A physicist’s view of the notion of “racism”

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Abstract  It is not uncommon (e.g. in the media) that specific groups are categorized as being racist. Based on an extensive dataset of intermarriage statistics our study questions the legitimacy of such characterizations. It suggests that, far from being group-dependent, segregation mechanisms are instead situation-dependent. More precisely, the degree of integration of a minority in terms of the frequency of intermarriage is seen to crucially depend upon the the proportion $p$ of the minority. Thus, a population may have a segregative behavior with respect to a high-$p$ ($p > 20\%$) minority $A$ and at the same time a tolerant attitude toward a low-$p$ ($p < 2\%$) minority $B$. This remains true even when $A$ and $B$ represent the same minority; for instance Black-White intermarriage is much more frequent in Montana than it is in South Carolina. In short, the nature of minority groups is largely irrelevant, the key factor being their proportion in a given area.

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1 Introduction

In the *New York Times* of 24 February 1980 one reads the following title “Swedes discover their dark side: racism”. This is by no means an isolated example; the medias frequently apply the terms “racism” or “racist” to populations or peoples. Over the period 1971-2005 *New York Times* articles featuring these words appeared with a frequency of 57 articles per year. For a scientist this raises the question of how these notions can be defined objectively and whether it is legitimate to apply them to groups of people or even to whole nations as in the example above. Naturally, it is well known that there is no scientific definition whatsoever of the concept of race, but one can rely on the self-identification definition used in U.S. censuses. Through that procedure one can define (at least for statistical purposes) populations and groups composed of “Whites”[^1], “Blacks” (or “Afro-Americans”), “American-Indians” and so on. A commonly held belief is that American states belonging to the Deep South (Alabama, Louisiana, Mississippi, etc.) are more “racist” than northern states. Can such a claim be supported by quantitative evidence in a way which is consistent with the *ceteris paribus* (i.e. “all other things being equal”) requirement? Econophysics was founded on the claim that ideas from physics can help us understand social phenomena. This paper hopes to be an illustration of this claim.

In the social science literature the question of segregation is most often considered from an anthropomorphic perspective, by which we mean that most studies single out specific populations and rely on factors such as religion, socioeconomic status, dating circumstances and so on (Clark-Ibanez et al. 2004, Houston et al. 2004, Kalminjn 1998, Pagnini et al. 1990, Tatum 1997). In contrast, from a physicist’s perspective the interaction between ethnic groups is naturally seen as a case of forming bonds between two types of units, a point of view which naturally leads to comparative investigations. It is fair to say that the comparative perspective was also adopted by some sociologists such as Blau et al. (1984), Duncan et al. (1959), Lieberson et al. (1959), although it was not developed in a systematic way.

To summarize the gist of our argument by a quick example let us consider the case of Louisiana. This

[^1]: Throughout this paper, “White” (W) means “White non Hispanic”.
The state belongs to the Deep South belt which until the mid-1960s had a well established tradition of segregation; moreover the Katrina disaster of 2005 revealed that inter-ethnic tension between Blacks and Whites is just beneath the surface. Apart from its substantial Black minority, Louisiana also has a small minority of American Indians. But whereas it has one of the smallest proportions\(^2\) of Black-White (B-W) couples among all US states, it has one of the largest proportions of American Indian - White (I-W) couples. This example suggests that speaking of Louisiana Whites as being a group prone to segregationist attitudes without further qualification is not consistent with observation. The low rate of B-W intermarriage in Louisiana is mainly brought about by the fact that Blacks represent a proportion of 32% in the total population, whereas the proportion of American Indians is only 0.56%. Naturally, this effect is by no means specific to the United States. Back in 1893, people of Italian descent made up 17% of the population of Marseilles in the south of France and it can be recalled that on 16-17 August serious clashes between French and Italian workers near Aigues-Mortes resulted in the death of 18 people\(^3\).

There are several ways of defining ethnic segregation/integration quantitatively, namely: (i) Residential integration (ii) School integration (iii) Marriage integration (iv) Economic integration. The first two criteria are closely related for the obvious reason that residential segregation at block or county level results in \textit{de facto} school segregation simply because pupils attend school in the area in which they live. Residential segregation has been measured by several sociologists\(^4\) while the second and third criteria have been less studied. In the present paper, we use the criterion of marriage integration. The conclusions drawn from this criterion are to a large extent consistent with results based on residential segregation and school integration (more on this below). One advantage of the inter-marriage criterion is that one would expect it to be less dependent on economic conditions than the residential criterion because it seems possible for two persons to meet one another (and possibly to get married) even if they live in segregated areas; workplaces, dance halls, stadiums, holiday resorts provide contact opportunities which to some extent are independent of housing location (see Houston et al. 2005).

The fourth criterion would lead us to consider segregation in the jobmarket and workforce. As census

\(^2\)In a normalized sense which will be explained below.

\(^3\)More details can be found in Roehner 2004, p. 197-198.

\(^4\)See for instance: Sorensen et al. (1975), Lieberson (1980), and Iceland et al. (2002).
data contain much information on occupations they would allow us to carry out such an investigation but we will leave it to a subsequent paper.

The paper is organized as follows. First we explain the methodology and test it on what we call a “null-experiment”. Then we describe our results for ethnically-mixed couples.

2 Methodology

Individual microdata from American censuses are available online on the website of the Minnesota Population Center. Fifteen federal censuses ranging from 1850 to 2000 are accessible through 1% samples; in addition, 5% samples are available for some years. Once the data have been selected, we count the number of ethnically-mixed couples in each state. For instance, using an unweighted random 1% sample of the 2000 census we find 3,400 Black-White couples in Alabama and 400 in New Hampshire. These counts include married couples (identification code 0201) as well as unmarried male-female partners (identification code 1114). To be compared in a meaningful way, these numbers must be normalized in two ways.

- A first natural normalization is to compute the number of mixed couples with respect to total number of married couples. In 2000 Alabama and New Hampshire had 0.906 million and 0.262 million married couples respectively. Thus, one obtains proportions of 3,753 and 1,527 B-W couples per million couples respectively. However, this comparison is still meaningless because it fails to take into account the respective numbers of Black people in each state, namely 259,000 in Alabama versus 7,300 in New Hampshire. To take this difference into account we need a second normalization.

- Let us denote by \( p \) the proportion of a minority \( B \) in a population \( A \). Then, it can be shown by a combinatorial argument that if male-female pairs are formed randomly in a population of size \( n \) the expected proportion of mixed couples (for large \( n \)) is:

\[
e_{A-B} = 2p(1-p)
\]
It can be noticed that if \( p = 0.5 \) formula (1) gives \( e_{A-B} = 0.5 \) as expected. The case \( p \ll 1 \) which corresponds to a small population immersed in a much larger population is of special interest because it corresponds to most of the minorities to be found in the United States (American Indians, Chinese, Japanese); in this case, (1) leads to \( e_{A-B} \simeq 2p \). Two crucial assumptions are made in the derivation of (1): (i) selection of husband and wife occurs randomly which means in particular that it is not subject to any distance limitation; in other words the probability of a marriage is the same whether both people live in southern California or in different parts of California. (ii) there are no institutional or social restrictions in the pairing of \( A \) and \( B \) people. In real life, these assumptions are usually not fulfilled. Indeed, because of housing segregation, the vicinity of \( B \) individuals comprises a proportion of \( B \) people which may be much larger than the proportion in the total population. Secondly, even once \( A-B \) contacts have been established, marriage may not follow due to the “barrier” of social conventions. As a result of these restrictions, actual rates of mixed couples show a discrepancy with respect to the rate given by (1) and the magnitude of this discrepancy can serve to measure the lack of integration. In short, the rationale of our normalization procedure is that equation (1) will be used not as a model but as a yardstick.

The normalization procedure can be summarized through the following formula giving the normalized frequency \( f_{A-B}(S) \) of \( A-B \) couples in state \( S \):

\[
f_{A-B}(S) = \frac{c_{A-B}}{C} \cdot \frac{1}{2p(1-p)}
\]  

(2)

where \( c_{A-B} \) = number of mixed couples living in state \( S \), \( C \) = number of married couples living in state \( S \) and \( p \) = proportion of the minority \( B \) in the total population of state \( S \). \( f_{A-B}(S) \) defines a propensity for integration through marriage. For the sake of brevity, we subsequently refer to it as a marriage integration index and express it in percent. In a perfectly integrated society \( f_{A-B} \) would be equal to 100\%, as illustrated by the case of people born in California considered below. In a society with a strong propensity for endogamy, \( f_{A-B} \) will be much smaller; on the contrary, in a society with a strong inclination for exogamy, \( f_{A-B} \) will be larger than 100%.

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Returning to our previous example and noting that in Alabama, \( p = 26\% \) whereas in New Hampshire \( p = 0.73\% \) one gets expected proportions \( e_{W-B} = 38\% \) and \( e_{W-B} = 1.4\% \) respectively. Thus, the B-W marriage integration indexes are \( f_{W-B}(\text{Alabama}) = 0.37/38 = 0.010 \) and \( f_{W-B}(\text{New Hampshire}) = 0.15/1.4 = 0.11 \), an integration index that is about 10 times larger than in Alabama.

**Null experiment**  
Before giving complete results for all 50 states we wish to test the normalization procedure through a “null-experiment”, by which we mean a test-observation of a situation in which one does not expect any segregation effect. To this end, we consider the minority formed in all states (except California) by the people who were born in California. In addition, in order to eliminate all effects that may be related to ethnicity we restrict the sample to White non Hispanic people. In this experiment we count as mixed couples any couple in which only one of the spouses is born in California. The results are summarized in Fig. 1. The graph suggest two comments: (i) For most of the states, the frequency of mixed couples is close to 100\% which is in conformity with randomly formed pairs. (ii) As expected on account of the lack of ethnic identification, the slope of the regression line is consistent with a zero value, \( a = -0.032 \pm 0.04 \).

## 3 Inter-marriage

We now repeat the previous procedure for ethnically mixed couples. Fig. 2a corresponds to the case of Black-White (B-W) couples; it shows that the frequency of mixed couples is at least 10 times smaller than in Fig. 1. The frequency of B-W couples has tripled in the period 1970-2000 but it still remains at a low level. In addition, there is a marked negative slope \( a = -0.62 \pm 0.09 \). The pattern for American Indian - White (I-W) couples is similar but the frequency is about 4 times higher and the slope about one half of the previous one: \( a = -0.36 \pm 0.12 \), see Fig. 2b.

The most interesting observation is the fact that the states of the Deep South (e.g. Alabama, Arkansas, Louisiana, South Carolina) which have low B-W frequencies are at top frequency levels in Fig. 2b.

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8This state was selected because it has the largest population, but similar tests carried out for New York State and Illinois led to comparable results.
Fig. 1: Normalized frequency of couples (born in Cal.) – (not born in Cal.), 2000 Census. Horizontal scale: percentage of residents of the state who were born in California (thereafter called the minority). Vertical scale: frequency of couples in which one of the partners (not both) belongs to the minority; this frequency has been normalized with respect to the number of married couples in the state and with respect to the importance of the minority (details can be found in the text in the paragraph about the definition of the marriage integration index). Each label refers to one of the states plus Washington, DC (California has been excluded). The sample has been restricted to White non Hispanic people. This is a situation in which one does not expect any ethnic segregation effect in other words one expects an horizontal scatter plot at a level close to 100%, which is indeed what is observed. The slope of the linear regression is 0.032 ± 0.04. Similar results hold for couples in which one of the partners is born in Illinois or in New York State. Source: The data are from a 1%, random sample of the 2000 Census, available online on the website of the Minnesota Population Center.

Similarly, states such as Arizona, Montana or South Dakota have low I-W frequencies but high B-W frequencies. In addition states such as New Hampshire or Vermont which do not have any substantial ethnic minority whatsoever are at the top of the scatter plots in both graphs.

The observation that low minority percentages are associated with higher integration levels can be made for other minorities as well. Let us give some examples.

- Alabama, Arkansas and Florida have small percentages ($p_J < 0.1\%$) of Japanese Americans and some of the highest frequencies of Japanese Americans - White (J-W) couples. In contrast,
Hawaii has both the highest percentage of ethnic Japanese ($p_J \approx 10\%$) and the lowest frequency of J-W couples; there is a ratio of about 10 between the frequencies in Florida and Hawaii.

- The frequency of mixed Hispanic - non Hispanic couples is about three times higher in Louisiana ($p_{Hisp} \approx 2\%$) than in Texas or California ($p_{Hisp} \approx 20\%$).

### 4 Other integration characterizations

#### 4.1 Alternative criterion

The previous observations can be confirmed by using an alternative criterion which does not require a renormalization procedure (at least for small $p$). We gauge the exogamous versus endogamous...
**Fig. 2b: Normalized frequency of American-Indian – White couples, 2000 Census.** Horizontal scale: percentage of the American Indian population with respect to total state population. It can be seen that Georgia and South Carolina (circled) which had a small mixed couple frequency in Fig. 2a have a high frequency here, whereas Montana and South Dakota (squares) which had a high frequency in Fig. 2a have a low one here due to their substantial proportion of American Indians. Vermont and New Hampshire (diamonds) which have only few minority residents of both kinds have a high frequency in both graphs. Similar conclusions can be drawn as well from the data for other states. The correlation is $-0.66$ (confidence interval for probability $0.95$ is $-0.79$ to $-0.47$); the slope of the regression line is $-0.36 \pm 0.12$. *Source: The data are taken from an unweighted 1%, sample of the 2000 Census.*

character of a minority by the ratio:

$$\Gamma_A = \frac{\text{Number of exogamous couples } A-X}{\text{Number of endogamous couples } A-A}$$

The notation $X$ instead of $B$ (as above) refers to the fact that in this definition *all* exogamous couples of $A$ with any other group are summed up in the numerator. Typical orders of magnitude of $\Gamma$ are given in Table 1.

It shows that:

$$\Gamma_{\text{Am.Ind.}}(\text{Low proportion of minority}) = 6.4 \Gamma_{\text{Am.Ind.}}(\text{High proportion of minority})$$
Table 1 Variation of the exogenous/endogenous ratio with respect to minority percentage

|                | Black % | Γ_Black | Am. Ind. % | Γ_Am. Ind. |
|----------------|---------|---------|------------|------------|
| Montana+South Dakota | 0.41    | 1.2     | 7.2        | 0.79       |
| Georgia+South Carolina | 29   | 0.010   | 0.28       | 5.1        |
| Vermont         | 0.49    | 1.0     | 0.34       | 7.0        |

Notes: A large Γ indicates a high degree of integration whereas a Γ close to zero suggests a high level of segregation. For each minority the first column gives its population percentage. The first two lines correspond to two contrasting situations in term of minority proportion; Montana+South Dakota (these states have been lumped together to increase the number of marriages) has a sizable proportion of American Indians whereas Georgia+South Carolina has a substantial Black population. In the case of Vermont both minorities have a small percentage. The table suggests that integration decreases when the population percentage of the minority increases. It is particularly striking that the integration of the Black populations in Montana+South Dakota and in Vermont is higher than the integration of American Indians in Montana+South Dakota because usually the integration of the Afro-American population is fairly low due to a long historical legacy of segregation.

Source: The data are from a 5% random sample of the 1980 Census.

\[ Γ_{\text{Black}}(\text{Low proportion of minority}) = 118 Γ_{\text{Black}}(\text{High proportion of minority}) \]

Note that the factors 6.4 and 118 cannot be really compared because what we call a “high proportion” is not the same in the two cases: for American Indians “high” means 7.2%, whereas for Blacks it means 29%. In addition there may be reinforcing and cumulating effects due to high proportions persisting over long periods of time; this historical aspect we leave for a subsequent study.

4.2 Residential segregation

At the beginning of the paper we said that our findings are consistent with observations based on residential segregation. Let us shortly illustrate this statement by a few examples based on a study published by the Bureau of the Census (Iceland et al. 2002):

- The most segregated Metropolitan Area for Blacks in 2000 was Milwaukee-Waukesha in Wisconsin (segregation index \( \delta = 0.89 \)) and it had a Black population percentage of \( p = 25\% \); the least segregated Metropolitan Area for Blacks was Orange county in California (\( \delta = 0.52 \)) with a Black population representing \( p = 2.0\% \).
- For Asians and Pacific Islanders the most segregated Metropolitan Area was San Francisco (California): \( \delta = 0.83 \), \( p = 33\% \) whereas the least segregated was the Nassau-Suffolk area (New York, New Jersey).
4.3 School integration

The third characterization of ethnic integration that we mentioned is school integration. In the late 1950s and early 1960s the *New York Times* published annual maps showing the (fairly slow) progress of school integration. For instance the map published on 12 May 1963 shows that the percentage of Black pupils who were in class with Whites was close to zero (< 0.6%) in 7 states of the Deep South (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, South Carolina); moreover, for the 16 Southern states for which the *New York Times* gives data there is a significant correlation ($r = 0.82$) between the lack of school integration and the proportion of the Black population.

4.4 Hate crimes

Is racial violence in the form of what the Federal Bureau of Investigation calls hate crimes directed against minority members also increasing with the minority’s proportion? As hate crimes are a form of rejection one would expect that their frequency decreases for any given minority as this minority becomes better integrated. Such a relaxation process suggests that the historical background is of importance. That is why we restrict our comparison to two communities which have been present in the United States at least since the end of the War of Independence, namely Blacks and American Indians. In 2000 there were 104 hate crimes against Blacks per million of their population as compared to a rate of 27 against American Indians\(^{10}\). These figures are consistent with our previous finding that marriage integration is substantially higher for American Indians.

5 Conclusion

Using an analysis based on the number of intermarriages in the United States we have seen that the proportion of minorities in the total population is a key parameter in order to understand segregation patterns. In the light of this finding the title of the *New York Times* article mentioned in the introduction can now be reinterpreted. Did Swedes really reveal a facet of their nature which had not been apparent so far? One should recall that prior to 1980 there were almost no sizable ethnic minorities in Sweden;\(^{10}\) Statistical Abstract of the United States 2000, p. 188.
even in 2006 they represented less than 5% of the population. Thus, Sweden was in a situation similar to New Hampshire or Vermont where tolerance is a natural consequence of small values of \( p \). As \( p \) increased, Sweden faced the kind of situations experienced by U.S. states with comparable \( p \) values in Fig. 2a,b. Thus, it is not surprising to see that Swedes reacted more or less in the same way as residents of those states.

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