The Evolution of Occupational Segregation in the U.S., 1940-2010: The Gains and Losses of Gender-Race/Ethnicity Groups*

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Abstract

The aim of this paper is twofold: a) To explore the evolution of occupational segregation of women and men of different racial/ethnic groups in the U.S. during the period 1940-2010; and b) to assess the consequences of segregation for each of them. For that purpose, this paper proposes a simple index that measures the monetary loss or gain of a group derived from its overrepresentation in some occupations and underrepresentation in others. This index has a clear economic interpretation. It represents the *per capita* advantage (if the index is positive) or disadvantage (if the index is negative) of the group, derived from its segregation, as a proportion of the average wage of the economy. Our index seems a helpful tool not only for academics but also for institutions concerned with inequalities related to gender, race, ethnicity, and migration status, among others, since it makes it possible to rank different groups in an economy or a target group across time according to its segregation nature.

JEL Classification: J15; J16; J71; D63

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1. Introduction

The literature on occupational segregation in the United States has traditionally focused on segregation by gender and more recently has turned its attention to segregation by race and ethnicity. With respect to gender, several papers document a reduction in segregation in the second half of the 20th century and stagnation at the beginning of the 21st century (Beller, 1985; Bianchi and Rytina, 1986; Levanon et al., 2009; Blau et al., 2013). Segregation between Blacks and non-Blacks also decreased in the second half of the past century, while segregation between Hispanics and non-Hispanics increased (Queneau, 2009). On the one hand, segregation by gender does not affect all racial/ethnic groups in the same way; it seems to be higher for Hispanics and lower for Asians than it is for other groups (Hegewisch et al., 2010; Mintz and Krymkowski, 2011). On the other hand, segregation by race/ethnicity does not affect women and men equally. In fact, differences in segregation among female groups are lower than among male groups (Spriggs and Williams, 1996; Reskin et al., 2004; Alonso-Villar et al., 2012).

When exploring segregation by race, analyses that focus on the male population or that aggregate women and men may obscure the particular situation of some gender-race groups. The same problem may arise when one is concerned with segregation by gender and the various racial groups are jointly considered. Since both gender and race/ethnicity contribute to shaping and maintaining inequalities in the labor market (Browne and Misra, 2003), more attention should be given to their intersection, a topic that so far has received little attention in the literature.

The aim of this paper is twofold: a) To explore the evolution of segregation of women and men of different racial/ethnic groups in the U.S. during the period 1940-2010; and b) to assess it in terms of the monetary losses/gains of these groups associated with their segregation. The analysis involves twelve gender-race/ethnic groups across a seventy-year period, paying special attention to women and men of the largest racial/ethnic groups: Whites, Blacks, Hispanics, and Asians.

This paper contributes to the literature on occupational segregation by race/ethnicity and gender in several ways. First, it explores the distinctive situation of each of these groups using recent tools that make it possible to determine the segregation of each group without comparing it with all alternative groups. To find out the segregation of Black

women, the literature has traditionally undertaken pair-wise comparisons between this group and other gender-race groups: Black women versus White women, Black women versus Black men, Black women versus White men, and so on. When many groups are involved in the analysis, this procedure becomes cumbersome and makes it difficult to summarize the situation of the group. The approach we follow here, which was proposed and axiomatically explored by Alonso-Villar and Del Río (2010), involves comparing the distribution of the target group across occupations with the occupational structure of the economy. These measures are labeled local segregation measures to distinguish them from overall or aggregate segregation measures. This approach permits one to determine a single segregation value for the target group, and, therefore, offers a summary statistic of the situation of the group, which is especially helpful for cross-time analysis because the evolutions of the various pair-wise comparisons may not coincide (King, 1991; Kaufman, 2010).

Second, apart from measuring the segregation of these groups, this paper also quantifies overall or aggregate segregation in our twelve-group context using the mutual information index, which has been axiomatically explored by Frankel and Volij (2011) and is consistent with the local segregation measure that we use to quantify the segregation of each group. The use of this multigroup overall segregation measure allows us to determine the extent to which segregation increases when the gender dimension is added to the racial/ethnicity analysis and, reciprocally, how much segregation increases when race/ethnicity is added to the gender analysis. This is an important matter because when dealing with segregation by race, scholars usually consider only two groups, Blacks and Whites, and employ a binary segregation measure, mainly the index of dissimilarity, to quantify the discrepancy between these two groups. This Black-White segregation is what is usually contrasted with segregation by gender in order to determine whether segregation by race is higher or lower than segregation by gender. However, by using multigroup segregation measures, one can simultaneously include not only three or more races/ethnicities in the analysis, which seems pertinent in a multiracial society like the U.S., but also gender. By doing so, one can measure how much overall segregation changes when one of these dimensions, either race/ethnicity or gender, is removed from the analysis, something that is not possible with binary segregation measures.

Third, an important contribution of the paper involves the assessment of segregation. Segregation measures quantify how uneven the distributions of social groups across occupations are, but this unevenness does not say anything about the consequences of segregation. The situation of a group of people who are mainly concentrated in highly paid occupations is clearly different from that of another group concentrated in low-paid ones. This paper proposes a simple index that measures the monetary loss or gain that a group experiences for being overrepresented in some occupations and underrepresented in others. This index seems very helpful to distinguish those cases that while having similar segregation levels depart in the nature of their segregation. This permits us to rank the various gender-race/ethnicity groups and explore their evolution during our seventy-year period. This paper also shows the proportion of the groups' earning gaps that this index accounts for. The (wage) earning gap of a group is defined as the difference between its per capita wage earnings and those the group would obtain if the group's distribution across occupations were similar to the occupational structure of the economy and the average wage of the group in each occupation were equal to the average wage in that occupation. Our analysis reveals that in 2010 occupational segregation still accounts for the majority of the earnings gap for most gender-race/ethnic groups.

The paper is structured as follows. Section 2 presents the local and the overall segregation index that will be used in our empirical analysis and introduces the data. Section 3 offers, firstly, the evolution of overall segregation by gender, overall segregation by race/ethnicity, and overall segregation by both gender and race/ethnicity from 1940 to 2010. Next, this section shows the evolution of segregation for our gender-race/ethnicity groups (local segregation,) as well as the contribution of each of the groups to overall segregation. Section 4, first proposes an index with which to quantify the monetary loss/gain of a target group derived from its occupational segregation and, second, uses this index to assess the situations of women and men of various racial/ethnic groups, paying special attention to Whites, Blacks, Hispanics, and Asians.

2. Measuring Segregation: Methodology

2.1 Segregation Measures

The index of dissimilarity is a well-known segregation measure that has been extensively used to quantify the discrepancy between the distribution of women and men across occupations. Moreover, to compute segregation in a multigroup context, scholars often employ this index to measure disparities between pairs of groups. Thus, for example, one could use it to quantify the segregation between Black and White women, Black and Hispanic women, Black women and men, Black women and White men, and so on. When many groups are involved in the analysis, these pair-wise comparisons become cumbersome, especially if one is interested in showing segregation trends over a seventy-year period. Alternatively, to summarize the performance of each group (in each year), one could compare the distribution of that group across occupations with the occupational structure of the economy. This means that, for example, Black women are segregated so long as they are overrepresented in some occupations and underrepresented in others, whether those latter occupations are filled by White women, Hispanic women, Black men, White men, or any other group.

This approach was formally developed by Alonso-Villar and Del Río (2010), who define several segregation measures in a multigroup context and axiomatically explore them. These measures, labeled local segregation measures to distinguish them from overall segregation measures, allow one to quantify the segregation of a group. In our empirical analysis, we use one of those measures to quantify the occupational segregation of each of our gender-race/ethnicity groups, *g*:

$$\Phi_1^g(c;t) = \sum_j \frac{c_j^g}{C^g} \ln\left(\frac{c_j^g / C^g}{t_j / T}\right) \quad , \qquad (1)$$

where c_j^g denotes the number of individuals of group *g* in occupation *j*, t_j is the number of jobs in that occupation, $C = \sum_j c_j$ is the size of group *g* in the economy, and

$T = \sum_j t_j$ is the total number of jobs in the economy. This index ranges from a minimum of 0 to a maximum of $\ln(T)$.[1]

In a multigroup context, apart from calculating the segregation of a group, one might also be interested in determining total or overall segregation. The literature offers several measures with which to summarize the simultaneous discrepancies that exist among all groups (Silber, 1992; Boisso et al. 1994; Reardon and Firebaugh, 2002; Frankel and Volij, 2011).[2] As in the two-group case, no segregation exists if every group is evenly distributed among occupations (i.e., if the population share of the group in each occupation, $\frac{c_j^g}{C^g}$, is the same for all groups). As shown by Alonso-Villar and Del Río (2010), several of these overall segregation measures can be written as weighted averages of the above local segregation measures applied to each of the mutually exclusive groups into which the whole population is partitioned, with weights equal to their share on the total workforce. In particular, the mutual information index, M, borrowed from the information theory and characterized by Frankel and Volij (2011) in terms of basic segregation properties, can be written as the weighted average of index Φ_1^g for each of the groups:

$$M = \sum_g \frac{C^g}{T} \Phi_1^g . \qquad (2)$$

Consequently, using the segregation of each group and its demographic weight in the economy, it is possible to quantify the contribution of each group to overall segregation by gender and race/ethnicity, as we will do in our empirical analysis.

2.2 Data

Our dataset comes from the IPUMS (Integrated Public Use Microdata Series) samples covering the period 1940-2010 (Ruggles et al., 2010). This dataset offers harmonized information assigning uniform codes to variables, which makes long-term comparisons possible. These data are based on the decennial censuses for the period 1940-2000 and

[1] This index has been used to quantify segregation in the U.S. (Alonso-Villar et al., 2012; Alonso-Villar et al., 2013).

[2] For studies applying these measures to explore occupational segregation by race/ethnicity and/or gender in the U.S., see Watts (1995) and Gradín et al. (2014).

the 2005-2007 and 2008-2010 American Community Surveys for the period 2000-2010 (in the 2000s, we use the 2005-2007 and 2008-2010 samples separately to explore if the Great Recession has affected occupational segregation).

Regarding occupational breakdown, the Census Bureau has reorganized its occupational classification system several times, but IPUMS brings two consistent long-term classifications: the 1950 classification, available for the whole period, and a modified version of the 1990 classification, available from 1950 onwards. For the period 1940-1980, we calculate segregation using the codes of the 1950 classification system, which accounts for 269 occupations. For the period 1980-2010, we use instead the 1990-based classification, which accounts for 389 occupations, since although the 1950 classification is available for the whole period, the Minnesota Population Center recommends the 1990-based classification from 1980 onwards (for 1980 we use the two classifications, which makes it possible to assess the break in the series).[3]

Regarding race and ethnicity, this paper considers six mutually exclusive groups of workers composed of the four major single-race groups that do not have a Hispanic origin, plus Hispanics of any race and others: Whites, African Americans or Blacks, Asians (Chinese, Japanese, and other Asians or Pacific Islanders), Native Americans (American Indians and Alaskan natives), Hispanics, and "other race" (those non-Hispanics reporting some other race or more than one race).[4] Since occupational segregation is a gendered phenomenon, this paper crosses the above groups with sex to finally obtain twelve mutually exclusive gender-race/ethnic groups of workers.

3. Segregation Trends

[3] In any case, the harmonization process involved several adjustments which imply that both classifications have some empty employment occupations in several years. Consequently, the number of occupations with positive employment is not exactly the same every year. The number of occupations in 1940, 1970, and 1980 are, respectively, 213, 258, and 220, according to the 1950 classification. In the 1990-based classification, the numbers in 1980, 1990, 2000, 2005-07, and 2008-10 are, respectively, 382, 384, 337, 333, and 333. Fortunately, the majority of the empty occupations have a low employment in the years in which they appear.

[4] The residual category "other race" is different each year. In particular, multiple-race responses were allowed since 2000. Regarding Hispanic origin, there is a break between 1970 and 1980 (before 1980, the origin was imputed by IPUMS).

3.1 Overall Segregation Trends by Gender and/or Race/Ethnicity

Figure 1 displays overall segregation trends over the period 1940-2010 according to the *M* index. One of the time series corresponds to the analysis of segregation by gender (2 groups), another refers to segregation by race/ethnicity (6 groups), and the other results from the combination of both dimensions (12 groups).

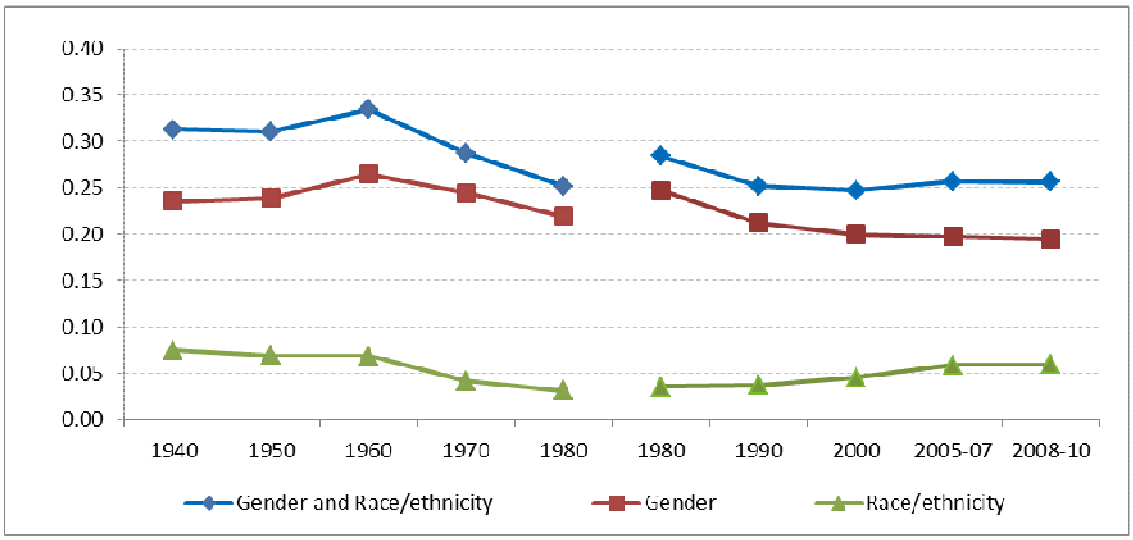

Figure 1. Overall segregation by gender, by race/ethnicity, and by gender and race/ethnicity (index *M*), 1940-2010

Segregation by gender increased up to 1960, decreased during the next four decades, and experienced only a very small reduction during the 2000s. This trend is consistent with that found in previous works for shorter periods of time using the index of dissimilarity, as is the case of Blau and Hendricks (1979) and Blau et al. (2013), who explored the 1950-1970 and 1970-2009 periods, respectively.[5]

The evolution of overall segregation by race/ethnicity is different from that of gender: it fell from 1940 to 1980 and has increased ever since. Comparisons with previous works are in this case more difficult. On the one hand, they are based on pair-wise comparisons and, therefore, do not offer summary statistics of total segregation. On the other hand, they do not consider the wide range of races used here since most scholars have traditionally dealt with employment segregation between Blacks and Whites, and only recently have they included Hispanics and/or Asians in their analyses

[5] Hegewisch et al. (2010) found a similar evolution when analyzing Whites, Blacks, and Hispanics separately although, in this case, no further progress is observed between mid-1990s and 2009. Asians, however, do improve at the beginning of the 2000s.

(Tomaskovic-Devey and Stainback, 2007; Queneau, 2009; Mintz and Krymkowski, 2011).

Our analysis shows that when crossing gender and race/ethnicity, overall segregation peaks in 1960, slides until 2000, and increases slightly from 2000 to 2007, remaining stable afterwards.[6] The evolution of this time series resembles that of gender more than that of race/ethnicity. In any case, the reductions observed from 1960 to 1980 occurred along both gender and race/ethnicity lines. The reduction from 1980 to 1990 seems to have been due exclusively to gender integration, while the slight rise observed in the early 2000s seems to be the consequence of growing differences among racial/ethnic groups.

These results are consistent with those papers that claim that civil rights legislation was behind the progress of minorities during the 1960s and 1970s (Conrad, 2005; Tomaskovic-Devey and Stainback, 2007; Kurtulus, 2012). Once political pressures for racial equality weakened, segregation by race/ethnicity was augmented. The only progress came from the sex desegregation that occurred perhaps as consequence of entry to the workforce of new cohorts of women with higher educational achievements than their predecessors (Blau et al., 2013) and as result of political pressure for gender equality, "which did not start effectively until the 1970s, continued through the 1990s" (Tomaskovic-Devey et al., 2006, p. 585). This may have somehow offset racial segregation leading to a fall in gender-race/ethnicity segregation in the 1980s. To the extent that gender desegregation stalled in the 2000s while segregation by race/ethnicity continuously rose since 1990, no further reductions in overall segregation by gender and race/ethnicity occurred afterwards. In fact, it has slightly increased in the past decade.

When comparing the above series it is hardly surprising to see that segregation by gender is higher than segregation by race/ethnicity since several works based on pair-wise comparisons have already documented this fact using estimates of Black-White segregation within sex groups and sex segregation within racial groups (King, 1992; Blau et al., 2001; Kaufman, 2010). The most startling result here is the extent of those differences, something that can be easily determined in our multigroup approach, which allows disentangling the contributions of gender and race/ethnicity to overall

[6] This evolution is in line with that obtained by Watts (1995) for the period 1983-1992 using the I_p index proposed by Silber (1992) and considering 6 rather than 12 groups.

segregation in our 12-group context. Thus, when adding the gender dimension to the racial/ethnic analysis, the segregation index rises by more than 317%, while when adding race/ethnicity to the gender analysis, segregation increases by 33% at most.[7] To put it another way, most of the differences that we observe in the distribution of our 12 gender-race/ethnic groups across occupations arise from gender. When neglecting the gender dimension, segregation drops sharply.

3.2 Contribution of Each Group to Overall Segregation by Gender and Race/Ethnicity

Table 1 documents the contribution of each of the 12 groups to overall segregation according to the decomposition given by expression (2). White women and men are the groups with the highest contributions to overall segregation due to their large demographic weights (see Table A1 in the appendix). The evolutions of these groups have been rather different, however. The contribution of White women to index *M*, which is larger than that of men, diminished over time (from almost 45% in 1940 to 30% in 2010) as a consequence of both segregation falling for this group up to 1990 (Figure 2) and its demographic share shrinking since then (Table A1). On the contrary, White men increased their contribution to overall segregation from 23% in 1940 to 35% in 1980 as a consequence of their increasing segregation, which more than offset the demographic weight reduction experienced by this group. Since 1980, the contribution of White men has decreased, though, reaching 28% in 2010, due to their lower representation among workers (note that their segregation has barely changed in the last few decades, as shown in Figure 2).

This explains why segregation by gender increased between 1950 and 1960, as documented by Blau and Hendricks (1979), and also increased slightly between 1940 and 1950, as we show in Figure 1. The rise in segregation by gender between 1940 and 1960 was mainly due to a rise in the segregation of White men, who accounted for more than 60% of workers, as the segregation of White women, who accounted for almost 30% of workers, actually fell during this period (Figure 2). In the 2000s, White men were still more evenly distributed across occupations than the remaining groups, while

[7] In 1940, when adding the gender dimension to the racial/ethnic analysis, the segregation increased by 317%. This percentage peaked in 1980, with a value of 713%, and it decreased thereafter until 2010 where it was 326%. Regarding the contribution of race/ethnicity to the gender-race/ethnicity analysis, the increase was around 33% in 1940, and then dipped until 1990, where it was 15%, rising to 32% in 2010.

White women had a segregation level which was similar to that of Black men but below those of minority women and men (see Figure 2, which shows the values of the index for the largest racial/ethnic groups, and Table A2 in the appendix, which gives the values for all groups).

	1940	1950	1960	1970	1980	1980	1990	2000	2005-07	2008-10
White men	23.5	25.0	28.3	32.1	35.4	35.9	34.9	31.6	27.8	27.6
African American men	12.0	11.1	9.5	7.3	6.0	6.1	5.8	4.9	4.6	4.6
Asian men	0.5	0.5	0.4	0.6	1.1	1.1	1.7	2.7	3.2	3.4
Native American men	0.3	0.3	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.3
Hispanic men	1.2	1.7	2.1	2.2	3.8	3.8	6.4	9.5	13.7	13.7
Men of Other Races		0.1	0.1	0.1	0.0	0.1	0.1	0.6	0.4	0.5
White women	44.6	44.9	43.1	43.5	40.5	39.5	36.2	33.5	30.9	29.6
African American women	17.0	15.2	14.4	11.3	8.5	8.5	7.9	7.5	7.8	7.7
Asian women	0.1	0.1	0.3	0.6	1.1	1.2	1.9	2.4	2.8	3.3
Native American women	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Hispanic women	0.6	1.0	1.4	1.9	3.0	3.3	4.5	5.9	7.6	8.4
Women of Other Races		0.0	0.1	0.1	0.1	0.1	0.1	0.7	0.6	0.7

Table 1. Contribution of each gender-race/ethnicity group to overall segregation (index *M*), 1940-2010

Regarding the contribution of minorities to overall segregation (Table 1), the analysis reveals that the contribution of Black women dropped sharply between 1940 and 1990, from 17% to 8%, due to the marked reduction in segregation experienced by this group during this period (Figure 2), and it remained relatively stable afterwards due to stagnation in both the level of segregation and relative size of the group.[8] On the contrary, Hispanic women increased their contribution throughout the whole period—despite the reduction in segregation that this group experienced up to 1990—due to their higher presence among workers. We also observe that the contribution of this group was traditionally much smaller than that of its Black counterpart, while in the 2000s they became alike (7-8%) as a consequence of the similarities between both groups in terms of size and segregation level. The contributions of Native American women and women from other races were very small during the whole period, with values similar to their population shares (Table 1 and Table A1 in the appendix). In the 2000s, the segregation level of Native American women was intermediate between those of white women and

[8] The evolution of the segregation of Black women reported in Figure 2 was previously shown by Alonso-Villar and Del Río (2013), who undertook an in deep analysis for this particular group. Using an approach which is based on pair-wise comparisons between Black women and other demographic groups (White women, White men, Black men, etc.), King (1992) and Mintz and Krymkowski (2011) obtained results for shorter periods which are consistent with our evolution.

other minority women; the segregation of women from other races was close to that of white women (Table A2 in the appendix).

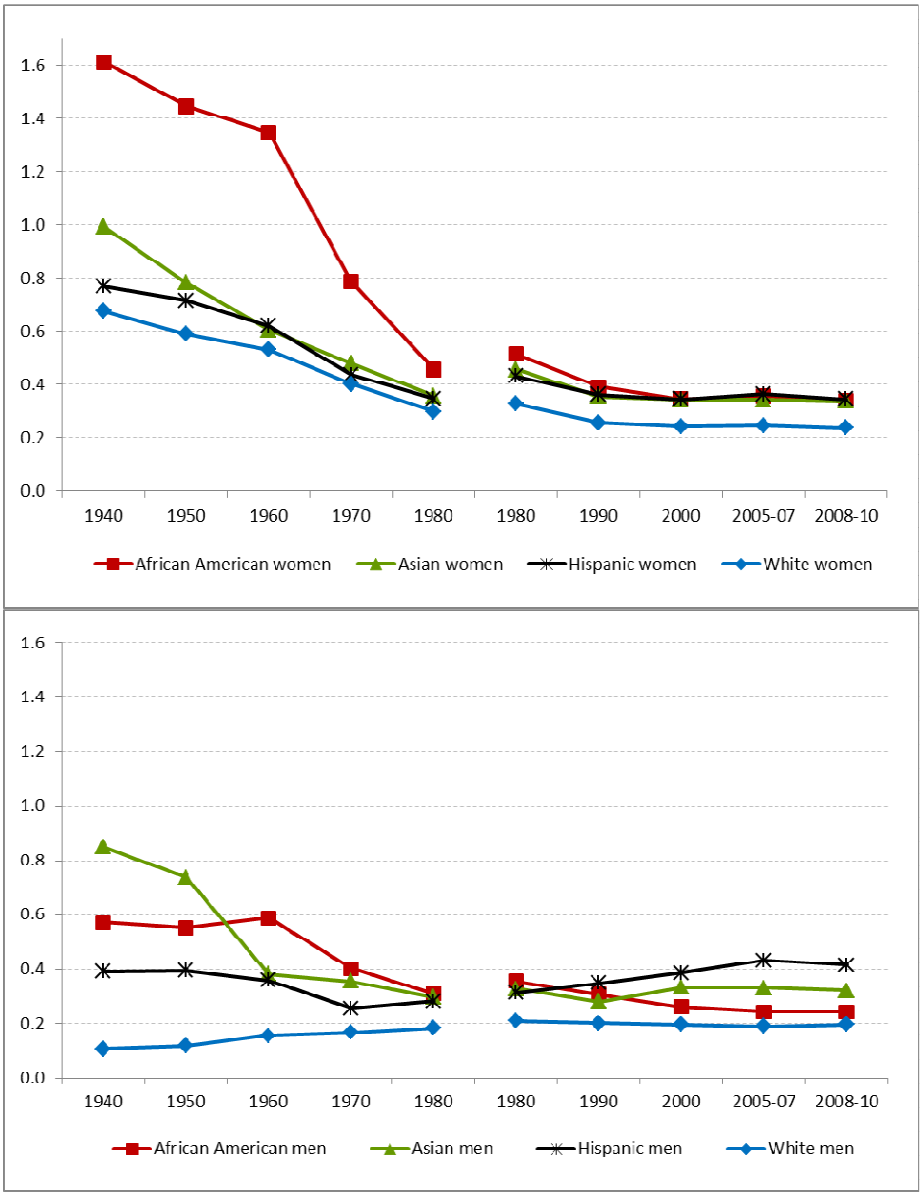

Figure 2. Segregation of the largest gender-race/ethnic groups (Φ_1^g), 1940-2010

As for Black women, Black men also experienced a remarkable reduction in their contribution to overall segregation during this period—from 12% in 1940 to 5% in 2010—because of their drop in segregation but, as opposed to their female counterparts, men did lose population share.[9] Hispanic men had an evolution similar to that of Hispanic women up to 1970, although with lower segregation levels, but since then important differences have appeared between them. Thus, the contribution of Hispanic

[9] Queneau (2009) also documented a fall in the segregation between Blacks and non-Blacks between 1983 and 2002, although his study did not distinguish between women and men.

men increased notably, reaching almost 14% in 2010, due to the increase in segregation that this group has experienced in the last decades, which makes it a distinctive group.[10] In fact, this is the group with the highest and most steadily increasing segregation since 2000. As in the case of their female counterparts, Native American men also have made a small contribution to overall segregation due to their small population share (Table A1). Since the 1990s, they have had an intermediate segregation level between those of Black men and Hispanic men (Table A2). Men from other races, who also have a small contribution to overall segregation, constitute the group with the lowest segregation in the 2000s.

With respect to Asians, despite segregation being reduced for both women and men up to 1990, these two groups have increased their contribution to overall segregation—representing around 3% in 2010—due to their growing share in the labor force. In the last decades, the segregation of Asian men has been between that of Hispanic and Black men, while the segregation of Asian women has been quite close to that of other minority women. Despite the high segregation of Asian women and men, in the next section we will show that, as opposed to other minorities, these groups are advantaged when considering the wages of the occupations they tend to fill.

The analysis also suggests that, in the 2000s, differences in segregation along race/ethnic lines were more marked among men, while there were barely differences among minority women. This finding is in line with those obtained in other studies for earlier periods (Reskin et al., 2004; Spriggs and Williams, 1996; Alonso-Villar et al., 2012).

4. Assessing Segregation: Occupational attainment

So far we have documented the contributions of the different gender-race/ethnicity groups to overall segregation, the segregation level of each group, and the evolution of each group over time. But segregation alone does not permit us to assess the position of a group in the labor market because it depends not only on whether the group has access

[10] Analyzing pair-wise segregation between Hispanic men and either Black or White men, Mintz and Krymkowski (2011) documented an increase in segregation for men of this ethnicity between 1983 and 2002. Alonso-Villar et al. (2012) also gave evidence of the distinctive pattern of Hispanic men in the mid-2000s. In addition, Queneau (2009) found a rise in the segregation between Hispanics and non-Hispanics between 1983 and 2002, although his analysis did not distinguish between women and men.

to any type of occupation but also the "quality" of occupations that the group tends to fill or not to fill. Thus, for example, Hegewisch et al. (2010) document that median earnings in 2009 were higher for male-dominated than for female-dominated occupations in either low-, medium-, or high-skilled occupations.

4.1 Our Proposal

To deal with this issue, this paper proposes a simple index, Γ, that measures the monetary loss or gain that a group experiences as a consequence of its underrepresentation in some occupations and its overrepresentation in others. In other words, this index assesses the segregation of the group according to occupational wages. To build this index, we first compare the share of the group in each occupation, $\frac{c_j}{C}$, with the employment share of that occupation, $\frac{t_j}{T}$, which represents the share the group would have if there were it no segregation. If this difference is positive, this means that the group is overrepresented there; otherwise it is underrepresented. Next, we quantify how much in earnings the group gains (respectively, loses) for being overrepresented (respectively, underrepresented) in that occupation. For that purpose, we take into account the (average) wage of that occupation, w_j. Since the index is aimed at assessing the occupational segregation of a group, it only accounts for wage disparities that arise from differences across occupations, while salary differences within occupations are disregarded.

Once we aggregate the losses and gains for all occupations and express them as a proportion of the average wage of occupations, $\bar{w} = \sum_j \frac{t_j}{T} w_j$, we have a summary statistic of the position of the group. Namely,

$$\Gamma = \sum_j \left(\frac{c_j}{C} - \frac{t_j}{T} \right) \frac{w_j}{\bar{w}} \ . \qquad (3)$$

In what follows, we explain in more detail why this index is useful to rank various demographic groups or a group across time. Note that $\sum_j C \left(\frac{c_j}{C} - \frac{t_j}{T} \right) w_j = \sum_j \left(c_j - C \frac{t_j}{T} \right) w_j$ can be thought of as the total sum of the gains and losses that the group has as a consequence of its underrepresentation in some

occupations ($c_j < C\frac{t_j}{T}$) and overrepresentation in others ($c_j > C\frac{t_j}{T}$). Therefore, expression $\sum_j \left(\frac{c_j}{C} - \frac{t_j}{T} \right) w_j$ represents the (*per capita*) loss/gain of each member of the group derived from the occupational segregation of the group. This expression would allow making comparisons among groups of different sizes in a given year but would not be suitable to compare either groups among economies that differ in their occupational wages or a group across time. However, by dividing this expression by the average wage of occupations, $\overline{w}$, it is possible to obtain the loss/gain of each member of the group as a proportion of that average wage (this average wage actually coincides with the average wage of the economy since the wage of each occupation is determined by the average wage of the individuals working there).

The interpretation of this index is very intuitive. A value of 0.1 means that the group has a *per capita* gain of 10% of the average wage of the economy due to its uneven distribution across occupations. On the contrary, a value of -0.1 implies that the consequences of segregation are negative for the group since it has a *per capita* loss of 10% the average wage of the economy. Note that the losses/gains of all mutually exclusive groups into which the economy can be partitioned, when weighted by the demographic shares of the groups, add up to zero since the advantages of some groups with respect to the average wage must exactly offset the disadvantages of the others. For exposition purposes, in our empirical implementation, the values of the index are given multiplied by 100.

This index satisfies several good properties. It is equal to zero when either the group has no segregation or all occupations have the same wage. In other words, given that this index aims at quantifying the consequences of segregation, if all occupations offer the same wage or if the group is evenly distributed across occupations, the index should reflect that there are no penalties or advantages for the group. In addition, the index increases when some individuals of the group move from one occupation to another that has a higher wage, while it decreases if the opposite holds. Moreover, the index is unaffected by the size of the group, so that if, for example, the group doubles in each occupation, the index does not change. This makes it suitable for comparing different demographic groups. Likewise, the index is unaffected by the number of total workers

in the economy (so long as the occupational structure of the economy does not change) or the monetary units in which wages are measured, which makes it appropriate to compare a group across time or across countries. This index does not take distributive issues into account, however. It cares not about where the changes occur but about the magnitude of losses/gains. Moving into an occupation that has an additional wage of $1 has the same effect on the index, whether the occupation left behind was low paid or high paid.

As mentioned above, our index does not measure the whole earning gap of a group since it neglects wage inequalities that exist within occupations. However, we can determine the share of the earning gap that our index does take into account. Note that the earning gap the group has as a consequence of both its uneven distribution across occupations and its within-occupation wage discrepancy with respect to other groups can be written as $C\sum_j \frac{c_j}{C} w_j^{'} - C\sum_j \frac{t_j}{T} w_j$, where $w_j^{'}$ is the average wage the group receives in occupation *j* (which can differ from the average wage of that occupation, denoted by w_j). By writing this earning gap as a proportion of the total wage revenues that the group would have it there were no segregation and no within-occupation wage disparities with respect to other groups, i.e., as a proportion $C\overline{w}$, we can determine the *per capita earning gap ratio* of the group (denoted by *EGap*):[11]

$$\begin{aligned}
\text{EGap} &= \left(C\sum_j \frac{c_j}{C} w_j^{'} - C\sum_j \frac{t_j}{T} w_j \right) \frac{1}{C\overline{w}} = \\
&= \left(C\sum_j \frac{c_j}{C} w_j^{'} - C\sum_j \frac{c_j}{C} w_j + C\sum_j \frac{c_j}{C} w_j - C\sum_j \frac{t_j}{T} w_j \right) \frac{1}{C\overline{w}} = \\
&= \underbrace{\left[\sum_j c_j \left(w_j^{'} - w_j \right) \right] \frac{1}{C\overline{w}}}_{\Delta} + \underbrace{\sum_j \left(\frac{c_j}{C} - \frac{t_j}{T} \right) \frac{w_j}{\overline{w}}}_{\Gamma}.
\end{aligned} \tag{4}$$

This *per capita* earning gap ratio can be decomposed in two terms: one associated with the occupational segregation of the group, represented by Γ, and the other associated with within-occupation wage disparities with respect to other groups, denoted by Δ.

[11] Note that this earning gap is the differential between the average wage of the group and the average wage of the economy, expressed as a proportion of the latter.

Therefore, by dividing the *Egap* by Γ, we can calculate the contribution of segregation to the earning gap ratio of the group.

4.2 Implementation of the Index

For 1990, 2000, 2005-2007, and 2008-2010, we proxied the wage of each occupation by the average wage per hour (calculated from the information provided by the IPUMS).[12] Due to data limitations, for 1940, 1960, and 1970 we instead used the average wage per week (for the last two years, together with 2008-2010, the number of worked weeks was estimated using a variable coded in intervals). For 1980, we used both wages per week and per hour to make the time series consistent with either previous or subsequent years. The average wage of each occupation (and, therefore, the index) was not calculated for 1950 because for that particular year, we only have information for the sample-line person of each household.

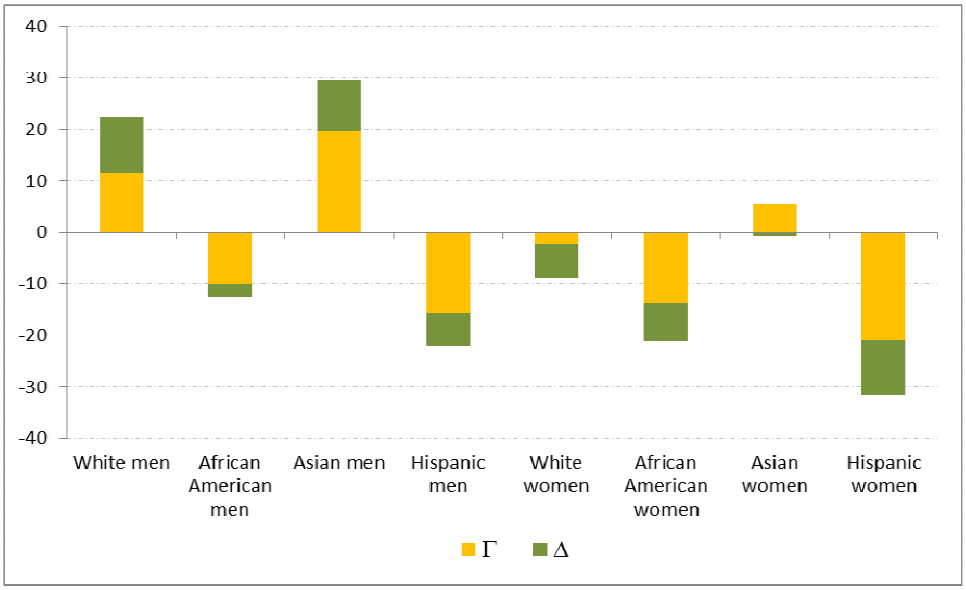

Figure 3. Decomposition of the *per capita earning gap ratio* (*Egap*) for the largest groups in terms of segregation (Γ) and within-occupation wage disparities (Δ)
Note: The indexes are multiplied by 100.

Figure 3 displays the decomposition of the *per capita earning gap ratio* of the four largest racial/ethnic groups in 2008-2010 (the corresponding values for the 12 groups are given in Table A3 in the appendix). This chart shows that segregation explains the

[12] We have trimmed the tails of the hourly wage distribution to prevent data contamination from outliers. Thus, we computed the trimmed average in each occupation eliminating all workers whose wage is either zero or situated below the first or above the 99th percentile of positive values in that occupation.

majority of the *per capita earning gap ratio* for African American, Asian, and Hispanic women and men. On the contrary, 74% of the negative earning gap of White women is associated with the salary disadvantage that this group faces within occupations, while the positive earning gap of White men arises from occupational segregation and within-occupation wage advantages in equal shares.

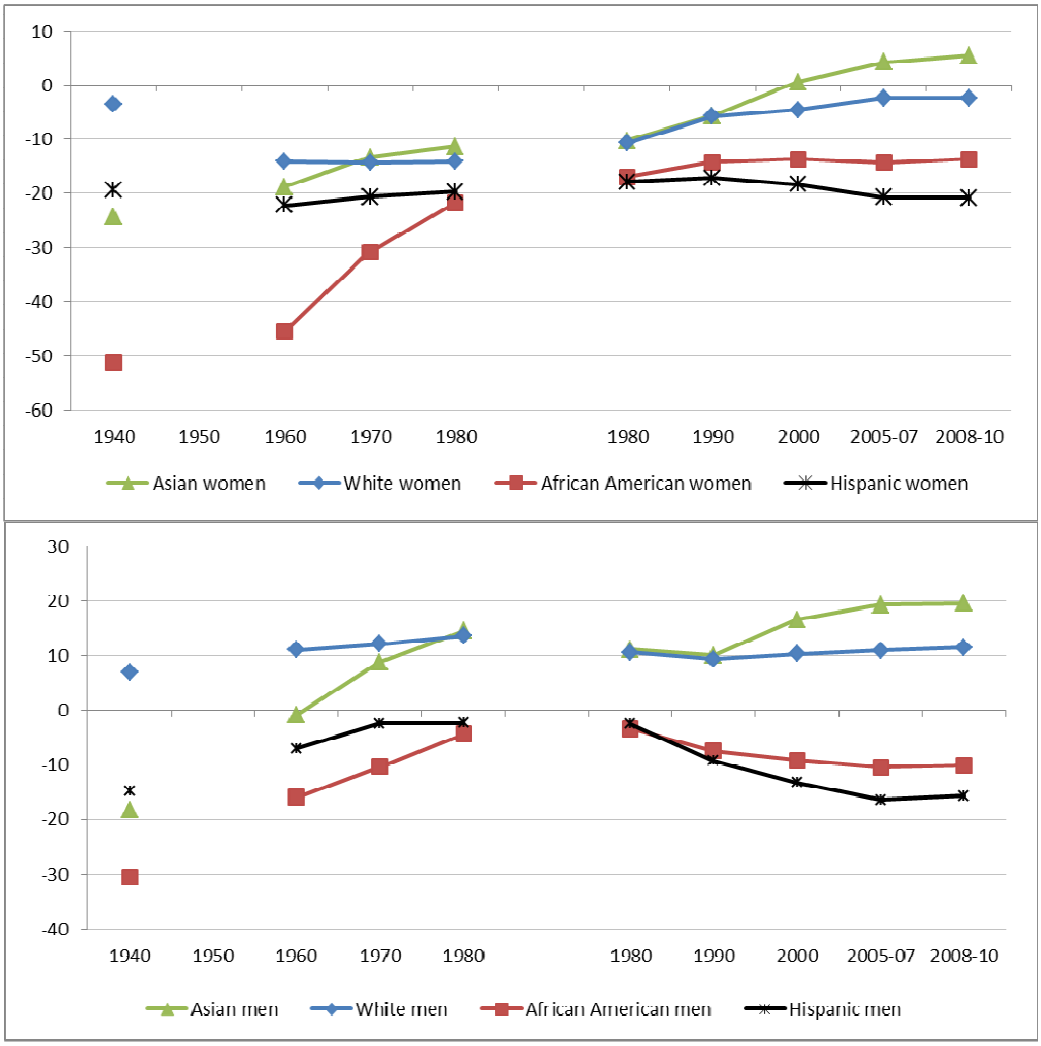

Figure 4. Gains/losses of the largest gender-race/ethnic groups (index Γ*100), 1940-2010

Figure 4 documents the evolution of index Γ (multiplied by 100) for these groups (the values of this index for the 12 groups are given in Table A4 in the appendix). This chart reveals that all groups of men improved between 1940 and 1980 in terms of occupational attainment. Asian men caught up with White men in 1980, where both groups had a value around 11, which means that their uneven distributions across occupations brought them an 11% gain above the average hourly wage of the economy.

Black and Hispanic men also caught up with each other in 1980 but at a negative value (around -3), which gives evidence of their disadvantaged positions. From 1990 on, important divergences appear among male groups. Asian men increasingly improved (reaching an advantage of 20%), surpassing even White men (12%), who no longer make up the most advantaged group (this group's index has barely changed since 1980). On the contrary, the indexes of Black men and especially Hispanic men have markedly decreased (reaching -10 and -16, respectively), which suggests a worsening economic status for these two groups. Exploring the effects of affirmative action on the occupational advancement of minorities, Kurtulus (2012) found that Black men benefited from it, which may explain why when enforcement of affirmative action weakened in the 1980s, integration fell for this group. On the contrary, Kurtulus did not find evidence that Hispanic men benefited from affirmative action. As we explain later on, the recent evolution of Hispanic men may be affected by the group's immigration profile.

Figure 4 also reveals the disadvantage of women. All groups of women except Asians have negative values. When analyzing the evolution of the index, we find that all groups improved from 1960 until 1990, which is consistent with the progress along gender lines mentioned in the previous section. Apart from the rise in education (Blau et al., 2013), civil rights legislation may have been behind these advances. Thus, Kurtulus (2012) claims that affirmative action played an important role in the advancement of Black, Hispanic, and White women into management, professional, and technical occupations during the 1970s and early 1980s, while the impact was smaller in the 1990s.

Since 1990, only Asian and White women have improved in terms of occupational attainment, especially the former, perhaps as a consequence of their advantage on educational grounds. A central finding of this paper is that since 2000 the index has been positive for Asian women and reached a value of 5 in 2010, which suggests that the current segregation of this group brings it a *per capita* gain of 5% of the average wage of the economy. This advantage is, however, lower than that of either White men (12%) or Asian men (20%). Regarding White women, the analysis reveals that they did not progress too much between 1960 and 1980, although since then the index has been closer and closer to zero. In 2010, the index was -2, which implies a disadvantage of 2% of the average wage. This makes this group has a better position in terms of

occupational attainment than Black men but worse than White men and either Asian men or women. The situation is much worse for Black and especially Hispanic women, whose positions have worsened in the past decade (their values in 2010 were -14 and -21, respectively).[13] As Table A4 displays, Native American women have not seen an improved position in the last few decades either (the index value for this group, -15, is the lowest one after those of Hispanic women and men and is much lower than that of their male counterparts, which is -5). Consequently, the small reduction in gender segregation seen in the 2000s has not equally affected all racial/ethnic groups of women. The progress of women in the past decade was concentrated among Asians and Whites.[14]

Our analysis allows us to distinguish the situation of those groups that while having a level of segregation similar to or higher than those of others have a better position in the labor market when accounting for occupational wages. Thus, despite segregation being higher for Asian men than for Black men in 2010 (Figure 2), the assessment of that segregation according to index Γ seems to be positive for Asians but negative for Blacks. Something similar happens to Asian women, whose level of segregation in 2010 was similar to that of other minority women although the assessment of that segregation is positive for them and negative for the other minorities. In addition, despite Hispanic men having a higher level of segregation than Hispanic women, the situation of women seems to be worse since their occupational attainment in 2010 was lower than that of men according to index Γ.[15]

The high value of index Γ for Asians, both women and men, could be the result of their high educational achievements. Notwithstanding important differences in education among Asian subgroups,[16] the proportion of Asians holding a bachelor's degree is significantly higher than that of non-Asians. As documented by Xie and Goyette (2004),

[13] As mentioned above, this index only cares for wage disparities that arise from working in different occupations while wage disparities or discrimination within occupations is left aside. In fact, as Figure 3 shows, the situation of Black and Hispanic women is worse when taking wage disparities into account (their per capita earning gap ratios are, -21 and -32, respectively). Conrad (2005) documents the widening wage gap of Black women, with respect White women, between 1980 and 2000 derived from the persistent discrimination and the racial gap in education that still remains.

[14] As Table A4 displays, women from other races also improved their situation in this period.

[15] These results are in line with those obtained by Alonso-Villar et al. (2012) when dealing with segregation and wage disparities separately.

[16] The proportion of Asian Indians who have bachelor's degrees or higher education is more than twice as much as that of Vietnamese (Allard, 2011).

the educational achievements of Asians may have facilitated their access to high-skilled occupations, such as scientific, medical, and engineering jobs, from 1960 to 2000.[17] Other scholars also document the occupational advantage of particular Asian subgroups. Thus, using four broad occupational categories, Woo et al. (2012) find occupational advantages for second-generation South Asian women and men when comparing them with their White counterparts. These authors claim that educational achievements may have played an important role in this; due not only to the high educational level of this group but also to its concentration on science, technology, engineering, and medical studies.

The low value of index Γ for Hispanics could be the result of their lower educational achievements and their immigration profile. As Duncan et al. (2006) documented, when controlling for years of schooling and English proficiency, Hispanics barely lag behind Whites in terms of employment and earnings. Alonso-Villar et al. (2012) and Gradín (2013) also pointed out that these factors are an important source of occupational segregation for Hispanics so that when controlling for them, the segregation of this group decreases dramatically. Since the deficit in years of education and English proficiency tend to be higher for foreign-born Hispanics than for U.S.-born Hispanics (Duncan et al., 2006), the arrival of new immigrants of low socioeconomic status may have contributed to worsening the situation of Hispanics in the labor market (Mintz and Krymkowski, 2010).

5. Conclusions

Analysis of labor market inequalities among demographic groups usually involves studying segregation across organizational units—occupations, industries, and workplaces—and wage disparities separately. But an uneven distribution across units does not inform us about the nature of that unevenness. Moreover, a higher segregation for a group as a consequence of it moving into highly paid occupations in which it was initially overrepresented does not seem to be a sign of disadvantage for that group. It seems convenient, therefore, to distinguish distributions that while sharing similar segregation levels depart from each other regarding their segregation nature.

[17] Despite this, Asians are a group highly bipolarized between high- and low-paid occupations, as documented by Alonso-Villar et al. (2012). This bipolarization might be a consequence of the marked differences in education among subgroups.

This paper has contributed to the literature by proposing an index that assesses the consequences of occupational segregation in a simple way. It quantifies the monetary loss or gain of a target group associated with its overrepresentation in some organizational units (in our case occupations, although it could be used in other contexts as well) and underrepresentation in others. This index has a clear economic interpretation. It represents the *per capita* advantage (if the index is positive) or disadvantage (if the index is negative) of the group, derived from its segregation, as a proportion of the average wage of the economy. Our index seems a helpful tool not only for academics but also for institutions concerned with inequalities by gender, race, ethnicity, and migration status, among others, since it makes it possible to rank different groups in an economy or a target group across time according to their segregation nature.

Our empirical analysis has not only shown the evolution of occupational segregation in the U.S. by gender, race, and ethnicity during a seventy-year period, 1940-2010, but has also assessed it by quantifying the monetary gains/losses of the various groups. This study has revealed that the segregation reduction that most female groups experienced between 1940 and 1990 did not allow any of them to reach a neutral position in the labor market; the consequences of segregation were negative for them. Things started to change for Asian women in 2000 but not for other women. In 2010, the segregation of Asian women, according to our index, brought them a *per capita* advantage of 5% of the average wage of the economy, while the segregation reduction for White women only allowed them to reach a 2% disadvantage. The situation was much worse for other female groups. The position of Black women did not improve in the past decade, and that of Hispanic women even worsened; their disadvantages in 2010, which represented 14% and 21% of the average wage, respectively, have turned them back several decades. Regarding male groups, our study has revealed that the position of Whites has barely changed since 1980, their advantage in 2010 being about 12% of the average wage. As in the case of their female counterparts, Asians have been the more advantaged male group since 2000, reaching an index value of 20% in 2010. On the contrary, Hispanic and Black men have worsened since 1980; in 2010 they had a *per capita* disadvantage of 16% and 10%, respectively, which turned them back to earlier decades.

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Appendix

	1940	1950	1960	1970	1980	1990	2000	2005-07	2008-10
White men	67.8	64.7	60.4	54.7	48.3	43.5	39.8	37.3	35.6
African American men	6.6	6.2	5.4	5.2	4.9	4.7	4.6	4.9	4.8
Asian men	0.2	0.2	0.4	0.5	0.9	1.5	2.0	2.5	2.7
Native American men	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3
Hispanic men	1.0	1.3	1.9	2.4	3.4	4.6	6.0	8.1	8.4
Men from other races		0.0	0.1	0.0	0.1	0.0	0.9	0.7	0.8
White women	20.7	23.6	27.2	31.2	34.3	35.5	34.1	32.3	31.9
African American women	3.3	3.3	3.6	4.1	4.7	5.1	5.4	5.6	5.9
Asian women	0.0	0.1	0.2	0.3	0.8	1.3	1.8	2.1	2.5
Native American women	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.3	0.3
Hispanic women	0.3	0.4	0.7	1.2	2.2	3.1	4.3	5.4	6.2
Women from other races		0.0	0.0	0.0	0.0	0.0	0.7	0.6	0.7

Table A1. Demographic weight of gender-race/ethnicity groups, 1940-2010

	1940	1950	1960	1970	1980	1980	1990	2000	2005-07	2008-10
White men	0.108	0.120	0.157	0.169	0.184	0.211	0.202	0.197	0.191	0.198
African American men	0.572	0.554	0.588	0.404	0.310	0.357	0.308	0.263	0.245	0.245
Asian men	0.850	0.738	0.382	0.357	0.298	0.329	0.281	0.333	0.332	0.322
Native American men	0.727	0.825	0.724	0.430	0.315	0.360	0.341	0.315	0.337	0.311
Hispanic men	0.393	0.396	0.359	0.258	0.283	0.315	0.350	0.388	0.433	0.417
Men from other races		1.366	0.745	0.569	0.220	0.273	0.349	0.171	0.169	0.154
White women	0.675	0.590	0.530	0.400	0.297	0.327	0.257	0.243	0.246	0.237
African American women	1.612	1.447	1.347	0.786	0.456	0.514	0.391	0.344	0.357	0.338
Asian women	0.992	0.783	0.605	0.478	0.357	0.457	0.354	0.342	0.343	0.338
Native American women	0.918	1.561	0.951	0.583	0.313	0.368	0.285	0.268	0.292	0.281
Hispanic women	0.768	0.714	0.620	0.435	0.346	0.430	0.362	0.344	0.364	0.345
Women from other races		2.133	0.847	0.869	0.352	0.424	0.382	0.242	0.254	0.233

Table A2. Local segregation of gender-race/ethnicity groups (index Φ_1^g), 1940-2010

	Γ	Δ	Egap
White men	11.52	10.89	22.40
African American men	-10.08	-2.49	-12.57
Asian men	19.60	9.95	29.55
Native American men	-5.35	-6.05	-11.40
Hispanic men	-15.72	-6.22	-21.94
Men from other races	1.63	-1.39	0.24
White women	-2.37	-6.59	-8.96
African American women	-13.72	-7.48	-21.20
Asian women	5.41	-0.60	4.81
Native American women	-15.02	-13.43	-28.45
Hispanic women	-20.87	-10.75	-31.61
Women from other races	-7.97	-10.03	-18.00

Table A3. Decomposition of the *per capita earning gap ratio* of each group (*Egap*) in terms of segregation (Γ) and within-occupation wage disparities (Δ), 2008-10

	1940	1960	1970	1980	1980	1990	2000	2005-07	2008-10
White men	6.95	11.09	12.13	13.61	10.58	9.35	10.30	11.00	11.52
African American men	-30.61	-15.99	-10.31	-4.36	-3.39	-7.41	-9.19	-10.43	-10.08
Asian Men	-18.24	-0.77	8.76	14.49	11.18	10.08	16.61	19.27	19.60
Native American men	-29.40	-13.87	-2.75	3.27	2.18	-3.45	-6.23	-7.19	-5.35
Hispanic men	-14.82	-7.00	-2.47	-2.34	-2.55	-9.21	-13.22	-16.42	-15.72
Men from other races		0.72	9.28	7.11	5.60	-4.60	-0.65	-1.61	1.63
White women	-3.48	-14.18	-14.36	-14.13	-10.70	-5.80	-4.59	-2.42	-2.37
African American women	-51.28	-45.47	-30.84	-21.74	-16.97	-14.26	-13.70	-14.31	-13.72
Asian women	-24.27	-18.79	-13.38	-11.33	-10.21	-5.66	0.53	4.28	5.41
Native American women	-26.22	-32.17	-24.05	-18.80	-15.59	-14.01	-13.46	-14.29	-15.02
Hispanic women	-19.46	-22.23	-20.60	-19.74	-17.87	-17.17	-18.38	-20.77	-20.87
Women from other races		-18.63	-19.02	-15.49	-12.19	-14.46	-10.32	-9.36	-7.97

Table A4. Gains and losses of the gender-race/ethnicity groups (index Γ*100), 1940-2010