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The Great Recession and U.S. partial discrimination orderings by race

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Abstract

We gauge the impact of the Great Recession on racial and ethnic subgroups by applying a stochastic dominance method proposed by Le Breton *et al.* (2012). The method generates a partial discrimination ordering, or alternatively, a measure of the economic advantage for one subgroup relative to another. We apply the method to Current Population Survey data for 2006 through 2012, covering the recession years and the beginning of the recovery, and construct a comprehensive income measure that includes in-kind transfers and taxes. We find statistically significant differences in the impact of the Great Recession at the lower tails of the income distributions for blacks and Hispanics.

Keywords: Great Recession, income distribution, discrimination, economic advantage, stochastic dominance

JEL Classification Codes: D31, D63, E30

1. Introduction

The Great Recession (GR) of 2007-09 delivered powerful shocks to labor and capital incomes and elicited policy responses that altered government taxes and transfers. Hence, the GR directly or indirectly shifted the income distribution in many ways. Given differences in human capital,

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other assets, transfer eligibility, and tax burdens across population subgroups defined by race, we expect the net impact of the GR to vary by subgroup.[1]

To measure the impacts we use a stochastic dominance method that Le Breton *et al.* (2012) proposed for constructing partial discrimination orderings and apply it to data from the Current Population Survey (CPS) for 2006-2012. The orderings are derived from discrimination curves, or interdistributional Lorenz curves (Bishop *et al.*, 2010) capturing economic advantage, which involve *pairs* of income distributions for minority and reference groups. We construct the discrimination curves for African-Americans and Hispanics relative to whites and to each other in 2006, 2009, and 2012, looking for changes in discrimination (disadvantage) over time.

We make the comparisons using an income measure that includes cash income and transfers, various in-kind transfers, net of taxes, but we do not include either in-kind transfers in the form of government-provided health insurance or accrued capital gains for reasons explained below. Still, the income measure is quite comprehensive and it allows us to capture many effects of the GR. Section 2 shows how we construct discrimination curves and test for discrimination or economic advantage. Section 3 explains more fully the choice of income measure, income sharing unit, and equivalence scale. Section 4 presents the empirical results, revealing the impact of the GR on racial discrimination curves. Section 5 gives our conclusions.

2. Methods

We compare income (m) distributions for population subgroups represented by two cumulative distribution functions,[2] $F_c(m) = \int_0^m f_c(y)dy$ and $F_r(m) = \int_0^m f_r(y)dy$ such that $F_c(z) = F_r(z) = 1$ for some $z < \infty$, where c is the comparison group and r is a reference group. We illustrate these functions on the left side of Figure 1. Le Breton *et al*. (2012) have defined a first-order discrimination curve (FDC), $\Gamma^1(t) = F_r[F_c^{-1}(t)]$, shown on the right side of Figure 1. It is clear from Figure 1 that FDC dominance is equivalent to first-order stochastic dominance, because $\Gamma^1(t) \leq t$ for all $t \in [0,1]$ is equivalent to $F_c(m) - F_r(m) \geq 0$ for all $m \in [0, z]$.

Earlier, Butler and McDonald (1987) had defined interdistributional Lorenz curves (ILCs) in terms of the normalized partial moments $\varphi_c(m;k) = [\int_0^m y^k f_c(y)dy]/E(y^k)$ and $\varphi_r(m;k)$ of the two distributions. Their first ILC sets $k = 0$, yielding $\varphi_c(m;0) = F_c(m)$ and $\varphi_r(m;0) = F_r(m)$. Then we can write $\Gamma^1(t) = \varphi_r[\varphi_c^{-1}(t;0);0]$. In either formulation, $\Gamma^1(t)$ associates with any proportion t of the comparison subgroup (with incomes less than or equal to m) the corresponding proportion $\Gamma^1(t)$ of the reference subgroup with incomes less than or equal to m. Deutsch and Silber (1999) interpret $\Gamma^1(t) < t$ as an economic advantage for the reference subgroup. Unlike Lorenz curves, ILCs could intersect the line of equality, $\Gamma^1(t) = t$. For the quantiles where $\Gamma^1(t) \geq t$, the comparison group faces no discrimination (disadvantage).

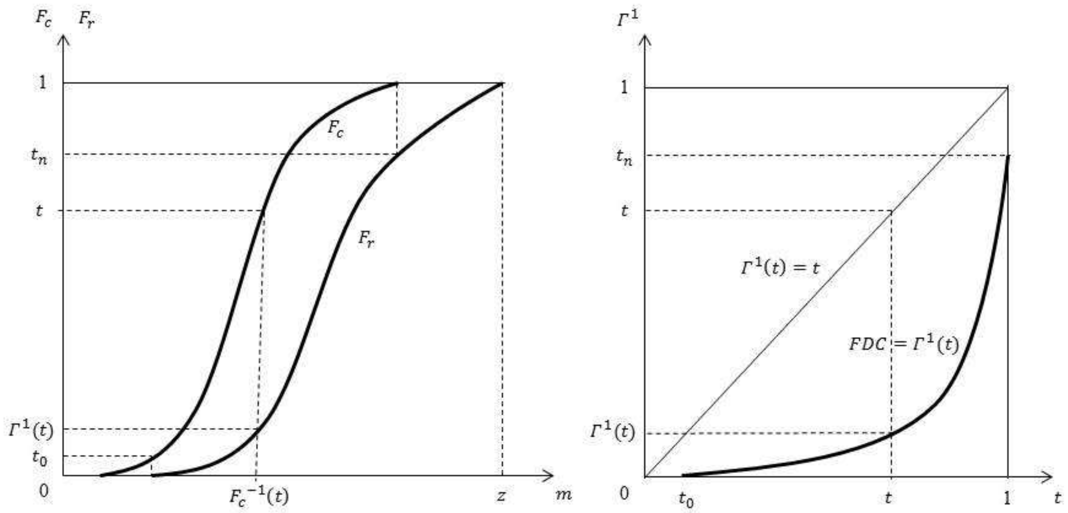
For convenience in implementation, we pool all subgroup incomes and set t at pre-selected percentiles of the pooled distribution, ranging from 0.05 to 0.95. We then decompose the pooled distribution, first by subgroup and then by year, to obtain the information needed to plot the FDC (ILC). Note from Figure 1 that the difference between the FDC (ILC) and the 45-degree line,

[1] Larrimore *et al.* (2013) shows that the impacts of the GR and the tax and transfer policy responses to it differ from previous recessions, and also vary across the distribution of incomes. On the latter issue, see also Thompson and Smeeding (2013).

[2] The cumulative distribution function of a random variable Y can be defined more generally as $F(y) = P(Y \leq y)$, where Y can be either continuous or discrete. In the latter case, $F(y)$ is a step function of y.

$t - \Gamma^1(t)$, is equivalent to $F_c(m) - F_r(m)$, where m is the income corresponding to the population share t. Thus, to check for FDC dominance, we can test whether $F_c(m) - F_r(m)$ differs significantly from zero at each income (m) corresponding to the preselected percentiles t in the pooled distribution. To check for changes in FDCs (ILCs) over time, we test whether, say, $[F_c^{06}(m) - F_r^{06}(m)] - [F_c^{09}(m) - F_r^{09}(m)]$ differs significantly from zero. Positive differences imply *convergence* between the distributions, while negative differences imply *divergence*. For all these tests, Bishop *et al.* (2010) provides the necessary inference procedures.

Figure 1
Construction of First-Order Discrimination Curve (FDC)



3. Data

The choice of income measure is an important step in analyzing changes in the distribution of U.S. incomes. Armour *et al.* (2013, 173) have recently demonstrated that this choice can "profoundly impact observed levels and trends in 'income' and its distribution." As they emphasize, an ideal income measure would conform to the Haig-Simons income definition – consumption plus the change in net wealth in that year. Yet both components include parts that are difficult to value (in-kind benefits, such as Medicare, Medicaid, food stamps, school lunches, housing subsidies, and employer-provided health insurance) or measure (accrued capital gains in stocks, bonds, and homes). The available methods for valuing Medicare and Medicaid and for measuring accrued but not yet realized capital gains involve strong assumptions, and their inclusion can shift the income distribution sharply, so they could be contentious.

In this study, which focuses on *changes* in discrimination (economic advantage) over time, we can sidestep some contentious issues. Medicare and Medicaid policies changed little over the years considered, so their omission washes out. The accrued capital gains (and losses), however, can vary widely over time, and did so over the period we examine (2006-2012). From a theoretical perspective, the accrued capital gains fit the Haig-Simons income definition but the available survey data for stock and bond holdings and home values are rather limited, requiring researchers (e.g., Armour *et al.,* 2013) to make very broad generalizations to develop useable measures. In this short paper, we do not tackle this issue, but it could be a topic for future research.

After these omissions, our comprehensive income measure includes Census money income [wages and salaries, self-employment income, dividends, rent, interest, cash transfers (e.g., Social Security, Unemployment Insurance), and other cash income] *plus* the market value of food stamps, the market values of housing, energy, and school lunch subsidies, the implicit return on home equity, and the earned income tax credit *minus* federal and state income taxes, payroll taxes, and property taxes. Together with the adjustment for household size described below, this income measure is similar to column 3 of Table 1 in Armour *et al.* (2013, 176), called "household size-adjusted posttax, posttransfer income plus in-kind income."

After determining what counts as income and how to value it, we must determine the income sharing unit (ISU) – the individuals who share income to meet their consumption needs. The two main possibilities are families and households. The social trends in recent decades have created more complex family structures (cohabitation, blended families, etc.), making patterns of income sharing more complex. Thus, following other researchers we use households as the ISU. We adjust income for economies of scale in household consumption by defining $m = x/(n^{\alpha})$ as equivalent income, where x represents the household income, n is the total number of persons in the household, and $0 < \alpha < 1$ reflects economies of scale in household consumption. Raising α reduces economies of scale, which vanish at $\alpha = 1$. We select the widely used square-root rule, $\alpha = 0.5$, but check the sensitivity of our results to that choice. We assign the equivalent income (m) to each household member; therefore, our unit of analysis is the individual. Recent work by Bishop *et al.* (2014) finds similar marginal costs for adults and children in the household, so we make no distinction between them.

4. Results

As noted above, we use a comprehensive income measure, including some in-kind transfers and imputed rent, and deducting income, payroll, and property taxes, and adopt the square root of household size as the equivalence scale. In Table 1 we present mean equivalent household income by race and ethnic group. Incomes for whites were \$10,000–\$12,000 higher than for blacks or Hispanics, on average. The incomes of the latter groups were similar in 2006, but diverged thereafter, with black household incomes declining by 1.9 percent (less than whites) and Hispanic household incomes falling by 3.5 percent (more than whites).

Comparisons at mean incomes for blacks and Hispanics, however, mask important differences in the underlying income distributions. To reveal these differences, Table 2 shows the cumulative income distribution functions for each of the groups. We first pool the incomes for all the groups across all the years (in constant dollars) and then decompose the distributions by race or ethnic group at each of the income percentiles of the pooled distribution in column 1. Columns 2–4 give the *cumulative* percentages of whites, blacks, and Hispanics with incomes at or below each percentile. Looking at the first row, 3.2 percent of white households, 9.5 percent of black households, and 7.2 percent of Hispanic households are at or below the 5th percentile in the pooled income distribution. We test whether such differences are statistically significant in columns 5-7, and find significant differences between all groups. For blacks and Hispanics, the differences are *positive* at or below the 25th percentile (implying that blacks are overrepresented relative to Hispanics at the bottom of the income distribution) and *negative* at both the 50th and 75th percentiles (implying that Hispanics are overrepresented relative to blacks there). These findings show that the black-Hispanic FDC (ILC) crosses the 45-degree line.

As expected, whites have smaller cumulative subgroup percentages than blacks or Hispanics at every income percentile in Table 2. This finding implies first-order stochastic dominance of blacks and Hispanics by whites, and therefore FDC (or ILC) dominance as well, which means that blacks and Hispanics are discriminated against (or disadvantaged) relative to whites. Here the comparisons at the means of the distributions are *not* misleading, unlike the case of blacks and Hispanics.

Table 1. Equivalent real household income by race and ethnic group*

Group	**2006**	**2009**	**2012**
Whites	$39,248	$38,351	$38,168
	(143)	(134)	(143)
Blacks	$26,932	$27,080	$26,437
	(268)	(242)	(277)
Hispanics	$26,863	$26,563	$25,943
	(257)	(227)	(230)

* Expressed in 2012 dollars
Standard deviations in parentheses
Source: March Current Population Survey (CPS), 2007, 2010, and 2013

Table 2. Cumulative percentages of subgroups at percentiles of the pooled income distribution (all years)

Income Percentile (1)	**Cumulative Subgroup Percentages**			**Differences**		
	Whites (W) (2)	**Blacks (B) (3)**	**Hispanics (H) (4)**	**W – B (5)**	**W – H (6)**	**B – H (7)**
0.05	0.032	0.095	0.072	-0.063*	-0.040*	0.023*
				(0.002)	(0.002)	(0.003)
0.10	0.063	0.182	0.154	-0.119*	-0.091*	0.028*
				(0.004)	(0.002)	(0.004)
0.25	0.177	0.388	0.402	-0.212*	-0.228*	0.014*
				(0.006)	(0.006)	(0.007)
0.50	0.422	0.661	0.698	-0.239*	-0.276*	-0.037*
				(0.010)	(0.004)	(0.010)
0.75	0.705	0.862	0.888	-0.157*	-0.184*	-0.026*
				(0.012)	(0.004)	(0.011)
0.90	0.883	0.956	0.964	-0.073*	-0.081*	-0.008
				(0.012)	(0.004)	(0.013)
0.95	0.941	0.982	0.984	-0.041*	-0.043*	-0.002
				(0.013)	(0.004)	(0.013)

* Statistically significant at the 5 percent level (standard errors in parentheses)

Table 3 further decomposes the pooled income distribution by year, enabling us to investigate the convergence or divergence of racial or ethnic income distributions in the GR. Table 3 shows FDC dominance of whites over blacks and Hispanics in all three years, though whites and blacks are statistically equivalent at the 95th percentile. Comparisons of blacks and Hispanics are once again more complicated. Hispanics FDC dominate blacks in 2006, with the significant differences at the 5th and 10th percentiles, but in 2009 and 2012, significant crossings emerge. That is, Hispanics had an unambiguous economic advantage over blacks just before the GR, but by 2009 the situation had changed. Here we find the first evidence that the GR affected blacks and Hispanics differently.

Table 4 uses the information in Table 3 to conduct statistical tests for changes in FDCs (or ILCs). We test for significant "differences in differences" across time: 2006-09 (before and after the GR), 2009-12 (the slow recovery), and 2006-12 (the entire period). The test statistics in Table 4 reveal one significant change during 2006-09: blacks *converging* toward Hispanics at the 5th percentile. Blacks were the disadvantaged group at this percentile in 2006, so the GR reduced the disadvantage of blacks relative to Hispanics. However, in 2009-12, we find blacks *diverging* from whites and Hispanics at the 5th and 10th percentiles, thereby increasing the disadvantage of blacks relative to both groups. For the entire period (2006-12) we find no significant change in FDCs (ILCs). Therefore, the poorest households in these racial or ethnic groups had different experiences in the recession and recovery years, but the significant changes were not all in the same direction, so they disappear when we look at the entire period (2006-12).

The next issue to investigate is the sensitivity of these results to our initial assumption about economies of scale in household costs, set at the midpoint (0.5) of the range, $0 < \alpha < 1$. A key difference between the black and Hispanic subgroups is the average number of persons in the household: 3.5 for Hispanics and 2.7 for blacks. To explore how economies of scale interact with household size, we consider Table 2, column 7, where the cumulative distribution functions for blacks and Hispanics intersect for $\alpha = 0.5$, thus ensuring an ambiguous FDC (ILC) outcome. We reproduce this result in column 3 of Table 5, and repeat the comparison using smaller (0.35) and larger (0.85) values for α. Reducing α advantages Hispanics, as economies of scale become larger, while increasing α advantages blacks, as economies of scale become smaller. Columns 2 and 4 indicate that for $\alpha = 0.85$, Hispanics unambiguously FDC (ILC) dominate blacks, but for $\alpha = 0.35$, blacks unambiguously FDC (ILC) dominate Hispanics. Therefore, changes in α can alter the discrimination ordering of Hispanics and blacks.

Are the results in Table 4 also sensitive to the choice of α? We find that for a similar range of values for α, these results are more robust – the cumulative distribution functions for Hispanics and blacks tend to converge over time at the lower tails. Here the results may be less sensitive to the choice of α because they involve differences in differences, whereas the Table 5 results simply involve differences. In the former comparisons, the effects of economies of scale may "wash out," as family sizes within subgroups do not change appreciably over short periods. Thus, our sensitivity analysis suggests that assumptions about economies of scale are important for constructing FDC (ILC) orderings of subgroups, but might be less important for detecting *changes* in the discrimination or economic advantage orderings over short periods.

Finally, are the results in Table 4 sensitive to the choice of income concept? When we replicate Table 4 without taxes and transfers, we find nine cases of growing white advantage in market incomes, suggesting that government tax and transfer policies may have reduced income divergence during and after the GR.

Table 3. Differences in cumulative population shares by income percentiles

2006

Income Percentile	**White – Black**	**White – Hispanic**	**Black – Hispanic**
	Differences in Cumulative Distribution Functions		
0.5	-0.064* (0.004)	-0.038* (0.003)	0.026* (0.005)
0.10	-0.119* (0.005)	-0.086* (0.005)	0.033* (0.007)
0.25	-0.212* (0.006)	-0.217* (0.010)	-0.005 (0.012)
0.50	-0.243* (0.008)	-0.275* (0.017)	-0.032 (0.017)
0.75	-0.160* (0.008)	-0.185* (0.020)	-0.025 (0.021)
0.90	-0.076* (0.008)	-0.085* (9.022)	-0.009 (0.022)
0.95	-0.044 (0.084)	-0.046* (0.022)	-0.002 (0.022)

2009

Income Percentile	**White – Black**	**White – Hispanic**	**Black – Hispanic**
	Differences in Cumulative Distribution Functions		
0.5	-0.055* (0.004)	-0.043* (0.004)	0.012* (0.005)
0.10	-0.104* (0.006)	-0.090* (0.005)	0.014* (0.007)
0.25	-0.203* (0.011)	-0.221* (0.010)	-0.017 (0.012)
0.50	-0.237* (0.017)	-0.274* (0.016)	-0.036* (0.017)
0.75	-0.152* (0.021)	-0.181* (0.020)	-0.029 (0.020)
0.90	-0.071* (0.023)	-0.077* (0.021)	-0.006 (0.022)
0.95	-0.039 (0.023)	-0.041 (0.022)	-0.002 (0.022)

2012

Income Percentile	**White – Black**	**White – Hispanic**	**Black – Hispanic**
	Differences in Cumulative Distribution Functions		
0.5	-0.071* (0.005)	-0.040* (0.003)	0.032* (0.005)
0.10	-0.134* (0.007)	-0.096* (0.005)	0.038* (0.007)
0.25	-0.219* (0.012)	-0.237* (0.011)	-0.017 (0.012)
0.50	-0.238* (0.017)	-0.278* (0.016)	-0.041* (0.017)
0.75	-0.160* (0.021)	-0.185* (0.019)	-0.024 (0.020)
0.90	-0.074* (0.023)	-0.082* (0.021)	-0.008 (0.021)
0.95	-0.040 (0.024)	-0.042* (0.021)	-0.002 (0.021)

***** Statistically significant at the 5 percent level (standard errors in parentheses)

Table 4. Test statistics for changes in first-order discrimination

Income Percentile	**White – Black Differences in Differences**		
	2006-09	**2009-12**	**2006-12**
0.05	-1.59	2.49*	1.09
0.10	-1.92	3.25*	1.74
0.25	-0.71	0.98	0.52
0.50	-0.31	0.04	-0.26
0.75	-0.35	0.26	0.00
0.90	-0.20	0.09	-0.08
0.95	-0.20	0.03	-0.16

Income Percentile	**White – Hispanic Differences in Differences**		
	2006-09	**2009-12**	**2006-12**
0.05	1.00	-0.60	0.47
0.10	0.56	0.84	1.41
0.25	0.28	1.08	-1.34
0.50	-0.04	0.17	0.12
0.75	-0.14	0.14	0.00
0.90	-0.26	0.16	-0.09
0.95	-0.16	0.03	0.13

Income Percentile	**Black – Hispanic Differences in Differences**		
	2006-09	**2009-12**	**2006-12**
0.05	1.98*	-2.82*	-0.84
0.10	1.91	-2.42*	-0.50
0.25	0.70	0.00	0.70
0.50	0.16	0.20	0.37
0.75	0.13	-0.26	-0.24
0.90	-0.09	-0.46	-0.55
0.95	0.00	0.00	0.00

* Statistically significant at the 5 percent level

Table 5. Black-Hispanic differences in cumulative population percentages with alternative equivalence scales (all years)

Income Percentile (1)	Equivalence Scale $(1/n^{\alpha})$ $\alpha = 0.35$ (2)	$\alpha = 0.5$ (3)	$\alpha = 0.85$ (4)
0.05	0.024*	0.023*	0.007
	(0.002)	(0.003)	(0.003)
0.10	0.042*	0.028*	-0.023*
	(0.004)	(0.004)	(0.005)
0.25	0.018*	0.014*	-0.084*
	(0.006)	(0.007)	(0.008)
0.50	-0.017	-0.037*	-0.079*
	(0.009)	(-0.010)	(0.010)
0.75	-0.015	-0.026*	-0.042*
	(0.011)	(0.011)	(0.012)
0.90	-0.005	-0.008	-0.011
	(0.012)	(0.013)	(0.012)
0.95	-0.002	-0.002	-0.004
	(0.012)	(0.013)	(0.012)

* Statistically significant at the 5 percent level

Notation: n is the number of persons in the household and α is an economies of scale parameter.

5. Concluding remarks

We investigate the impact of the Great Recession on the discrimination (economic disadvantage) faced by racial and ethnic groups. Using the first-order discrimination curves (FDC) proposed by Le Breton *et al.* (2012), we find that Hispanics unambiguously dominated blacks in 2006, but lost their advantage by 2009. We detect statistically significant shifts in the FDCs at lower percentiles in the distribution of incomes, with blacks experiencing gains relative to Hispanics at the 5th percentile in 2006-2009, and losses relative to whites and Hispanics at the 5th and 10th percentiles in 2009-2012. We also demonstrate that the relative positions of blacks and Hispanics are sensitive to assumptions about economies of scale within households, which are implicit in the choice of equivalence scale. In addition, we find evidence that government taxes and transfers offset a widening white advantage in market incomes.

Our study focuses on the impact of the GR on incomes, rather than wealth. Wolfe (2014) examines the latter issue and finds that Hispanics suffered larger losses in home values in the GR (many bought homes during the housing boom, and in the states where home values fell the most sharply in the housing bust). This result is consistent with our finding that blacks gained relative to Hispanics during the recession years, though as we have shown, many of the income gains of blacks were lost during the recovery years.

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