Local Segregation and Wellbeing[*]

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Abstract

This paper proposes a measure with which to quantify the wellbeing of a demographic group associated to its distribution across occupations of different status. In doing so, it extends the status-sensitive segregation measures proposed by Del Río and Alonso-Villar (2012a). While those measures allow researchers to assess the segregation of a target group penalizing its concentration in low-status occupations, the new measure allows ranking demographic groups in terms of wellbeing.

JEL Classification: D63; J0; J15; J71

Keywords: Segregation measures; occupations; status; wellbeing

1. Introduction

The literature on segregation devotes a great deal of attention to analyzing segregation in the case of two population subgroups (mainly women versus men but also blacks versus whites).[1] The study of segregation in a multigroup context does not have a long tradition, even though in recent years this topic has received increasing attention among scholars (Silber, 1992; Boisso et al., 1994; Reardon and Firebaugh, 2002; Frankel and Volij, 2011). These multigroup measures allow researchers to quantify the disparities among the population subgroups into which the economy can be partitioned and provide an aggregate or overall segregation value (Iceland, 2004).

Nevertheless, one may be interested in measuring not only overall segregation, which involves simultaneous comparisons among all groups, but also the segregation of a target population subgroup, a topic that gains special relevance in a multigroup context. To address this issue, the literature mainly opts to undertake pairwise comparisons. Thus, in ethnic/racial analyses, for example, studies often contrast Hispanics with whites as well as Hispanics with blacks, Asians, or non-Hispanics in general by using two-group measures (Albelda, 1986; King, 1992; Reardon and Yun, 2001; Cutler et al., 2008; Hellerstein and Neumark, 2008). Alternatively, Alonso-Villar and Del Río (2010) offer an axiomatic set-up within which the segregation of a target group (labeled as local segregation as opposed to overall segregation) can be addressed. In this framework, the distribution of a target group across organizational units is contrasted with the distribution of the total population. This approach places emphasis on how the different demographic groups fill the units, and it allows easy comparisons among groups. [2] These local segregation measures are naturally related to overall measures because they add up to the whole segregation when they are aggregated according to the demographic weights of the mutually exclusive subgroups into which the population can be partitioned.

None of these works, however, consider that organizational units might have different statuses. In particular, in measures of occupational segregation, standard indexes do not take into account whether demographic groups tend to occupy high or low status jobs,

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[1] See classical works by Duncan and Duncan (1955), Karmel and MacLachlan (1988), and Silber (1989). For more recent proposals, see Hutchens (1991, 2004) and Chakravarty and Silber (2007).
[2] Recent studies using this approach to analyze the occupational segregation of several demographic groups are Alonso-Villar et al. (2012) and Del Río and Alonso-Villar (2012b).

even though wage earnings vary considerably among occupations.[3] A segregation measure that takes into account the status of occupations should explicitly assume that it is important not only to determine how uneven the distribution of a group across occupations is with respect to others but also to identify the direction of these differences. In order to illustrate the relevance of these questions in the case of local segregation, consider the following economy with three demographic groups (*A, B,* and *C*) of equal size and two occupations (*j* and *k*). Table 1 presents the distribution of these groups between occupations together with the corresponding wages.

	Group A	Group B	Group C	Wage
Occupation *j*	20	80	50	3
Occupation *k*	80	20	50	7

Table 1. Example

Any of the local segregation measures proposed by Alonso-Villar and Del Río (2010) would suggest that demographic groups *A* and *B* share identical segregation levels since the discrepancy between the distribution of each of them and that of total employment $(150,150)$ is of the same magnitude. However, some researchers would agree that the segregation suffered by group *B* is of a different nature and more disturbing than that of group *A*, since its employment is strongly concentrated in the low-paid occupation. In this regard, one might reasonably wonder whether it is possible to develop measures that allow one to include the status of organizational units (occupations, branches of activity, etc.) in the segregation measurement of a demographic group. These tools should give a higher segregation value to group $B \equiv (80, 20)$ than to $A \equiv (20, 80)$.

So far, few studies have included the status of occupations in their segregation measurement proposals. The few studies that do include the status of occupations in their proposals have focused on overall segregation by considering either an ordinal categorization of occupations in a multigroup context or a cardinal categorization in a two-group context (Reardon, 2009; Hutchens, 2006, 2009). To our knowledge, Del Río

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[3] This study focuses on occupational segregation even though it also works for other types of segregation. For simplicity, we use wage as a proxy for status, although a set of relevant dimensions of job status can also be used and then summarized into a one-dimensional variable.

and Alonso-Villar (2012a) is the only attempt made in the literature to quantify status-sensitive segregation in a multigroup context by invoking a cardinal measure of status. Their tools take into account the discrepancies between the distribution of a target group and that of total employment by penalizing the concentration of the group in low-paid occupations. This paper extends those measures to assess the wellbeing of the target group.

For that purpose, Section 2 presents the background and proposes an index to quantify the wellbeing of a target group. These tools are used in Section 3 to assess the evolution of segregation of black women in the U.S. from 1940 to 2010. This illustration shows the potential of this approach, which offers useful hints for distinguishing between occupational distributions that are similar in terms of shares but differ in terms of assessment of those shares. Finally, Section 4 offers the main conclusions.

2. Incorporating Status: Assessing the Impact of Occupational Wage Inequality on Segregation

As mentioned above, few studies have included the status of occupations in their segregation measurement proposals cardinally and those that exist have focused on segregation in a two-group context (Hutchens, 2006, 2009). An exception is Del Río and Alonso-Villar (2012a), who extend local segregation measures by incorporating status in a multi-group context cardinally. These measures can be used to assess the occupational segregation of a target group, the distribution of which departs from the occupational structure of the economy, by penalizing its concentration in low-status occupations. These measures aggregate the employment gaps of a target group across occupations by taking into account their wages but, as we discuss below, they cannot be used to rank demographic groups according to their wellbeing or a group in different years. Before defining a measure with which the wellbeing of a group can be measured, we present here the measures developed by Alonso-Villar and Del Río (2010) and Del Río and Alonso-Villar (2012a) on which our measure is based.

2.1 Background: Local Segregation and Status-Sensitive Local Segregation

The index of dissimilarity proposed by Duncan and Duncan (1955) is the most popular segregation index. This index compares the proportion of a group in each occupation

with the proportion of another group and aggregates those gaps in a certain way. It has been used to quantify, for example, the segregation between women and men (i.e., gender or sex segregation), the segregation between blacks and whites (i.e., racial segregation), etc. This index is actually an overall segregation index since it measures the segregation between two groups rather than the segregation of one of the groups. In recent years, overall segregation measures have been also proposed in a multigroup context to quantify discrepancies among all groups taken together (Silber, 1992; Boisso et al., 1994; Reardon and Firebaugh, 2002; Frankel and Volij, 2011).

To explore the situation of a target group in a multigroup context, for example that of black women, what scholars usually do is to consider all pair-wise comparisons among groups (black women versus white women, black women versus black men, etc.) and calculate an overall segregation index (mainly the index of dissimilarity) for each of these cases (Albelda, 1986; King, 1992; Reskin, 1999; Kaufman, 2010; Mintz and Krymkowski, 2011). However, when many groups are involved, these comparisons become cumbersome, and the performance of a target group is difficult to summarize.

Local Segregation Measures

The segregation measures proposed by Alonso-Villar and Del Río (2010) allow quantifying the segregation of a target group and are labeled local segregation measures to distinguish them from overall segregation measures. These measures compare the distribution of the target group across J occupations, $c \equiv \left(c_1, c_2, ..., c_J \right)$, with the distribution of total employment across these occupations, $t \equiv \left(t_1, t_2, ..., t_J \right)$. This means that black women are segregated, so long as they are overrepresented in some jobs and underrepresented in others (whether the latter are filled by white women, white men, black men, or by another demographic group). Depending on how the discrepancies between c and t are taken into account, several indices can be defined to measure the segregation of black women. Denoting by $T = \sum_j t_j$ the total number of workers in the economy and by $C = \sum_j c_j$ the total number of black women workers, these authors propose the following indices:

$$G(c;t) = \frac{\sum_{i,j} \dfrac{t_i}{T}\dfrac{t_j}{T}\left| \dfrac{c_i}{t_i} - \dfrac{c_j}{t_j} \right|}{2\dfrac{C}{T}} \tag{1}$$

$$\Phi_a(c;t) = \begin{cases} \dfrac{1}{a(a-1)} \sum_j \dfrac{t_j}{T}\left[\left(\dfrac{c_j/C}{t_j/T} \right)^a - 1 \right] & \text{if } a \neq 0,1 \\[3ex] \sum_j \dfrac{c_j}{C} \ln\left(\dfrac{c_j/C}{t_j/T} \right) & \text{if } a = 1 \end{cases} \tag{2}$$

$$D(c;t) = \frac{1}{2}\sum_j \left| \frac{c_j}{C} - \frac{t_j}{T} \right| \tag{3}$$

The first measure is a variation of the classic Gini index, the second represents a family of indices related to the generalized entropy family,[4] and the third measure is a variation of the index of dissimilarity.[5] The higher the value of these indices, the larger is the segregation of black women. Both G and D take values within the interval $[0,1)$, while Φ_a is unbounded.

Apart from these indices, these authors also propose the use of the local segregation curve, $S(\tau_j) = \dfrac{\sum_{i \leq j} c_i}{C}$, where $\tau_j \equiv \sum_{i \leq j} \dfrac{t_i}{T}$ is the proportion of employment represented by the first j occupations ranked in ascending order of the ratio $\dfrac{c_j}{t_j}$ (see Figure 1). The value of this curve at point 0.1 shows the proportion of black women who work in occupations in which this group has the lowest representation ($\dfrac{c_j}{t_j}$) and that account for 10% of total employment. The curve at point 0.2 shows the proportion of black women who work in occupations that represent 20% of total employment and in which this

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[4] a can be interpreted as a segregation sensitivity parameter, so that the higher its value, the higher the sensitivity of the index against employment movements that involve occupations where the group has a high representation (c_j/t_j).

[5] As shown by Alonso-Villar and Del Río (2010), these local segregation measures are consistent with multi-group (overall) segregation measures that exist in the literature because these multi-group measures can be written as the sum of the local segregation level of each group into which the economy is partitioned (e.g. black women, black men, white women, white men, other women, and other men), weighted by the group's share in the whole population.

minority has the lowest representation, and so on.[6] Therefore, this curve shows the underrepresentation of black women with respect to the occupations' size, percentile by percentile. If black women were distributed across occupations in the same manner as the distribution of total employment (i.e., if the share of black women in each occupation, $\frac{c_j}{C}$, equals the weight of that occupation in the economy, $\frac{t_j}{T}$), the curve would be equal to the 45° line, and no segregation would exist for this group. The more distant the curve is from this line, the higher is the segregation of black women.
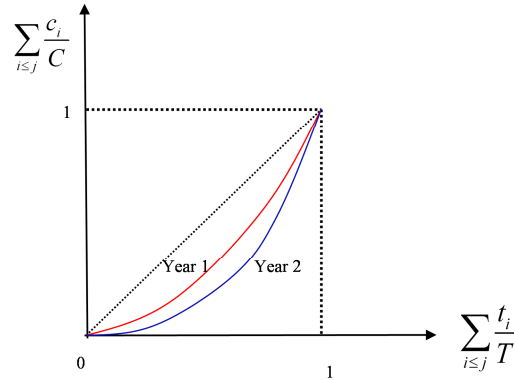

Figure 1. Local segregation curves of black women, S, in two years

When comparing the distribution of black women in two years, if the curve in year 1 lies at no point below year 2 and at some point above (as in Figure 1, where year 1 dominates year 2), all of the indices defined above (except D) will always lead to the same conclusion as the curves do: Segregation is higher in year 2. This makes the use of these curves a robust procedure because, when segregation curves do not cross, a powerful conclusion can be reached without using several indices (as proved in Alonso-Villar and Del Río, 2010). However, if curves cross or if one is interested in quantifying the extent of segregation, the use of the indices seems to be the most appropriate.

Status-sensitive Local Segregation Measures

Del Río and Alonso-Villar (2012a) define the status-sensitive (local) segregation curve

of black women as $S^w(\lambda_j) = \dfrac{\sum\limits_{i \leq j} c_i}{C}$, where $\lambda_j \equiv \sum\limits_{i \leq j} \dfrac{t_i \frac{w_i}{\overline{w}}}{T} = \sum\limits_{i \leq j} \dfrac{t_i w_i}{\sum\limits_i t_i w_i}$ (w_j being the wage

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[6] This local segregation curve is related to the Lorenz curve used in the literature on income distribution and is also related to the segregation curve proposed by Duncan and Duncan (1955).

of occupation j and $\overline{w} = \sum_j \dfrac{t_j w_j}{T}$ the weighted average wage) and occupations are now

ranked in ascending order of the ratio $\dfrac{c_j}{t_j w_j}$ (see Figure 2 while considering
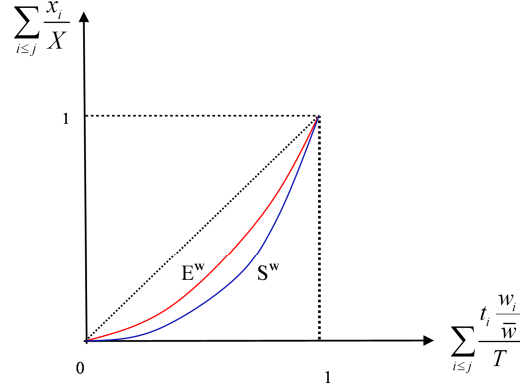
$x_i = c_i$ and $X = C$).

Figure 2. Status-sensitive segregation curve of black women, S^w, and status-sensitive curve of total employment, E^w

The interpretation of this curve is simple: It shows the cumulative discrepancy between the employment distribution of black women and the distribution they would have if they followed the distribution of wage revenues ($t_j w_j$) across occupations (assuming that no wage differences exist within each occupation). The further the curve is from the 45° line, the larger is the status-sensitive segregation of black women.

The corresponding status-sensitive (local) segregation indices, in the case of the generalized entropy family, are:

$$\Phi_a^w(c;t) = \begin{cases} \dfrac{1}{a(a-1)} \sum_j \dfrac{t_j \frac{w_j}{\overline{w}}}{T} \left[\left(\dfrac{c_j/C}{\left(t_j \frac{w_j}{\overline{w}}\right)\big/T} \right)^a - 1 \right] & \text{if } a \neq 0,1 \\[4ex] \sum_j \dfrac{c_j}{C} \ln\left(\dfrac{c_j/C}{\left(t_j \frac{w_j}{\overline{w}}\right)\big/T} \right) & \text{if } a = 1 \end{cases} \tag{4}$$

These indices are consistent with the dominance criterion that these curves give so that when one curve is above another, any of these indices will lead to the same conclusion—a lower status-sensitive segregation for the distribution above.

2.2 A Proposal to Assess Segregation in Terms of Wellbeing

It is important to note that the discrepancy between the employment distribution of black women across occupations and the distribution of wage revenues across occupations is the result of two inequality sources: occupational segregation of black women (i.e., disparities between the distribution of black women across occupations and the occupational structure of the economy) and occupational wage inequality. Both factors, which are jointly considered in the above measures, determine the economic position of black women in the labor market. This explains why the status-sensitive segregation measures are not exactly segregation measures. As Del Río and Alonso-Villar (2012a) show, these measures are not equal to zero when local segregation is zero if occupational wage inequality exists.

In fact, one can define the status-sensitive curve of total employment as $E^w(\lambda_j) = \dfrac{\sum\limits_{i \leq j} t_i}{T}$

where occupations are now ranked from the highest to the lowest wage (see Figure 2, where this curve is obtained while considering $x_i = t_i$ and $X = T$). This curve, which departs from the 45° line due to the existence of wage dispersion across occupations, shows the status-sensitive segregation that black women would have if they were distributed across occupations according to the occupational structure. From all of the above, it follows that changes in the distribution of wages will affect the value of the status-sensitive segregation measures, even if the segregation of black women remains unaltered, because the situation of this minority has actually changed.

Nevertheless, the status-sensitive segregation measures taken alone do not allow us to quantify the effect of occupational wage inequality on the situation of black women. The fact that the status-sensitive segregation curve of a group is below that of another group does not necessarily imply the former group being worse than the latter. What it really means is that its distribution across occupations is more distant from the distribution of wage revenues across occupations, but this could be a consequence of a higher concentration of the group in either low- or high-paid occupations since in both cases the curve can be far away from the 45° line.

Despite this, the status-sensitive segregation measures seem a helpful tool. The status-sensitive segregation curve can be thought of as a modified local segregation curve in which high-paid occupations gain importance given that they have a higher weight in

the distribution of wage revenues than in the employment distribution. Contrasting the local segregation curve and the status-sensitive segregation curve seems a reasonable strategy to approximate the effect that occupational wage inequality has on the group when the status-sensitive segregation curve is dominated by the local segregation curve.

To assess the segregation of black women while accounting for wages, we propose to use $\Psi_1(c;t)$, that result from the difference between the local segregation and status-sensitive segregation of the group, according to index $\Phi_1(c;t)$, adjusted by the status-sensitive "unevenness" of total employment ($\Phi_1^w(t;t)$). Namely,

$$\Psi_1(c;t;w) = \Phi_1(c;t) - \Phi_1^w(c;t) + \Phi_1^w(t;t) \qquad (5)$$

The difference between the first two terms allows us to quantify how much the status-sensitive segregation curve departs from the local segregation curve. The third term makes the index be equal to zero when the group has no segregation (if $\Phi_1(c;t) = 0$ then $\Phi_1^w(c;t) = \Phi_1^w(t;t)$), which facilitates over-time comparisons.

3. Assessing Segregation: An Illustration

To illustrate our index, in this section we assess the occupational segregation of black women in the U.S. during a seventy-year period, 1940-2010. Our data come from the IPUMS samples drawn from the U.S. decennial census for the period 1940-2000 and the 2005-2007 and 2008-2010 American Community Surveys, homogenized by the Minnesota Population Center of the University of Minnesota (Ruggles et al., 2010).[7] This dataset offers harmonized information that assigns uniform codes to variables. Based on self-reported identity, black women are those who identify themselves as blacks and do not have a Hispanic origin (the share of workers who are black women is given in Table 1).

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[7] We use these two ACS samples rather than that of 2005-2010 to find out possible effects derived from the recession that began in 2007.

	Percentage of black women	Share of black women with Less than High School	Share of black women with High School	Share of black women with Some College	Share of black women with Bachelor's degree	Share of workers with Bachelor's degree
1940	3.31	86.98	7.58	3.39	2.05	5.84
1950	3.26					
1960	3.56	68.84	18.71	6.79	5.66	9.76
1970	4.12	52.34	29.53	11.42	6.71	12.82
1980	4.68	30.82	33.93	23.89	11.36	18.53
1990	5.08	20.46	30.55	33.36	15.63	23.31
2000	5.35	15.40	28.04	37.35	19.21	27.24
2005-7	5.60	10.71	31.04	36.62	21.63	29.36
2008-10	5.85	9.16	26.74	40.77	23.33	30.86

Table 1. Percentage of black women and shares of black women by educational level.

Along this period, the census bureau reorganized its occupational classification system several times, but this dataset offers two consistent long-term classifications: the 1950 classification, available for the entire period, and a modified version of the 1990 classification, available from 1950 onward. For the period 1940-1980, we use the codes of the 1950 classification system, which accounts for 269 occupations. For the period 1980-2010, we instead use the modified version of the 1990 classification, which accounts for 387 occupations, as although 1950 is available for the entire period, the Minnesota Population Center recommends the 1990-based classification from 1980 onward. Consequently, for each sub-period, we can calculate the index using a common classification of occupations, based on either that of 1950 or 1990, which allows us to minimize the effect that changes in the occupations' titles has on segregation.[8]

The reduction in segregation shown by Alonso-Villar and Del Río (2013) reveals that black women were much more evenly distributed across occupations in 2010 than in 1940 (see Figure 3), but it does not say anything about whether they increased their representation in low- or high-paid occupations.

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[8] In any case, the harmonization process involved several adjustments, which implies 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 "real" 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 low employment in the years in which they appear.
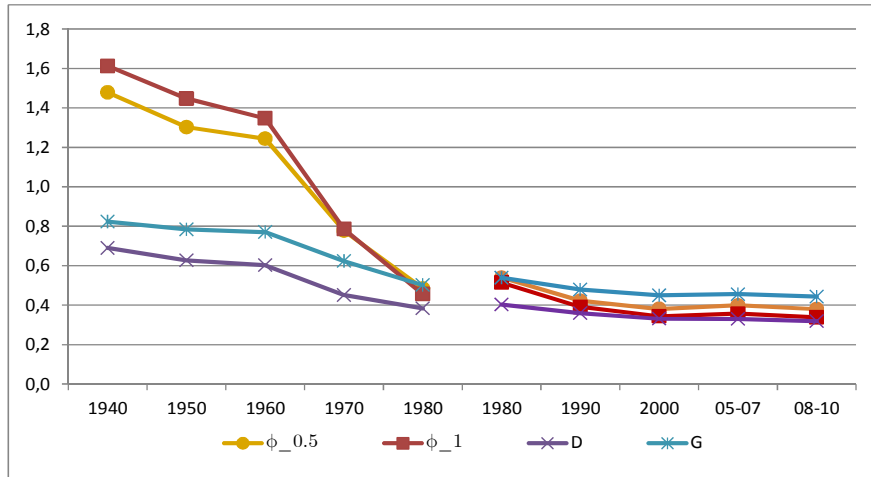
Figure 3. Segregation of black women in 1940-2010 according to indices G, D, and Φ_a with $a = 0.5$ and 1 (1950 and 1990-based classifications). Source: Alonso-Villar and Del Río (2013)

To analyze this matter, we now use the tools presented in section 2 that penalize the concentration of the group in low-paid occupations. For 1980, 1990, 2000, 2005-07, and 2008-2010 the wage of each occupation is proxied by the average wage per hour. Due to data limitations, for 1940, 1960, and 1970 we instead use the average wage per week (during the last two years, the number of worked weeks was estimated using a variable coded in intervals). In any case, note that the status-sensitive segregation measures used do not depend on these wages but on relative wages ($w_j / \overline{w}$). For 1980, we calculate these relative wages using both wages per hour and per week, and the values of the status-sensitive segregation indices were higher in the latter. This makes the two series (that based on the 1950 classification and the one based on the 1990 classification) less comparable than in the segregation analysis which does not take status into account. For 1950, we cannot calculate the average wage in each occupation because we only have information for the sample-line person of each household.

By comparing the local segregation curve (S) and the status-sensitive segregation curve (S^w) of each year, we find that the latter is always below the former. As an example, the curves for 2008-2010 are shown in Figure 4. Curve S shows that some occupations represent 20% (respectively, 40%) of jobs but account for only 2.2% (respectively, 11.8%) of black women. Curve S^w indicates that the share of black women who worked in occupations that accounted for 20% (respectively, 40%) of total wage revenues is even lower, 1.6% (respectively, 7%). This fact, together with the similarity between the status-sensitive concentration curve, C^w, and the status-sensitive

segregation curve, S^w, shows the low presence of black women in high-paid occupations.[9] In line with previous literature, the results for earlier years show that this weak position was a common characteristic of the participation of black women in the labor market over the seventy-year period.
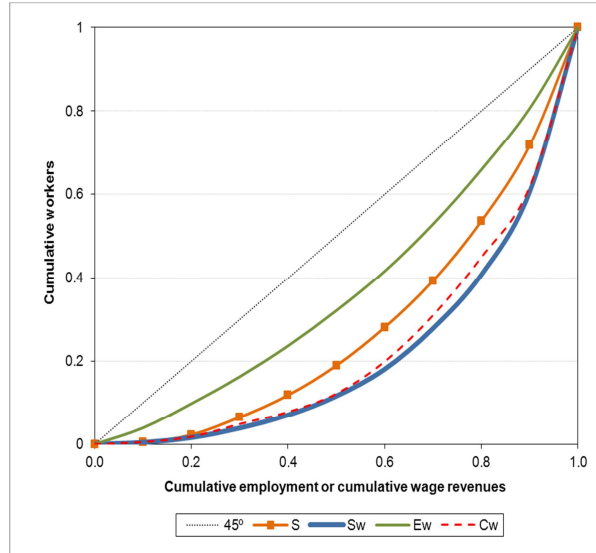

Figure 4. Local segregation curve (S), status-sensitive segregation curve (S^w), status-sensitive employment curve (E^w), and status-sensitive concentration curve (C^w) of black women, 2008-2010 (1990-based classification)

To quantify the extent of this matter, Figure 5 shows index Ψ_1 along the 1940-2010 period. It reveals that black women notably improved up to 1980; the process was much slower between 1980 and 2000, and it slightly worsened from 2000 to 2010. This temporal pattern is analogous to that depicted in the segregation analysis without taken wages into account (Alonso-Villar and Del Río, 2013), except that the introduction of wages in the study has permitted us to single out the drawing back of black women at the turn of the century.

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[9] Curve C^w is built as curve S^w except that the ranking of occupations is that of curve S. We find that, in each year, C^w and S^w are rather similar. This suggests that there are not significant changes in the ranking of occupations when using $\left(c_j/t_j w_j\right)$ rather than $\left(c_j/t_j\right)$. Hence, the fact that S^w is below S is the result of black women being concentrated in low-paid occupations.
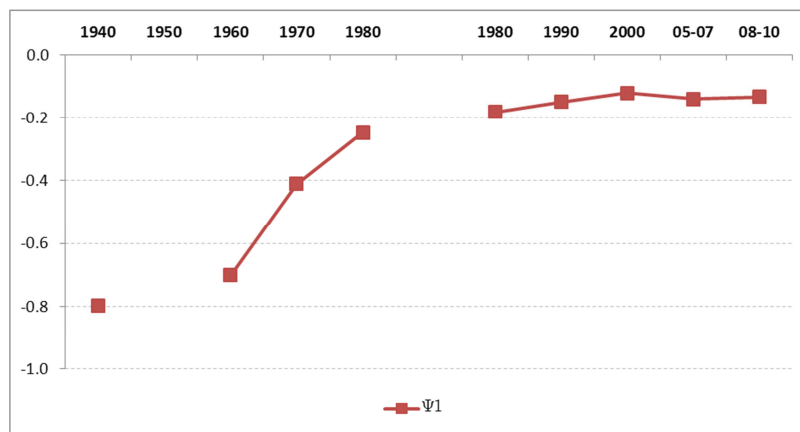
Figure 5. Index Ψ_1 for black women in 1940-2010 (1950 and 1990-based classifications)

We can conclude that the strong segregation reduction in the 1960s and 1970s was accompanied by important wage improvements due to the higher presence of black women in occupations with relative wages higher than those they had in 1940. However, from 1990 onward, the increasing wage inequality and the low improvement in segregation gave rise to small advances in the integration of black women in the labor market. Consequently, their position in 2008-10 was not too different from that twenty years before.

4. Conclusions

To assess occupational segregation while accounting for the status of occupations, this paper has proposed an index that allows researchers to rank different groups in a given year or a target group along time in terms of wellbeing. In doing so, this paper has extended recent tools that quantify the discrepancy between the distribution of a target across occupations and the occupational structure of the economy by penalizing the concentration of the group in low-paid jobs (Alonso-Villar and Del Río, 2010; Del Río and Alonso-Villar, 2012a). To illustrate this measure, this paper has explored the occupational segregation of black women in the US along the period 1940-2010. Based on harmonized and detailed occupation titles (269 for the period 1940-1980 and 387 for 1980-2010), this paper has suggested the existence of an integration process for black women from 1940 to 1980, especially in the 1960s and 1970s. The process was not so intense in the next two decades, and it slightly reversed after 2000.

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