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Occupational Segregation Measures: A Role for Status

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A Role for Status[*]

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Abstract

This paper defines local segregation measures which are sensible to status differences among organizational units. So far as we know, this is the first time that status-sensitive segregation measures are offered in a multigroup context by invoking a cardinal measure of status. These measures allow aggregating employment gaps of a target group penalizing its concentration in low-status occupations. They are intended to complement, rather than substitute, previous local segregation measures. The usefulness of these tools is illustrated in the case of occupational segregation by race and ethnicity in the U.S.

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1. Introduction

The literature on segregation has devoted a great deal of attention to analyzing segregation in the case of two population subgroups (blacks-whites, high-low social position, and women-men).[1] The study of segregation in a multigroup context does not have such 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 quantifying 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 has mainly opted to undertake pairwise comparisons. Thus, in ethnic/racial analyses, for example, Hispanics are often contrasted with whites, but also with blacks, Asians, or with non-Hispanics in general, 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 (2010a) offers 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 total population. This approach places emphasis on how the different demographic groups fill the units and allows easy comparisons among groups. [2] These local segregation measures are naturally related to overall measures because when they are aggregated according to the demographic weights of the mutually exclusive subgroups into which the population can be partitioned, they add up to the whole segregation.

None of these works consider, however, the fact organizational units might have different status. In particular, in measuring occupational segregation, standard indexes do not take account whether demographic groups tend to occupy high or low status jobs, even though

[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 and Del Río (2010b) and Del Río and Alonso-Villar (2010, 2012).

wage earnings vary considerably among occupations.[3] A segregation measure taking 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 (2010a) would conclude 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 $A \equiv (20, 80)$. Considering the salary level of occupations in the segregation measurement of a target group means placing emphasis on individuals' well-being, since well-being is not be the same for those population subgroups who are strongly concentrated in high-paid occupations rather than in low-paid occupations.

[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 be also used and then summarized into one-dimensional variable.

This paper extends the local measures proposed by Alonso-Villar and Del Río (2010a) by incorporating the status of organizational units (in our case, occupations) cardinally measured. So far as we know, this is the first time that status-sensitive segregation measures, either local or overall, are offered in a multigroup context by invoking a cardinal measure of status. The few studies including the status of occupations in their proposals have focused on overall segregation considering either an ordinal categorization of occupations in a multigroup context or a cardinal (and ordinal) categorization in a two-group context (Reardon, 2009; Hutchens, 2006, 2009a). Our measures are intended to 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 should be used to complement, rather than substitute, previous measures since they are aimed at aggregating the employment gaps of a target group taking into account the wage distribution.

For that purpose, Section 2 presents the discussion existing in the literature regarding the inclusion of status in segregation measurement. Section 3 offers a reflection about the properties that a local segregation measure taking into account the status of organizational units should satisfy and offers several measures consistent with them. In addition, it proposes status-sensitive segregation curves and establishes the relationship between the corresponding dominance criterion and the aforementioned indexes. All these tools are later used in Section 4 to analyze the occupational segregation by race and ethnicity in the U.S. This illustration shows the potential of this approach, which offers useful hints in distinguishing between occupational distributions that are similar in terms of shares but differ regarding the assessment of those shares. Finally, Section 5 offers the main conclusions.

2. Background and discussion

Three recent papers have tackled the inclusion of status or prestige in the measurement of overall segregation. Reardon (2009) offers ordinal overall measures in a multigroup context, which are useful when organizational units can be defined by ordered categories. In doing so, he establishes a set of desirable properties that any ordinal segregation measure should satisfy and develops a general procedure with which to build this kind of measures.[4] By following an approach more closely related to that of the literature on inequality, Hutchens (2006, 2009a) proposes overall segregation measures in the binary case that take into account differences in the prestige of organizational units. In some cases, these measures use ordinal classifications of units, while in others, disparities are addressed by following a cardinal scale of prestige. This allows him to distinguish between the effect of changes in the distribution of employment across occupations and the effect of changes in the status of the occupations.

These studies have opened the axiomatic debate, offering valued proposals for empirical research. However, none of them have tackled the inclusion of status in local segregation measurement, which is a context where this approach appears particularly relevant. To close that gap somewhat, this paper aims to extend previous local segregation measures to incorporate this new dimension. The objective is to offer new measures with which to compare the situation of various demographic groups attending not only to their distributions across occupations but also to the consequences of this phenomenon in economic terms.

There is not a consensus in the literature about the convenience of including status in the analysis of segregation, as the debate between Jargowsky (2009) and Hutchens (2009b) shows. Two main points are dealt with in Jargowsky's criticism. Firstly, he considers that "the consequences of segregation should not be equated with the phenomenon itself" (p. 121), and secondly, he states that it involves "an implicit assumption about the casual link between the two dimensions," since status is "stated a priori" (p. 123). However, these criticisms do not seem conclusive. With respect to the former, it seems legitimate to wonder why important characteristics of the segregation phenomenon have to be ignored when measuring segregation. In empirical analyses, it seems helpful to be able to distinguish between the performances of demographic groups who share a similar concentration level in a few occupations but they do it in occupations with very different economic or social status. This allows one to discriminate among similar concentration levels depending on their consequences in terms of well-being. Certainly, it seems convenient to use different labels for each phenomenon since they are not exactly the same. Thus, in this paper, we use the term "status-sensitive segregation" to distinguish it from standard segregation. Regarding the

[4] This paper also offers a reflection on previous proposals existing in the literature regarding ordinal segregation following alternative approaches, as is the case of Meng et al. (2006).

second criticism, Hutchens sustains that “an index can combine different kinds of information without implying causality” (p. 127). Jointly analyzing two variables does not necessarily imply a causal relationship between them. In fact, one can find many examples of it in the literature of multidimensional inequality and poverty.

To address the issue of combining the distribution of status across occupations and that of employment, one could think of using bi-dimensional inequality measures and adapt them to our context. The advantage of these measures is that they have been analyzed from an axiomatic point of view, showing the roles played by the correlation between both variables and the inequality of each of them in measuring aggregate inequality (Kolm, 1977; Atkinson and Bourguignon 1982; Tsui, 1999). However, we cannot follow this approach to extend local segregation measurement since the effect of increasing status inequality should depend on the kind of occupations in which the target group tends to concentrate, and this requirement does not suit with inequality measurement. If the target group is concentrated in low-status occupations and they lose status as compared to the remaining occupations, it seems reasonable to call for an increase in status-sensitive segregation. On the contrary, status-sensitive segregation should decrease if the group is concentrated in high-status occupations that improve their status. But these requirements are incompatible with some of the basic principles used in the literature of multidimensional inequality, such as the *Pigou-Dalton bundle principle* (Fleurbaey and Trannoy, 2003) and the c*orrelation increasing principle* (Tsui, 1999).

For this reason, this paper does not follow the multidimensional inequality approach but takes Alonso-Villar and Del Río (2010a) and Hutchens (2006) as a start point and adapts them to incorporate the status of occupations in local segregation measurement. For this purpose, the next section presents several basic properties in this new context and offers status-sensitive local segregation measures verifying them.

3. Local segregation measures: The status of occupations

This paper considers an economy with $J > 1$ occupations among which total population, denoted by *T*, is distributed according to distribution $t \equiv \left(t_1, t_2, ..., t_J\right)$, where $T = \sum_j t_j$.

Assume that the status of occupations is represented by distribution $s = (s_1, ..., s_J)$, where each

s_j is a cardinal measure of the status of occupation j and $\sum_j \frac{t_j}{T} s_j = 1$. Denote by $c^g \equiv \left(c_1^g, c_2^g, ..., c_J^g\right)$ the distribution of target group g, where $c_j^g \leq t_j \quad (g = 1, ..., G)$. Distribution c^g could represent, for example, the number of individuals of an ethnic/racial group or any other group of citizens in each occupation. Therefore, the economy can be summarized by status vector s and matrix E, which represents the number of individuals of each population subgroup in each occupation, where rows and columns correspond to population subgroups and occupations, respectively. The total number of individuals in occupation j is $t_j = \sum_g c_j^g$, and the total number of individuals of target group g is $C^g = \sum_j c_j^g$.

$$\begin{array}{c} G \text{ subgroups} \times J \text{ occupations} \\ E = \begin{bmatrix} c_1^1 & \cdots & c_J^1 \\ \vdots & & \vdots \\ c_1^G & \cdots & c_J^G \end{bmatrix} \rightarrow \begin{bmatrix} \sum_j c_j^1 = C^1 \\ \vdots \\ \sum_j c_j^G = C^G \end{bmatrix} \\ \downarrow \\ \begin{bmatrix} \sum_g c_1^g = t_1 & \cdots & \sum_g c_J^g = t_J \end{bmatrix} \end{array}$$

A measure of local segregation taking into account status is a function, Φ_s, that allocates a real number to each vector $\left(c^g; t; s\right)$ by measuring the differences between the distribution of target group g among occupations, c^g, and the distribution of reference, t, both distributions expressed in proportions, taking into account the status of occupations. In other words, distribution $\left(\frac{c_1^g}{C^g}, ..., \frac{c_J^g}{C^g}\right)$ is compared with $\left(\frac{t_1}{T}, ..., \frac{t_J}{T}\right)$ according to distribution $(s_1, ..., s_J)$. Namely, $\Phi_s : D \rightarrow \mathbb{R}$, where $D = \bigcup_{J>1} \left\{\left(c^g; t; s\right) \in \mathbb{R}^J_+ \times \mathbb{R}^J_{++} \times \mathbb{R}^J_{++} : c_j^g \leq t_j \forall j\right\}$.

3.1 Basic properties

We propose the following four basic properties for measuring local segregation in a hierarchical context:

Property 1. *Scale Invariance*: Let α and β be two positive scalars such that when $\left(c^g;t;s\right)\in D$ vector $\left(\alpha c^g;\beta t;s\right)\in D$, then $\Phi_s\left(\alpha c^g;\beta t;s\right)=\Phi_s\left(c^g;t;s\right)$.

Property 2. *Symmetry in Groups*: If $\left(\Pi(1),...,\Pi(J)\right)$ represents a permutation of occupations $\left(1,...,J\right)$ and $\left(c^g;t;s\right)\in D$, then $\Phi_s\left(c^g\Pi;t\Pi;s\Pi\right)=\Phi_s\left(c^g;t;s\right)$, where $c^g\Pi=\left(c^g_{\Pi(1)},...,c^g_{\Pi(J)}\right)$, $t\Pi=\left(t_{\Pi(1)},...,t_{\Pi(J)}\right)$, and $s\Pi=\left(s_{\Pi(1)},...,s_{\Pi(J)}\right)$.

Property 3. *Insensitivity to Proportional Divisions*: If vector $\left(c^g{}';t';s'\right)\in D$ is obtained from vector $\left(c^g;t;s\right)\in D$ in such a way that **a)** $c^g{}'_j=c^g{}_j$, $t'_j=t_j$, $s'_j=s_j$ for any $j=1,...,J-1$ and **b)** $c^g{}'_j=c^g_J/M$, $t'_j=t_J/M$ and $s'_j=s_J$, for any $j=J,...,J+M-1$, then $\Phi_s\left(c^g{}';t';s'\right)=\Phi_s\left(c^g;t;s\right)$.

The first property means that the segregation index does not change when the total number of jobs in the economy and/or the total number of individuals of target group g vary so long as their respective shares in each occupation remain unaltered. In other words, in measuring local segregation, only employment shares matter, not employment levels. The second property means that the "occupation's name" is irrelevant so that if we enumerate occupations in a different order, the segregation level remains unchanged. The third property states that subdividing an occupation into several categories of equal size, both in terms of total employment and in terms of individuals of the target group, does not affect the segregation measurement so long as the status of the new categories coincides with that of the original occupation.

Property 4. *Sensitivity to Disequalizing Movements between Organizational Units*: Consider two occupations, *i* and *h*, satisfying $\frac{c^g_i}{t_is_i}<\frac{c^g_h}{t_hs_h}$. If vector $\left(c^g{}';t';s'\right)\in D$ is obtained from vector $\left(c^g;t;s\right)\in D$ in such a way that either **a)** $c^g_i{}'=c^g_i-d$ and $c^g_h{}'=c^g_h+d$ $\left(0<d\le c^g_i\right)$, other things being equal (i.e., $c^g_j{}'=c^g_j$ $\forall j\neq i,h$ and $t_j{}'=t_j$ and $s_j{}'=s_j$ $\forall j$), or **b)** $t_i{}'=t_i+e$ and $t_h{}'=t_h-e$ $(0<e<t_h;\ s_i=s_h)$, other things being equal (i.e., $s_j{}'=s_j$ and $c^g_j{}'=c^g_j$ $\forall j$

and $t_j' = t_j \quad \forall j \neq i,h$), or **c)** $s_i' = s_i + f$ and $s_h' = s_h - f \quad (0 < f < s_h;\ t_i = t_h)$, other things being equal (i.e., $t_j' = t_j$ and $c_j^g{}' = c_j^g \ \forall j$ and $s_j' = s_j \quad \forall j \neq i,h$), then $\Phi_s\left(c^g{}';t';s'\right) > \Phi_s\left(c^g;t;s\right)$.

This property requires local segregation to increase when there are disequalizing movements between occupations (being either a consequence of changes in employment or status). It implies, for example, that if occupation *i* has the same number of jobs and status as occupation *h* (i.e., $t_i = t_h$ and $s_i = s_h$) but a lower number of positions for the target group (i.e., $c_i^g < c_h^g$), a movement of target individuals from *i* to *h* is a disequalizing movement fostering the segregation of that group. In this case, there would be no difference between this property and that of "movement between groups" proposed by Alonso-Villar and Del Río (2010a) (henceforth AV-DR), since both occupations are considered to have the same status and, therefore, the target group has a lower presence in occupation *i* regarding not only employment in that occupation, t_i, but also regarding employment weighted by status, $t_i s_i$.

But property 4 also refers to disequalizing movements between occupations with different status, which are not considered in AV-DR. Thus, for example, if there is a movement of target individuals from *i* to *h*, segregation increases when occupation *i* has the same number of jobs as occupation *h* (i.e.,$t_i = t_h$) but a higher status and lower (or equal) number of positions for the target group (i.e.,$s_i > s_h$ and $c_i^g \leq c_h^g$). In addition, a disequalizing movement between two occupations can be found if the employment structure of the economy changes in such a way that the number of jobs increases in occupation *i* and decreases in *h* (in the same amount), the former having lower employment positions for the target group and higher (or equal) employment level weighed by status (i.e., $c_i^g < c_h^g$ and $t_i s_i \geq t_h s_h$).

One might consider it necessary to include an additional property to compare disequalizing movements of employment that differ in the status of the "receiving" occupation. Thus, it seems reasonable that a disequalizing movement of employment toward an occupation with a lower status fosters segregation to a higher extent than a movement toward an occupation with the same status. Following the property of "movements between groups with different prestige" established by Hutchens (2006) to measure overall segregation in a binary context, the next property could be defined in our context.

Property 5. *Sensitivity to Disequalizing Movements between Organizational Units with Different Status:* Consider three occupations, *i*, *h*, and *k*, such that $\frac{c_i^g}{t_i} < \frac{c_h^g}{t_h} = \frac{c_k^g}{t_k}$ and $s_i = s_h > s_k$. If vectors $\left(c^g\,';t;s\right), \left(c^g\,'';t;s\right) \in D$ are obtained from vector $\left(c^g;t;s\right) \in D$ in such a way that $c_i^g\,' = c_i^g - d$ and $c_h^g\,' = c_h^g + d$, and $c_i^g\,'' = c_i^g - d$ and $c_k^g\,'' = c_k^g + d$ with $\left(0 < d \leq c_i^g\right)$, other things being equal, then $\Phi_s\left(c^g\,'';t;s\right) - \Phi_s\left(c^g;t;s\right) > \Phi_s\left(c^g\,';t;s\right) - \Phi_s\left(c^g;t;s\right) > 0$.

Note, however, that property 5 is a particular case of property 4, and, therefore, if the latter is required, there is no need for the former.

Regarding the performance of Φ_s under changes in the correlation between the distribution of status across occupations and that of the employment of the target group, we find convenient to propose the next property.

Property 6. *Correlation decreasing principle:* Consider two occupations, *i*, and *h*, with $t_i = t_h$, satisfying $c_i^g < c_h^g$ and $s_i > s_h$. If vector $\left(c^g;t;s'\right) \in D$ is obtained from vector $\left(c^g;t;s\right) \in D$ in such a way that $s'_i = s_h$ and $s'_h = s_i$, other things being equal (i.e., $s_j\,' = s_j$ $\forall j \neq i,h$), then $\Phi_s\left(c^g;t;s'\right) < \Phi_s\left(c^g;t;s\right)$.

This property has the opposite effect than the one required in the *correlation increasing principle* proposed by Tsui (1999) to measure multidimensional inequality. According to it, an increase in the correlation between two variables leads to an increase in bi-dimensional inequality. On the contrary, in our case, an increase in the correlation between the distribution of a group across occupations and the distribution of status (other things being equal) has to lead to a decrease in the status-sensitive segregation of that group since it involves a higher concentration of the group in high-paid occupations. Note, however, that we do not need to add property 6 to the list of properties that we will require for our measures, since it is a consequence of properties 2 and 4 taken together.

3.2 Status-sensitive local segregation curves

Keeping properties 1-4 in mind, we now define local segregation curves that are sensible to differences among occupations' status. The dominance criterion of these curves is later shown to be consistent with these properties. In order to propose measures that can be easily implemented, we use wage as a proxy for occupational status. Namely, we assume that the distribution of status across occupations is equal to $s \equiv \left(\frac{w_1}{\overline{w}}, ..., \frac{w_J}{\overline{w}} \right)$, where w_j is the wage of occupation j and $\overline{w} = \sum_j \frac{t_j w_j}{T}$.

In building these new local curves we use the local segregation curves proposed in AV-DR, but now we modify the distribution of reference against which to compare that of the target group so as to incorporate the importance of each occupation in terms of status/wages. Thus, the weight of each occupation in the new distribution of reference is now equal to its employment level, t_j, weighted by its relative wage ($\frac{w_j}{\overline{w}}$). Consequently, if occupation j has a wage above the average ($w_j > \overline{w}$), it has a high status (>1), and, therefore, the employment benchmark against which to compare that of the target group gains relevance ($t_j \frac{w_j}{\overline{w}} > t_j$). In this way, the discrepancies between the distribution of the target group and the occupational structure of the economy have a larger impact in high-paid occupations that in low-paid. Later on, we will see that this change allows the new local measures to satisfy the aforementioned four basic properties.

According to the above, to define a status-sensitive segregation curve for target group g we propose to compare the distribution of that group, $\left(\frac{c_1^g}{C^g}, ..., \frac{c_J^g}{C^g} \right)$, with distribution $\left(\frac{t_1}{T} \frac{w_1}{\overline{w}}, ..., \frac{t_J}{T} \frac{w_J}{\overline{w}} \right)$ and plot the cumulative proportion of employment, $\sum_{i \le j} \frac{t_i \frac{w_i}{\overline{w}}}{T}$, on the horizontal axis and the cumulative proportion of individuals of the target group, $\sum_{i \le j} \frac{c_i^g}{C^g}$, on the vertical axis.[5] In doing so, occupations have to be lined up in ascending order of the ratio $\frac{c_j^g / C^g}{(t_j \frac{w_j}{\bar{w}}) / T}$, which is equivalent to ranking according to $\frac{c_j^g}{t_j \frac{w_j}{\bar{w}}}$. Given that $\frac{t_i}{T} \frac{w_i}{\bar{w}} = \frac{t_i w_i}{\sum_i t_i w_i}$, the interpretation of this curve is simple: it shows the cumulative discrepancy between the employment distribution of the target group and the distribution it would have if the group followed the distribution of salaries, $t_i w_i$, across occupations (assuming there is no wage differences within each occupation).

Definition*:* We say that the status-sensitive local segregation curve of $\left(c^g; t; \frac{w}{\bar{w}}\right) \in D$, *dominates in segregation that of* $\left(c^g{}'; t'; \frac{w'}{\bar{w}'}\right) \in D$, where $w \equiv (w_1, ..., w_J)$, if the status-sensitive segregation curve of the former lies at no point below the latter and at some point above.

Figure 1 shows the status-sensitive local segregation curves for two demographic groups, A and B, where the former dominates in status-sensitive segregation to the latter, i.e., B has higher status-sensitive segregation than A. Note that, on the one hand, the status-sensitive local segregation curve generalizes that previously proposed by AV-DR, since the latter can be obtained as a particular case where all occupations have the same wage. On the other hand, assuming for simplicity that $t_i = t_h \ \forall i, h$, it is easy to see that the higher the wage inequality across occupations (according to the Lorenz criterion), the larger the difference between this curve and the curve with no wage inequality. It is important to note, however, that the direction of these changes does depend on the correlation between the distributions of wages and the employment distribution of the target group across occupations. Thus, an augment in wage inequality reduces status-sensitive segregation if the relationship between both variables is perfectly linear and positive (the new curve dominates the former). In fact, the curve coincides with the 45º-line when the wage of each occupation is equal to the corresponding

[5] Note that considering $s \equiv \left(\frac{w_1}{\bar{w}}, ..., \frac{w_J}{\bar{w}}\right)$ warranties that $\sum_j t_j s_j = \sum_j t_j \frac{w_j}{\bar{w}} = \sum_j t_j = T$.

employment of the group multiplied by a constant. On the contrary, an increment in wage inequality leads to higher status-sensitive segregation levels if the rank correlation between both variables is -1.

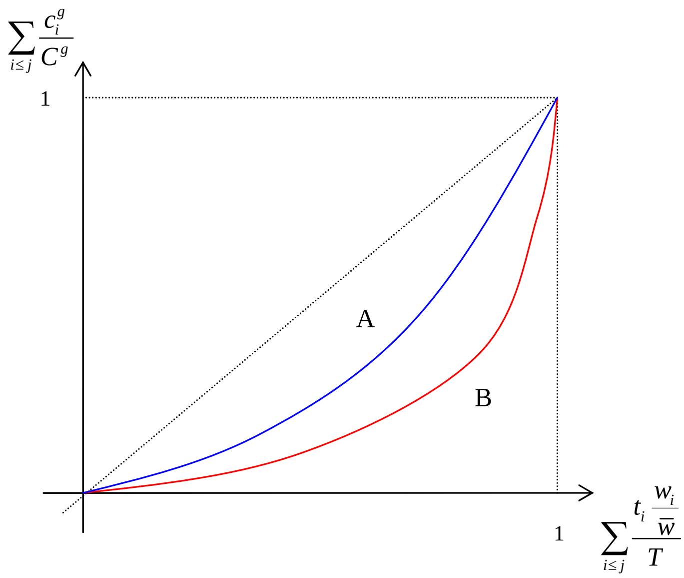

Figure 1. Status-sensitive local segregation curves

Next, we show the relationship between our segregation curves and segregation indexes satisfying the aforementioned basic properties.

Proposition 1. *Given vectors* $\left(c^g;t;\frac{w}{\overline{w}}\right),\left(c^{g}{}';t';\frac{w'}{\overline{w}'}\right)\in D$, *the status-sensitive local segregation curve of* $\left(c^g;t;\frac{w}{\overline{w}}\right)$ *dominates that of* $\left(c^{g}{}';t';\frac{w'}{\overline{w}'}\right)$ *if and only if* $\Phi_s\left(c^g;t;\frac{w}{\overline{w}}\right)<\Phi_s\left(c^{g}{}';t';\frac{w'}{\overline{w}'}\right)$ *for any status-sensitive local segregation index* Φ_s *satisfying properties 1-4.*

Proof: See Appendix

This result shows the robustness of the dominance criterion for measuring the segregation of a demographic group when taking into account the status of occupations, since when a status-sensitive curve dominates in segregation another curve, any local segregation index satisfying the above properties will be necessarily consistent with this criterion. This makes the use of these curves a powerful procedure for empirical analysis. However, if curves cross or if one is interested in quantifying the extent of status-sensitive segregation, the use of indexes satisfying the basic properties seems most appropriate.

3.3 Status-sensitive local segregation indexes

In what follows, we extend several local segregation measures existing in the literature by incorporating the status of occupations. Thus, the status-sensitive local segregation Gini index of a target group (G_s^g) can be written as the weighted sum of the employment differences between pairs of occupations according to the relative presence of the target group--all ratios being expressed in terms of weighted-status employment--divided by twice the demographic weight of the group:

$$G_s^g = \frac{\sum_{i,j} \frac{t_i}{T}\frac{t_j}{T}\frac{w_i}{\bar{w}}\frac{w_j}{\bar{w}} \left| \frac{c_i^g}{t_i \frac{w_i}{\bar{w}}} - \frac{c_j^g}{t_j \frac{w_j}{\bar{w}}} \right|}{2\frac{C^g}{T}}. \qquad [1]$$

Given the parallelism between the classical Gini index and the Lorenz curve, one can easily observe that this measure is equal to twice the area between the above status-sensitive local segregation curve and the 45º-line.

The generalized entropy family of local segregation indexes proposed by AV-DR can also be conveniently modified in order to take into account the status of occupations (the generalized entropy family of status-sensitive local segregation indexes, $\Phi_{s,\alpha}^g$):

$$\Phi_{s,\alpha}^g \equiv \Phi_\alpha(c^g; t; \frac{w}{\bar{w}}) = \begin{cases} \frac{1}{\alpha(\alpha-1)} \sum_j \frac{t_j \frac{w_j}{\bar{w}}}{T} \left[\left(\frac{c_j^g / C^g}{\left(t_j \frac{w_j}{\bar{w}} \right) / T} \right)^{\alpha} - 1 \right] & \text{if } \alpha \neq 0,1 \\ \sum_j \frac{c_j^g}{C^g} \ln \left(\frac{c_j^g / C^g}{\left(t_j \frac{w_j}{\bar{w}} \right) / T} \right) & \text{if } \alpha = 1 \end{cases} \qquad [2]$$

where α is a parameter.[6] Note that when $\alpha = 0.5$, the above index is $\Phi^g_{s,0.5} = \frac{1}{4}\left(1 - \sum_j \sqrt{\frac{w_j}{\bar{w}}}\sqrt{\frac{c^g_j}{C^g}\frac{t_j}{T}}\right)$, which can be interpreted as the local version, in a multigroup context, of the square root index proposed by Hutchens (2006) to measure overall segregation in the binary case when taking the prestige of occupations into account.[7]

Moreover, the index of dissimilarity proposed by Duncan and Duncan (1955), the most popular segregation measure, can also be conveniently adapted to measure the segregation of target group *g* when taking status into account (the status-sensitive local dissimilarity index, D^g_s):

$$D^g_s = \frac{1}{2}\sum_j \left| \frac{c^g_j}{C^g} - \frac{t_j}{T}\frac{w_j}{\bar{w}} \right|. \qquad [3]$$

Given the parallelism between the status-sensitive local segregation curve of vector $\left(c^g; t; \frac{w}{\bar{w}}\right)$ and the Lorenz curve of fictitious distribution $\left(\underbrace{\frac{c^g_1}{t_1 \frac{w_1}{\bar{w}}}, \ldots, \frac{c^g_1}{t_1 \frac{w_1}{\bar{w}}}}_{t_1 \frac{w_1}{\bar{w}}}, \ldots, \underbrace{\frac{c^g_J}{t_J \frac{w_J}{\bar{w}}}, \ldots, \frac{c^g_J}{t_J \frac{w_J}{\bar{w}}}}_{t_J \frac{w_J}{\bar{w}}} \right)$ defined in the proof of the above proposition, demonstrating that the status-sensitive Gini index of target group *g*, G^g_s, and the family of indexes $\Phi^g_{s,\alpha}$ satisfy properties 1-4 is easy. For the same reason, it follows that local index D^g_s only satisfies properties 1-3, since the classical index of dissimilarity is not consistent with the Lorenz dominance criterion.

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[6] If we had considered local segregation indexes defined on the space of distributions $(c^g; t; s)$, where all components of vector c^g were strictly positive, rather than positive, then another index could be defined: $\Phi^g_{s,\alpha} = \Phi_\alpha(c^g; t; \frac{w}{\bar{w}}) = \sum_j \frac{t_j \frac{w_j}{\bar{w}}}{T} \ln\left(\frac{(t_j \frac{w_j}{\bar{w}})/T}{c^g_j / C^g} \right)$ if $\alpha = 0$.

[7] The index proposed by Hutchens considers two groups of individuals (women and men, for example) and takes the following expression: $O(c^w; c^m; s) = 1 - \sum_j s_j \sqrt{\frac{c^w_j}{C^w}\frac{c^m_j}{C^m}}$, where *w* denotes women and *m* males.

In addition, it is easy to see that all these status-sensitive measures satisfy the following property:

Property 7. *Status-sensitive normalization*: $\Phi_s\left(c^g;t;s\right)=0$ if $\frac{c_j^g}{C^g}=\frac{(t_j\frac{w_j}{\overline{w}})}{T}$ $\forall j$.

This property has two implications. First, if $w_j=w_h$ $\forall j,h$ and $\frac{c_j^g}{C^g}=\frac{t_j}{T}$ $\forall j$, then $\Phi_s\left(c^g;t;s\right)=0$. In other words, when all wages are equal, the index is zero if there is no local segregation. In fact, if there is no wage dispersion, these status-sensitive local segregation measures coincide with the local segregation measures proposed by AV-DR. Second, if $w_j\neq w_h$ for some occupations j and h and $\frac{c_j^g}{C^g}=\frac{t_j}{T}$ $\forall j$, then $\Phi_s\left(c^g;t;s\right)\neq 0$. The reason of this is that these measures take into account not only the distribution of individuals across occupations but also salary dispersion across occupations. When a demographic group is distributed according to the occupational structure of the economy, these indexes depart from zero if there is heterogeneity in occupations' wages since they measure segregation respect to the distribution of salaries, $t_i w_i$. Therefore, these status-sensitive measures do not satisfy the following normalization property, focused on segregation alone:

Property 8. *Normalization*: $\Phi_s\left(c^g;t;s\right)=0$ if $\frac{c_j^g}{C^g}=\frac{t_j}{T}$ $\forall j$.

Consequently, given that the use of status-sensitive measure may lead to counterintuitive results when the employment distribution of a group across occupations is equal to that of total employment, some researchers may consider reasonable to restrict the set over which our indexes are defined as follows: $\tilde{D}=\bigcup_{J>1}\left\{\left(c^g;t;s\right)\in\mathbb{R}^J{}_+\times\mathbb{R}^J{}_{++}\times\mathbb{R}^J{}_{++}:c_j^g\leq t_j\forall j \text{ and } \frac{c_j^g}{C^g}\neq\frac{t_j}{T} \text{ for some } j\right\}$, so that $\Phi_s:\tilde{D}\subset D\to\mathbb{R}$. Within set $\tilde{D}$, our status-sensitive local segregation measures work more properly. Thus, the status-sensitive segregation of a demographic group increases with its concentration in a few occupations, this increase being larger, the lower the status of these occupations as compared with the rest.

These segregation measures are intended to complement, rather than substitute, local segregation measures previously proposed in the literature. They should be mainly used when one finds that the occupational distribution of a group departs from that of the economy as a whole since they will allow one to assess the extent of the segregation of that group by taking status into consideration. Thus, we can compare the performance of a group with those of the remaining groups according to the status of occupations in which each of them tend to concentrate. This allows identifying disparities among groups that standard segregation measures do not take into account. In any case, if we wanted to compare the status-sensitive segregation of groups who face different distributions of status across occupations—as in the case of comparisons among countries and comparisons across time—we should keep in mind that part of the observed differences can be a consequence of disparities in the occupation's status structure. Thus, a group concentrated in low-paid occupations will tend to have a higher status-sensitive segregation level, other things being equal, the higher the wage inequality of the economy to which the group belongs.

4. An illustration: Occupational segregation by race and ethnicity in the U.S.

To illustrate the usefulness of the above measures, we analyze occupational segregation by ethnicity/race in the U.S. paying special attention to the status of occupations.[8] The uneven distribution of a minority across occupations has important consequences on its individuals' well-being so long as the group concentrates in occupations with low wages and/or bad labor conditions. It seems therefore interesting to wonder not only which minorities experience higher segregation levels in the U.S. labor market, but also how the wage distribution across occupations affect each of them.

[8] Race/ethnicity disparities in the labor market may emerge from several sources. According to human capital theory, segregation arises from differences in skills among race/ethnic groups. Language and cultural differences are also likely to be a cause of segregation to the extent that minorities are newly arrived. Moreover, the job opportunities of newly arrived immigrants are likely to depend on migrant networks and the lack of legal status of many of them strongly determines their employment opportunities. Apart from these factors, the literature has also pointed to discriminatory practices regarding the types of jobs and promotions that minorities are offered.

The data used in this section come from the 2007 Public Use Microdata Sample (PUMS) files of the American Community Survey (ACS) conducted by the US Census Bureau. After selecting people who were employed, the sample includes 1,399,724 observations. In this survey, people are asked to choose the race or races with which they most closely identify and to answer whether they have or not Spanish/Hispanic/Latino origin. Based on this self-reported identity, we produce six mutually exclusive groups of workers composed by 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; American Indian, Alaskan, Hawaiian or Pacific Islander natives (referred here for simplicity as Native Americans); Hispanics; and other races (those non-Hispanics reporting some other race or more than one race). Occupations are considered at a 3-digit level of the Census recode classification, which includes 469 occupations based on the 2000 Standard Occupational Classification (SOC) System.

Using this survey, Alonso-Villar et al. (2012) analyzed the segregation patterns of these six ethnic/racial groups. They showed that Asians and Hispanics are the demographic groups with the highest segregation, while Native and African Americans have an intermediate position between the former and whites and workers of "other races." In order to assess the segregation of each target group by penalizing its concentration in low-paid occupations, we now use our status-sensitive local segregation measures. The segregation curves and the status-sensitive segregation curves for African Americans, Asians, and Hispanics are shown in Figure 1, and the corresponding indexes are given in Table 2.

LOCAL SEGREGATION: ETHNICITY/RACE	$\Phi^g_{0.1}$	$\Phi^g_{0.5}$	Φ^g_{1}	Φ^g_{2}	D^g	G^g
Hispanics	0.185	0.185	0.191	0.231	0.243	0.338
African Americans	0.145	0.139	0.136	0.147	0.209	0.289
Asians	0.264	0.247	0.260	0.371	0.264	0.377
STATUS-SENSITIVE LOCAL SEGREGATION: ETHNICITY/RACE	$\Phi^g_{s,\ 0.1}$	$\Phi^g_{s,\ 0.5}$	$\Phi^g_{s,\ 1}$	$\Phi^g_{s,\ 2}$	D^g_s	G^g_s
Hispanics	0.490	0.468	0.480	0.670	0.396	0.525
African Americans	0.388	0.363	0.359	0.436	0.345	0.464
Asians	0.268	0.249	0.260	0.398	0.278	0.383

Table 2. Local segregation indexes and status-sensitive local segregation indexes for the three largest minorities, and status-sensitive employment concentration indexes.

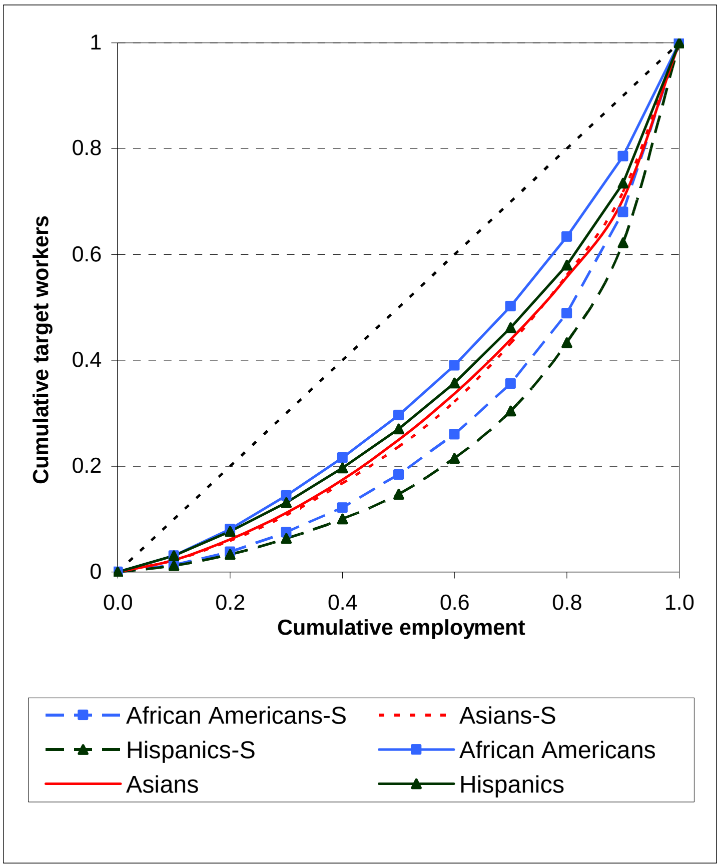

Figure 1. Segregation curves and status-sensitive segregation curves (-S) for the three largest minorities.

The analysis reveals that the segregation curves for African Americans and Hispanics do substantially change departing from the 45º-line when taking wages into account, while the curve for Asians remains almost unaltered. This indicates that as far as the status of occupations is considered, the performance of African Americans and Hispanics worsens with respect to that of Asians. Consequently, without considering the differences between the kinds of occupations in which each demographic group tends to work, one would conclude that Hispanics and Asians are rather similar in terms of segregation since their curves are rather close. However, despite their sharing a recent immigration profile and a high internal heterogeneity,[9] the performances of both groups clearly depart from each other when taking into account the status of occupations.[10] Thus, we find that the relative economic success of

[9] Hispanics includes relatively low-educated Puerto Ricans and Mexicans (some of the latter being undocumented) as well as Cubans, who enjoy higher education and support of the U.S.. Asians include Southeast Asians and Indians/Chinese.

[10] Hispanics tend to concentrate in the low-paid occupations to a larger extent than Asians while the latter are markedly bipolarized between some low-paid occupations (such as “miscellaneous personal appearance

advantaged Hispanics does not seem to offset the lower position of the disadvantaged, while the asymmetries between Asians do offset.

5. Conclusions

Segregation analyses have mainly focused on measuring the disparities among the occupational distributions of the demographic groups into which total population is partitioned (overall segregation). However, one might be interested not only in this matter but also in exploring the segregation of a target group (local segregation). In this context, the introduction of occupational status into the analysis becomes especially relevant, since the tendency of some demographic groups to concentrate in low pay/status jobs has an important impact on their well-being levels. The present paper has tackled this topic in a multigroup context by proposing an axiomatic framework in which to study the segregation of any population subgroup when taking into account the status of occupations (cardinally measured). This allows one to determine differences among demographic groups in terms of not only employment shares in each occupation but also status. In doing so, this paper has generalized the local segregation curves and indexes proposed by Alonso-Villar and Del Río (2010a).

Finally, the usefulness of these measures has been illustrated in our study of occupational segregation in the U.S., where these tools were used to analyze disparities in the distributive patterns of workers by race and ethnicity. We found that even though the segregation levels of Asians and Hispanics are rather similar and higher than that of African Americans, when taking into account the wages of the occupations in which each large minority tends to concentrate, the status-sensitive segregation of Hispanics and African Americans turns to be more severe than that of Asians.

workers," "tailors, dressmakers, and sewers," and "sewing machine operators") and highly-paid occupations linked to scientific, medical, and computer engineering jobs.

APPENDIX. *Proof of proposition 1*

First Implication

Assume that Φ_s satisfies properties 1-4 and consider distributions $\left(c^g;t;\frac{w}{\bar{w}}\right)$, $\left(c^{g}{}';t';\frac{w}{\bar{w}'}\right)\in D$, where $\bar{w}=\sum_j \frac{t_j}{T}w_j$ and $\bar{w}'=\sum_j \frac{t'_j}{T'}w_j$). In what follows, we first transform vector $\left(c^g;t;\frac{w}{\bar{w}}\right)$ into a fictitious "income" distribution whose Lorenz curve is equal to the segregation curve corresponding to $\left(c^g;t;\frac{w}{\bar{w}}\right)$, which allows us to use some well-known results from the literature on income distribution. Next, by following steps analogous to those followed by Foster (1985) in a context of income distribution, we multiply distributions $\left(c^g;t;\frac{w}{\bar{w}}\right)$ and $\left(c^{g}{}';t';\frac{w}{\bar{w}'}\right)$ by positive scalars in such a way that their corresponding fictitious distributions share the same dimension and mean, while keeping segregation unaltered.

It is easy to verify that the local segregation curve corresponding to $\left(c^g;t;\frac{w}{\bar{w}}\right)$ is equal to the Lorenz curve corresponding to fictitious distribution $\left(\underbrace{\frac{c_1^g}{t_1\frac{w_1}{\bar{w}}},\ldots,\frac{c_1^g}{t_1\frac{w_1}{\bar{w}}}}_{t_1\frac{w_1}{\bar{w}}},\ldots,\underbrace{\frac{c_J^g}{t_J\frac{w_J}{\bar{w}}},\ldots,\frac{c_J^g}{t_J\frac{w_J}{\bar{w}}}}_{t_J\frac{w_J}{\bar{w}}}\right)$. The same relationship can be established between $\left(Tc^{g}{}';Tt';\frac{w}{\bar{w}'}\right)$ and

$$y\equiv\left(\underbrace{\frac{Tc_1^{g}{}'}{Tt_1'\frac{w_1}{\bar{w}'}},\ldots,\frac{Tc_1^{g}{}'}{Tt_1'\frac{w_1}{\bar{w}'}}}_{Tt_1'\frac{w_1}{\bar{w}'}},\ldots,\underbrace{\frac{Tc_J^{g}{}'}{Tt_J'\frac{w_1}{\bar{w}'}},\ldots,\frac{Tc_J^{g}{}'}{Tt_J'\frac{w_1}{\bar{w}'}}}_{Tt_J'\frac{w_J}{\bar{w}'}}\right),$$

and between $\left(T'\frac{\frac{C^{g}{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\bar{w}}\right)$ and

$$z \equiv \left(\underbrace{T\frac{C^{g}\,'}{C^{g}}\frac{c_1^g}{T't_1\frac{w_1}{\overline{w}}},\ldots,T\frac{C^{g}\,'}{C^{g}}\frac{c_1^g}{T't_1\frac{w_1}{\overline{w}}}}_{T't_1\frac{w_1}{\overline{w}}},\ldots,\underbrace{T\frac{C^{g}\,'}{C^{g}}\frac{c_J^g}{T't_J\frac{w_J}{\overline{w}}},\ldots,T\frac{C^{g}\,'}{C^{g}}\frac{c_J^g}{T't_J\frac{w_J}{\overline{w}}}}_{T't_J\frac{w_J}{\overline{w}}} \right)$$. Note that y and z have the same number of "individuals" (TT') and "income" mean ($\frac{C^{g}\,'}{T'}$). Without loss of generality in what follows, we assume that $\frac{C^g}{T} > \frac{C^{g}\,'}{T'}$.

By using Lemma 2 proposed in Foster (1985), the Lorenz curves of the fictitious distributions corresponding to $\left(c^g; t; \frac{w}{\overline{w}}\right)$ and $\left(T'\frac{\frac{C^{g}\,'}{T'}}{\frac{C^g}{T}}c^g; T't; \frac{w}{\overline{w}}\right)$ coincide, since the latter is a (T' times) replication of the former multiplied by a positive scalar ($\frac{C^{g}\,'}{C^g}\frac{T}{T'}$). The same applies to distributions $\left(c^{g}\,'; t'; \frac{w}{\overline{w}'}\right)$ and $\left(Tc^{g}\,'; Tt'; \frac{w}{\overline{w}'}\right)$. Consequently, the local segregation curves of $\left(c^g; t; \frac{w}{\overline{w}}\right)$ and $\left(T'\frac{\frac{C^{g}\,'}{T'}}{\frac{C^g}{T}}c^g; T't; \frac{w}{\overline{w}}\right)$ coincide, and also the ones corresponding to $\left(c^{g}\,'; t'; \frac{w}{\overline{w}'}\right)$ and $\left(Tc^{g}\,'; Tt'; \frac{w}{\overline{w}'}\right)$ do.

Assuming that the local segregation curve of $\left(c^g; t; \frac{w}{\overline{w}}\right)$ dominates that of $\left(c^{g}\,'; t'; \frac{w}{\overline{w}'}\right)$ (i.e., the local segregation curve of the former is at no point below that of the latter), two cases can be distinguished:

a) The local segregation curve of $\left(c^g;t;\frac{w}{\overline{w}}\right)$ coincides with that of $\left(c^g{}';t';\frac{w}{\overline{w}'}\right)$.

Consequently, the local segregation curve of $\left(T'\frac{\frac{C^g{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\overline{w}}\right)$ coincides with that of $\left(Tc^g{}';Tt';\frac{w}{\overline{w}'}\right)$. By using Lemma 1 proposed in Foster (1985), it follows that the ordered distribution (from low to high values) corresponding to y, labeled $\hat{y}$, majorizes that of z, labeled $\hat{z}$, and vice versa.[11] In other words, distributions $\hat{y}$ and $\hat{z}$ are identical, which implies that $\Phi_s(z;e;s)=\Phi_s(y;e';s')$, where $e\equiv\left(\underbrace{\frac{\overline{w}}{w_1},\ldots,\frac{\overline{w}}{w_1}}_{Tt_1\frac{w_1}{\overline{w}}},\ldots,\underbrace{\frac{\overline{w}}{w_J},\ldots,\frac{\overline{w}}{w_J}}_{Tt_J\frac{w_J}{\overline{w}}}\right)$ and $s\equiv\left(\underbrace{\frac{w_1}{\overline{w}},\ldots,\frac{w_1}{\overline{w}}}_{Tt_1\frac{w_1}{\overline{w}}},\ldots,\underbrace{\frac{w_J}{\overline{w}},\ldots,\frac{w_J}{\overline{w}}}_{Tt_J\frac{w_J}{\overline{w}}}\right)$. Note that, on one hand, Φ_s satisfies the properties of symmetry, insensitivity to proportional subdivisions, and scale invariance, which implies that $\Phi_s(y;e';s')=\Phi_s\left(Tc^g{}';Tt';\frac{w}{\overline{w}'}\right)$ and $\Phi_s(z;e;s)=\Phi_s\left(T'\frac{\frac{C^g{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\overline{w}}\right)$. On the other hand, by using the scale invariance property, $\Phi_s\left(Tc^g{}';Tt';\frac{w}{\overline{w}'}\right)=\Phi_s\left(c^g{}';t';\frac{w}{\overline{w}'}\right)$ and $\Phi_s\left(T'\frac{\frac{C^g{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\overline{w}}\right)=\Phi_s\left(c^g;t;\frac{w}{\overline{w}}\right)$ (since $\frac{C^g}{T}>\frac{C^g{}'}{T'}$). Consequently, $\Phi_s\left(c^g;t;\frac{w}{\overline{w}}\right)=\Phi_s\left(c^g{}';t';\frac{w}{\overline{w}'}\right)$.

[11] Given two income distributions with the same dimension and ranked in ascending order, one is said to majorize the other if and only if both distributions have the same total income, and the cumulative income level of the former, up to next to last individual, is lower than that of the latter.

b) The local segregation curve of $\left(c^g;t;\frac{w}{\bar{w}}\right)$ is at no point below that of $\left(c^{g}{}';t';\frac{w}{\bar{w}'}\right)$ and at some above. By following analogous steps to those in case a), it follows that the local segregation curve of distribution $\left(T'\frac{\frac{C^{g}{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\bar{w}}\right)$ also dominates that of $\left(Tc^{g}{}';Tt';\frac{w}{\bar{w}'}\right)$, which implies, by Lemma 3 in Foster (1985), that $\hat{y}$ is obtained from $\hat{z}$ by a finite sequence of regressive transfers. Therefore, since Φ_s satisfies the property of symmetry and that of movement between locations, $\Phi_s(y;e';s') > \Phi_s(z;e;s)$. In addition, the properties of insensitivity to proportional subdivisions of locations and scale invariance mean that $\Phi_s(y;e';s') = \Phi_s\left(Tc^{g}{}';Tt';\frac{w}{\bar{w}'}\right) = \Phi_s\left(c^{g}{}';t';\frac{w}{\bar{w}'}\right)$ and $\Phi_s(z;e;s) = \Phi_s\left(T'\frac{\frac{C^{g}{}'}{T'}}{\frac{C^g}{T}}c^g;T't;\frac{w}{\bar{w}}\right) = \Phi_s\left(c^g;t;\frac{w}{\bar{w}}\right)$. Therefore, $\Phi_s\left(c^{g}{}';t';\frac{w}{\bar{w}'}\right) > \Phi_s\left(c^g;t;\frac{w}{\bar{w}}\right)$.

Second Implication

Assume now that Φ_s is consistent with the local segregation criterion. As mentioned above, the local segregation curve corresponding to distribution $\left(c^g;t;\frac{w}{\bar{w}}\right)$ coincides with the Lorenz curve of the corresponding fictitious distribution

$$\left(\underbrace{\frac{c_1^g}{t_1\frac{w_1}{\bar{w}}},\ldots,\frac{c_1^g}{t_1\frac{w_1}{\bar{w}}}}_{t_1\frac{w_1}{\bar{w}}},\ldots,\underbrace{\frac{c_J^g}{t_J\frac{w_J}{\bar{w}}},\ldots,\frac{c_J^g}{t_J\frac{w_J}{\bar{w}}}}_{t_J\frac{w_J}{\bar{w}}}\right).$$

Therefore, when comparing two occupational distributions, there is consistency between the conclusions reached by using the local segregation curves and those attained with the Lorenz curves of the fictitious distributions. In what follows, we show that index Φ_s satisfies the four basic properties.

a) Φ_s satisfies scale invariance, since the Lorenz curve of the fictitious distribution $\left(\underbrace{\frac{\alpha c_1^g}{\beta t_1 \frac{w_1}{\overline{w}}},\ldots,\frac{\alpha c_1^g}{\beta t_1 \frac{w_1}{\overline{w}}}}_{\beta t_1 \frac{w_1}{\overline{w}}},\ldots,\underbrace{\frac{\alpha c_J^g}{\beta t_J \frac{w_J}{\overline{w}}},\ldots,\frac{\alpha c_J^g}{\beta t_J \frac{w_J}{\overline{w}}}}_{\beta t_J \frac{w_J}{\overline{w}}} \right)$ coincides with that of $\left(\underbrace{\frac{c_1^g}{t_1 \frac{w_1}{\overline{w}}},\ldots,\frac{c_1^g}{t_1 \frac{w_1}{\overline{w}}}}_{t_1 \frac{w_1}{\overline{w}}},\ldots,\underbrace{\frac{c_J^g}{t_J \frac{w_J}{\overline{w}}},\ldots,\frac{c_J^g}{t_J \frac{w_J}{\overline{w}}}}_{t_J \frac{w_J}{\overline{w}}} \right)$.

b) Φ_s satisfies symmetry, since "individuals" of the fictitious distribution play symmetric roles in the Lorenz curves.

c) Φ_s satisfies insensitivity to proportional subdivisions because when an occupation j is subdivided into two occupations (j' and j'') such that $c_{j'}^g = c_{j''}^g = \frac{c_j^g}{2}$ and $t_{j'} = t_{j''} = \frac{t_j}{2}$, the Lorenz curve of the fictitious distribution does not change.

d) Φ_s satisfies the property of sensitivity to disequalizing movements between organizational units, since any movement from occupation i to h of the types mentioned in property 4 leads to a sequence of regressive transfers in the fictitious distribution, which results in an increase in inequality according to the Lorenz criterion. As a consequence, the local segregation index Φ_s also increases.[12]

□

[12] Note that Φ_s also satisfies the property of sensitivity to disequalizing movements between organizational units with different status since a movement of target individuals from occupation *i* to *k* involves a sequence of transfers in the fictitious distribution that are more regressive than those corresponding to the movement between occupations *i* and *h* (observe that $\frac{c_i^g / C^g}{t_i \frac{w_i}{\overline{w}}} < \frac{c_h^g / C^g}{t_h \frac{w_h}{\overline{w}}} < \frac{c_k^g / C^g}{t_k \frac{w_k}{\overline{w}}}$).

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