UNIVERSIDAD CARLOS III DE MADRID working papers

Working Paper 03-36
Economics Series 12
July 2003

Departamento de Economía
Universidad Carlos III de Madrid
Calle Madrid, 126
28903 Getafe (Spain)
Fax (34) 91 624 98 75

GENDER SEGREGATION: FROM BIRTH TO OCCUPATION *

Ricardo Mora[1] and Javier Ruiz-Castillo[2]

Abstract

This paper offers a framework to study the gender segregation induced, not only by occupational choices among the employed population, but also by human capital characteristics and labor market participation decisions in the population consisting of non-students of working age. For that purpose, an additively decomposable gender segregation index related to the entropy notion in information theory is used. The approach is illustrated with Labor Force Survey data for Spain in 1977 and 1992. It is found that gender differences in labor market participation behavior is the most important source generating gender segregation in a given moment in time and the reduction in overall gender segregation during this period.

Keywords: Gender segregation, additively decomposable segregation indexes.
JEL Classification: J16, J24.

[1] R. Mora, Departamento de Economía, Universidad Carlos III de Madrid; E.mail: ricmora@eco.uc3m.es. Phone: (34) 91 624 9576
[2] J. Ruiz-Castillo, Departamento de Economía, Universidad Carlos III de Madrid. E.mail: jrc@eco.uc3m.es. Phone: (34) 91 624 9588

* We wish to acknowledge the excellent work done by the Research Assistant Neus Herranz, who acknowledges financial support from the Ministerio de Educación y Ciencia, 2001-2002. Javier Ruiz-Castillo and Ricardo Mora acknowledge financial support from the Spanish Instituto de la Mujer, Project Number 16/97. Ricardo Mora also received financial support from DGI, Grant BEC2003-03943. This paper has been presented in the September 2002 meeting of the network "Living Standards, Inequality, and Taxation", in Lübeck, financed by the European Communities (Contract #ERBCHRXCT980248).

I. INTRODUCTION

Most of the literature on gender segregation has been concerned with a single dimension, usually occupation.[1] Many analysis of intertemporal and international comparisons have provided a detailed picture of occupational gender segregation for the employed population.[2] Furthermore, the links between occupational gender segregation and some socioeconomic factors, such as human capital characteristics or race, have been investigated in a number of countries.[3] Yet the distribution of the employed population across occupations (and/or industries) is conditional on labor market participation and previously-made human capital investment decisions. For instance, it can be argued that in some Southern European countries such as Spain, the low female participation in the labor market and the resources that women devote to investment in human capital are essential aspects for the analysis of gender segregation.

The main contribution of this paper is to extend the domain of previous studies by considering, not only the gender segregation of the employed population, but also the gender segregation of the entire non-student population of legal working age, referred to

[1] In a few instances, some authors have classified all existing jobs according to two dimensions in order to study different structural aspects of gender segregation in a given moment of time, such as the effect of aggregation on the gender segregation induced by occupational choice, or the relative importance of the gender segregation induced by either the occupational or the industrial choice –see, Sections 7.2 to 7.5 in Flückiger and Silber (1999).

[2] For time-series analysis of individual countries, see, *inter alia*, Gross (1968), Blau (1977), Blau and Hendricks (1979), England (1981), Beller (1985), Albelda (1986), Jacobs (1989a, 1989b), Watts and Rich (1991, 1993), Jacobsen (1994, 1998), Blau *et al.* (1998), and Weeden (1998). For cross-country studies, see Jacobs and Lim (1992), Charles (1992, 1998), Charles and Grusky (1995), Grusky and Charles (1998), Anker (1998), and Dolado *et al.* (2001). For a recent treatise on segregation, see Flückiger and Silber (1999).

[3] See, *inter alia*, Roos (1985), Albelda (1986), King (1992), Hakim (1996), and Jacobsen (1994, 1998) for the U.S., Borghans and Groot (1999) for the Netherlands, Mora and Ruiz-Castillo (2003a) for Spain, and Charles *et al.* (2001) for a comparative study between the U.S. and Switzerland.

simply as the ``population´´ from here on. In particular, a measurement framework is presented where the overall gender segregation in the population at a given moment in time is accounted for by three factors: human capital characteristics, labor market participation status, and occupation/industry choice.[4]

To investigate these issues that involve a triple of classification variables, an additively decomposable index is needed. This paper uses a gender segregation index with this property that it is based in the entropy concept used in information theory. The index was originally presented in Theil and Finizza (1971) and Fuchs (1975), and has been recently further developed and analyzed in Mora and Ruiz-Castillo (2003a, 2003b). The additive decomposability property of the index is exploited not only to decompose gender segregation into the effects attributable to human capital characteristics, labor market status, and occupational choice, but also to report segregation differences amongst population subgroups and to analyze intertemporal changes in gender segregation.

It has been forcefully argued that, for rigorous cross-section and time-series comparisons of occupational segregation, the effect of both changes in the overall female share and in the occupational structure of the employed population should be removed.[5] The entropy index used in this paper is not independent of those changes. However, it must be recalled that the present application refers to the non-student population of working age. In this context, the overall female share remains essentially

[4] As in other measurement exercises, it will not be possible to disentangle the direction of causality between these three factors, nor the role in gender segregation of individual preferences, technological constraints, cultural forces or open gender discrimination.

constant both across countries and over different periods, rendering the removal of the effect of its changes an irrelevant issue.[6] Regarding variations in the population composition by human capital characteristics, labor market status and occupations, the structure of the index facilitates the decomposition, say, of the intertemporal change in overall gender segregation into two terms. The first one accounts for the effect of changes in gender composition across the partitions' subgroups, while the second term captures the impact of changes in the subgroups' relative demographic importance.[7]

The interest of this extension of the notion of gender segregation is illustrated with an empirical application using Labor Force Survey data for Spain for 1977 and 1992, two years for which there is comparable data. As far as the division of labor and study opportunities between the genders, the 1977 Spanish society conforms to the cultural patterns of a traditional Southern European society. For instance, two thirds of Spanish women are devoted to housework, while 80% of males are in the active population. Moreover, women constitute 55% of those with less than secondary education whilst only 43% of those with at least secondary education. In the fifteen years covered by this study, there was a sizeable increase both in female labor market participation and in the proportion of women with secondary and higher education. There were also important changes in the gender composition across occupations in response to the decline of agricultural and industrial activities, the growth of the service sector, and the increase in

[5] For instance, Charles (1992), Charles and Grusky (1995) and Grusky and Charles (1998) propose a segregation index consistent with a log-multiplicative model which is composition and occupational invariant. For a discussion, see Watts (1998).

[6] As will be seen below, the female share in Spain changes from 53.1% in 1977 to 51.9% in 1992.

[7] Examples of this approach to the treatment of changes in the occupational mix in segregation studies can be found in Fuchs (1975), Blau and Hendricks (1989), Flückiger and Silber (1999, chapter 8), and Karmel and MacLachlan (1988).

the size of the public sector.

Among the main results, we summarize here the following three. (1) Gender differences in labor market participation behavior constitute by far the most influential feature generating gender segregation in Spain. (2) During the 1977-1992 period, there is a reduction in overall gender segregation of 13.4 index points, or 26.6% of the 1977 level. Most of this change arises from differences in the evolution of labor market participation by gender. (3) Overall gender segregation takes place mostly within, rather than between, age/education subgroups. Nevertheless, notable differences in the gender segregation induced by labor market participation and occupational choices can be found across these human capital categories.

The rest of the paper contains five Sections and an Appendix. Section II is devoted to the measurement of segregation. Section III contains the empirical results for 1977 and 1992, while Section IV focus on the partitions by age/education and labor market subgroups. Section V is devoted to the dynamic analysis, and Section VI offers some concluding remarks. Some measurement aspects of gender segregation, as well as the description of the data, are contained in the Appendix .

II. THE MEASUREMENT OF SEGREGATION

At any point in time, any member of the population: a) has certain personal characteristics which determine her/his productive capacities; b) is in a certain relationship with the economic activity, as employed, unemployed, or as a member of the inactive population; and c) if employed, s/he is in a certain occupation.

Consequently, it is useful to view the gender segregation of the population as

arising from three different sources: the segregation induced by human capital characteristics; the one resulting from the distribution of people across labor market categories; and the one due to the distribution of the employed people across occupations, which is the only one usually studied in the literature.

For clarity of exposition, the decomposition of the gender segregation index for the population is presented in the following in two steps. In the first step, individuals are classified in terms of only two characteristics.[8] In the second step, the three characteristics demanded by the analysis -human capital investment, labor participation status, and occupational choice- are simultaneously considered.

II. 1. Gender Segregation Along Two Dimensions

Consider an economy in which all members of the population can be classified in terms of two variables: their human capital and their labor market status. Let there be I human capital categories, indexed by i = 1,…, I, and K labor market statuses, indexed by k = 1,…, K. Let F_{ik} and T_{ik} be the number of females and people of both genders, respectively, in human capital group i and labor market status k. Let $F_i = \Sigma_k F_{ik}$ and $T_i = \Sigma_k T_{ik}$ be the number of females and people in human capital i, and let $T = \Sigma_i T_i$ be the total number of people in the population. Let $W = F/T$ be the proportion of females in the population, $W_i = F_i/T_i$ the proportion of females with human capital i, and $w_{ik} = F_{ik}/T_{ik}$ the proportion of females with human capital i and labor market status k.

The population in human capital category i and labor market status k is said to be

[8] See Mora and Ruiz-Castillo (2003a, 2003b) for a full discussion.

segregated whenever w_{ik} differs from W. In information theory, the expression

$$I_{ik} = w_{ik} \log (w_{ik}/W) + (1 - w_{ik}) \log ((1 - w_{ik})/(1 - W)) \quad (1)$$

is known as the expected information of the message that transforms the proportions (W, (1 - W)) to a second set of proportions (w_{ik}, (1 - w_{ik})). The ratio w_{ik}/W can also be expressed as the ratio between the female distribution across human capital and labor market categories to the distribution of the overall population, $(F_{ik}/F)/(T_{ik}/T)$. Therefore, the greater the discrepancy between the distribution of female and male workers over occupations, the greater is I_{ik}. This is intuitively reasonable for a measure of local segregation. The value of this expected information is zero when the two sets of proportions are identical; it takes larger and larger positive values when the two sets are more different. The index I_{ik} provides what is called a *direct* measure of gender segregation in human capital category i and labor market status k in relation to the entire population.

The weighted average of the I_{ik}s, with weights proportional to the number of people in the age/education category i and labor market category k, provides a reasonable overall measure of occupational segregation:

$$I = \Sigma_i \Sigma_k (T_{ik}/T) I_{ik}.$$

This measure of overall gender segregation can be decomposed into two components: a *between-group* term and a *within-group* term.[9] The expected information of

[9] It can also be shown that this index of segregation fulfils most previously proposed desirable properties for a measure of gender segregation, such as *complete integration and segregation*, *symmetry in types and groups* and the *principle of transfers*. In addition, it can be interpreted as a log likelihood test in a non-parametric discrete choice model. See Mora and Ruiz-Castillo (2003b) for a detailed exposition of the properties of the index.

the message that transforms the proportions (W, (1 – W)) into the proportions (W_i, (1 – W_i)) is given by

$$I_i = W_i \log (W_i/W) + (1 - W_i) \log ((1 - W_i)/(1 - W)). \quad (2)$$

Consider the weighted average of the I^is with weights proportional to the number of people in each subgroup, that is,

$$I^B_{(i)} = \Sigma_i (T_i/T) I_i. \quad (3)$$

Equation (3) can be interpreted as the *between-group* (direct) gender segregation induced by human capital differences between men and women.

On the other hand, the expected information of the message that transforms the proportions (W_i, (1 – W_i)) into the proportions (w_{ik}, (1 – w_{ik})) is given by

$$I^{ik} = w_{ik} \log (w_{ik}/W_i) + (1 - w_{ik}) \log ((1 - w_{ik})/(1 - W_i)) \quad (4)$$

The gender segregation induced by labor market choices within category i as a whole is defined by

$$I^i = \Sigma_k (T_{ik}/T_i) I^{ik}. \quad (5)$$

Thus, the *within-group* gender segregation in the partition by human capital categories can be defined as

$$I^{Wk}_{(i)} = \Sigma_i (T_i/T) I^i. \quad (6)$$

As shown in Mora and Ruiz-Castillo (2003a), it turns out that

$$I = I^B_{(i)} + I^{Wk}_{(i)}. \quad (7)$$

Moreover, the index I has a very convenient commutative property where the roles of the

variables i and k can be reversed. For that purpose, let $W_k = F_k/T_k$, where $F_k = \Sigma_i F_{ik}$ and $T_k = \Sigma_i T_{ik}$ are, respectively, the number of females and people with labor market status k. Define a *between-group* term which measures the direct gender segregation induced by labor market status, $I^B_{(k)} = \Sigma_k (T_k/T) I_k$, where $I_k = W_k \log (W_k/W) + (1 - W_k) \log ((1 - W_k)/(1 - W))$; and a *within-group* term which measures the gender segregation induced by human-capital categories at each labor market status, $I^{Wi}_{(k)} = \Sigma_k (T_k/T) I^k$, $I^k = \Sigma_i (T_{ik}/T_k) I^{ki}$, where $I^{ki} = w_{ik} \log (w_{ik}/W_k) + (1 - w_{ik}) \log ((1 - w_{ik})/(1 - W_k))$. Then, we have that

$$I = I^B_{(k)} + I^{Wi}_{(k)}. \qquad (8)$$

Thus, the overall segregation index I admits two alternative decompositions. In the first one, the term $I^{Wk}_{(i)}$ measures the contribution of labor market status to the overall gender segregation, the impact of human capital categories being kept constant in $I^B_{(i)}$. Similarly, the term $I^{Wi}_{(k)}$ measures the role of human capital categories on gender segregation, the impact of labor market status being kept constant in $I^B_{(k)}$.[10]

Finally, it can be seen that

$$I = \Sigma_i (T_i/T) I(i) = \Sigma_k (T_k/T) I(k), \qquad (9)$$

where $I(i) = I_i + I^i$, and $I(k) = I_k + I^k$, is the gender segregation in subgroup i or k,

[10] For an alternative decomposition using the Gini-Segregation Index, see Silber (1989), Boisso *et al.* (1994), Deutsch *et al.* (1994), and Sections 7.4 and 7.5 of Flückiger and Silber (1999). For the decomposition of the

respectively. Equation (9) indicates that overall gender segregation I is the weighted average of gender segregation in each human capital or labor market category, with weights equal to their relative demographic importance in the economy as a whole.

II. 2. The Case of Three Classification Variables

Assume that the population can be classified according to three variables indexed by i = 1,…, I; k = 1,…, K; and j = 1,…, J. Let F_{ikj} and T_{ikj} be the number of females and the number of people with characteristics i, k and j, respectively, and let $w_{ikj} = F_{ikj}/T_{ikj}$. In the present context, let I, K, and J be the number of human capital categories, labor market status, and occupations, respectively. Assume that the value k = 1 corresponds to those individuals currently employed. Of course, the unemployed and those out of the labor force have no occupation. This means that the relevant transformation is the one which leads directly from the proportions (W, (1 –W)) to the proportions (w_{i1j}, (1 – w_{i1j})) for the employed population, and to the proportions (w_{ik}, (1 – w_{ik})) for all k ≠ 1. As shown in the Appendix, the index of overall segregation in this case, I*, can be written as follows:

$$I^* = \Sigma_i \Sigma_{k\neq 1} (T_{ik}/T)\, I_{ik} + \Sigma_i \Sigma_j (T_{i1j}/T)\, I_{i1j},$$

where I_{ik} is defined in equation (1), and $I_{i1j} = w_{i1j} \log (w_{i1j}/W) + (1 - w_{i1j}) \log ((1 - w_{i1j})/(1 - W))$.

As shown in equation (e) in the Appendix, the index of overall segregation I* can

---

Karmel and MacLachlan (1988) segregation index, see Silber (1992), Watts (1997), and Borghans and Groot (1999).

also be written as

$$I^* = I^B_{(i)} + I^{Wk}_{(i)} + (T_1/T)\, \hat{I}^{Wj}_{(i)}, \qquad (10)$$

As in the previous subsection, the terms $I^B_{(i)}$ and $I^{Wk}_{(i)}$ measure, respectively, the gender segregation directly induced by human capital categories, and by labor market status within the partition by human capital characteristics. The term $\hat{I}^{Wj}_{(i)}$ measures the gender segregation induced by gender specific distributions across occupations within the partition by human capital categories in the employed population. This is the usual measure of occupational gender segregation and it appears in equation (10) appropriately scaled down by the importance of the employed population in the population at large, T_1/T.

III. SOURCES OF GENDER SEGREGATION

The data used comes from the Spanish *Encuesta de Población Activa* (EPA), a labor force survey representative of the household population living in residential housing. The first year of study is 1977, the first time for which microeconomic data is available in electronic support. 1992 is the last year for which comparable data on occupations is available. Therefore, the period under study starts in 1977 and ends in 1992. Individuals are classified according to three variables. First, human capital categories result from the combination of readily available variables, namely, age and education. This combination gives rise to 11 age/education categories. Second, labor market status is represented by 5 labor market categories. Finally, using an algorithm

based on the bootstrap, Herranz *et al.* (2003) shows that the 106 occupations available for 1977 and 1992 can be aggregated into a common list of 29 occupational categories without significantly reducing the original gender segregation level. Thus, to avoid small-cell problems in our analysis, we compute all segregation indices using these 29 occupational categories.[11]

The study of gender segregation will be organized in three sub-sections. First, descriptive statistics for 1977 in the partition by age/education, labor market status, and occupation will be presented. This sub-section will also include a preliminary discussion of each variable's relative importance as a determinant of gender segregation with the help of indexes of *between-group*, direct gender segregation. Second, the overall gender segregation in that year will be studied in two steps: the gender segregation induced by age/education characteristics and labor market decisions in the population as a whole, and the gender segregation attributed to occupational choices in the employed population. Finally, descriptive statistics for all partitions and the overall gender segregation in 1992 will be discussed in the third sub-section.

III. 1. Descriptive Statistics and Between-group Segregation in 1977 in the Partitions By Age, Education, Labor Market Status, and Occupation

As pointed out in the Appendix, the target population in 1977 consists of 23,711,000 individuals, 53.1% of which are females. The first three columns of Table 1 present the frequency distribution of females, males, and the total population, respectively, classified in two panels by age/education categories and labor market status. There are 11 age/education subgroups and 5 labor market categories, indexed by i

[11] See the Appendix for a brief explanation of the data and the full description of the variables.

= 1,…, 11, and k = 1,…, 5, respectively. Column 4 provides the percentage of females in each cell, while column 5 informs about the direct segregation indexes I^i, and I^k, defined in equation (1), and their bootstrapped 1% and 99% bounds.[12] For ease of interpretation, all index numbers are multiplied by 100.

Table 1 around here

As can be seen in columns 1 and 2 in the first panel of Table 1, males and females with a primary education, who represent almost 60% of the population, share a similar age distribution. For the remaining 40%, educational experience varies considerably with age. Consequently, their direct segregation index I_i increases with age, but for different reasons at different educational levels: the older the age bracket, the greater is the percentage of females with a low education and the smaller is the percentage of females with a secondary or a College education. However, due to the large weight of individuals with a primary education, a subgroup for which gender segregation is practically absent, the between-group gender segregation term is very low: $I^B_{(i)} = 1.23$, with 1% and 99% bounds equal to 1.10 and 1.42, respectively. Thus, people's broad educational choices, even when they are combined with age differences, induce a very low degree of direct gender segregation.[13]

[12] All bootstrapped lower (1%) and upper (99%) bounds reported in the paper are obtained from 1,000 empirical sample replications with replacement.

[13] By analogy to equations (7) and (8), the value $I^B_{(i)} = 1.23$ can be decomposed in two ways. The first one consists of an index of direct segregation induced by age only (whose value is 0.13) and a within index induced by education (1.10). The second decomposition consists of an index of direct segregation induced by education (0.99) and a within index induced by age (0.24). Not surprisingly, except for a greater percentage of older females, the frequency distribution by age is very similar for both genders, so that the segregation index in each age cell is very small indeed. On the other hand, there are almost 10 percentage points more females than males with a low education and about a half with a College education, probably revealing a lack of equal study opportunities for women. Although this explains why education induces more

Contrary to the previous partition, gender differences in labor market decisions are very important (see the second panel of Table 1). For instance, among the inactive individuals devoted essentially to housework, 96.1% are females; however, among those employed, only 28.6% are females (see column 4). Therefore, the segregation indexes in these two cells are 68.0 and 17.9, respectively. The weighted average over all labor market categories is $I^B_{(k)}$ = 34.2, a relatively high value, whose bootstrapped lower and upper bounds are 33.6 and 35.1, respectively (see column 5). Clearly, the *between-group* term for this partition is significantly much larger than the *between-group* term for the partition which reflects human capital investment decisions.

Finally, in order to review the usual case studied in the literature, namely, the gender segregation induced by occupational choices, attention should be shifted to the employed population. For clarity of presentation, the 29 occupational categories are classified under three main categories: 4 integrated occupations, each of which has a proportion of females within 10 percentage points of that in the overall population; 14 male occupations; and 11 female occupations. In turn, each of these categories can be further divided into a maximum of four groups, depending on whether they contain agricultural, blue collar, white collar, as well as professional and managerial occupations. In addition, male occupations include the armed forces. This gives a total of 12 aggregate categories.

Table 2 around here

The direct segregation index for any occupation, $\hat{I}_{1j}$, results from the

segregation than age, such inequality of study opportunities gives rise to a surprisingly low level of gender segregation.

discrepancy between the proportion of females in the employed population, W_1 = 28.6%, and the proportion of females in that occupation, w_{1j} (see column 4 in Table 2). Naturally, the direct segregation indexes reach high values in the male and female occupations, and low values in the integrated occupations (see column 5 in Table 2). The between-group term $\hat{I}^B_{(j)} = \Sigma_j (T_{1j}/T_1) \hat{I}_{1j}$ is equal to 27.0, and its 1% and 99% bootstrapped bounds are 26.4 and 27.7, respectively. That is, the usual gender segregation in the employed population studied in the literature is much larger than the gender segregation induced by age/education characteristics, but 21% smaller than the gender segregation induced by labor market choices in the population as a whole.

III. 2. The Overall Gender Segregation in 1977

The overall segregation at a given moment in time can be treated in two steps: the gender segregation induced by age/education characteristics and labor market status; and the gender segregation induced by occupational categories. As far as the first step is concerned, according to equations (7) and (8) we have:

$$I = I^B_{(i)} + I^{Wk}_{(i)} = I^B_{(k)} + I^{Wi}_{(k)}.$$

Given that, as was discussed in the previous sub-section, $I^B_{(k)}$ = 34.2 is much larger than $I^B_{(i)}$ = 1.2, it might be instructive to focus now on the partition by labor market status and examine in some detail the term $I^{Wi}_{(k)}$.

Column 4 of panel 1 in Table 1 showed that the proportion of females in the population as a whole did not differ much from the female share in each age/education

subgroup. However, the age/education profile of employed females, for example, is expected to be very different from the profile of females engaged in housework. The actual differences are illustrated in the two panels of Table 3 (see column 1). Females with a low education represent 17.4% of all the employed females but as many as 33.4% of females devoted to housework; conversely, the percentage of females with a College degree in these two subgroups are 5.6 and 1.1%, respectively.

Table 3 around here

Do such patterns lead to large differences in the segregation indexes within these two subgroups? They do not. The reason is that the male distributions by age/education characteristics are very similar to the females ones (compare columns 1 and 2 in Table 3). Consequently, the set of female ratios w_{ik}, i = 1,…, 11 for k = 1, 5, are not very different from the corresponding female proportions $W_1 = 28.6$ and $W_5 = 96.1$, respectively (see column 4). Therefore, the segregation indexes in each cell, I_{ik}, are all small[14] (see column 5), giving rise to low weighted index values: $I_1 = 1.8$ and $I_5 = 0.8$ in these two cases. Since something very similar occurs in the three remaining labor market categories –details are available on request- it is found that the within-group term in this decomposition is very low indeed, $I^{Wi}_{(k)} = \Sigma_k (T_k/T) I_k = 1.6$.

[14] Among the employed, however, there are some interesting differences across age/education characteristics (see panel 1 in Table 3). Among the older employed, the proportion of females decreases with the educational level, but among the younger employed the pattern is the opposite. Since the proportion of females among the employed is very low (28.6%), the segregation indexes for younger females with a secondary or a College education become relatively high: 7.4 and 8.4, respectively. But since these two groups represent only about 10 per cent of the population, the segregation index induced by age/education characteristics in the employed cell as a whole is only 1.76 (see column 1).

In brief, gender segregation at this stage is seen to be equal to $I^{B}_{(k)} + I^{Wi}_{(k)} =$ 34.2 + 1.6 = 35.8. The ratio 100(34.2)/35.8 = 95.5 is very high, and the interpretation is clear: 95.5% of the gender segregation created so far is attributable to labor market participation decisions. Naturally, little is changed from the perspective of the partition by age/education characteristics: $I^{B}_{(i)} + I^{Wk}_{(i)} = 1.23 + 34.57 = 35.8$. Hence, the part of overall segregation due to differences in the distribution across broad educational categories by gender, even when age effects are taken into account, is of a small order of magnitude.

As far as the second step is concerned, recall that, according to equation (10), overall gender segregation, I*, can be expressed as:

$$I^* = I^{B}_{(i)} + I^{Wk}_{(i)} + (T_1/T)\, \hat{I}^{Wj}_{(i)} = I + (T_1/T)\, \hat{I}^{Wj}_{(i)}.$$

In other words, the gender segregation induced by occupational categories within the age/education groups in the employed population, $\hat{I}^{Wj}_{(i)}$, should be added to the gender segregation already examined, I, weighted by the share of the employed over the population, $T_1/T = 51.2$.

In Mora and Ruiz-Castillo (2003a) it was found that the gender segregation due to age/education characteristics and occupational choices in the employed population in 1977 was $\hat{I} = \hat{I}^{B}_{(i)} + \hat{I}^{Wj}_{(i)} = 1.77 + 28.27 = 30.04$. Therefore,

$$I^* = I^{B}_{(i)} + I^{Wk}_{(i)} + (T_1/T)\, \hat{I}^{Wj}_{(i)} = 1.23 + 34.57 + (0.512)\, 28.27 = 50.27.$$

Thus, in 1977 the labor market status and the occupational decisions account for 68.8% and 28.8%, respectively, of the overall gender segregation. The remaining residual, 2.4%,

is accounted for by the age/education characteristics.[15]

III. 3. Descriptive Statistics and Overall Gender Segregation in 1992

As indicated in the Introduction, during the period spanning from 1977 to 1992 there are important changes in male and female behavior relating to the investment in human capital through formal education, labor market participation and occupational choices. Taking into account that the percentage of females in the population as a whole -which in 1992 is equal to 51.9%- has remained practically stable, these changes should affect the estimates of gender segregation in the three dimensions we are concerned with.

The information about the population in 1992 relative to the human capital dimension is in the first panel of Table 4. The comparison with the first panel in Table 1 shows the following differences. In the first place, as a consequence of the decline in fertility and the increase in life expectancy, the proportion of males and females over 50 years of age has increased by 3.0 and 4.4 percentage points, respectively. In the second place, there has been a remarkable improvement in educational achievements. As a result, 23.4% of the population has a low education (versus 27.1% in 1977), whereas 35.3% has a secondary or a College education (versus 13.6% in 1977).

Table 4 around here

What are the implications of this upgrading in educational achievements, particularly among the young, for the gender segregation induced by age/education

[15] It should be noticed that, using a two-digit classification that combines educational levels and educational subjects into 54 categories, Borghans and Groot (1999) find that direct education segregation accounts for 80% of occupational segregation in The Netherlands. However, the segregation induced by 5 broadly defined educational levels is 5 times smaller. See also Charles *et al.* (2001) for the comparison of Switzerland, where a highly differentiated system provides more opportunities for sex segregation within secondary education,

characteristics? In this framework, differences in gender segregation must come from gender differences in the above patterns. The comparison of column 1 in Tables 1 and 4, indicates that the proportion of females with a secondary or a College education has increased, approximately, by a factor of 3 and 2.5, respectively, while the proportion with a low education or, above all, with a primary one, has decreased dramatically. However, judging from the evidence presented in column 2 of these Tables, something similar has also taken place among the males. Nevertheless, the female share among people over 30 with a secondary education, as well as among people of all ages with a College degree, has increased, while the female ratio among young people with a primary or a secondary education has decreased. Consequently, for people over 30 with a secondary or a College education, the gender segregation indexes have decreased; but this is offset by the increase in the indexes for the young, including those with a College degree, where the proportion of females is now 61.1% -almost 10 percentage points above the female proportion for the population as a whole. As a result, the between-group gender segregation induced by age/education characteristics is in 1992 $I^{B}_{(i)} = 1.06$, the same low order of magnitude as in 1977.

The conclusion is inescapable. The Spanish population in 1992 is considerably more educated than in 1977. But in spite of the fact that the investment in human capital has been particularly large among females, the combination of people's broad educational choices with age effects induces again in 1992 a very low degree of gender segregation.

---

and the U.S., where the educational system emphasizes general training and offers fewer opportunities for

The comparison between column 3 in the second panel of Tables 1 and 4 shows drastic changes in the relation to economic activity. Unemployment has increased from 2.6% to 8.7%, while the employed population now represents 6.9 percentage points less than in 1977. The inactive population has remained approximately constant, but its composition has changed: there has been an increase of 4.1 percentage points in the retired population, comprising pensioners and the disabled, offset by a corresponding decrease of people devoted to housework, which still represents as much as 31.5% of the population.

These trends result from rather different variations in gender patterns (compare columns 1 and 2 in Tables 1 and 4). Among females, the proportion of people devoted to housework has been reduced by 7.2 percentage points, which is approximately the amount by which female unemployment has increased; most of this increase takes place among the unemployed, presumably the young searching for a first job. Among males, the employed now represent 16.2 percentage points less than in 1977; the corresponding increase takes place not only among the unemployed -especially, those searching for a first job- but also among the early retired in the category of pensioners and the disabled. As a result, the female share (see column 4) increases in all categories within the active population, and decreases in both categories within the inactive population. The direct segregation indexes (see column 5) in the "housework" and "searching for a first job" categories and, to a smaller extent, among the employed, decrease dramatically. This novelty is only partially offset by the increase in gender segregation in the remaining two labor market categories. Therefore, the between-group component $I^{B}_{(k)}$ becomes equal to

---

gender differentiation.

23.2, 32.2% less than its value in 1977.

Table 5 presents the descriptive statistics and the direct gender segregation indexes in the partition of the employed population by 29 occupations in 1992. Together with the decline in agriculture, as well as in integrated and female blue collar occupations, the most important change in total employment structure during the 1977-1992 period is the growth of the service sector induced mostly by the increase in the size of the public sector. Such changes in the occupational mix cause a slight increase in gender segregation. This is partly offset by a decrease attributable to changes in the gender composition in a scenario characterized by a considerable increase in the female labor participation rate from 28.6% to 32.9% of the employed population. The net result is a non-significant increase of 0.37 index points in the between-group term $\hat{I}^{B}_{(j)}$, which captures the direct gender segregation induced by occupational choices.[16]

Table 5 around here

Similarly, the gender segregation induced by occupational choices within the partition by age/education characteristics in the employed population, $\hat{I}^{Wj}_{(i)}$, decreases by 0.60 percentage points (details available on request). Moreover, since the proportion of employed people has gone down from 51.2% in 1977 to 44.3% in 1992, the term (T_1/T)

[16] In turn, the within-group index of segregation induced by age/education characteristics within occupational categories, $\hat{I}^{Wi}_{(j)}$, also decreases from 3.04 to 1.95 index points. Consequently, total gender segregation goes down by an insignificant 0.71 index points, or 2% relative to the level reached in 1977. As indicated in Mora and Ruiz-Castillo (2003a), the slight decline in gender segregation in the employed population observed in Spain during the 1977-1992 period is broadly consistent with the relative stability shown by the dissimilarity index in the U.S. throughout the first half of the twentieth century (see Jacobs, 1989a, and the discussion of the early papers on the U.S. in England, 1991). This period in the U.S. is characterized by female labor participation rates comparable to the Spanish ones: in 1960, that rate was 37.7% in the U.S. –see Beller (1985).

$\hat{I}^{Wj}_{(i)}$ decreases to 12.0, about 18.91% below its value in 1977. To sum up, the overall gender segregation in 1992 can be expressed as

$$I^* = I^B_{(i)} + I^{Wk}_{(i)} + (T_1/T)\hat{I}^{Wj}_{(i)} = 1.06 + 23.8 + (0.443)\ 27.09 = 36.9$$

Thus, in 1992 the labor market status and the occupational decisions account for 100 $(I^{Wk}_{(i)})/I^*$ = 64.6% and 100 $((T_1/T)\ \hat{I}^{Wj}_{(i)})/I^*$ = 32.6%, respectively, of overall gender segregation. The remaining residual, 2.9%, is accounted for by the age/education characteristics. The main difference with 1977 is the decline of 4.2 percentage points in the share of $I^{Wk}_{(i)}$ in favor, essentially, of the segregation induced by occupational choices.

IV. GENDER SEGREGATION IN THE PARTITION BY AGE/EDUCATION AND LABOR MARKET SUBGROUPS

IV.1. The Partition by Age/education Characteristics

In the previous section it has been shown that overall gender segregation in Spain takes place mostly within age/education subgroups. Nevertheless, it is still interesting to study how gender segregation induced by labor market status and occupational decisions varies across specific age/education subgroups.

For this purpose, overall gender segregation can be expressed using equation (10) as the weighted sum of segregation indices in each of the age/education categories:

$$I^* = \Sigma_i\ (T_i/T)\ I^*(i) \qquad (11)$$

where, for each i,

$$I^*(i) = I_i + I^i + (T_{i1}/T_i)\, \hat{I}^{i1}. \qquad (12)$$

Recall that I_i is the direct segregation attributed to category i (see equation 2); I^i is the gender segregation induced by labor market decisions within that category (see equation 4); and $\hat{I}^{i1}$ measures the segregation induced by occupational choices within each age/education category in the employed population; that is, $\hat{I}^{i1} = \Sigma_j\, (T_{i1j}/T_{i1})\, \hat{I}^{i1j}$, where $\hat{I}^{i1j} = w_{i1j} \log (w_{i1j}/ w_{i1}) + (1 - w_{i1j}) \log (1 - w_{i1j})/ (1 - w_{i1})$. In equation (12), this term appears appropriately weighted by the proportion of people in each age/education category which is employed. The information for 1977 and 1992 is in Table 6.

Table 6 around here

Column 1 in both panels of Table 6 simply reproduces the direct gender segregation in each age/education cell in 1977 and 1992 (this is taken from column 5 in the first panel of Tables 1 and 4, respectively). In 20 out of the 22 cases, direct segregation indexes belong to the small interval [0.0, 7.5]; the remaining 2 indexes (for subgroups 10 and 11 in 1977), have a slightly larger range of variation from 10.9 to 16.7.

Column 2 presents the indexes measuring the segregation induced by labor market status. In 1977, the subgroups 4, 7, and 10, consisting of people 31-50 years of age, show the maximum segregation within all educational categories. However, in 1992 the pattern has changed: gender segregation increases monotonically with age in all educational categories. This reflects most likely the fact that the main shift observed during this period, from housework to active participation in the labor force, has been more prevalent among the younger females.

Column 3 presents the indexes capturing the segregation induced by occupational choices. In all educational categories, segregation among the old is lower compared to the previous age brackets. Recall that the female share among the employed decreases monotonically with age in all educational categories, except for those with a low level of education (see column 4 in the upper part of Table 3 for the 1977 data). This implies that, at every educational level, those females who remain employed in the later part of their life-cycle are a selected group of the population. As pointed out in Mora and Ruiz-Castillo (2003a), from a human capital perspective, young women will choose those occupations where their skills depreciate less if they must leave their jobs for extended periods of time because of family obligations. As a result, occupational segregation among young workers will be larger than among older workers in all educational categories.

Column 4 presents the overall segregation indexes $I^*(i) = I^i + I_i + (T_{i1}/T_i)\, \hat{I}^{i1}$, while column 5 presents the ratio $I^*(i)/I^*$ for every i. When this ratio is greater (smaller) than 1, it indicates that category i is contributing to overall gender segregation above (below) what could be expected from its demographic weight. People between 31 and 50 with a primary or a secondary education (subgroups 4 and 7 in Table 6), which represent about one quarter of the population, contribute between 11% to 33% more to overall gender segregation than what would be expected from their demographic weight. About two thirds of this contribution is due to the segregation induced by labor market participation decisions. At the opposite end of the spectrum, young people with a secondary education (subgroup 6) and people with a College degree (subgroups 9, 10,

and 11), which represent 9% and 22% of the population in 1977 and 1992, respectively, contribute to overall gender segregation below what would be expected from their demographic weight. For instance, in 1992, the three College subgroups contribute 61%, 38%, and 19% less to overall segregation than what would be expected from their demographic weight.

IV.1. The Partition by Labor Market Categories

Thanks to the commutative property of the index, gender segregation can be alternatively analyzed from the perspective of the partition by labor market status. Although lack of space precludes a detailed discussion, the main information is in Table 7. First, in 1977 the subgroup of people engaged in housework, which represents slightly over one third of the population, contributes to overall gender segregation 36% more than what would be expected from its demographic weight (see column 5). In 1992, this percentage is raised up to 41%; the reason is that although its direct gender segregation is considerably reduced (see column 1), the overall level of gender segregation declines even further (see the last row in column 4). In both years, most of this contribution is due to segregation induced by labor market participation decisions. Second, both the unemployed having worked before and the subgroup consisting of pensioners and disabled workers contribute to overall gender segregation in both years well below what would be expected from their demographic weight. Third, the important subgroup of the employed, which in 1977 represents 51.2% of the population, contributes 4% less than what would be expected from its demographic weight. Even though segregation within the employed decreases in 1992, its contribution to overall gender segregation increases

due to the large reduction in overall gender segregation for the population as a whole.

Table 7 around here

V. INTERTEMPORAL COMPARISONS

The following two equations from the previous section summarize the decomposition of the overall gender segregation in Spain in 1977 and 1992 according to age/education characteristics, labor market status, and occupational choices, respectively:

$$I^*_{1977} = 1.23 + 34.57 + (0.512)\ 28.27 = 50.27;$$

$$I^*_{1992} = 1.06 + 23.8 + (0.443)\ 27.09 = 36.9.$$

Overall gender segregation decreases by 13.4 index points, or 26.6% of its 1977 value. The three sources contribute to this decrease in different amounts. The gender segregation induced by labor market participation decisions decreases by 31.1% with respect to its 1977 level. This accounts for 10.8 index points, or 80.6% of the overall decline. Gender segregation induced by occupational choices remains virtually constant, but its contribution to overall gender segregation declines by 17.1% because of the reduction in the proportion of the employed population from 51.2% to 44.3%. This accounts for 2.5 index points, or 11.2% of the overall reduction. The remaining 0.2 index points is attributable to the decline in the gender segregation induced by age/education characteristics.

To investigate which are the subgroups mainly responsible for this reduction of 13.4 points in overall gender segregation, a decomposition of this change into change in segregation indexes and change in demographic weights is carried out in the following.

Let $\Delta I^* = I^*_{1992} - I^*_{1977}$. According to equation h in the Appendix, for the partition by age/education characteristics, we have:

$$\Delta I^* = \Sigma_i \Delta S_i + \Delta D_i. \quad (13)$$

For each i, ΔS_i is the part of the overall change attributed to the change in gender segregation indexes, holding constant the demographic shares at their 1977 levels, while ΔD_i is the part of the overall change attributed to changes in the demographic shares. The information about all the terms in equation (13) is in Table 8.

Table 8 around here

Gender segregation decreases the most among individuals of 16-50 years of age with a primary or a low education (subgroups 3, 4, and 1), for which a combined reduction of 17.2 index points is found. This is the result of a reduction of 7.5 index points in the segregation induced by labor market status (not shown in Table 8 but available upon request) and, above all, a reduction due to change in demographic weights -10.5 index points. On the other hand, essentially as a consequence of their demographic increase, people 16-50 years of age with a secondary education (subgroups 6 and 7) yield a combined *increase* in overall gender segregation of 4.6 index points, or 9.1% of the initial segregation level.

Finally, from the point of view of the partition by labor market status (information available on request), overall segregation decreased the most for those employed and the inactive devoted to housework. In both cases, the main sources of such a decrease are again the reduction in segregation induced by labor market participation decisions as well as the decrease in their respective demographic

weight.

VI. CONCLUDING REMARKS

VI. 1. Summary

This paper investigates how much of the overall segregation can be attributed to decisions already made before employed individuals are allocated to different occupations. In particular, a framework has been offered to study the segregation induced, not only by occupational choices, but also by human capital characteristics and labor market participation decisions in the population consisting of non-students of working age. For that purpose, an additively decomposable gender segregation index related to the entropy notion in information theory has been used.

The interest of this measurement approach is illustrated with Spanish data from the Labor Force Survey in 1977 and 1992, two years for which there is comparable data. Three main results can be summarized as follows. First, in Spain, with a female employment rate of only around 27% during this period, gender differences in labor market participation behavior constitute the most influential feature generating overall gender segregation. Second, changes in labor market participation decisions account for 80.6% of the 26.6% decrease in overall gender segregation. In contrast, gender segregation attributable to occupational choices in the employed population remains basically constant. However, because of the decline in the proportion represented by the employed population, this source accounts for 11.2% of the overall decrease. Third, the change in overall gender segregation is mainly attributable to changes in the gender composition within age and education categories, holding constant the 1977

demographic weights in all subgroups.

Although most of the gender segregation in Spain takes place within, rather than between age/education subgroups, some caution should be exercised in interpreting this result, as only broad educational categories were available. Nevertheless, the measurement instrument permits to study how gender segregation induced by labor market participation or occupational choices varies across specific age/education subgroups. For instance, it has been found that (i) in 1992 the gender segregation induced by labor market participation decisions increase monotonically with age in all educational categories; (ii) in both years, the segregation induced by occupational choices follows exactly the opposite pattern.

Probing into the variations across different partitions, the subgroups mainly responsible for the decrease in overall gender segregation from 1977 to 1992 have been isolated, namely: people 16-50 years of age with a primary or a low education, and the employed and the inactive devoted to housework. Finally, the subgroups whose contribution to gender segregation differs greatly from what we can expect from its demographic importance have also been isolated. People over 30 years of age with a primary or a secondary education, and those devoted to housework contribute to gender segregation well above their demographic importance; the opposite is the case for people of all ages with a College education, the unemployed, and those receiving an old-age or a disability pension.

VI. 2. Policy Recommendations and Extensions

The measurement instruments used in this paper do not allow us to distinguish

which part of gender segregation is due to voluntary choices and technical restrictions, and which part is due to gender discrimination or, in other words, to unequal opportunities for studying, participating in the labor market or being employed in a certain occupation. Nevertheless, if a reduction of overall gender segregation is sought for, it appears that the main hope lies in a continuation of the trend towards less female specialization in housework. Thus, the factors that should be favored are an independent increase in the male share of child care and housework generally, an increase in the female wage rate, and/or a reduction in the cost of housework activity through, for example, the availability of day care centers at affordable prices. On the other hand, the gender segregation among the employed may decrease if more females enter into the male occupations or, more importantly, if more males get jobs in the traditionally female occupations. Judging from the U.S. experience, this process might be favored by the strong enforcement of laws on equal employment opportunity.[17]

When making policy or normative conclusions from this type of results, it should be remembered that the decomposition analysis in this paper is merely an accounting exercise which leaves no room for the possible interdependencies between the partitions. For instance, to assess the role of education in diminishing gender segregation, one should explicitly model the link between education and labor participation.

[17] The pattern of gender segregation in the U.S. changes substantially since the 1970s, when occupational segregation in the employed population began to decline noticeably (compare with footnote 16). Beller (1985) and Blau *et al.* (1997) offers some evidence in favor of the idea that in the U.S. laws on equal employment opportunity introduced since 1972 have contributed to this decrease. For instance, changes in the sex composition of occupations were the predominant cause of the decrease in segregation in both the 1970s and the 1980s, suggesting that expanding opportunities for women, particularly in nontraditional occupations at the white-collar level, played a significant role.

A natural extension of this paper will be in the direction of international comparisons. One would like to verify: (i) whether other countries in transition in Southern Europe and elsewhere present similar gender segregation patterns; (ii) whether in Northern European and Anglo-Saxon societies, where female labor participation rates are much higher, the overall gender segregation is essentially due to occupational rather than to labor market participation choices; and (iii) whether in underdeveloped countries with even more pronounced traditional gender patterns, age/education characteristics are also responsible for a relatively small degree of gender segregation. It would be also interesting to verify whether there is any connection between female labor market participation rates and the level of gender segregation induced by occupational choices.

There are other aspects of gender segregation which can be conceivably investigated with the present tools. We refer to the possibility of estimating the gender segregation induced by vocational training or by the partition into different categories within the firm's hierarchical structure. Likewise, in countries with racial diversity, one could analyze simultaneously racial and gender segregation using the metric that we have presented in this paper.[18] Finally, the results of gender segregation –particularly the segregation induced by occupational choices- might be used as control variables in studies of wage differences between genders.

[18] Albelda (1986) obtained interesting results about racial and gender segregation in the U.S. during the 1958-1981 period. However, he measured the two phenomena separately using the dissimilarity index which is not additively decomposable. Instead, Boisso *et al.* (1994) provide an appropriate measurement instrument, namely, a multidimensional version of the Gini segregation index.

APPENDIX

I. The Measurement of Gender Segregation

Assume that the population can be classified according to three variables indexed by i = 1,…, I; k = 1,…, K; and j = 1,…, J. Let F_{ikj} and T_{ikj} be the number of females and the number of people with characteristics i, k and j, respectively, and let $w_{ikj} = F_{ikj}/T_{ikj}$. In the absence of any restrictions, the overall index of direct segregation is defined by:

$$I^{**} = \Sigma_i \Sigma_k \Sigma_j (T_{ikj}/T)\, I_{ikj}, \qquad (a)$$

where $I_{ikj} = w_{ikj} \log (w_{ikj}/W) + (1 - w_{ikj}) \log ((1 - w_{ikj})/(1 - W))$. Among other alternatives, it can be shown that the overall segregation index can be decomposed into the following three terms:

$$I^{**} = I^{B}_{(i)} + I^{Wk}_{(i)} + I^{Wj}_{(i)}, \qquad (b)$$

where $I^{B}_{(i)}$ and $I^{Wk}_{(i)}$ were defined in equations (3) and (6), respectively, and $I^{Wj}_{(i)}$ is the weighted average of the gender segregation induced by the third variable in the subgroups of the combination between the first and the second partition:

$$I^{Wj}_{(i)} = \Sigma_i (T_i/T)\, I^{i'}, \qquad (c)$$
$$I^{i'} = \Sigma_k (T_{ik}/T_i)\, I^{ik'},$$
$$I^{ik'} = \Sigma_j (T_{ikj}/T_{ik})\, I^{ikj},$$
$$I^{ikj} = w_{ikj} \log (w_{ikj}/w_{ik}) + (1 - w_{ikj}) \log ((1 - w_{ikj})/(1 - w_{ik})).$$

Let I, K and J be the number of age/education characteristics, labor market status, and occupations, respectively. Assume that the value k = 1 corresponds to those employed. Let $F_1 = \Sigma_i F_{i1}$ and $T_1 = \Sigma_i T_{i1}$ be the number of employed females and the total employed population, respectively, and let $W_1 = F_1/T_1$. Denote by $\hat{I}$ the gender segregation index induced by occupational choices and age/education characteristics in the employed population. The analysis in subsection II.1 leads to the following expression

$$\hat{I} = \Sigma_i \Sigma_j (T_{i1j}/T_1)\, \hat{I}_{i1j} = \hat{I}^{B}_{(i)} + \hat{I}^{Wj}_{(i)} = \hat{I}^{B}_{(j)} + \hat{I}^{Wi}_{(j)}, \qquad (d)$$

where $\hat{I}_{i1j} = w_{i1j} \log (w_{i1j}/W_1) + (1 - w_{i1j}) \log ((1 - w_{i1j})/(1 - W_1))$; $\hat{I}^{B}_{(i)}$ is the direct segregation induced by age/education characteristics in the employed population; $\hat{I}^{Wj}_{(i)}$ is the weighted average of the gender segregation induced by occupational choices

within each age/education category in that population; $\hat{I}^{B}_{(j)}$ is the direct segregation induced by occupational choices in the employed population; and $\hat{I}^{Wi}_{(j)}$ is the weighted average of the gender segregation induced by age/education characteristics within each occupation.

As the unemployed and those out of the labor force have no occupation, the transformation we are actually interested in is the one which leads directly from the proportions (W, (1 –W)) to the proportions (w_{i1j}, (1 – w_{i1j})) for the employed population, and to the proportions (w_{ik}, (1 – w_{ik})) for all $k \neq 1$.To take this restriction into account, let $w_{ikj} = I_{ikj} = 0$ for all i, j and $k \neq 1$. Applying this condition in equation (a), the overall index of segregation can be written as follows:

$$I^{*} = \Sigma_i \Sigma_{k\neq 1} (T_{ik}/T)\, I_{ik} + \Sigma_i \Sigma_j (T_{i1j}/T)\, I_{i1j},$$

where I_{ik} was defined in equation (1), and $I_{i1j} = w_{i1j} \log (w_{i1j}/W) + (1 - w_{i1j}) \log ((1 - w_{i1j})/(1 - W))$.

Consider the decomposition in equation (b) which takes the age/education partition as the leading one. Taking into account the restriction $w_{ikj} = I^{ikj} = 0$ for all i, j and $k \neq 1$ in equation (c), the term $I^{Wj}_{(i)}$ becomes:

$$I^{Wj}_{(i)} = \Sigma_i (T_{i1}/T) \Sigma_j (T_{i1j}/T_{i1})\, I^{i1j} = \Sigma_i \Sigma_j (T_{i1j}/T)\, I^{i1j},$$

where

$$I^{i1j} = w_{i1j} \log (w_{i1j}/w_{i1}) + (1 - w_{i1j}) \log ((1 - w_{i1j})/(1 - w_{i1})).$$

But $I^{i1j} = \hat{I}^{i1j}$, the index of gender segregation induced by the choice of occupation j within the employed population with age/education i. This is the index that enters into the term $\hat{I}^{Wj}_{(i)}$ in equation (d):

$$\hat{I}^{Wj}_{(i)} = \Sigma_i (T_{i1}/T_1)\, \hat{I}^{i1} = \Sigma_i (T_{i1}/T_1) \Sigma_j (T_{i1j}/T_{i1})\, \hat{I}^{i1l} = \Sigma_i \Sigma_j (T_{i1j}/T_1)\, \hat{I}^{i1j}.$$

Therefore, $\hat{I}^{Wj}_{(i)} = \Sigma_i \Sigma_j (T_{i1j}/T_1)\, I^{i1j}$ and $I^{Wj}_{(i)} = (T_1/T)\, \hat{I}^{Wj}_{(i)}$, so that equation (c) becomes:

$$I^{*} = I^{B}_{(i)} + I^{Wk}_{(i)} + (T_1/T)\, \hat{I}^{Wj}_{(i)}. \qquad (e)$$

In equation (e), the term $I^{B}_{(i)}$ measures the gender segregation directly induced by age/education characteristics; the within-group term $I^{Wk}_{(i)}$ measures the gender

segregation induced by labor market participation decisions within the partition by age/education characteristics; and the within-group term $\hat{I}^{Wj}_{(i)}$ measures the gender segregation induced by occupational choices within the partition by age/education characteristics in the employed population, and appears appropriately scaled down by the importance of the employed population in the population at large, T_1/T.

Finally, denote by $\Delta I^* = I^*92 - I^*77$ the change in overall segregation, and let $\Delta I^B_{(i)} = I^B_{(i)}92 - I^B_{(i)}77$, $\Delta I^{Wk}_{(i)} = I^{Wk}_{(i)}92 - I^{Wk}_{(i)}77$, and $\Delta I^{Wj}_{(i)} = I^{Wj}_{(i)}92 - I^{Wj}_{(i)}77$. It can be shown that:

$$\text{(i) } \Delta I^B_{(i)} = \Sigma_i (S^i_i + D^1_i),$$

where $S^i_i = (T_i77/T77)\,(I^i92 - I^i77)$ and $D^1_i = [(T_i92/T92) - (T_i77/T77)]\, I^1 92$;

$$\text{(ii) } \Delta I^{Wk}_{(i)} = \Sigma_i (S^k_i + D^k_i + D^2_i),$$

where $S^k_i = \Sigma_k (T_{ik}77/T77)(I_{ik}92 - I_{ik}77)$, $D^k_i = (T_i77/T77)\Sigma_k[(T_{ik}92/T_i92) - (T_{ik}77/T_i77)]\, I_{ik}92$, $D^2_i = [(T_i93/T93) - (T_i77/T77)]\, \Sigma_k (T_{ik}92/T_i93) I_{ik}92$; and

$$\text{(iii) } \Delta I^{Wj}_{(i)} = \Sigma_i (S^j_i + D^j_i + D^3_i),$$

where $S^j_i = \Sigma_{ij}\,(T_{i1j}77/T77)\,(I_{i1j}92 - I_{i1j}77)$, $D^j_i = (T_1 77/T77)\,\Sigma_{ij}[(T_{i1j}92/T_1 92) - (T_{i1j}77/T_1 77)]\, I_{i1j}92$, $D^3_i = [(T_1 92/T92) - (T_1 77/T77)]\, \Sigma_{ij}(T_{i1j}92/T_1 92) I_{i1j}92$.
Therefore,

$$\Delta I^* = \Sigma_i \Delta S_i + \Delta D_i \qquad \text{(h)}$$

where $\Delta S_i = S^i_i + S^k_i + S^j_i$, and $\Delta D_i = (D^1_i + D^2_i + D^3_i) + D^k_i + D^j_i$. Thus, for each i ΔS_i is the part of the overall change attributed to the change in gender segregation indexes, holding constant the demographic shares at their 1977 levels, while ΔD_i is the part of the overall change attributed to changes in the demographic shares.

II. The Data

The EPA is a labor force survey, consisting of about 50,000 household observations per quarter, representative of the Spanish household population living in private residential housing. It is a rotating panel in which each household is interviewed

during 7 consecutive quarters; thus, one eighth of the sample is renewed every quarter. It investigates the relationship with economic activity and other characteristics of every household member over 14 years of age. In this paper, data from the second quarter is taken as representative of the year as a whole.

The time period studied in this paper starts in 1977, the first year for which micro-economic data is available in electronic support, and lasts until 1992, the year before a fundamental change in the National Classification of Industries (NCI) took place, making the comparison of our data with the period starting in 1993 impossible. The Spanish economy entered into economic recession in 1975. The following 10 years are of slow, if not negative, economic growth in real terms. This phase comes to an end in 1985, when the economy starts growing at rates near or above 5%. The expansion lasts until 1992, when growth turned negative. Therefore, both 1977 and 1993 are years of economic stagnation, occupying similar positions in the business cycle.

The legal working age in Spain is 16. According to EPA, the working age population in 1977 is, approximately, 25,000,000 persons, 52.8% of which are females. Almost 6% of the population consists of full-time students, all of whom are, by definition, part of the inactive population. Since labor market participation choices by every educational category must be analyzed, students must be excluded from the analysis. Members of the clergy are also dropped from the sample because it only includes people living in private residential housing, who are mostly male, but it excludes those members of the clergy living in convents and monasteries, who are both male and female. Thus, the target population in 1977 consists of 23,711,000 individuals, 53.2% of which are females.

According to EPA, the employed population in 1977 and 1992 is, approximately, 12,148,346 and 12,361,738 people, respectively. Employed people interviewed in EPA can be classified according to the two-digit NCI of 1974 and the two-digit National Classification of Occupations (NCO) of 1979. In Herranz *et al.* (2003) occupations are taken as the basic partition and combined with the list of 2-digit industries to obtain a 107 occupational classification. Using an algorithm based on the bootstrap, an admissible aggregation level of 29 occupational categories is obtained, yielding a gender segregation value which is not significantly different from the maximum gender segregation level obtained from the 107 original occupations. The description of the 107 occupations, as well as their classification into the final 29 categories, can be found in Herranz *et al.* (2003) and are available on request.

There are 141,881 and 139,421 individual observations in 1977 and 1992, respectively. Of course, this limits the number of subgroups that can be considered. In particular, we distinguish three age categories (16-30; 31-50; 51-99); four educational attainment levels (illiterates and without formal studies or "low education"; with less than 9 years of education or "primary education"; between 9 and 12 years of education or "secondary education"; and College education); and eleven age/education subgroups (resulting from the combination of the age and education variables, except for the low

education category that must be combined with a 16-50 age interval). There are five labor market participation situations: (i) employment; (ii) and (iii), two types of unemployment, depending on whether the individual has worked before or s/he is searching for her/his first job; (iv) retired from the active population as a pensioner or as disabled; and (v) another type of inactivity, meaning essentially housework.

LIST OF OCCUPATIONS

The 106 initial occupations are listed within the 29 final categories obtained with the bootstrap algorithm.

MALE

Agriculture

1 Independent farm workers, fishermen in farms and other agricultural production. Farm workers, ranchers, ranch hands in other industries.

2 Fish and game workers. Forestry workers.

Blue collar

3 Construction workers and bricklayers. Drivers, other transport personnel. Electricians in other industries. Iron and steel workers. Miners and quarry workers. Machine operators, radio & TV station operators, and sound-system operators. Stonemasons. Chemical laboratory workers in other industries.

4 Construction workers in other industries. Foundry workers. Furniture makers and carpenters. Workers not classified in other subgroups (unskilled workers) in services. Graphic arts workers. Wood and paper mill workers. Painters. Furriers and leather workers.

5 Mechanics, machinists, watchmakers and other precision mechanics. Shoemakers in repair services.

6 Plumbers, welders, sheet metal workers.

White collar

7 Personnel in protection and security services. Foremen and overseers. Mailroom workers and office assistants. Engineers, inspectors, and conductors in passenger transport.

8 Employees in accounting, cashier, teller positions in other industries. Sculptors, painters, decorators, photographers. Sales assistants, sales representatives in wholesale trade. Stockbrokers, bonds brokers, real estate agents, and insurance brokers. Accountants and bookkeepers. Adding machine operators and data processors.

9 Sales personnel and sales representatives.

Professional and managerial

10 Companies Directors and managers. Owners or managers of commercial establishments in wholesale trade. Head of sales and head buyers. Inspectors of transport and communication services. Operator of agricultural or fishing enterprises. Directors and managers of commercial establishments. Owners or managers of commercial establishments in other industries. Members of governmental branches.

11 Owners or managers of hotel, restaurant services in restaurants. Head clerks and office managers. Directors and managers of hotel in restaurant services.

12 Physicians, veterinarians, and pharmacists.Legal professionals. Professional musicians and show business professionals. Statisticians, mathematicians, computer analysts, and other like technicians

Economists. Chemists, physicists, and geologists. Writers and journalists. Biologists and agricultural and forestry specialists. Sports professionals.

13 Draftsmen and engineering technicians. Architects and engineers. Pilots and Officers of air and maritime navigation.

Armed forces

14 Members of the Armed Forces

INTEGRATED

Agriculture

15 Farm workers, ranchers, and ranch hands in farms. Independent farm workers and fishermen in livestock production.

Blue collar

16 Food and drink preparation workers in food and kindred products. Workers not classified in other subgroups (unskilled workers) in agriculture and industry. Cargo handlers in other industries. Cargo handlers in agriculture and mining. Glass and ceramic factory workers. Rubber and plastic manufacturing plant workers. Chemical laboratory workers in chemicals and allied products

17 Electricians in equipment manufacturing. Crafts people and similar not classified in above subgroups
Jewelers and silversmiths. Garment workers: upholsterers.

White collar

18 Employees in administrative services in non-classified areas in other services. Employees in administrative services in non-classified areas in agriculture and mining. Employees in administrative services in non-classified areas in wholesale trade. Employees in administrative services in non-classified areas in hotels and restaurants. Supervisors of domestic service personnel.

FEMALE

Agriculture

19 Farm workers, ranchers, and ranch hands in livestock production

Blue collar

20 Textile workers. Cargo handlers in manufacturing. Food and drink preparation workers in other industries. Shoemakers in other industries. Paper and cardboard factory workers. Tobacco production workers.

21 Garment workers: other.

White collar

22 Sales assistants and sales representatives in retail. Employees in administrative services in non-classified areas in retail. Sales assistants and sales representatives in other industries.

23 Concierges, building supervisors, and cleaning service personnel in other services. Hair stylists and beauty treatment personnel. Concierges, building supervisors, and cleaning service personnel in trade and transport. Chefs, cooks, and food service personnel in other industries. Dry cleaning and laundry service employees. Telephone and telegraph operators. Concierges, building supervisors, and cleaning service personnel in agriculture and mining.

24 Chefs, cooks, and food service personnel in hotels, restaurants, and other lodging services. Personnel in other services not classified in other subgroups in education and health. Personnel in other services not classified in other subgroups in other industries.

25 Concierges, building supervisors, and cleaning service personnel in personal household

26 Domestic service personnel and other like personnel. Stenographers, typists, and key-punch operators.

27 Medical, veterinary, and pharmaceutical assistants and technicians. Employees in accounting, cashier, and teller positions in trade and miscellaneous repair.

Professional and managerial

28 Owners or managers of commercial establishments in retail. Owners or managers of hotel, restaurant services in hotels and other lodging services.

29 Teachers. Professionals or technicians in non-classified areas.

REFERENCES

Albelda, R. (1986), "Occupational Segregation by Race and Gender, 1958-1981", *Industrial and Labor Relations Review*, **39**: 404-411.

Anker, R. (1988), *Gender and Jobs. Sex Segregation of Occupations in the World*, International Labor Office, Geneva.

Beller, A. (1985), "Changes in the Sex Composition of U.S. Occupations, 1960-1981", *Journal of Human Resources*, **20**: 235-250.

Blau, F. (1977), *Equal Pay in the Office*, Lexington, Heath.

Blau, F. and Hendricks, W. (1979), "Occupational Segregation by Sex: Trends and Prospects", *Journal of Human Resources* **12**: 197-210.

Blau, F., P. Simpson, and D. Anderson (1998), "Continuing Progress? Trends in Occupational Segregation Over the 1970s and 1980s", *Feminist Economics*, **4**: 29-71.

Boisso, D, K. Hayes, J. Hirschberg, and J. Silber (1994), "Occupational Segregation in the Multidimensional Case", *Journal of Econometrics*, **61**: 161-171.

Borghans, L., and Groot, L. (1999), "Educational Presorting and Occupational Segregation", *Labour Economics* **6**: 375-395.

Charles, M. (1992), "Cross-National Variation in Occupational Sex Segregation", *American Sociological Review* **57**: 483-502.

Charles, M. (1998), "Structure, Culture, and Sex Segregation in Europe", *Research in Social Stratification and Mobility* **16**: 89-116.

Charles, M. and Grusky, D. (1995), "Models for Describing the Underlying Structure of Sex Segregation", *American Journal of Sociology* **100**: 931-971.

Charles, M., Buchmann, M., Halebsky, S., Powers, J. and Smith, M. (2001), "The Context of Women's Market Careers: A Cross-National Study." *Work and Occupations* **28**: 371-96.

Deutsch, J, Flückiger, Y. and Silber, J. (1994), "Measuring Occupational Segregation", *Journal of Econometrics* **61**: 133-146.

Dolado, J., Felgueroso, F. , and Jimeno, J.F. (2001), "Female Employment and Occupational Changes in the 1990s: How Is the EU Performing Relative to the U.S.?", *European Economic Review* **45**: 875-889.

England, P. (1981), "Assessing Trends in Occupational Sex Segregation, 1900-1976", en I.

Berg, ed., *Sociological Perspectives on Labor Markets*, New York, Academic Press.

Flückiger, Y. and J. Silber (1999), *The Measurement of Segregation in the Labor Force*, Heidelberg: Physica-Verlag.

Fuchs, V. (1975), "A Note on Sex Segregation in Professional Occupations," *Explorations in Economic Research* **2**: 105-111.

Gross, E., "Plus ça change...? The Sexual Structure of Occupations Over Time"(1968), *Social Problems* **16**:198-208.

Grusky, D.B. and Charles, M. (1998), "The Past, Present, and Future of Sex Segregation Methodology", *Demography* **35**:497-504.

Hakim, C. (1996), *Key Issues in Women's Work,* University Press, Cambridge.

Herranz, N., R. Mora and J. Ruiz-Castillo (2003), "An Algorithm to Reduce the Occupational Space in Gender Segregation Studies", Working Paper 03-14, Economic Series 03, Universidad Carlos III, forthcoming in the *Journal of Applied Econometrics*.

Jacobs, J., "Long-Term Trends in Occupational Segregation by Sex"(1989a), *American Journal of Sociology* **95**: 160-173.

Jacobs, J. (1989b), *Revolving Doors: Sex Segregation and Women's Careers*, Stanford University Press, California.

Jacobs, J. and Lim, S. (1992), "Trends in Occupational Segregation by Sex", *Work and Occupations* **19**: 450-486.

Jacobsen, J., "Trends in Work Force Sex Segregation, 1960-1990"(1994), *Social Science Quarterly* **75**: 204-211.

Jacobsen, J. (1998), *The Economics of Gender*, second edition, Blackwell, Oxford.

Karmel, T. and MacLachlan, M. (1988), "Occupational Sex Segregation: Increasing or Decreasing?", *Economic Record* **64**: 187-195.

King, M., "Occupational Segregation by Race and Sex, 1940-88", *Monthly Labor Review* 115 (1992), 30-37.

Mora, R. and J. Ruiz-Castillo (2003a),"Additively Decomposable Segregation Indexes. The Case of Gender Segregation by Occupations and Human Capital Levels in Spain", Working Paper 00-63, Economic Series 24, Universidad Carlos III.

Mora, R. and Ruiz-Castillo, J. (2003b), "An Evaluation of the Entropy's Index of Segregation", *mimeo*, Universidad Carlos III de Madrid, Madrid.

Roos, P.A. (1985), *Gender and Work: A Comparative Analysis of Industrial Societies,* State University of New York Press, New York.

Silber, J. (1989), "Factor Components, Population Subgroups and the Computation of the Gini Index of Inequality," *Review of Economics and Statistics*, **LXXI**: 107-115.

Silber, J. (1992), "Occupational Segregation Indices in the Multidimensional Case: A Note", *Economic Record* **68**: 276-277.

Theil, H. and Finizza, A.J., "A Note on the Measurement of Racial Integration of Schools by Means of Information Concepts", *Journal of Mathematical Sociology* 1 (1971), 187-194.

Watts, M. (1997), "Multidimensional Indexes of Occupational Segregation", *Evaluation Review* **21**: 461-482.

Watts, M. (1998), "Occupational Gender Segregation: Index Measurement and Econometric Modeling", *Demography* **35**: 489-496.

Watts, M.J. and Rich, J. (1991), "Equal Employment Opportunity in Australia? The Role of Part-Time Employment in Occupational Sex Segregation", *Australian Bulletin of Labour* **17**:160-179.

Watts, M.J. and Rich, J. (1993), "Occupational Sex Segregation in Britain, 1979-89. The Persistence of Sex Stereotyping", *Cambridge Journal of Economics* **17**: 159-177.

Weeden, K.A. (1998), "Revisiting Occupational Sex Segregation in the United States, 1910-1990: Results from a Log-Linear Approach", *Demography* **35**: 475-487.

Table 1. Descriptive Statistics and Direct Gender Segregation Indexes in the Partitions By Age/ Education and Labor Market Status, 1977

	Population Distribution			Female	Direct Gender
	Female[a]	Male[b]	Total[c]	Shares[d]	Segregation[e]
PANEL 1: EDUCATION/AGE (years)					
LOW/	**31.2**	**22.5**	**27.1**		
1. 16 - 50	10.6	8.9	9.8	57.8	0.60
2. More than 50	20.6	13.6	17.3	63.3	3.00
PRIMARY/	**57.7**	**61.3**	**59.3**		
3. 16 - 30	15.4	16.3	15.8	51.8	0.06
4. 31 - 50	22.4	24.2	23.2	51.4	0.10
5. More than 50	19.9	20.8	20.3	52.2	0.03
SECONDARY/	**8.6**	**11.6**	**9.9**		
6. 16 - 30	5.2	5.7	5.4	51.4	0.10
7. 31 - 50	2.3	3.8	3.0	40.3	4.86
8. More than 50	1.1	2.1	1.5	37.2	7.52
COLLEGE/	**2.5**	**4.8**	**3.6**		
9. 16 - 30	0.9	1.0	1.0	49.6	0.37
10. 31 - 50	1.0	2.2	1.5	33.9	10.87
11. More than 50	0.6	1.6	1.1	29.4	16.71
TOTAL	**100.0**	**100.0**	**100.0**	**53.2**	**1.23 (1.10, 1.42)**
PANEL 2: LABOR MARKET STATUS					
1. Employed	27.5	78.2	51.2	28.6	17.9
UNEMPLOYED	**1.4**	**4.0**	**2.6**		
2. Having worked before	0.8	0.9	0.8	51.3	0.1
3. Searching for first job	0.6	3.1	1.8	19.1	35.6
INACTIVES	**71.0**	**17.9**	**46.2**		
4. Pensioners and disabled	8.2	15.0	11.4	38.4	6.4
5. Housework	62.8	2.9	34.8	96.1	68.0
TOTAL	**100.0**	**100.0**	**100.0**	**53.2**	**34.2 (33.6, 35.1)**

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis for the direct measures of gender segregation

[a] $100(F_S/F)$; [b] $100(M_S/M)$; [c] $100(T_S/T)$; [d] $100(F_S/T_S)$; $s = i,k.$

[e] Indexes of direct gender segregation induced by age/education categories, I_i, $i = 1,\ldots, 11$ (panel 1), and labor market status, I_k, $k = 1,\ldots, 5$ (panel 2)

Table 2. Descriptive Statistics and Direct Gender Segregation Indices in the Partition by Occupations, 1977

OCCUPATION	Labor Force Distribution Across Occupations			Female Shares [d]	Direct Gender Segregation[e]
	Female[a]	Male[b]	Total[c]		
MALE	**10.17**	**62.91**	**47.81**		
Agriculture	**4.26**	**10.75**	**8.89**		
1.	4.24	9.40	7.92	15.32	7.06
2.	0.02	1.36	0.98	0.71	43.48
Blue Collar	**2.20**	**35.28**	**25.81**		
3.	0.21	15.98	11.47	0.51	44.68
4.	1.74	13.13	9.87	5.05	26.46
5.	0.23	4.15	3.03	2.16	36.48
6.	0.03	2.02	1.45	0.57	44.36
White Collar	**1.46**	**7.04**	**5.45**		
7.	0.26	3.05	2.25	3.32	32.02
8.	1.12	2.47	2.08	15.43	6.94
9.	0.08	1.53	1.12	2.08	36.82
Prof. & Manag.	**2.24**	**8.70**	**6.85**		
10.	0.26	3.38	2.49	3.02	33.07
11.	1.09	2.02	1.75	17.82	4.53
12.	0.74	1.61	1.36	15.52	6.84
13.	0.15	1.69	1.25	3.51	31.33
Armed Forces: 14.	**0**	**1.13**	**0.81**	**0**	48.65
INTEGRATED	**25.34**	**21.83**	**22.83**		
Agriculture: 15	**12.01**	**9.28**	**10.06**	**34.17**	1.05
Blue Collar	**5.69**	**7.73**	**7.14**		
16.	4.58	6.52	5.97	21.98	1.64
17.	1.11	1.20	1.18	26.89	0.11
White Collar: 18.	**7.64**	**4.82**	**5.63**	38.89	3.50
FEMALE	**64.48**	**15.26**	**29.35**		
Agriculture: 19.	**3.12**	**1.19**	**1.75**	**51.21**	16.20
Blue Collar	**13.86**	**3.06**	**6.15**		
20.	6.90	2.60	3.83	51.56	16.69
21.	6.97	0.46	2.32	85.76	102.64
White Collar	**37.95**	**7.32**	**16.09**		
22.	10.55	2.78	5.00	60.39	31.40
23.	7.68	1.46	3.24	67.80	47.37
24.	5.25	2.30	3.14	47.81	11.81
25.	7.44	0.36	2.39	89.16	116.69
26.	4.87	0.13	1.48	93.88	139.16
27.	2.15	0.30	0.83	74.37	64.58
Prof. & Manag.	**9.55**	**3.68**	**5.36**		
28.	5.15	2.43	3.21	45.87	9.61
29.	4.40	1.25	2.15	58.59	28.03
TOTAL	**100.00**	**100.00**	**100.00**	**28.62**	**27.01 (26.4, 27.7)**

Notes: See the Appendix for the list of occupations indexed by j = 1,…, 29

[a] $100(F_j/F)$; [b] $100(M_j/M)$; [c] $100(T_j/T)$; [d] $100(F_j/T_j)$

[e] Indexes of direct gender segregation induced by occupational choices, $\hat{I}_{1j}$

Table 3. Descriptive Statistics and Indexes Of Gender Segregation Induced By Age/education Characteristics Within Selected Labor Market Subgroups in 1977

	Population Distribution			Female Shares[d]	Within-Group Gender Segregation[e]
	Female[a]	Male[b]	Total[c]		
PANEL 1: Employed (k = 1)					
LOW/	**17.4**	**16.5**	**16.8**		
1. 16 - 50	8.8	9.3	9.2	27.4	0.05
2. More than 50	8.6	7.2	7.6	32.3	0.47
PRIMARY/	**60.4**	**64.9**	**63.5**		
3. 16 - 30	25.6	18.9	20.8	35.1	1.45
4. 31 - 50	22.0	29.5	27.3	23.0	1.14
5. More than 50	12.8	16.5	15.4	23.6	0.91
SECONDARY/	**16.6**	**13.2**	**14.2**		
6. 16 - 30	12.6	6.5	8.3	43.6	7.37
7. 31 - 50	3.0	4.8	4.3	20.2	2.69
8. More than 50	1.0	1.9	1.6	17.5	4.79
COLLEGE/	**5.6**	**5.4**	**5.4**		
9. 16 - 30	2.3	1.2	1.5	44.7	8.38
10. 31 - 50	2.3	2.7	2.6	25.4	0.38
11. More than 50	1.0	1.5	1.3	21.2	2.05
TOTAL	**100.0**	**100.0**	**100.0**	**28.6**	**1.76**
PANEL 2: Housework (k = 5)					
LOW/	**33.4**	**53.9**	**34.2**		
1. 16 - 50	12.8	23.0	13.2	93.2	1.33
2. More than 50	20.6	30.9	21.0	94.3	0.58
PRIMARY/	**60.1**	**41.1**	**59.4**		
3. 16 - 30	12.3	6.3	12.1	98.0	0.78
4. 31 - 50	25.8	10.6	25.2	98.4	1.24
5. More than 50	22.0	24.2	22.1	95.7	0.03
SECONDARY/	**5.4**	**3.4**	**5.3**		
6. 16 - 30	2.0	1.9	2.0	96.4	0.02
7. 31 - 50	2.3	0.8	2.2	98.6	1.53
8. More than 50	1.1	0.7	1.1	97.6	0.48
COLLEGE/	**1.1**	**1.5**	**1.1**		
9. 16 - 30	0.3	0.3	0.3	95.5	0.08
10. 31 - 50	0.5	0.5	0.5	96.6	0.04
11. More than 50	0.3	0.7	0.3	91.0	3.74
TOTAL	**100.0**	**100.0**	**100.0**	**96.1**	**0.76**

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis for the direct measures of gender segregation

[a] $100(F_i/F)$; [b] $100(M_i/M)$; [c] $100(T_i/T)$; [d] $100(F_i/T_i)$; $i = 1,\ldots, 11$

[e] Gender segregation induced by age/education characteristics within selected labor market categories

Table 4. Descriptive Statistics and Direct Gender Segregation Indexes in the Partitions By Age/ Education and Labor Market Status, 1992

	Population Distribution				Direct Gender
	Female[a]	Male[b]	Total[c]	Female Shares[d]	Segregation[e]
PANEL 1: EDUCATION/age (years)					
LOW/	**27.2**	**19.4**	**23.4**		
1. 16 - 50	5.2	4.4	4.8	56.1	0.51
2. More than 50	22.0	15.0	18.6	61.2	2.54
PRIMARY/	**41.1**	**41.4**	**41.2**		
3. 16 - 30	3.6	5.1	4.3	43.1	2.23
4. 31 - 50	16.7	16.3	16.5	52.4	0.01
5. More than 50	20.8	20.0	20.4	52.9	0.03
SECONDARY/	**25.0**	**31.5**	**28.1**		
6. 16 - 30	13.4	16.2	14.8	47.1	0.65
7. 31 - 50	9.1	11.5	10.2	46.0	0.98
8. More than 50	2.5	3.8	3.1	41.6	3.08
COLLEGE/	**6.8**	**7.8**	**7.2**		
9. 16 - 30	2.2	1.5	1.8	61.1	2.51
10. 31 - 50	3.3	4.1	3.7	46.4	0.86
11. More than 50	1.3	2.2	1.7	38.6	5.10
TOTAL	**100.0**	**100.0**	**100.0**	**51.9**	**1.06**
					(0.92, 1.21)
PANEL 2: LABOR MARKET STATUS					
1. Employed	27.8	62.0	44.3	32.6	10.93
UNEMPLOYED	**8.3**	**9.2**	**8.7**		
2. Having Worked before	2.1	1.1	1.6	67.9	7.59
3. Searching for first job	6.2	8.1	7.1	45.4	1.21
INACTIVES	**63.8**	**28.8**	**47.0**		
4. Pensioners & disabled	8.9	22.6	15.5	29.8	14.39
5. Housework	54.9	6.2	31.5	90.5	50.55
TOTAL	**100.0**	**100.0**	**100.0**	**51.9**	**23.2**
					(22.6, 23.8)

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis for the direct measures of gender segregation.

[a] $100(F_S/F)$; [b] $100(M_S/M)$; [c] $100(T_S/T)$; [d] $100(F_S/T_S)$; $s = i,k$

[e] Indexes of direct gender segregation induced by age/education categories, I_i, $i = 1,\ldots,11$ (panel 1), and labor market status, I_k, $k = 1,\ldots, 5$ (panel 2)

Table 5. Descriptive Statistics and Direct Gender Segregation Indices in the Partition by Occupations, 1992

OCCUPATION	Labor Force Distribution Across Occupations			Female Shares [d]	Direct Gender Segregation[e]
	Female[a]	Male[b]	Total[c]		
MALE	**14.32**	**64.25**	**47.83**		
Agriculture	**2.29**	**5.35**	**4.34**		
1.	2.28	4.42	3.71	20.22	5.72
2.	0.01	0.93	0.63	0.76	51.87
Blue Collar	**2.72**	**37.05**	**25.76**		
3.	0.7	17.56	12.01	1.93	45.8
4.	1.64	12.81	9.14	5.89	31.31
5.	0.25	4.38	3.02	2.67	42.56
6.	0.13	2.3	1.59	2.78	42.12
White Collar	**3.99**	**9.81**	**7.89**		
7.	1.03	4.8	3.56	9.49	22.06
8.	2.51	3.16	2.94	28.04	0.79
9.	0.45	1.85	1.39	10.59	19.71
Prof. & Manag.	**5.32**	**11.02**	**9.15**		
10.	0.72	4.03	2.94	8.11	25.29
11.	1.5	2.17	1.95	25.29	1.98
12.	2.82	2.8	2.81	33.11	0
13.	0.28	2.02	1.45	6.41	29.8
Armed Forces: 14.	**0**	**1.02**	**0.69**	**0**	**57.56**
INTEGRATED	**22.55**	**17.95**	**19.46**		
Agriculture: 15	**4.4**	**4.63**	**4.56**	**31.8**	**0.04**
Blue Collar	**4.47**	**7.74**	**6.66**		
16.	3.95	6.72	5.8	22.36	3.88
17.	0.52	1.02	0.86	20.02	5.92
White Collar: 18.	**13.68**	**5.58**	**8.24**	**54.6**	**14.32**
FEMALE	**57.12**	**17.8**	**32.71**		
Agriculture: 19.	**1.6**	**0.64**	**0.96**	**55.08**	**14.95**
Blue Collar	**6.98**	**2.44**	**3.94**		
20.	3.29	2.09	2.49	43.55	3.54
21.	3.69	0.35	1.45	83.83	79.91
White Collar	**40.84**	**9.34**	**19.7**		
22.	9.54	3.78	5.67	55.29	15.23
23.	11.29	1.75	4.89	75.99	56.16
24.	3.57	2.64	2.95	39.84	1.52
25.	2.8	0.38	1.17	78.44	63
26.	7.48	0.13	2.55	96.55	135.2
27.	6.16	0.66	2.47	82.04	74
Prof. & Manag.	**13.7**	**5.38**	**8.11**		
28.	5.47	2.66	3.58	50.24	9.22
29.	8.23	2.72	4.53	59.7	21.67
TOTAL	**100**	**100**	**100**	**32.9**	**27.38 (26.7, 28.1)**

Notes: See the Appendix for the list of occupations indexed by j = 1,…, 29

[a] $100(F_j/F)$; [b] $100(M_j/M)$; [c] $100(T_j/T)$; [d] $100(F_j/T_j)$

[e] Indexes of direct gender segregation induced by occupational choices, $\hat{I}_{1j}$

Table 6. Decomposition of Overall Gender Segregation in the Partition by Age/education Characteristics.

	Gender Segregation Indices				
	Between [a]	**Within 1[b]**	**Within 2[c]**	**Total[d]**	**Ratio[e]**
PANEL 1: Year 1977					
1. LOW/16 - 50	0.6	37.7	15.2	53.5	1.06
2. LOW/More than 50	3.0	26.3	6.2	35.4	0.70
3. PRIMARY/16 - 30	0.1	27.6	24.5	52.2	1.03
4. PRIMARY/31 - 50	0.1	47.3	17.3	64.7	1.28
5. PRIMARY/>50	0.0	39.6	9.0	48.6	0.96
6. SECONDARY/16 - 30	0.1	11.1	22.2	33.4	0.66
7. SECONDARY/31 - 50	4.9	40.7	17.6	63.1	1.25
8. SECONDARY/ > 50	7.5	41.6	8.8	57.9	1.14
9. COLLEGE /16 - 30	0.4	7.8	18.7	26.9	0.53
10. COLLEGE /31 - 50	10.9	17.9	20.9	49.6	0.98
11. COLLEGE /> 50	16.7	14.3	13.5	44.5	0.88
TOTAL	**1.2**	**34.6**	**14.5**	**50.3**	-
	(1.1, 1.4)	**(34.0, 35.3)**	**(14.4, 15.4)**	**(50.2, 51.4)**	
PANEL 2: Year 1992					
1. LOW/16 - 50	0.5	18.9	13.9	33.3	0.90
2. LOW/More than 50	2.5	26.8	3.6	32.9	0.89
3. PRIMARY/16 - 30	2.2	14.6	18.6	35.4	0.96
4. PRIMARY/31 - 50	0.0	31.8	17.1	48.9	1.33
5. PRIMARY/>50	0.0	35.2	6.0	41.3	1.12
6. SECONDARY/16 - 30	0.6	7.4	19.1	27.1	0.74
7. SECONDARY/31 - 50	1.0	22.3	17.6	40.8	1.11
8. SECONDARY/ > 50	3.1	32.0	6.5	41.6	1.13
9. COLLEGE /16 - 30	2.5	0.4	11.5	14.4	0.39
10. COLLEGE /31 - 50	0.9	5.2	16.9	22.9	0.62
11. COLLEGE /> 50	5.1	12.9	11.9	29.9	0.81
TOTAL	**1.1**	**23.8**	**12.0**	**36.9**	-
	(0.9, 1.2)	**(23.2, 24.3)**	**(11.8, 12.7)**	**(36.4, 37.7)**	

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis

[a] Direct Gender Segregation Attributed to Age/education Category i: I_i

[b] Gender Segregation Induced by Labor Market Status Within Category i: I^i

[c] Gender Segregation Induced by Occupational Choices Within Category i in the Employed Population: $(T_{i1}/T_i)\,\hat{I}^{i1}$; [d] $I(i) = I_i + I^i + (T_{i1}/T_i)\,\hat{I}^{i1}$; [e] Ratio $= I(i)/(\Sigma_i I(i))$

Table 7. Decomposition of Overall Gender Segregation in the Partition By Labor Market Status.

	Gender Segregation Indices				
	Between [a]	**Within 1[b]**	**Within 2[c]**	**Total[d]**	**Ratio[e]**
			PANEL 1: Year 1977		
1. Employed	17.9	27.0	3.4	48.6	0.96
UNEMPLOYED					
2. Having worked before	0.1	-	1.7	1.8	0.04
3. Searching for first job	35.6	-	6.6	42.3	0.84
INACTIVES					
4. Pensioners and disabled	6.4	-	2.8	9.2	0.18
5. Housework	68.0	-	0.8	68.8	1.36
TOTAL	**34.2**	**13.5**	**2.5**	**50.3**	-
	(33.6, 34.9)	**(13.1, 14.2)**	**(2.4, 2.8)**	**(50.2, 51.4)**	
			PANEL 2: Year 1992		
1. Employed	10.9	26.8	2.1	39.8	1.08
UNEMPLOYED					
2. Having worked before	7.6	-	6.0	13.6	0.37
3. Searching for first job	1.2	-	3.1	4.4	0.12
INACTIVES					
4. Pensioners and disabled	14.4	-	1.1	15.5	0.42
5. Housework	50.6	-	1.3	51.8	1.41
TOTAL	**23.2**	**11.8**	**1.9**	**36.9**	-
	(22.6,23.8)	**(11.3,12.4)**	**(1.8,2.2)**	**(36.4,37.7)**	

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis

[a] Direct Gender Segregation in Labor Market Subgroup k.

[b] Direct Gender Segregation Induced by Occupational Choices in the Employed Population.

[c] Gender Segregation Induced by Age/education Characteristics within Labor Market Subgroup k.

[d] a + b + c

[e] Gender segrgation by Labor Market Status/Overall Gender Segregation

Table 8. Changes in Overall Gender Segregation During the 1977-1992 Period. Dynamic Decomposition In Percentage Terms.

	CHANGE IN GENDER COMPOSITION[a]	CHANGE IN DEMOGRAPHIC SHARES[b]	TOTAL[c]
LOW EDUCATION			
1. 16 - 50	-1.9	-1.7	-3.6
2. More than 50	-0.4	0.4	-0.0
PRIMARY EDUCATION			
3. 16 - 30	-1.5	-5.1	-6.6
4. 31 - 50	-3.4	-3.6	-7.0
5. More than 50	-1.2	-0.2	-1.4
SECONDARY EDUCATION			
6. 16 - 30	-0.2	2.5	2.3
7. 31 - 50	-0.6	2.9	2.3
8. More than 50	-0.3	0.7	0.4
COLLEGE EDUCATION			
9. 16 - 30	-0.1	0.2	0.1
10. 31 - 50	-0.3	0.4	0.1
11. More than 50	-0.2	0.2	0.0
TOTAL	**- 9.8**	**- 3.6**	**- 13.4**
	(- 11.0, - 8.8)	**(- 4.6, - 3.2)**	**(-14.7, -12.9)**

Notes: Upper (99%) and lower (1%) bootstrap bounds from 1,000 empirical sample replications with replacement are shown in parenthesis for the overall change in gender segregation

[a] Change in gender segregation induced by gender composition changes in the partition by age/education characteristics holding constant the demographic shares at their 1977 levels: ΔS_i

[b] Change in gender segregation induced by changes in age/education categories' demographic shares: ΔD_i

[c] TOTAL = Change in Overall Gender Segregation