a small and constant

number of occupational categories, as in the analysis performed for comparative purposes in this study (cf. Poston, 1968). An OST measure independent of n is required for the main analysis of this investigation, in which n varies. As noted in the previous section, M4 is independent of n. Otherwise, however, it is similar to CRV, being based on absolute, rather than squared, deviations from the mean (Martin and Gray, 1971:496-497; Smith and Snow, 1976:525). A variation of M4, therefore, may be used to measure OST in the main analysis of this study. To distinguish it from M4, the principal measure of ODS, this adapted index of OST is here called M7:[1]

$$M7 = 100 \times \left[\frac{(\Sigma |R_i - \bar{R}|)/2}{\Sigma R_i} \right]$$

M7 ranges from zero to 100 and indicates the degree of OST: the higher the value, the greater the OST. Like CRVc, M7 lacks an interpretation with reference to the redistribution required to achieve evenness.

M7 may be calculated for the standardized hypothetical labour force with the ratios and their deviations from the mean, obtained in the course of computing CRV (Tables 12 and 13, above):

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[1] Gibbs and Poston (1975) present six measures in all: M1 through M6.

$$M7 = 100 \times \left[\frac{(\Sigma|R_i - \bar{R}|)/2}{\Sigma R_i}\right]$$

$$= 100 \times \left[\frac{(0.778 + 0.111 + 0.889)/2}{2.334}\right]$$

$$= 100 \times \left[\frac{1.778/2}{2.334}\right]$$

$$= 100 \times (0.889/2.334)$$

$$= 100 \times (0.3809)$$

$$= 38.09 \text{ per cent}$$

Thus, M7 is introduced as an index of OST for data series in which n is large and varies, as in the main analysis of this study.

Measurement of SIS

Unlike ODS and OST, SIS has never been subjected to summary measurement. This study introduces an adaptation of Duncan and Duncan's (1955:495) low-rent concentration index[1] to measure the relative occupational status of the sexes in the labour force. This index of relative occupational status (RS) is obtained by (1) ordering the occupations from high to low rank, (2) removing the structural effects of the occupational-rank distribution of the total labour force through standardization, as for M4 above, (3) calculating the proportional distributions of the standardized male and female labour forces among the

[1]This measure is formally identical to the Gini index (Duncan, 1952:267).

occupational ranks, (4) cumulating the proportional standardized distributions from high to low occupational rank, and (5) computing the quantity

$$\sum X_{i-1} Y_i - \sum X_i Y_{i-1}$$

where X_i is the cumulated proportion of the standardized female labour force, and Y_i is the cumulated proportion of the standardized male labour force, in the ith of n occupational ranks, and the summations are over the specified intervals. Calculated in this way, the index serves as a measure of the occupational status of females relative to males. RS values range from -100 to +100. Negative values indicate that women, in comparison to men, are concentrated in occupations of lower rank; positive values indicate that women, in comparison to men, are concentrated in occupations of higher rank. Zero indicates sexual equality in occupational status. The magnitude of RS values lacks a direct interpretation with reference to redistribution required to bring about evenness (cf. CRVc and M7, above). According to Duncan's (1952) interpretation, however, absolute values greater than 20.0 indicate a "very" inequitable situation.

Imposing order on the hypothetical labour force data used above permits an illustration of the calculation of RS. Since standardization is accomplished as for measuring ODS, we use the distribution standardized on occupation for obtaining DI and M4, above. These data are reproduced and ranked in Table 14.

Table 14

Numerical Distribution of Hypothetical Labour Force, by Three Occupational Ranks, and by Sex, Standardized on Occupational Rank

Occupational Rank	Male	Female	Total
High	100	0	100
Medium	80	20	100
Low	29	71	100
Totals	209	91	300

With our hypothetical data now standardized and ordered, we next calculate, then cumulate, the proportional distributions of both the male and female labour force (Table 15).

Table 15

Proportional and Cumulated Proportional Distributions of Hypothetical Male and Female Labour Forces, by Three Occupational Ranks, Standardized on Occupational Rank

Occupational Rank	Proportional Distribution		Cumulated Distribution	
	Male	Female	Male	Female
High	0.48	0.00	0.48	0.00
Medium	0.38	0.22	0.86	0.22
Low	0.14	0.78	1.00	1.00
Totals	1.00	1.00	—	—

We are now ready to calculate the components of RS; the operations are shown in Table 16.

Table 16

Calculation of Components of RS
for Hypothetical Labour Force

Occupational Rank	Male Y_i	Female X_i	$X_{i-1}Y_i$	X_iY_{i-1}
High	0.48	0.00	0.00	—
Medium	0.86	0.22	0.22	0.11
Low	1.00	1.00	—	0.86
Totals	—	—	0.22	0.97

The index of SIS is then obtained as follows:

$$RS = 100 \times \left(\sum_{2}^{n} X_{i-1}Y_i - \sum_{2}^{n} X_iY_{i-1}\right)$$

$$= 100 \times (0.22 - 0.97)$$

$$= 100 \times (-0.75)$$

$$= -75.0$$

The negative sign of this RS value indicates that in the hypothetical labour force women, in comparison to men, are concentrated in the lower ranking occupations. The magnitude of the value suggests that the degree of relative concentration is extreme. Whether RS is affected by the number of categories to which it is applied remains an empirical question. Accordingly, no assumptions concerning the relation of RS to n are warranted at this stage. This study, however, may be expected to provide some evidence as to this relationship.

This section has described conventional measures of OSS and introduced indexes of ODS, OST, and SIS. The data to which

they are applied are specified in the following section.

The Data

This section describes the bodies of data to which the measures of the dependent and independent variables defined above are applied. The data sets used are based on census and other official Canadian series for the nine census years from 1891, when occupational data were first classified by sex, through 1971, the most recent census year. Although it would be desirable to have a more lengthy series of annual data, the basic observations on most of the variables are made no more frequently than every ten years.[1] Decennial series, however, do not present a serious problem, since the variables are aggregate characteristics which probably exhibit little yearly change. A greater limitation of the data base is the short period which it covers (cf. Land, 1970:272-273). Were the requisite data available for the two census years preceding 1891, the analysis could include the period from 1871, the point from which industrialization in Canada, while remaining largely resource-based, may be regarded as developing under market conditions (Pentland, 1959:455). Nevertheless, the 1891-1971 period is at least one decade longer than that encompassed by the longest previous analyses of change in OSS or SIS.

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[1]The continuous survey of the labour force, begun on a quarterly basis in 1945, and carried out monthly since 1952, provides neither the time span nor the detail required for an analysis of long-term change in OSS and its relation to industrialization (cf. Ostry and Zaidi, 1972:10).

ODS and OST

The main data series used to generate ODS and OST values is based on the detailed, national occupational data published for each census year from 1891 through 1971. The historical series published in the 1921 census is used for the years 1891 through 1921 (Canada. D.B.S., 1929:Table 1). There are two reasons for selecting this series. First, the occupational data for 1901 are not contained in the publications of the 1901 census (Canada. Statistics Canada, 1977b; cf. Canada. Census Office, 1902; 1904; 1905; 1906), although they are presented in the occupational volumes of both the 1911 and 1921 census (Canada. Department of Trade and Commerce, 1915:Table 1; Canada. D.B.S., 1921:Table 1). One of the latter publications, therefore, must be used as the source of detailed occupational data for 1901. Second, in the 1921 census publication the 1901 data form part of a comparative series for the census years 1891 through 1921. Accordingly, the 1921 census is used as the most appropriate source of data for the first four census years included in this analysis.

No similar series of data exists for the period 1931 through 1971, during which the census classification of occupations underwent basic revision every census year, reflecting the rapid and fundamental transformation of the occupational composition of the labour force. As a result, comparability is achieved either at the cost of detail, as long-run, but broadly classified, series are constructed (cf. Ostry, 1967:Table 3), or at the cost of coverage, as detailed series which necessarily

exclude the newer, incomparable occupations are created (cf. Canada. D.B.S., 1966:Table 8; Meltz, 1968). The data for 1931 through 1971, therefore, are based on the pertinent census publications for those years (Canada. D.B.S., 1936:Table 40; 1946:Table 4; 1953:Table 4; 1963:Table 6; Statistics Canada, 1974:Table 2).

Although these bodies of data permit measurement of OSS throughout the entire labour force and at the most detailed level published, there is a problem of comparability, at least for the 1931-1971 period, during which the definition, as well as the number, of occupations varied greatly. Although neither the index of ODS (M4) or the measure of OST (M7) is appreciably affected by variation in the number of categories, there remains the question of definitional consistency. Accordingly, Ostry's (1967:Table 3) definitionally consistent, but broadly classified,[1] series of occupational data for the census years 1901 through 1961 is used to calculate ODS and OST values with the conventional measures (DI and CRVc), as well as with the indexes introduced in this study (M4 and M7). These calculations permit an evaluation of the detailed data used in the main analysis, as well as of the measures introduced here.

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[1]The classification is based on the broad "divisions" of the 1951 census scheme. In order to maximize definitional consistency, as well as to preserve a constant number of categories, the "occupation not stated" category, not used until 1921, is not included in this analysis. For the same reasons, the "commercial" and "financial" divisions, inseparable for 1901, are collapsed into a single category. These adjustments, also made by Ostry (1967:3-8) for analytic purposes, result in fourteen divisions for all census years, 1901 through 1961.

A definitional difference of another sort remains in both the detailed series based on the original 1891-1971 census counts and the broadly but comparably classified series prepared by Ostry (1967). Prior to 1951 the census used the "gainfully occupied," rather than the current "labour force," definition of the economically active population. This difference affects the enumeration of the female labour force, as well as of student-age male workers and persons in seasonal occupations (Canada. D.B.S., 1967:4), and may, therefore, be expected to have consequences for the measurement of OSS. Determining the nature and extent of these effects, however, is beyond the scope of the present study. There is one advantage in using the gainfully occupied concept which may compensate in part for the effects of the difference in work-force definitions. Since the gainfully occupied concept refers to customary or habitual activity, this definition of the working population is less susceptible to the disruptions occasioned by the Great Depression and the Second World War[1] (Denton and Ostry, 1967:4; Ostry, 1967:32).

Three additional inconsistencies remain in the detailed 1891-1971 series. First, the minimum age for the work force has been revised upward over the past generation. The gainfully occupied count included persons ten years of age and over until

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[1] In an analysis of change over a shorter period, especially of the effects of a war, for example (cf. Pierson, 1977), the differences between the data for 1951 and those for 1931 and 1941 would present the very sort of problem to which the recurring labour force survey and its labour force concept of the work force were a response (Denton and Ostry, 1967:4-8).

1941, when the minimum age was changed to fourteen. In 1961, the age was raised again, to fifteen years. Since the nature of Canadian society and the economy prior to the 1960's was such that the labour force included a few people less than fifteen years of age,[1] the detailed data sets have been left unadjusted, as reflecting the circumstances of the times in which they were recorded. The other discrepancies in the detailed series are the exclusion of the Yukon and Northwest Territories until 1961 and the inclusion, in 1941, of persons on active service with a gainful occupation prior to enlistment.

SIS

As stressed above, the measurement of SIS requires ranked occupational data. The availability of socioeconomic indexes for the detailed occupations of the 1951, 1961, and 1971 censuses (Blishen, 1958; 1967; Blishen and McRoberts, 1976), make it possible to analyse SIS for the three most recent census years. The ranked 1951 occupations include all those specified in the 1951 census, with the exception of two occupations, "flower growers and landscape gardeners" and "lodging and boarding house keepers," for which the 1951 scale contains no indexes. This resulted in an omission of 3,424 men and 6,364 women, less than 1 per cent of the workers of each sex.

The ordered 1961 occupations include all those specified

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[1] With the exception of girls in 1911, who constituted 2 per cent of all gainful workers, these young people never exceeded 1 per cent of the total work force. Most of the boys were classified as unpaid family workers on farms, the girls as domestic servants.

in the census of that year except nine, for which Blishen's 1961 scale contains no entries. Excluded are 392,496 men and 24,123 women. Nearly all of the males excluded (384,410) and one-third of the females (8,996) are "farmers and stockraisers," then the most numerous single type of worker.[1] The ranked 1971 occupations include all those specified in the 1971 census.

There are three features of the occupational scales which could affect the analysis of SIS. First, the 1951 index is based entirely on education and income, whereas the 1961 and 1971 scales are based on Porter-Pineo (1967) prestige scores, as well as on education and income. It is unlikely that this difference in construction could appreciably affect the analysis of OSS, however, as Blishen (1967:50) reports a rank correlation of 0.96 between the 1961 index and the 1951 scale.

Second, the 1961 and 1971 indexes are based on the characteristics of male workers only. This strategy is founded on the assumption that "the family's social status is dependent upon the occupation of the husband rather than the wife when both are working" (Blishen, 1967:42). Similarly, though critically, Meissner et al. (1975:426) contend that "women's position is a function of . . . their kin relationship as constituted through their dependent labour in the household. . . . and the jobs . . . available to them confirm their dependent

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[1]The other occupations excluded are nuns and brothers, dieticians, delivery managers, owners and managers in tobacco products industries, owners and managers in unspecified industries, doctors' and dentists' office attendants, unspecified sales occupations, and milliners, hat and cap makers (cf. Blishen, 1967:431).

labour status." In contrast, Eichler (1973:47) argues that, in addition to the status derived from their husband's position, employed women have an independent status which is established on the same basis as that of men, though it is lowered by the fact of their femaleness. Available data and techniques do not permit direct measurement of such a gender effect here. However, the availability of an additional set of indexes, based on the characteristics of female workers, for 205 of the 279 occupations listed in 1951, and for all listed in 1971 (Blishen and Carroll, forthcoming), permits a partial assessment of the extent to which basing occupational ranks on the characteristics of male workers only may affect the analysis of SIS.

Pearson correlations between male and female scores for both 1951 and 1971 are high (0.92 and 0.84, respectively). Moreover, in the case of the 205 occupations of the 1951 census, weighted-average scores, based jointly on the male and female indexes, correlate even more highly with the separate male and female scores (0.99 and 0.94, respectively). Furthermore, separate calculations of the index of SIS (RS) for the 205 occupations for 1951, with the occupations ordered first according to male scores (RS = -0.14) and then according to the weighted-average indexes (RS = -0.17), suggest that the use of male rankings may only slightly underestimate the degree of OSS. Since only male indexes are available for 1961, however, the male scores are also used to order occupations for 1951 and 1971. Occupations for each year, then, are ranked on a consistent, if perhaps not ideal, basis.

The third issue that arises in preparing data for measuring SIS concerns variation in the number of ranked occupations (n) among the three census years included in this phase of the analysis. As noted above, the relationship between RS values and n is uncertain. In addition to the detailed, ranked occupations, therefore, Blishen's six broad "class intervals" are also used to provide a series with a consistent number of ranked categories. Since the published 1951 scale is divided into seven "somewhat arbitrary" intervals (Blishen, 1958:522), the ranked 1951 occupations are reclassified into six equal-interval categories. Because the range of the 1951 scale (31.95 - 89.95) differs considerably from that for both 1961 (25.36 - 76.69) and 1971 (14.40 - 75.28), the cutting points used to determine the six class intervals of the 1951 scale are made at every eight index points, ranging from 72.00 downward to 40.00, rather than at the tens digits as for the 1961 and 1971 scales (Blishen, 1967:51; Blishen and McRoberts, 1976:73). Blishen (1978), who also uses the 1951 index divided into six class intervals, regards the method employed here as appropriate.

Indicators of Industrialization

With the exception of productivity, the four indicators of industrialization are measured with census data. The number of professional engineers per thousand workers, the indicator of technological development, is taken from the detailed occupational data used in the analysis of OSS. The number of surveyors is inseparable from that of engineers for the census years 1891 through 1941. To maximize consistency, therefore,

surveyors are included for the remaining census years as well.

Productivity, measured as output per man-hour in manufacturing industries, is the only independent variable for which data are not available for all census years included in this study. Canada's "National Accounts," which contain the required information on volume and type of industrial production, as well as on the numbers of persons employed and the amount of time worked, cover only the period following the close of the Second World War (cf. Jaffe and Froomkin, 1968:180-181). Like SIS, then, productivity can be measured only for the census years 1951, 1961, and 1971. The data on output per man-hour are taken from a comparable series of productivity measures for manufacturing, which are given in index form, using 1971 as the base year (Canada. Statistics Canada, 1977a:Table 13).

The source of data on urbanization, measured as the percentage of the population residing in areas defined as urban by the census, for 1891 through 1961 is the definitionally consistent series of decennial rural-urban distributions prepared by Stone (1967:Table 22). The information for 1971 is taken from the 1971 census and adjusted for comparability with Stone's figures (Canada. Statistics Canada, 1973:Table 10).

Data on bureaucratization, the number of clerical workers per thousand workers, for 1901 through 1961 are taken from the broadly but consistently classified series of occupational data used to measure OSS (Ostry, 1967:Table 3). The original, unadjustable census figures must be used for 1891 and 1971 (Canada. Department of Agriculture, 1893:Table XII; Canada.

Statistics Canada, 1974:Table 2).

The methods by which the results of measuring these data on the dependent and independent variables are analysed will be specified following a restatement of the hypotheses of inverse relationships between industrialization and both OSS and SIS.

Statement of Hypotheses

According to the theory of change in OSS and SIS developed in Chapter I, inverse relations are expected between these phenomena and each dimension of industrialization. From this general expectation are derived twelve specific hypotheses:

1. In Canada between 1891[1] and 1971 there will be an inverse relationship between industrialization and ODS; as industrialization advances, ODS will decline. Thus:
   - 1.1 There will be an inverse relation between technological development and ODS.
   - 1.2 There will be an inverse relation between productivity and ODS.
   - 1.3 There will be an inverse relation between urbanization and ODS.
   - 1.4 There will be an inverse relation between bureaucratization and ODS.
2. In Canada between 1891[1] and 1971 there will be an inverse relationship between industrialization and OST: as industrialization advances, OST will decline. Thus:
   - 2.1 There will be an inverse relation between technological development and OST.

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[1] 1951 in the case of productivity.

2.2 There will be an inverse relation between productivity and OST.

2.3 There will be an inverse relation between urbanization and OST.

2.4 There will be an inverse relation between bureaucratization and OST.

3. In Canada between 1951 and 1971 there will be an inverse relationship between industrialization and SIS; as industrialization advances, SIS will decline. Thus:

3.1 There will be an inverse relation between technological development and SIS.

3.2 There will be an inverse relation between productivity and SIS.

3.3 There will be an inverse relation between urbanization and SIS.

3.4 There will be an inverse relation between bureaucratization and SIS.

The methods by which the above hypotheses are tested are specified in the following section.

Methods

The theory of the effects of advancing industrialization on changes in OSS and SIS implies a temporal sequencing, such that declines in OSS and SIS follow increases in industrialization. Since this theoretical ordering is not known, the tests of the hypotheses stated in the previous section are necessarily confined to examining the linear associations between each of the four indicators of industrialization and the indexes of OSS and SIS (cf. Dubin, 1968:93-94). The techniques to be used include correlation, regression, and trend analysis.

Correlating the values of the industrialization

indicators with those of the indexes of OSS and SIS will indicate the existence, direction, and strength, of the linear relations among the variables examined. A more crucial test of the hypotheses that do not involve productivity or SIS (i.e., hypotheses 1.1, 1.3, 1.4, 2.1, 2.3, and 2.4, above) will be the regression of ODS and OST values on the indicators of technological development, urbanization, and bureaucratization. The results of the regression analysis will indicate the relative and collective impact of the forces of technological development, urbanization, and bureaucratization on ODS and OST. Such regressions will not be carried out with productivity or SIS data, available for only 1951, 1961, and 1971 and, therefore, insufficient for multiple regression. Finally, the measurements of each of the dependent variables will be tested for the presence and the direction of trends with the Cox-Stuart test for trend (Bradley, 1968:174-176).

Summary

In the initial sections of this chapter empirical indicators were specified for the four aspects of industrialization, and indexes were defined for both dimensions of OSS and for SIS. Next, the data to which these measures are applied were described. Finally, the hypotheses to be tested were stated, and the procedures to be used in their testing were outlined. The results of the analysis are reported in the following chapter.

CHAPTER III

OSS, SIS, AND INDUSTRIALIZATION: CANADA, 1891-1971

This chapter reports the results of the analysis outlined in the previous chapter. The first section contains the values of the four indicators of industrialization and the indexes of OSS and SIS. The correlations among these measurements are presented in the second section. The third section summarizes the results of the regression analysis. Finally, the values of OSS and SIS are examined for the presence and direction of trends. Each set of results serves as a basis for testing the hypotheses of inverse relations between industrialization and the dependent variables.

Measurements of Industrialization, OSS, and SIS

Before examining the results of the analysis of change in OSS and SIS, we may consider briefly the growth in the male and female labour forces, as well as the changes in the participation rates of the sexes, over the period studied. Table 17 presents the labour force counts and rates by sex for Canada from 1891 through 1971. While the numbers of both male and female workers increased greatly over the eighty-year period, the rate of expansion for women was nearly four times that for

Table 17

Labour Force[a] and Participation Rates,[a] by Sex: Canada, 1891-1971

Year	Labour Force		Participation Rate (Per Cent)	
	Male	Female	Male	Female
1891	1,410,379	195,990	76.6[b]	11.1[b]
1901	1,544,883	237,949	78.3	14.4
1911	2,358,813	364,821	82.0	16.6
1921	2,683,019	490,150	80.3	17.7
1931	3,261,371	665,859	78.4	19.4
1941	3,613,045	833,729	85.6	22.9
1951	4,121,832	1,164,321	84.1	24.2
1961	4,705,518	1,766,332	80.8	29.1
1971	5,665,705	2,961,210	76.1[b]	36.5[b]

[a]Age: 1891-1931, 10 years of age and over
1941-1961, 14 years of age and over
1971, 15 years of age and over

[b]Not comparable with intervening census years (cf. sources below)

Sources: Labour force, Censuses cited in Chapter II
Participation rates, 1891 (Canada. D.B.S., 1929: Table 1)
1901-1961 (Denton and Ostry, 1967:22-29)
1971 (Canada. Labour Canada, 1971:3)

men. The male labour force increased fourfold, from 1.4 million in 1891 to 5.7 million in 1974. Over the same period, the female labour force expanded from less than 200,000 to nearly three million, a fifteenfold increase. Since the total population increased by just over four times, these contrasting rates of growth in the male and female labour forces resulted from markedly different trends in male and female labour force participation rates.

Representing the percentage of the total working-age population in the labour force, the rates in Table 17 obscure distinct and opposite trends for certain age groups in both the male and female labour forces, as well as differences in the rates by marital status for women. Nevertheless, the overriding difference between the sexes is evident: some fluctuation (due mainly to differences in the minimum age), but little change, in male rates, while the female rates increased about threefold, over the eighty-year period, during which the overall sex ratio of the labour force (males/females) decreased from over seven to one, to less than two to one. According to the theory of change in OSS and SIS developed in Chapter I, this transformation of the overall sex composition of the Canadian labour force should have been accompanied by advances in industrialization and decreases in OSS and SIS. The findings reported below indicate the changes in OSS, SIS and the four indicators of industrialization, as well as their interrelations.

Trends in Industrialization

The argument that technological development and a commitment to productivity, as well as urbanization and bureaucratization, erode OSS and SIS is predicated on the assumption that each of these dimensions of industrialization increase over time. The measurements taken for the four dimensions of industrialization indicate that at least for Canada between 1891 and 1971 this is not a gratuitous supposition (Table 18). Indicating technological development, the number of professional

Table 18

Indicators of Four Dimensions of Industrialization: Canada, 1891[a]-1971

Year	Dimension of Industrialization[b]			
	Technological Development	Productivity	Urbanization	Bureaucratization
1891	1.8	—	29.8	8.6
1901	1.4	—	34.9	32.1
1911	2.7	—	41.8	38.2
1921	4.0	—	47.4	68.9
1931	4.0	—	52.5	66.7
1941	4.6	—	55.7	72.8
1951	6.0	43.7	62.4	106.7
1961	8.0	64.5	69.7	126.8
1971	10.1	100.0	76.2	159.2

[a]1951-1971 in the case of productivity

[b]Indicators of industrialization:

Technological development: number of professional engineers per 1,000 workers
Productivity: output per man-hour in manufacturing industries
Urbanization: percentage of the population residing in areas defined as urban by the census
Bureaucratization: number of clerical workers per 1,000 workers

engineers per thousand workers exhibited a net increase of nearly sixfold over the eighty-year period. In 1891 there were less than two engineers per thousand workers. By 1971 there were ten. Urbanization, measured by the percentage of the population residing in areas defined as urban by the census, more than doubled between 1891 and 1971. At the beginning of

the period less than one-third (29.8 per cent) of Canadians resided in urban areas; by 1971 the figure was greater than three-quarters (76.2 per cent). The level of bureaucratization, indicated as the number of clerical workers per thousand workers, exhibited an eighteenfold net increase over the 1891-1971 period. In 1891 there were about nine clerical workers per thousand workers; as of 1971 the figure was 159. The growth of technological development levelled off and bureaucratization declined slightly, over the 1921-1931 decade, which overlapped the beginning of the Great Depression. Of the three dimensions of industrialization measurable throughout the 1891-1971 period, only urbanization exhibited a strictly monotonic increase over the eight decades examined. The level of productivity, indicated as output per man-hour in manufacturing industries, available for only the three most recent census years, more than doubled over the two decades preceding 1971.

The increments in the industrialization variables may be portrayed more vividly by means of graphs. Figure 1 traces the trend in the number of professional engineers per thousand workers and indicates the emergence of the various engineering specialties in the order in which they were recognized by the census. The successive specification of civil, mechanical, mining, electrical, chemical, industrial, metallurgical, petroleum, and nuclear engineers indicates the increasing sophistication of technology in Canada between 1891 and 1971. The trends for productivity, urbanization, and bureaucratization

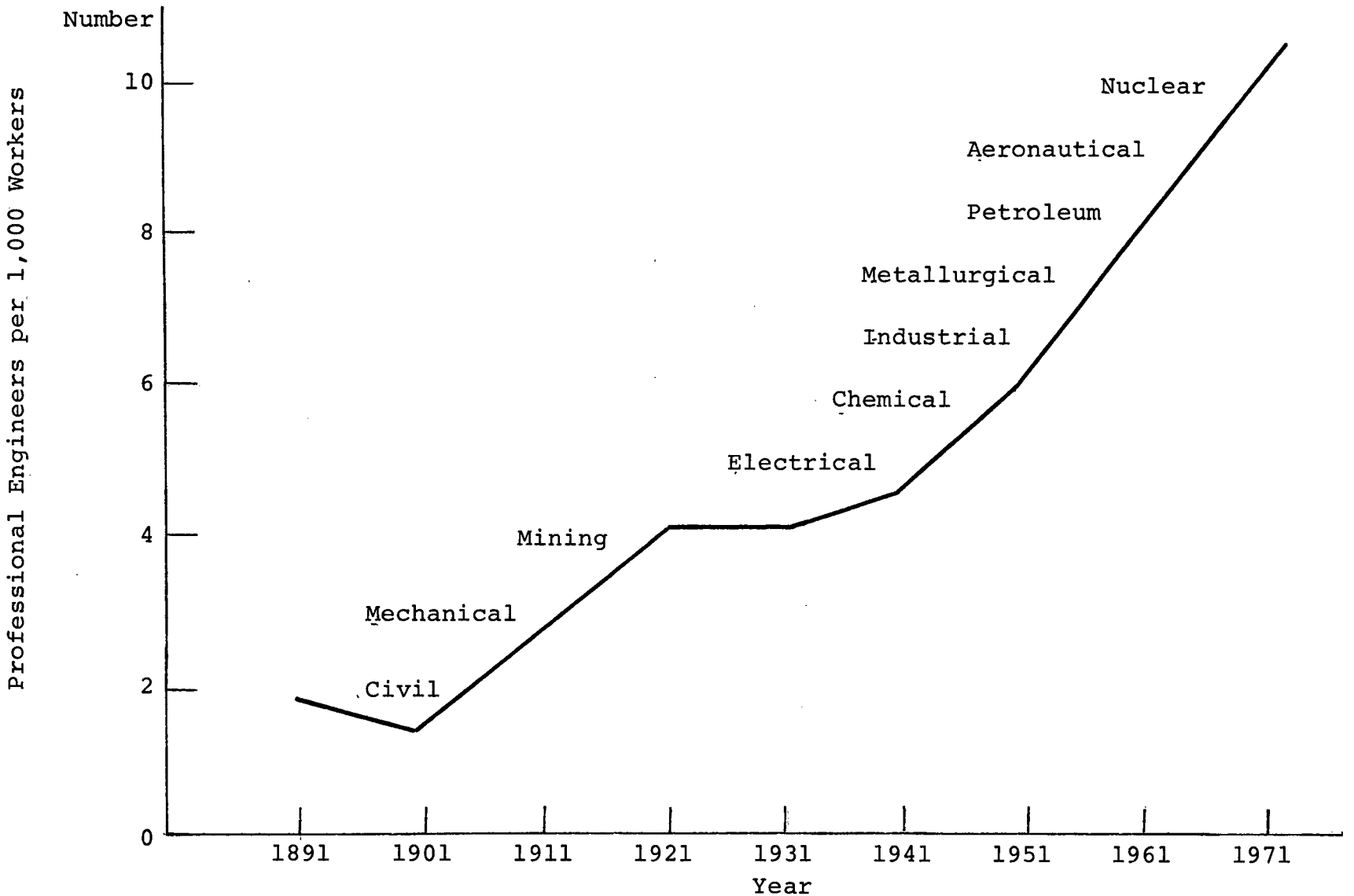
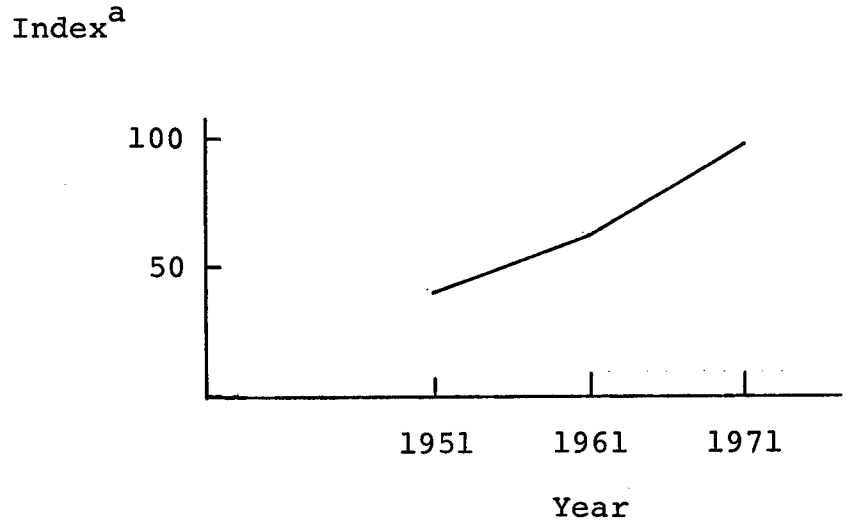


Figure 1. Technological Development: Number of Professional Engineers per 1,000 Workers, Canada (1891-1971)

are graphed in Figures 2, 3, and 4, which illustrate the substantial increases in these three indicators of industrialization. The extent to which these trends in the independent variables are accompanied by the expected declines in OSS and SIS is considered in the remainder of this chapter.



[a]Reference base: 1971 = 100

Figure 2. Productivity: Output per Man-hour in Manufacturing Industries, Canada (1951-1971)

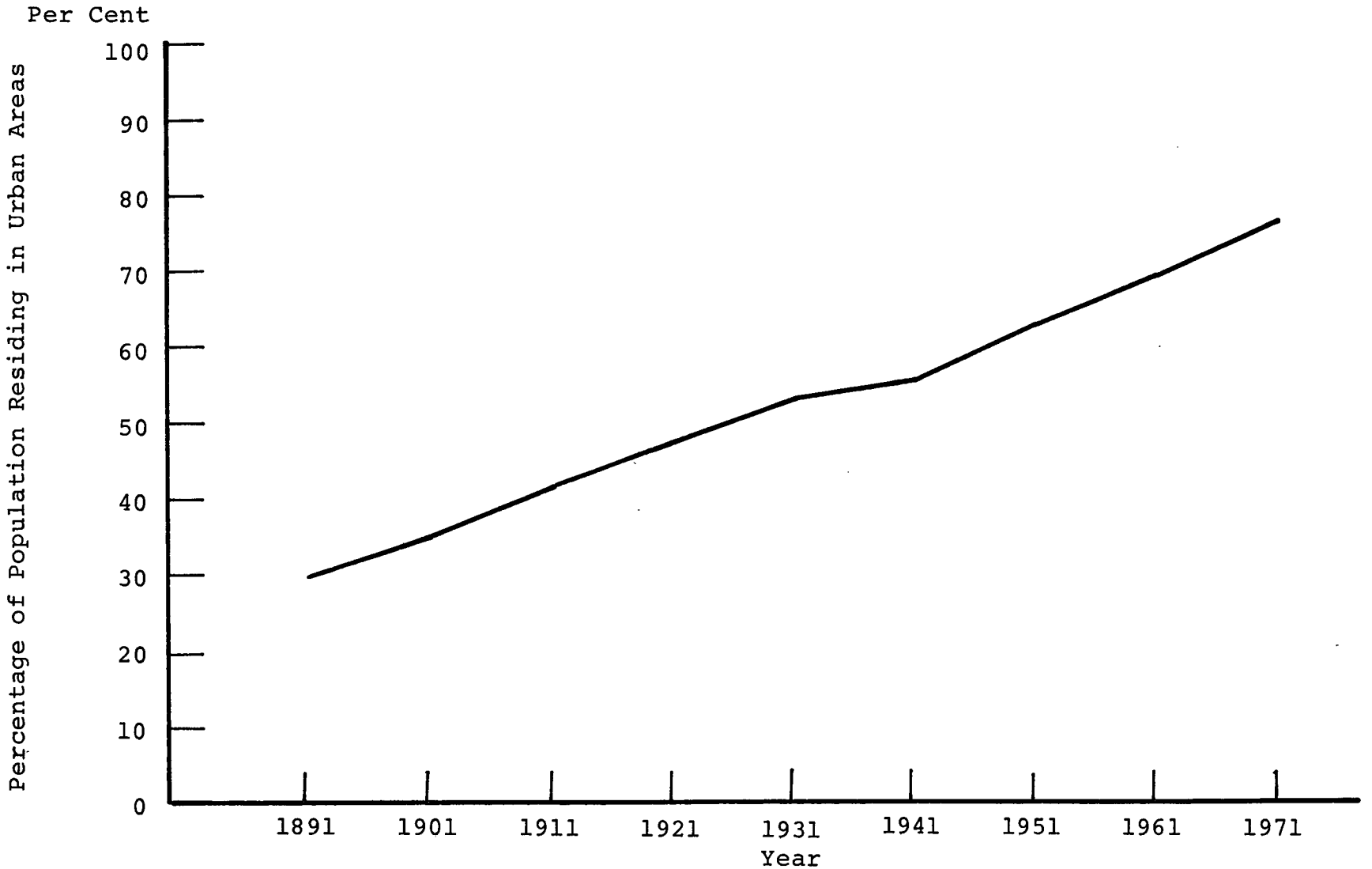


Figure 3. Urbanization: Percentage of the Population Residing in Urban Areas, Canada (1891-1971)

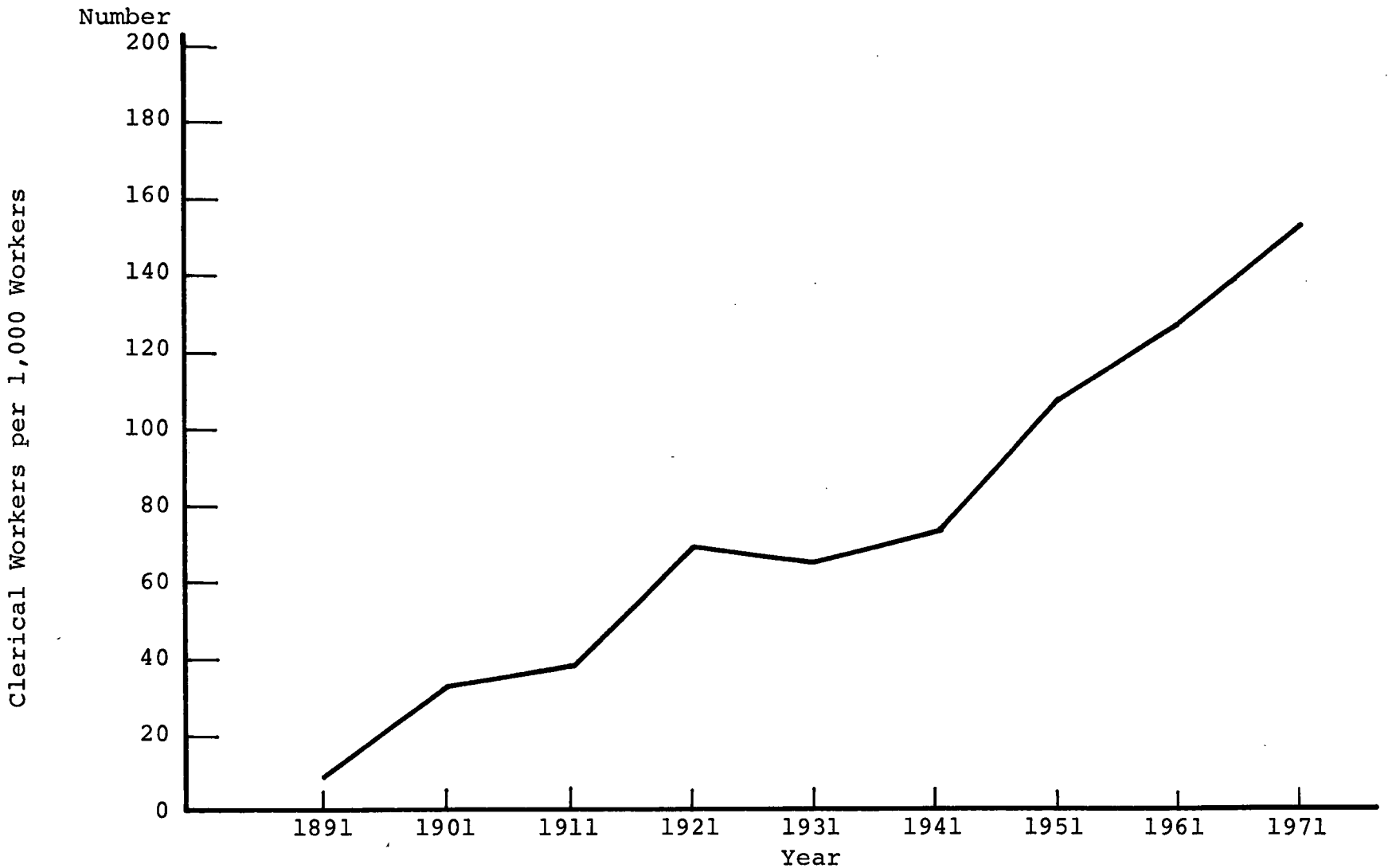


Figure 4. Bureaucratization: Number of Clerical Workers per 1,000 Workers, Canada (1891-1971)

Indexes of OSS and SIS

Having examined the trends in the industrialization indicators, we turn now to the measurements of the dependent variables, OSS and SIS. Table 19 contains the values of the indexes of ODS and OST calculated with the detailed, occupational data for 1891 through 1971. The level of ODS shows a net decline over the eighty-year period. The M4 value of 46.3 per cent for 1971 indicates that nearly half the female labour force would have to change jobs in order to achieve a prefectly even distribution of women among all occupations. Although the 1971 figure represents a 26 per cent relative decrease from the 1891 level (62.8 per cent), the fluctuation in ODS was such that the 1941 level is the same as that at the beginning of the period. The M7 values for OST suggest a similar trend: a net relative decline of 20 per cent, from 50.7 per cent in 1891 to 41.3 per cent in 1971, although both the 1931 and 1941 levels are higher than that for 1891.

Table 19

Indexes of OSS: Canada, 1891-1971

Dimension of OSS (Index)	Year								
	1891	1901	1911	1921	1931	1941	1951	1961	1971
ODS (M4)	62.8	62.1	56.4	53.5	62.5	62.8	57.6	57.1	46.3
OST (M7)	50.7	49.8	46.2	44.0	54.6	53.4	48.2	49.3	41.3
Number of Occupations	133	145	153	154	397	216	281	333	499

Table 20 presents another set of M4 and M7 values, as

Table 20

Indexes of OSS: Canada, 1901-1961

Dimension of OSS (Index)	Year						
	1901	1911	1921	1931	1941	1951	1961
ODS (M4)	60.2	56.0	53.1	55.8	55.4	52.4	49.5
OST (M7)	50.4	45.3	44.1	46.3	47.2	44.1	41.5
ODS (DI)	69.2	65.6	64.0	66.5	66.8	63.6	61.1
OST (CRVc)	31.2	27.8	27.1	28.5	29.1	27.5	26.9
Number of Categories	14	14	14	14	14	14	14

well as the values of the conventional indexes of ODS and OST (DI and CRVc, respectively), calculated for the broadly but consistently classified series of data for 1901 through 1961. These measurements permit two comparisons. First, the results obtained with the broadly classified data may be compared with those for detailed data by examining the M4 and M7 values in both Tables 19 and 20. Second, the results obtained with the indexes of ODS and OST introduced in this study (M4 and M7, respectively) may be compared with those generated by the conventional indexes (DI and CRVc, respectively) by examining the two sets of measurements in Table 20.

Comparing the M4 and M7 values calculated with the broadly but consistently classified data (Table 20) to those for detailed data for 1901 through 1961 (Table 19), we see that the overall pattern of change is similar: fluctuations, but net declines over the 1901-1961 period. In the case of the broadly

classified data, the 1931 and 1941 values do not exceed those for 1901, as happens with the detailed data. With the exception of the M7 value for OST for 1911, the measurements for the broadly but consistently classified data are lower than the values for the detailed data, particularly for the 1931-1961 period.

Examining the M4 and M7 values calculated with broadly classified data with the corresponding measurements obtained with conventional indexes of ODS and OST (DI and CRVc, respectively), we see (Table 20) that the two sets of values suggest similar patterns: net declines with rises over the 1931-1941 period. One may also note that, according to the M4 value for 1961, half (49.5 per cent) of the female labour force would require redistribution to bring about a perfectly even distribution of women among occupational categories. It may further be noted that, according to the DI value of that year, over three-fifths (61.1 per cent) of women would have to change jobs to achieve a distribution the same as that of men.

Having considered the measurements of OSS with both detailed and comparable data, as well as with both conventional measures and the indexes introduced in this study, we next examine the measurements of SIS. Table 21 presents RS values for 1951, 1961, and 1971, the only years for which census occupations may be ranked. There are two sets of results: measurements taken with the detailed occupations ranked according to the Blishen indexes as well as values calculated with the data grouped according to the six, equal-interval "classes."

Table 21

Measurements of SIS: Canada, 1951-1971

Index and Ranking	Year		
	1951	1961	1971
RS, detailed	-10.7	-11.8	- 3.4
(Number of ranks)[a]	(209)	(298)	(497)
RS, broad	-28.8	6.9	0.6
(Number of classes)	(6)	(6)	(6)

[a]Do not correspond to the number of occupations in Table 19 because of ties.

According to the conventions of interpreting the results of other applications of this index (Duncan, 1952:268), the RS values of -10.7 and -11.8, based on the detailed rankings for 1951 and 1961, respectively, would indicate that the overall occupational status of women was "somewhat" lower than that for men in those years. The corresponding value for 1971 (-3.4) is closer to the situation of general equality (i.e., 0.0), but still favouring the male labour force. The RS values calculated with the ranked data grouped into the six equal-interval classes suggest a slightly different trend. The value for 1951 indicates that, relative to men, women were very concentrated in the lower classes. The values for 1961 and 1971 suggest a reversal in the relative positions of the sexes, with some advantage for women in 1961, scarcely any in 1971. RS values,

then, appear to be affected slightly by the number of categories to which they are applied. Nevertheless, the results obtained with both detailed and grouped data suggest a decline in the degree of SIS.

The measurements reviewed in this section generally support the hypotheses of inverse relations between industrialization and both OSS and SIS. Between 1891 and 1971, the industrialization indicators exhibited upward trends, as assumed. The indexes of OSS and SIS suggest that the dependent variables underwent net declines over the same period. In the next section we examine the correlations among these sets of measurements to test the hypotheses further.

Correlation Analysis: OSS, SIS, and Industrialization

This section contains correlations within and between the sets of values for the dependent and independent variables examined above. We are interested in the intercorrelations among the indicators of industrialization for two reasons. First, if technological development, productivity, urbanization, and bureaucratization are inversely related to OSS and SIS, as expected, there should be positive relations among the indicators of industrialization. Second, the strength of these interrelations indicates the extent to which multicollinearity might present a problem in the regression analysis. We also expect to find positive interrelations among indexes of ODS, OST, and SIS. As well, the correlations between the measurements of OSS and SIS taken with detailed, rather than broadly

classified, occupational data provide further evidence of the consequences of using detailed data. Similarly, the correlations between the values of the OSS indexes introduced in this study and those of conventional measures, as well as the relation between RS values computed with detailed rankings and those calculated for grouped data, are of interest in evaluating the utility of the measures of OSS and SIS introduced here. Finally, the coefficients for the relations between the dependent and independent variables provide a test of the hypotheses of inverse relations between industrialization and both OSS and SIS.

Intercorrelations: Independent Variables

Table 22 presents the intercorrelations among the indicators of industrialization. The values above the diagonal are for the 1951-1971 period and include those involving productivity, measurable only for the three most recent census years. The coefficients below the diagonal are for 1891 through 1971 and, therefore, involve only technological development, urbanization, and bureaucratization. All correlations are positive, as theoretically expected. For 1951-1971, the correlations between technological development and productivity and between urbanization and bureaucratization are perfect ($r = 1.00$), and none of the others is less than 0.98. For 1891-1971, the lowest coefficient is that for technological development and urbanization (0.97). Both correlations involving bureaucratization are 0.98. The magnitude of these correlations among

Table 22

Intercorrelations (Pearson's r) Among Indicators[a] of Dimensions of Industrialization: Canada, 1891-1971 (Below Diagonal), 1951-1971 (Above Diagonal)

	Technological Development	Productivity	Urbanization	Bureaucratization
Technological Development	—	1.00*	0.99*	0.99*
Productivity		—	0.99*	0.98
Urbanization	0.97*		—	1.00*
Bureaucratization	0.98*		0.98*	—

*Significant at the 0.05 level.

[a]For specification of indicators of industrialization, see Table 19.

technological development, urbanization, and bureaucratization indicates that the implications of multicollinearity must be borne in mind when these variables are subjected to multiple regression.

Intercorrelations: Dependent Variables

Intercorrelations among the dependent variables are contained in Table 23. All are in the expected, positive direction. Examining the values by column, from left to right, we may observe that in the 1891-1971 series ODS and OST are highly correlated (r = 0.93). The other coefficients (i.e., those above the diagonal) are for the 1951-1971 period, for which SIS is calculated with both detailed rankings and the equal-interval classes. The correlation between ODS and OST is virtually perfect (0.99). The RS measurements[1] of SIS calculated with detailed data are perfectly correlated with OST (r = 1.00) and nearly so with ODS (0.99). The RS values calculated with the ranked data grouped into the six classes, however, are only moderately correlated with ODS (0.70) and OST (0.57), as well as with the RS measurements based on detailed rankings (0.59). If squared, all correlations involving RS values calculated with grouped data would produce coefficients of determination less than 0.50. These results indicate that, with the exception of RS values calculated with broad classes, the dependent variables are highly intercorrelated. The very high correlations between the measurements of ODS and OST

[1]The absolute RS values are used for all correlations.

Table 23

Intercorrelations (Pearson's r) Among Dependent Variables: Canada, 1891-1971 (Below Diagonal), 1951-1971 (Above Diagonal)

	ODS M4D[a]	OST M7D[a]	SIS RSD[a]	SIS RSB[a]
ODS M4D[a]	—	0.99*	0.99*	0.70
OST M7D[a]	0.93*	—	1.00*	0.57
SIS RSD[a]			—	0.59
SIS RSB[b]				—

*Significant at the 0.05 level.

[a]"D" indicates indexes calculated with detailed data.

[b]"B" indicates RS calculated with six, equal-interval classes.

suggest that either the index of ODS (M4) or that of OST (M7) might be used as a single, general index of OSS. The association between the RS values computed with detailed, ranked data and those calculated with the six equal-interval classes suggests that RS may be sensitive to the number of categories to which it is applied, although the small number of cases precludes a definitive conclusion. Nevertheless, consistent with the hypotheses of inverse relations between industrialization and both OSS and SIS, all coefficients are positive.

Before turning from the interrelations among

measurements of the dependent variables to the associations between the dependent and independent variables, we shall consider the correlations between the values of OSS computed with detailed occupations and those based on broadly but consistently classified occupational data, as well as the association between each of the measures of ODS and OST introduced in this study (M4 and M7, respectively) and the corresponding conventional index (DI and CRVc, respectively). The former correlations will suggest the extent to which the use of detailed data may bias the measurement of OSS, whereas the latter associations will indicate the utility of M4 and M7 used to measure ODS and OST, respectively, for the first time in this study.

Table 24 contains the intercorrelations among these measurements of OSS for the 1901-1961 period. Although it may be noted that, again, all the relations are positive, we are interested mainly in the coefficients in the second diagonal above and to the right of the principal diagonal. Starting at the top of this diagonal, we note that the correlation between M4 values for ODS computed with detailed data and those calculated with broadly but consistently classified data is moderate ($r = 0.57$), and the corresponding coefficient for the two sets of M7 measurements of OST is low (0.37). These results suggest that definitional consistency, if not the number of categories, may affect both M4 and M7. Continuing down the diagonal, we observe that in the broadly but consistently classified data, the correlations of the conventional indexes of ODS (DI) and OST (CRVc) with M4 and M7 are very high

Table 24

Intercorrelations (Pearson's r) Among Indexes of OSS: Canada, 1901-1961

	ODS M4D[a]	OST M7D[a]	ODS M4B[b]	OST M7B[b]	ODS DIB[b]	OST CRVcB[b]
ODS M4D[a]	—	0.92*	0.57	0.70*	0.68*	0.75*
OST M7D[a]		—	0.25	0.37	0.38	0.43
ODS M4B[b]			—	0.97*	0.98*	0.90*
OST M7B[b]				—	0.99*	0.96*
ODS DIB[b]					—	0.91*
OST CRVcB[b]						—

*Significant at the 0.05 level.

[a]"D" indicates index calculated with detailed occupations.

[b]"B" indicates index calculated with broadly, but consistently classified occupational data.

(r = 0.98 and 0.96, respectively). These findings indicate that with consistently classified data M4 and M7 are valid measures of ODS and OST. Bearing the implications of these results in mind, we next consider the associations between each of the dependent variables and the indicators of industrialization.

Correlations: Dependent and Independent Variables

Having observed that the intercorrelations among both

the dependent and independent variables are consistently positive, as implied by the hypotheses of inverse relations between industrialization and both OSS and SIS, we are now ready to examine the associations between the dependent and independent variables. Table 25 summarizes the correlations between technological development, urbanization, and bureaucratization and each measurement of ODS and OST. All values are negative, as predicted. Examining the coefficients by column, from left to right, we see that although the inverse correlations between ODS, measured by M4 with detailed occupations from 1891 through 1971, and both technological development ($r = -0.72$) and bureaucratization (-0.71) are substantial, the inverse relation between this measurement of ODS and urbanization is only moderate (-0.62). In the second column we may note that the inverse relations between OST, measured by M7 with the detailed data for 1891-1971, and each of the three dimensions of industrialization are relatively low and, again, the lowest involves urbanization.

The remaining columns of Table 25 contain the correlations of the industrialization indicators with values for M4 and M7, as well as for the conventional indexes of ODS and OST (DI and CRVc), calculated with the broadly but consistently classified occupational data for 1901 through 1961. All these coefficients indicate very strong inverse associations between the three dimensions of industrialization and these measurements of OSS. The only correlations with absolute values below 0.85 involve OST or urbanization. These results indicate general

Table 25

Correlations (Pearson's r) Between Indexes of OSS and Indicators[a] of Dimensions of Industrialization: Canada, Detailed Occupations (1891-1971) and Broad Occupational Categories (1901-1961)

Dimension of Industrialization	Indexes of OSS					
	1891-1971		1901-1961			
	ODS M4D[b]	OST M7D[b]	ODS M4B[c]	OST M7B[c]	ODS DIB[c]	OST CRVcB[c]
Technological development	-0.72*	-0.46	-0.94*	-0.84*	-0.88*	-0.71*
Urbanization	-0.62*	-0.32	-0.88*	-0.77*	-0.80*	-0.65
Bureaucratization	-0.71*	-0.44	-0.91*	-0.79*	-0.85*	-0.66*

*Significant at the 0.05 level.

[a]For specification of indicators of industrialization, see Table 19.

[b]"D" indicates index calculated with detailed occupations.

[c]"B" indicates index calculated with broadly but consistently classified occupational data.

support for the hypotheses of inverse relations between each of the dimensions of industrialization measurable for 1891 through 1971 and both ODS and OST. The relatively weaker association involving urbanization suggests that, as noted in Chapter I, the OSS occasioned by the employment of women in urban-based service industries may mitigate the general effect of urbanization on OSS.

Table 26 summarizes the correlations between the dependent and independent variables for 1951 to 1971, the only period for which productivity and SIS may be included. Again, all coefficients are in the expected, negative direction. Beginning with the column on the extreme left, we observe the very strong inverse relations indicated between ODS and each of the dimensions of industrialization; the absolute value of each correlation is above 0.85. The coefficients in the next column to the right indicate very strong inverse associations ($r = -0.87$) between OST and both urbanization and bureaucratization, and substantial inverse relations between OST and both technological development (-0.80) and productivity (-0.77). Moving to the second column from the right, we observe an almost identical set of associations between the four dimensions of industrialization and SIS measured with detailed, ranked data. The coefficients in the column on the far right indicate very strong inverse relations between SIS (measured with the ranked occupations collapsed into six equal-interval classes) and all four dimensions of industrialization; the absolute values of all these coefficients is at least 0.90.

Table 26

Correlations (Pearson's r) Between Indexes of OSS and SIS and Indicators[a] of Dimensions of Industrialization: Canada, 1951-1971

Dimension of Industrialization	ODS M4D[b]	OST M7D[b]	SIS RSD[b]	SIS RSB[c]
Technological development	-0.89	-0.80	-0.81	-0.95
Productivity	-0.87	-0.77	-0.78	-0.96
Urbanization	-0.94	-0.87	-0.87	-0.90
Bureaucratization	-0.94	-0.87	-0.88	-0.90

[a]For specification of indicators of industrialization, see Table 19.

[b]"D" indicates index calculated with detailed data.

[c]"B" indicates RS calculated with six, equal-interval classes.

These results for the 1951-1971 period uphold the hypotheses of inverse relations between productivity and both ODS and OST, and provide further support for the hypotheses of inverse relations between both ODS and OST and the other three dimensions of industrialization. Conclusions concerning the relationships between OSS and industrialization, however, should be drawn with caution, since these correlations involve M4 and M7 values calculated with detailed data only. These findings also support the hypotheses of inverse relations between SIS and each dimension of industrialization, although conclusions must be tentative, given the uncertainty concerning the independence of RS from the number of categories to which it is applied.

The results of the correlation analysis, then, support the hypotheses of inverse relations between industrialization and OSS and SIS. The intercorrelations among both the dependent and independent variables are consistently positive, as implied by the expectation of inverse relations between the dependent and independent variables. The associations between each of the dimensions of industrialization and all indexes of OSS and SIS are without exception negative, as predicted. We next consider the relative and collective impact of technological development, urbanization, and bureaucratization in accounting for variation in both ODS and OST.

Regression Analysis: ODS, OST, and Industrialization

The results presented so far indicate that (1) the level of each of the dimensions of industrialization increases over time, as assumed by the theory developed in Chapter I; (2) intercorrelations among both the dependent and independent variables are positive, as theoretically implied; and (3) the relations between the dependent and independent variables are consistently negative, as expected. In this section the values of ODS and OST are linearly regressed on those for technological development, urbanization, and bureaucratization. As indicated in Chapter II, the data for both productivity and SIS are insufficient to include these variables in such multiple regressions. The more stringent test of multiple regression, therefore, is necessarily confined to the hypotheses concerning the relations between OSS and technological development,

urbanization, and bureaucratization.

The regression analysis used is a forward stepwise procedure,[1] by which the independent variables are included in the analysis in succession, according to their contribution to explaining the variance of the dependent variable.[2] This procedure is used because it is relatively free of error in the presence of multicollinearity (cf. Poston and Johnson, 1971: 347). Although the independent variables are highly intercorrelated, multicollinearity does not present as serious a problem as it would if there were blocks of independent variables, differing with respect to the number of predictors contained, which clearly is not the case here (cf. Blalock, 1972:457).

Multiple regression analysis is not employed here to test a causal model of the relations between the dependent and independent variables, because the assumptions required for this use of the procedure are not warranted. As noted in the previous chapter, the theoretical sequencing of the independent and dependent variables is not established. Moreover, there is no justification for assuming that the set of variables under consideration constitutes, much less represents, a "closed system" (cf. Loether and McTavish, 1974:310). Instead, the purpose of the regressions is to describe the relative and

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[1]The specific technique is the SPSS "forward (stepwise) inclusion" subprogram (Nie et al., 1975:345).

[2]Thus, the variable entering on the first step of the analysis is the one most highly correlated with the dependent variable, and the remaining independent variables are included in order of the size of their respective squared partial correlations with the dependent variable.

collective impact of the independent variables on each dimension of OSS. Accordingly, the following review of the results of the regression analysis focusses on the squared multiple correlation coefficient (R^2), which is of interest for such descriptive purposes (Hocking, 1976:14).

Since the number of independent variables (three) is large relative to the number of units of analysis (nine census years), some "shrinkage" of R^2 may be expected. In these circumstances, it is more appropriate to consider adjusted R^2 values, corrected to account for the lost degrees of freedom, though not for sampling error (Crocker, 1972:32). The nine census years under examination, however, constitute a population, rather than a random sample thereof. The problem of shrinkage arising from sampling error (McNemar, 1961:184-185), therefore, should not constitute a serious difficulty in this analysis (cf. Poston and Johnson, 1971:345).

The results of the regression analysis are presented in Table 27. In the stepwise regressions of both ODS and OST on the independent variables, the three dimensions of industrialization are included in the order in which they have been considered throughout this study: technological development, urbanization, and bureaucratization. The adjusted R^2 values for the regression of ODS indicate that nearly half the variation in this dimension of OSS (46 per cent) would be accounted for by technological development, and over half (53 per cent) by technological development and urbanization jointly. These three dimensions of industrialization combined would account

Table 27

Stepwise Multiple Regressions of ODS and OST on the Indicators[a] of Dimensions of Industrialization: Canada, 1891-1971

Dimension of Industrialization	Step	ODS		OST	
		Adjusted R^2	F	Adjusted R^2	F
Technological development	1	0.46	7.705*	0.09	1.837
Urbanization	2	0.53	5.500	0.27	2.496
Bureaucratization	3	0.58	4.741	0.45	3.161

*Significant at the 0.05 level.

[a]For specification of the indicators of industrialization, see Table 19.

for 58 per cent of the variation in ODS. The adjusted R^2 values for OST indicate a somewhat different situation. Although technological development would account for very little (9 per cent) of the variation in OST, urbanization and technological development would jointly explain three times as much variation (29 per cent), and all three indicators combined raise the proportion of explained variance to nearly half of the total variation in OST.

It should be noted that in the final step in the computations for both ODS and OST, although the regression coefficients for technological development and bureaucratization are negative as predicted, that for urbanization is positive. This finding is the opposite not only of what is expected by

the hypotheses of inverse relations between urbanization and both ODS and OST, but also of the inverse (albeit relatively weaker) association indicated by the correlation analysis. This unexpected result of the regression analysis underscores the importance of examining the relative and collective associations between the independent variables and OSS, in addition to their simple correlations. The finding of a positive effect of urbanization suggests that, as noted in Chapter I, the OSS occasioned by the employment of women in urban-based service industries may mitigate the otherwise inverse relation between urbanization and OSS.

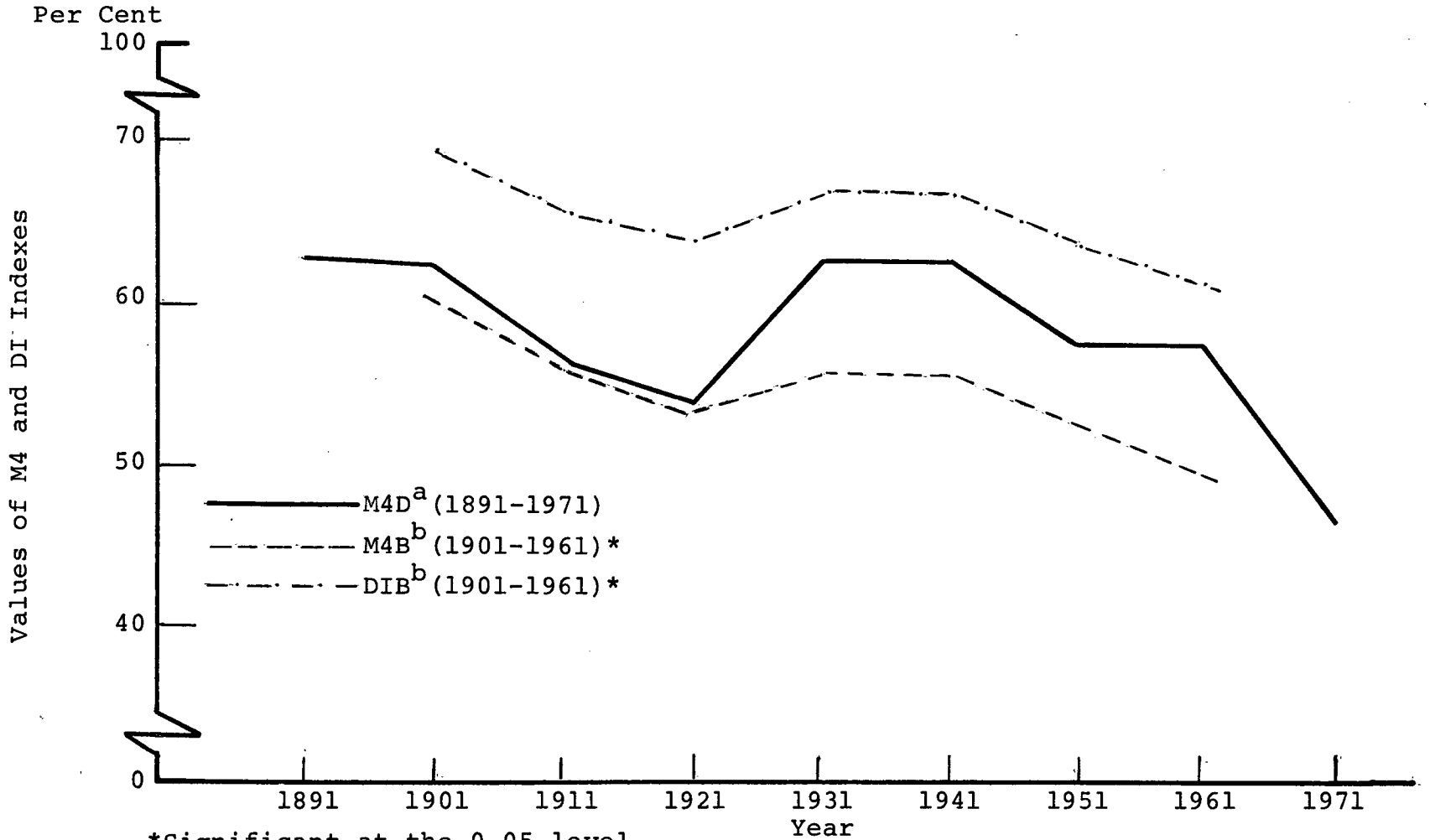
Apart from the positive effect of urbanization, however, the results of the regression analysis are consistent with the correlations examined in the previous section: there is an inverse relation between industrialization and the degree of OSS. The final set of results to be considered is that of the trend analysis of the dependent variables, reported in the next section.

Trend Analysis: OSS and SIS

At the outset of the theoretical discussion in Chapter I, it was noted that the various explanations of change in OSS and SIS have led to conflicting views of trends in these phenomena. While some authors have argued that the degrees of OSS and SIS should decline over time, as expected by the hypotheses under test here, others have concluded that these phenomena have grown more pronounced. Still others have

contended that there has been no change in the degree of OSS or SIS. Although measurements of OSS and SIS were reviewed in the first section of this chapter, the values of the dependent variables were not graphed, as were those of the indicators of industrialization, which exhibited upward trends, consistent with the theoretical assumption that industrialization advances over time. The measurements of OSS and SIS, while showing net declines, revealed considerable fluctuation over the eighty-year period under study. This section presents graphs of these changes, as well as the results of Cox-Stuart tests for trend (Bradley, 1968:174-176).

The M4 measurements of ODS, calculated with both detailed, and broadly but consistently classified occupational data, and DI values, calculated with the broadly classified data, are graphed in Figure 5. The net declines, as well as the fluctuations noted above, are apparent. Although the overall decline from 63 to 46 per cent in the M4 values computed with the detailed data for 1891 through 1971 is not statistically significant, both the DI and M4 measurements, calculated with the broadly but consistently classified data for 1901 through 1961, reflect significant downward trends, the movements of which almost precisely coincide. Similar observations may be made concerning the sets of OST values graphed in Figure 6. Despite the net drop from 51 to 41 in the M7 value over the 1891-1971 period, the fluctuation is such that no significant trend is present. Both the M7 and CRVc measurements, calculated with the 1901-1961 data series, however, exhibit significant

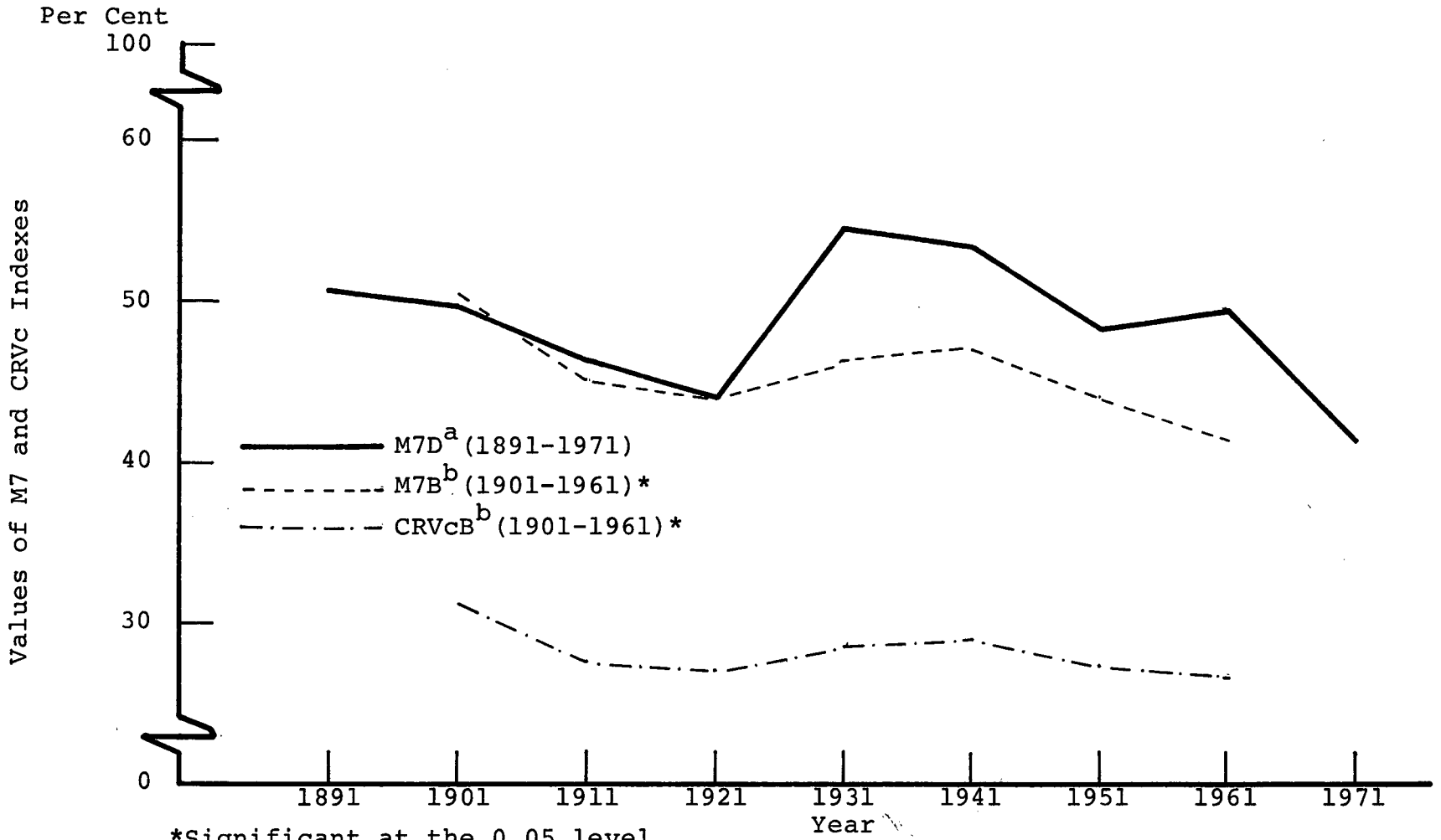


*Significant at the 0.05 level.

[a]"D" indicates index calculated with detailed occupations.

[b]"B" indicates index calculated with broadly but consistently classified occupational data.

Figure 5. ODS: Canada, Detailed Occupations (1891-1971), Broad Occupational Categories (1901-1961).



*Significant at the 0.05 level.

[a]"D" indicates index calculated with detailed occupations.

[b]"B" indicates index calculated with broadly but consistently classified occupational data.

Figure 6. OST: Canada, Detailed Occupations (1891-1971), Broad Occupational Categories (1901-1961)

downward trends, the curves for which coincide almost perfectly.

Measurements of SIS, calculated with the RS index using both detailed and broad rankings for 1951, 1961, and 1971, are graphed in Figure 7. There is an apparent movement toward equality (i.e., toward zero) in both sets of values, although there are insufficient observations for statistical significance. Another way to examine SIS is to compare the distributions of the male and female labour forces, according to a simple dichotomy of the Blishen scale. Figure 8 presents these distributions for 1951, 1961, and 1971. The lower three class intervals of the 1951 scale account for a greater proportion of women (89 per cent) than men (84 per cent). There is a slightly smaller proportion of the female labour force (79 per cent) than the male labour force (83 per cent) in the lower "half" of the 1961 scale. The lower three classes of the 1971 scale contain 65 per cent of the women, as compared with 75 per cent of the men, in the labour force. The upper "half" of the 1971 scale accounts for 35 and 25 per cent, respectively, of the female and male labour forces. The distributions in Figure 8 suggest a shift from a situation of slight advantage to men in 1951 to one somewhat in favour of women in 1971. If tested for trend, of course, the small number of observations would again preclude the possibility of significance.

The evidence reviewed above, then, upholds the hypotheses of declines in ODS and OST, at least for the 1901-1961 period. The fluctuation in OSS measurements calculated with the detailed 1891-1971 data, and the paucity of SIS

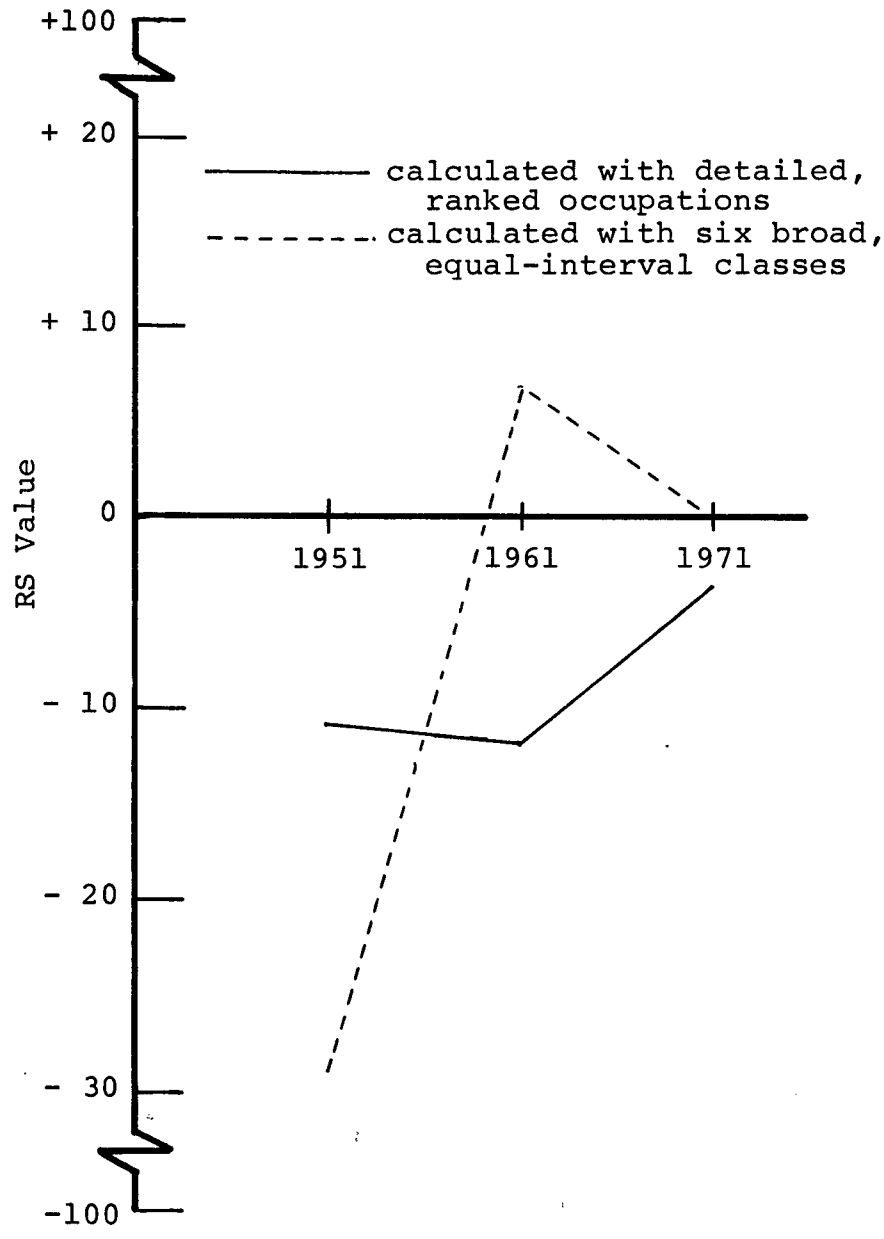


Figure 7. SIS: Canada, 1951-1971

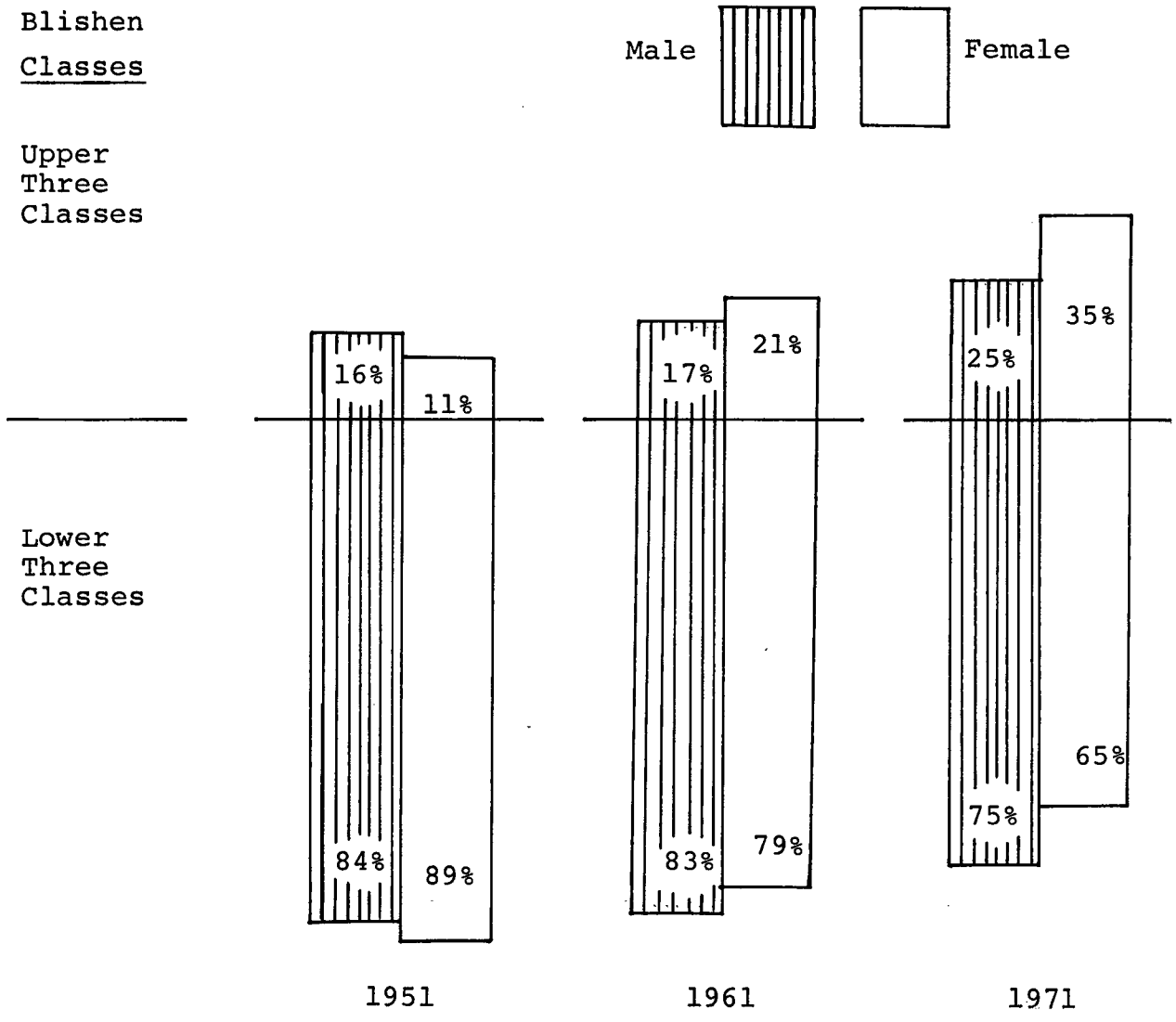


Figure 8. Percentages of Male and Female Labour Forces in the Upper Three, and the Lower Three, Classes of the Blishen Occupational Scale: Canada, 1951-1971

measurements, prevented the possibility of statistically significant trends in these sets of observations. As noted in the previous section, however, the observations under examination are not for a sample, but for the population itself. Accordingly, statistical significance is not critical in this analysis.[1]

Also of interest is the current level and future course of OSS. Based on the DI measurements for the broadly but consistently classified data for 1901 through 1961, the degree of ODS at the end of this period was such that over 60 per cent of the female labour force would have had to change jobs in order for the occupational distributions of the sexes to be the same. Although extrapolation beyond the range of the data is dangerous (cf. Hocking, 1976:15), assuming a straight line, and given the rate of decline in ODS, from about 70 per cent in 1901 to approximately 61 per cent in 1961, it would take roughly four and a half centuries (until about the year 2415) to achieve a sexually undifferentiated work force!

Summary

The results of the analyses reported above generally uphold the hypotheses of inverse relations between industrialization and both OSS and SIS. In Canada, between 1891 and 1971, the level of industrialization rose, while the amounts of

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[1] In the previous sections of this chapter, statistical significance has been reported, but not discussed; it is considered here because the Cox-Stuart trend test is a purely inferential procedure.

OSS and SIS declined, albeit more slowly and with some fluctuation. Correlations between dimensions of industrialization and both OSS and SIS were consistently inverse, as expected, although some of those involving urbanization and OST were relatively weak. The regression analysis indicated that, together, technological development, urbanization, and bureaucratization would explain about half the variation in ODS and OST. Multiple regression also revealed, however, that of the combined effects of these three industrialized variables those of both technological development and bureaucratization were negative, as predicted, whereas the effect of urbanization was positive, the opposite of what was expected and of what was suggested by the simple correlations. Finally, it was noted that, notwithstanding the net declines in the dependent variables, the degree of OSS remains pronounced. The apparent trends in SIS, however, indicate that OSS does not ipso facto imply SIS. Based on Blishen rankings at least, there was little SIS present in the Canadian labour force as of 1971. The majority of the female labour force was indeed concentrated in low ranking occupations over the 1951-1971 period, but so was the majority of the male labour force.[1]

The results examined above also reveal that the measurements of ODS and OST introduced in this study (i.e., M4 and M7, respectively) may be affected by definitional consistency, if not by the number of categories to which they are applied. To

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[1]This finding concerning SIS, of course, in no way gainsays the unequivocal disadvantage of women with respect to income.

the extent that such a property of these measures would put the results of the correlations for the 1891-1971 period and of the regression analysis in doubt, the hypotheses of inverse relations between industrialization and OSS are still supported by the consistently high inverse correlations of the industrialization variables (excluding productivity) with both these indexes and the conventional measures of OSS calculated with the broadly but consistently classified 1901-1961 data series.

We have also found that RS may be affected by the number of categories to which the index is applied. Since this study is the first to use a summary measure of relative occupational status, however, there is no conventional index with which to compare SIS measures or to provide an alternate test of the hypotheses concerning SIS and industrialization. Conclusions about SIS, therefore, remain tentative. The theoretical and methodological implications of the findings are considered further in the concluding chapter.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The present study provides evidence in support of the theory that industrialization erodes OSS and SIS. This final chapter summarizes the conceptualization, reasoning, and hypotheses presented in the first chapter. It also recapitulates the methods and findings reported in Chapters II and III. Finally, it outlines some theoretical and methodological implications of the study.

The Sexual Division of Industrial Labour

A sexual division of work outside the home occurs in industrial societies in the form of occupational segregation by sex (OSS), which comprises two dimensions, the differential distribution of the sexes among occupations (ODS) and variation in the sex composition within occupations (OST), patterns of which suggest sexual inequality of occupational status (SIS). Although materialist, socialization, discrimination, and interdisciplinary approaches to the study of OSS and SIS each identify important determinants of these phenomena, none of these explanations provides an adequate theory of change in OSS and SIS. In linking OSS to the process of industrialization,

the human ecologists outline the most promising explanation of change in OSS and SIS.

Identifying several dimensions of industrialization, including technological development, productivity, urbanization, and bureaucratization, the human ecologists argue that as a society industrializes, it becomes bureaucratized, and hiring practices give preference to those who are likely to contribute most to production. Ideally, therefore, workers are assigned to occupations on the basis of achievement, rather than on such ascriptive grounds as sex. Accordingly, the ecologists expect OSS to decline with advancing industrialization. They do not, however, extend this prediction to include SIS, nor do they specify mechanisms linking OSS to each dimension of industrialization.

The thesis of this study is presented as an extension and clarification of the argument advanced by the human ecologists. It is here argued that the development of machine technology tends to eliminate the necessity to select workers for jobs on the basis of strength, and hence in practice, usually by sex. It is also contended that hiring and promoting workers on the basis of their probable contribution to production is implied by the commitment to productivity, characteristic of industrial societies. It is further argued that the industrial urban milieu is characterized by conditions (e.g., low birth rate, career opportunities) conducive to the employment and advancement of women. Finally, bureaucracy ideally implies the selection and promotion of workers on the basis of achieved

qualifications, determined by formalized, calculable standards, rather than such traditional, often economically irrational, criteria as sex.

It was hypothesized, therefore, that OSS and SIS would be inversely related to technological development, productivity, urbanization, and bureaucratization, and that the degree of both OSS and SIS would decline, as the level of industrialization advanced, over time. These expectations, however, do not imply the elimination of OSS or SIS, at least within the time span examined.

OSS, SIS, and Industrialization: Canada, 1891-1971

The availability of census and other official Canadian data for 1891[1] through 1971 made it possible to test this expectation of an historical, inverse relationship between industrialization and both OSS and SIS. Indicators of the four dimensions of industrialization and indexes of OSS and SIS were calculated and subjected to correlation, regression, and trend analysis. The correlations between the dependent and independent variables were consistently inverse, as expected. The results of the regression analysis indicated that, taken together, technological development, urbanization, and bureaucratization would account for about half the variation in both ODS and OST. In their combined impact on the dependent variables, technological development and bureaucratization bore an inverse relation to ODS and OST, whereas the effect of

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[1] 1951 in the case of productivity and SIS.

urbanization was positive. Finally, the measurements of ODS, OST, and SIS exhibited net declines over the periods for which the data were available, although fluctuations and a paucity of observations prevented some of the trends from being statistically significant. The results summarized here support the thesis that as a society industrializes, technological development and a commitment to productivity, as well as urbanization and bureaucratization, erode OSS and SIS. The following sections of this chapter outline some theoretical and methodological implications of the findings of this study.

Theoretical Conclusions

The theory tested here amplifies the human ecological account of OSS. Concrete relations between OSS and four dimensions of industrialization are specified which account in part for the general relationship between industrialization and OSS. In addition, each of the dimensions of industrialization is linked logically not only to both ODS and OST, but also to SIS. Thus, the formulation developed here in part fulfills the promise of the perspective from which it is derived. In turn, the results confirm the heuristic utility of the ecological viewpoint.

To some extent, too, the theory of an inverse relationship between industrialization and OSS and SIS amplifies the socialization approach by indicating the changing conditions to which socialization practices must adapt. Although the conclusions of stability in OSS and SIS reached by those using the

socialization, economic, and interdisciplinary approaches are not strictly substantiated, neither are they entirely deprived of plausibility, by the results of this study. Although industrialization is not theoretically expected to eliminate OSS and SIS, the rate of decline observed in OSS is such that its effect is unlikely to be experienced for generations.

The assumption that OSS ipso facto implies SIS, however, finds no support in the findings reported here. Although levels of both ODS and OST remain high, SIS, calculated with Blishen occupational rankings, declined to negligible amounts over the 1951-1971 period for which it is measurable. Sex differentials in income, of course, are not contradicted by this finding. Moreover, until additional work is done with the RS index of SIS introduced in this study and further research on SIS is completed, results based on the measurement of SIS by the RS index remain tentative. According to the respective distributions of the male and female labour forces on the dichotomized Blishen scale, however, such SIS as remained in the Canadian work force in 1971 appears to have been to the advantage of women. More significantly, perhaps, the majority of workers of both sexes pursue occupations ranked in the lower half of the scale. We turn now from theoretical to methodological implications of this study.

Methodological Implications

This study is the first to involve simultaneous, summary measurement of both ODS and OST, among detailed occupations,

throughout an entire labour force, over so long a period of time. It has introduced M4 and M7 as indexes of ODS and OST, respectively, appropriate for data in which the number of occupations varies. The low to moderate correlations between these measures, computed with such data, and the conventional indexes of ODS (DI) and OST (CRVc), calculated with broadly but consistently classified occupational data, suggest, however, that definitional consistency, if not the number of categories, may affect M4 and M7. Measurement of change in OSS, then, should be confined to definitionally consistent data series. Given the almost perfect correlations among all OSS indexes calculated with consistently classified data, any one of the four measures used here could serve as a single, general index of OSS. DI would be recommended because of its direct interpretability.

This study is also the first to distinguish, theoretically and analytically, SIS from OSS, and the first to undertake summary measurement of SIS. The extent to which the use of detailed, ranked occupations rather than broad, equal-interval categories affects RS values remains an empirical question. Given the subsequent validation of the RS index, or a modification thereof, it could be applied in the analysis of race, ethnic, and sex differentials in status, income, or education within organizations (e.g., factories, universities), as well as populations of various types (e.g., countries, cities). Although it must not be assumed that greater quantification somehow resolves all theoretical issues, in the analysis of inequality in general, and of SIS in particular, measurement

remains conspicuously inadequate.

The historical relationship between industrialization and both OSS and SIS in Canada, documented in this study, remains to be confirmed in more refined aggregates and groupings. Much subsequent research would necessarily involve cross-sectional analyses, for which the abundance and quality of data are greater than were available for the present analysis. Taking the provinces or census metropolitan areas as units of analysis, one could design research to test the relations between aspects of industrialization and both OSS and SIS, with controls for ethnicity and age. As well, degrees of OSS and SIS unrevealed by the data and methods used in this study undoubtedly remain to be studied in the actual situations in which work is done, and in which the consequences of technological development and a commitment to productivity, as well as urbanization and bureaucratization, may be examined more directly.

In sum, this study has clarified, and found support for, the theory that aspects of the industrialization process erode both OSS and SIS. In so doing, it has produced the first such set of results for Canada, indeed for any country. Finally, it suggests several directions for subsequent research in this area. Such conceptual distinctions, theoretical specifications, and methodological refinements as undertaken in this study facilitate taking the questions at issue out of the realm of assumption and speculation and placing them in the realm of empirical investigation.

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