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REPLICATION

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# The US structural transformation and regional convergence: Racial heterogeneity

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**Summary**

Structural transformation and regional convergence in US income are both longstanding trends. Caselli and Coleman (2001) documented that 60% of regional convergence between the US South and North from 1940 to 1990 was due to structural transformation. Our replication confirms these robust findings. Examining black and white populations separately, we find the magnitude of regional income convergence was much larger for the black workers, and that structural transformation explains most regional income convergence for white workers but only 30% for black workers. Extending the analysis until 2020, however, we observe income convergence among black workers and divergence among white workers. Structural transformation's role in income convergence or divergence from 1990 to 2020 is negligible.

## 1 | INTRODUCTION

Structural transformation and regional convergence in wages are both well-documented, long-run trends in US economic growth over the last century. In a joint study of these two phenomena, Caselli and Coleman (2001) decomposed the convergence of labor income between the North and the South into three channels. The first one is the *labor reallocation* channel, which captures the convergence of labor force composition. Since the South had a more abundant agricultural labor force, it had more workers escaping from low-wage agriculture. The second one is the *between-industry* channel, which captures the economy-wide convergence of agricultural wages to non-agricultural wages between 1940 and 1990. Since the South was more agriculture-intensive before 1940, higher agricultural wages further contributed to the convergence of southern incomes with northern incomes. Lastly, the *within-industry* channel captures the convergence of wages that occur within an industry. This refers to the catching-up of southern wages to northern wages within agricultural and non-agricultural sectors.

This decomposition helpfully allows us to assess the role of structural transformation in the convergence of regional incomes. Structural transformation, regardless of the mechanism driving it, is characterized by (i) workers escaping the low-wage agricultural sector and (ii) increasing relative wages in the agricultural sector. In this sense, the labor reallocation and between-industry channels quantify to what extent structural transformation also contributed to the convergence of income between the North and the South. In their empirical exercise, Caselli and Coleman (2001) found

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**TABLE 1** Structural transformation and regional convergence in the United States.

| | 1940 | 1960 | 1980 | 2000 | 2020 |
|---|---|---|---|---|---|
| | A. Structural Transformation | | | | |
| Agricultural share of employment | .202 | .068 | .030 | .019 | .021 |
| Agricultural relative wage | .36 | .54 | .70 | .71 | .68 |
| | B. Regional Convergence | | | | |
| South/North relative wage | .60 | .79 | .89 | .83 | .80 |
| Midwest/North relative | .84 | .97 | .99 | .86 | .82 |
| West/North relative wage | .99 | 1.04 | 1.03 | .96 | .92 |

*Note*: This table replicates Table 1 in Caselli and Coleman (2001) with the extended sample. States in the North are Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. States in the South are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. States in the Midwest are Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin. States in the West are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

that more than half of the regional convergence between the US South and the North from 1940 to 1990 can be attributed to structural transformation.[1]

In this paper, we first conduct a narrow replication and confirm that these results are accurate and robust. Then, we conduct a broad replication by revisiting these results in two ways. First, we examine the contribution of structural transformation to regional convergence separately for black and white populations. While the heterogeneous effects of structural transformation have been occasionally studied in the recent literature (e.g., see Buera and Kaboski (2012) on skill premiums and wage inequality, and see Ngai and Petrongolo (2017) on the gender wage gap), little is known about how structural transformation affected black and white workers differently in the United States.

We confirm that structural transformation played a major role in the convergence of southern incomes to northern incomes at the aggregate level. However, our racial decomposition exercise suggests that this phenomenon was far more prevalent for white workers. First, the magnitude of regional convergence was much more pronounced among black workers in our sample. Between 1940 and 1990, the decline in the income differential between the South and North was 3.5 times larger for black workers. Second, the contribution of structural transformation to regional income convergence also vastly varies between white and black workers. For white workers, structural transformation explains 93% of the South–North wage convergence between 1940 and 1990. For black workers, on the other hand, it only explains 30% of this convergence. For black workers, southern incomes did converge to northern incomes between 1940 and 1990, but mainly because of South–North convergence for within-sector incomes, i.e., the convergence of southern and northern black incomes within agricultural and non-agricultural sectors. These results are consistent with a faster decline in racial discrimination against black workers in the South, which includes employer bias and barriers to educational attainment.

Although overall racial discrimination was significant in both the North and the South, it also varied considerably in degree between the two regions. Until 1940, southern black workers faced a higher degree of discrimination in the labor market and were more segregated than northern black workers (Sundstrom, 1994). With the implementation of civil rights laws in the 1960s, the conditions for black workers in the South underwent a dramatic change, and the disparity in racial discrimination between southern and northern black workers rapidly diminished as well. Our results suggest that for black workers, the main driver behind the convergence of income between the North and the South was not structural transformation, but rather the faster resolution of racial discrimination in the South.

We then extend the observation period through 2020. Noticeable trends emerging in post-1990 US economic growth include a slowdown of both structural transformation and regional convergence. Table 1 summarizes these two features. As seen in the first row of Panel A, the agricultural share of employment in the United States steadily declined until 2000, but the trend was reversed post-2000.[2] The same reversal is observed in the regional relative wages. South–North relative wages (shown in Panel B) had been converging until 1980 but have been diverging since then. This

[1]Caselli and Coleman (2001) also provided a theoretical model to reconcile their empirical findings. In this paper, however, we primarily focus on their empirical results.

[2]It is not expected that structural transformation ends with the agricultural share of employment at 2%. For example, Restuccia et al. (2008) set the long-run share of employment in agriculture, i.e., the share of agricultural employment when the structural transformation is completed, at 0.5%.

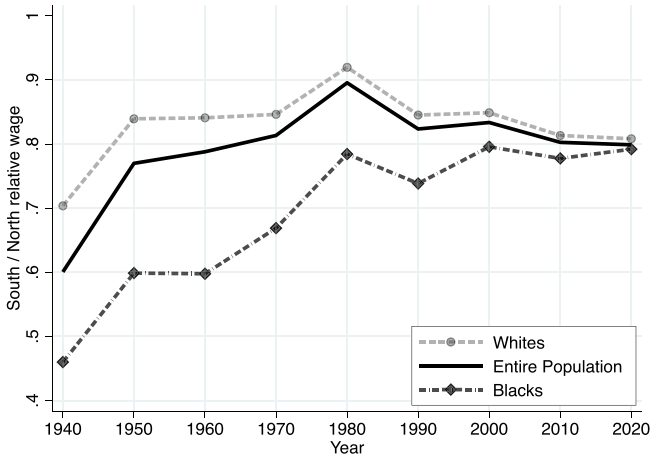


**FIGURE 1** Convergence of Southern and Northern Average Wages, 1940–2020. Note: This figure shows the average relative wages of southern workers to those of northern workers from 1940 to 2020, sorted by race. For the data source and sample restrictions, see Section 2.

divergence of regional income is not only observed between the North and South: the Midwest-North and West-North ratios of labor income have also diverged since 1980. A natural question is whether the slowdown of structural transformation contributed to regional divergence.

We also find differential patterns of regional convergence between black and white workers in recent years. While the South–North income gap broadened among white workers between 1990 and 2020, the gap between southern black workers and northern black workers was further reduced in the same period. Figure 1 illustrates the racial heterogeneity in South–North income convergence in the more recent period. While the South–North income gap narrowed for both races until 1980, that pattern only continued among black workers post-1980. Decomposing the total convergence between 1990 and 2020, we find that structural transformation is responsible for a mere 0.1 and 0.2 percentage point reduction in the South–North income gap for white and black workers, respectively. Structural transformation still helped to narrow the regional income gap, but its effect was insufficient to offset the opposing force.

The rest of our paper is organized as follows: Section 2 describes the dataset used for replication exercises. Section 3 revisits the role of structural transformation on the convergence of per capita income between the US South and North from 1940 to 1990 by conducting the same decomposition exercise done in Caselli and Coleman (2001), but separately for black and white populations. Section 4 then extends the data up to 2020 and investigates the effect of structural transformation on the recent slowdown in the US regional convergence. Section 5 concludes the paper.

## 2 | DATA

Following Caselli and Coleman (2001), we extract the individual-level microdata from the integrated public-use microdata series (IPUMS) of the US Census, as made available by the IPUMS project at the University of Minnesota (Ruggles et al., 2023). For 1940 to 1990, we use the exact same sample for each Census year: 1940 General, 1950 General, 1960 General, 1970 Form 1 State, 1980 1% Metro, and 1990 1% Unweighted sample. For 2000, we used the 5% general sample. For 2010, we used the 2010 American Community Survey (ACS). For 2020, we used a 5-year sample of the ACS, which used adjusted weights to mitigate data quality issues caused by the COVID-19 pandemic for the 2020 1-year ACS data.

We have extracted the variables describing age (AGE), wage income (INCWAGE), employment status (EMPSTAT), industry (IND1950), number of weeks worked (WKSWORK2), state of residence (STATEICP), and sampling weight (PERWT). Following Caselli and Coleman (2001), we dropped all individuals who were not employed, whose age was less than 16, or who had worked less than 50 weeks in the previous year.[3] We also dropped individuals who did not report their industry or whose industry was non-classifiable ($<0.6\%$ of the sample). We used self-identified major race as an identifier and did not assign a single race to individuals who reported more than two major races.

[3]The variable INCWAGE includes only income received as an employee and does not include self-employed income, which is particularly prominent in agriculture. In this sense, INCWAGE does not fully capture labor income in agriculture. However, if the bias from excluding self-employment income is roughly constant over time, INCWAGE should provide a reasonable proxy for agricultural labor income.

Agricultural and non-agricultural wages and employment for the four US regions (North, South, Midwest, and West) were calculated in the same way as in Caselli and Coleman (2001).

## 3 | RACIAL HETEROGENEITY IN US REGIONAL CONVERGENCE

We follow Caselli and Coleman (2001) and mostly focus on the convergence between the most and the least farm-intensive of the four regions of the United States: the South (S) and the North (N). For $i = S,N$ we have

$$w_t^i = w_{ft}^i L_{ft}^i + w_{mt}^i \left(1 - L_{ft}^i\right) \tag{1}$$

where $w_t^i$ is the average labor income in region $i$ in year $t$, $w_{ft}^i$ is labor income per worker in agriculture, $w_{mt}^i$ is income per worker outside of agriculture, and $L_{ft}^i$ is the share of the labor force that is employed in agriculture.

Following Caselli and Coleman (2001), we measure convergence by the quantity

$$\frac{w_t^S - w_t^N}{w_t} - \frac{w_{t-1}^S - w_{t-1}^N}{w_{t-1}} \tag{2}$$

where $w_t$ is the economy-wide average labor income. Define $\omega_{jt}^i = \left(w_{jt}^i - w_{jt}\right)/w_t$ for $i = S,N$, $j = f,m$. Also, let $\omega_t^i = \left(w_{ft}^i - w_{mt}^i\right)/w_t$, and $\omega_t = \left(w_{ft} - w_{mt}\right)/w_t$. We can now decompose this measure of convergence into three terms:

$$\begin{aligned} \underbrace{\frac{w_t^S - w_t^N}{w_t} - \frac{w_{t-1}^S - w_{t-1}^N}{w_{t-1}}}_{\text{Total Convergence}} = & \underbrace{\overline{\omega}_t^S \cdot \Delta L_{ft}^S - \overline{\omega}_t^N \cdot \Delta L_{ft}^N}_{\text{Labor Reallocation}} \\ & + \underbrace{\Delta\omega_t \cdot \left(\overline{L}_{ft}^s - \overline{L}_{ft}^N\right)}_{\text{Between Industry}} \\ & + \underbrace{\Delta\omega_{ft}^S \cdot \overline{L}_{ft}^s + \Delta\omega_{mt}^S \cdot \left(1 - \overline{L}_{ft}^S\right) - \Delta\omega_{ft}^N \cdot \overline{L}_{ft}^N - \Delta\omega_{mt}^N \cdot \left(1 - \overline{L}_{ft}^N\right)}_{\text{Within Industry}} \end{aligned} \tag{3}$$

where $\Delta x_t = x_t - x_{t-1}$ and $\overline{x} = (x_t + x_{t-1})/2$.[4] The left-hand side of the decomposition equation is the measure of convergence, as in Equation 2. The right-hand side of the first line of the equation corresponds to *labor reallocation*, which captures the decline of the share in agricultural employment in the South. Next, the *between-industry* term captures the convergence of the economy-wide average agricultural wage to the average non-agricultural wage. Lastly, the *within-industry* term captures the catching up of southern wages to northern wages *within* agricultural and non-agricultural sectors.

Combined, the labor reallocation and between-industry terms capture the role of structural transformation on the regional convergence of income. The two defining features of structural transformation are the movement of the labor force out of agriculture and the catch-up of agricultural wages to non-agricultural wages. Since the South had a more abundant agricultural labor force, it not only experienced a larger reallocation of labor out of agriculture but also an income increase for those who remained in agriculture. On the other hand, the within-industry term captures the contribution of forces not attributable to structural transformation. If there were some frictions or distortions preventing the northern and southern incomes from being equalized, then a reduction of such frictions over time would be captured by the within-industry component.

Table 2 reports the results of the decomposition between 1940 and 1990. The first panel replicates the original results in Caselli and Coleman (2001). Between 1940 and 1990, the South–North labor income differential declined by 28.6 percentage points. In this decline, 36.5% is due to a faster movement of the Southern labor force out of agriculture, and 22.8% is due to the nationwide convergence of agricultural wages to non-agricultural wages. Therefore, structural transformation accounts for 59% of the South–North income convergence in this period. This closely replicates the results found by Caselli and Coleman (2001), where structural transformation accounts for 60% of the South–North income convergence during the same period. Finally, 40.7% of the total convergence is accounted for by South–North convergence of within-sector incomes.

[4]Refer to Appendix B of Caselli and Coleman (2001) for the derivations.

**TABLE 2** Decomposition of convergence in South-to-North income per worker.

| Period: 1940–1990 | Total (1) | Labor Reallocation (2) | Between-Industry (3) | Within-Industry (4) |
|---|---|---|---|---|
| Entire population | .286 | .104 | 0.065 | .116 |
| Percentage of total | 100% | 36.5% | 22.8% | 40.7% |
| White | .169 | .100 | .056 | .012 |
| Percentage of total | 100% | 59.3% | 33.4% | 7.2% |
| Black | .599 | .111 | .066 | .422 |
| Percentage of total | 100% | 18.6% | 11.0% | 70.4% |

*Note*: Column 1 is the left-hand side of Equation 3. Column 2 is the component due to the convergence of $L_{ft}^S$ to $L_{ft}^N$. Column 3 is the component due to the convergence of $w_{ft}$ to $w_{mt}$. Column 4 is the component due to the convergence of $w_{ft}^S$ to $w_{ft}^N$ and $w_{mt}^S$ to $w_{mt}^N$. For the data source and sample restriction, see Section 2.

We now examine the contributions of structural transformation to regional convergence by race, separately for black and white populations. The second and third panels of Table 2 show the results from the decomposition when we focus on black and white populations, respectively. Among the white population, the South–North labor income differential declined by 16.9 percentage points between 1940 and 1990. Here, the role of structural transformation was dominant in closing the income gap between the North and the South. The within-industry convergence of wages between North and South accounts for only 7.2% of the total convergence, while the rest is attributable to structural transformation.[5]

On the other hand, different patterns are observed among the black population. The first thing to note is that black workers in the South experienced much larger income growth in the same period compared to white workers in the same region. Between 1940 and 1990, the income differential declined by 59.9 percentage points between the North and the South, which is around 3.5 times higher than the decline in the income differential among white workers. Therefore, even though labor reallocation (0.100 for white and 0.111 for black workers) and between-industry (0.056 for white and 0.066 for black workers) factors contributed almost equally to regional convergence, there was an extra boost to the convergence among black workers. Second, structural transformation only accounts for less than 30% of this convergence. For black workers, southern incomes converged to northern incomes mainly due to the South–North convergence of within-sector incomes.

Given that the within-industry component captures the removal of frictions that prevent factor price equalization across regions, why is it only prominent for black workers? One plausible explanation is a more rapid decline in racial discrimination against black workers in the South, which could be attributed to factors such as employer prejudice or barriers to accessing higher education. It is widely acknowledged that racial discrimination was more prevalent in the South compared to the North during the 1940s (Sundstrom, 1994). However, the disparity in racial discrimination between southern and northern black workers decreased significantly between 1940 and 1990 due to the enactment of a series of civil rights laws, including the Civil Rights Act of 1964.

This explanation is consistent with the empirical findings because the faster decline in racial discrimination for southern black workers would manifest as a larger contribution to the within-industry component of regional convergence. As the degree of racial discrimination declined more rapidly for southern black workers, their wages would have increased at a faster rate compared to those of northern black workers. The convergence caused by this trend is captured by the within-industry term since it occurs independently of the structural transformation. Our findings highlight that such effects were much more prominent for the convergence of income between southern and northern black workers than structural transformation. This interpretation is also consistent with recent findings that institutionalized racial discrimination is correlated with discrimination in economic measures (Cook et al., 2023).[6]

[5]In other words, 93% of the total convergence is attributable to structural transformation. Caselli and Coleman (2001) found that structural transformation accounted for 81% of the South–North income convergence during the 1880–1950 period. Unfortunately, we cannot conduct the decomposition by race for the 1880–1950 period, due to the unavailability of employment and wage information by sector and race.

[6]It is possible that the faster decline in racial discrimination for southern black workers could have indirectly increased through other channels than the within-industry channel. For example, if more black people were escaping agriculture in the South than in the North due to the faster reduction of discrimination in the South, then it may appear as higher contributions of the labor reallocation and the between-industry channels, even though structural transformation would be still the major force behind those channels. Given that the within-industry channel (70.4%) dominates the labor reallocation (18.6%) and the between-industry channels (11.0%) for black workers, the main interpretation of the paper does not change. Our main message is that in addition to structural transformation, there was an extra boost to convergence among the black workers between the North and the South, arising from the removal of racial discrimination that had been more prominent in the South.

**TABLE 3** Decomposition of the convergence in South to North income per worker.

| Period: 1990–2020 | Total (1) | Labor Reallocation (2) | Between-Industry (3) | Within-Industry (4) |
|---|---|---|---|---|
| Entire population | −.033 | .001 | −.000 | −.034 |
| Percentage of total | 100% | −4.16% | 1.07% | 103.09% |
| White | −.051 | .001 | −.000 | −.052 |
| Percentage of total | 100% | −2.82% | 0.64% | 102.17% |
| Black | .061 | .002 | .000 | .059 |
| Percentage of total | 100% | 3.06% | 0.79% | 96.14% |

*Note*: Column 1 is the left-hand side of Equation 3. Column 2 is the component due to the convergence of $L_{ft}^S$ to $L_{ft}^N$. Column 3 is the component due to the convergence of $w_{ft}$ to $w_{mt}$. Column 4 is the component due to the convergence of $w_{ft}^S$ to $w_{ft}^N$ and $w_{mt}^S$ to $w_{mt}^N$. For the data source and sample restriction, see Section 2.

Our findings are also qualitatively and quantitatively robust to different specifications. For instance, our results are not driven by the inflow of migrant workers from the South to the North, which would have put downward (upward) pressure on northern (southern) wages between 1940 and 1990. Appendix A also shows the robustness of the results for interstate migrants and elderly workers (see Tables A.I, A.II, and A.III).

## 4 | DECOMPOSITION OF THE RECENT SLOWDOWN OF US REGIONAL CONVERGENCE

Caselli and Coleman (2001) studied the structural transformation and regional income convergence until 1990. To what extent can structural transformation explain the declining rate of regional convergence in more recent years? We extend the sample to 2020 and run the same decomposition exercise as in Equation 3. Table 3 reports the results of the decomposition analysis, first for the entire population and then separately for the black and white populations. We first focus on the results from the aggregate population and white workers. As discussed, the results are consistent with the regional divergence of income observed in recent years, as shown in Figure 1. Between 1990 and 2020, the South–North income gap has *widened* by 3.3 percentage points for the entire population and by 5.1 percentage points for the white population. The bulk of the divergence in labor income between the two regions is from the within-industry component, as seen in the last column of the table. Unlike the 1940–1990 period, little convergence stemmed from structural transformation. The labor reallocation and between-industry components combined account for a mere 0.1 percentage point reduction in the labor income gap between North and South, both for all workers and for white workers. Although the structural transformation was exerting forces to close the income gap between the North and South, its magnitude was insufficient to offset the increase in the regional income gap caused by within-industry divergence of regional income.

Once again, however, different patterns are observed for the black population. Unlike that for all workers or white workers, the income gap between Northern and Southern black workers further declined by 6.1 percentage points between 1990 and 2020. Unlike white workers, where southern and northern incomes diverged within the agricultural and non-agricultural sectors, the labor income of southern and northern black workers converged by 5.9 percentage points. Overall, South–North income convergence is still observed between 1990 and 2020 among black workers, although the magnitude of this change is diminished compared to 1940–1990.

Taken together, our findings are consistent with the culmination of structural transformation since 1980, as discussed in Table 1. For both black and white workers, structural transformation played a role in closing the South–North income gap, but compared to the 1940–1990 period, its effect has been largely mitigated. Moreover, combined with the weakened force of structural transformation, the within-industry divergence of southern and northern incomes is attributable to the recent divergence of northern and southern incomes.[7]

[7]Several studies have documented the slowdown of regional income convergence since the 1980s (Ganong & Shoag, 2017; Giannone, 2022), but these studies focused on income convergence across states. Our results confirm that regional divergence is also observed at a more aggregated level, e.g., between the South and the North, and that it was enforced by the end of structural transformation. Ganong and Shoag (2017) found that deterred migration due to rising housing prices slowed down regional convergence after 1990. Giannone (2022) identified skill-biased technological change as a main channel behind the slowdown. Both mechanisms are captured in our *within-industry* component.

Our results also reveal that among black workers, the South–North income gap has been *narrowing* even recently, although the magnitude of the convergence is smaller compared to 1940–1990. The decomposition exercise suggests that structural transformation contributed little to this convergence, as observed among white workers. However, the within-industry income gap between southern and northern black workers has also narrowed between 1990 and 2020. One interpretation for this is a continued reduction in frictions between North and South, such as a steeper reduction in racial discrimination in the South relative to the North. This is consistent with a large body of research documenting that taste-based discrimination declined more in the South after 1980 (Bobo et al., 2012; Charles & Guryan, 2008; Hurst et al., 2021).[8]

## 5 | DISCUSSION AND CONCLUSION

Previous work has shown long-term structural transformation and regional convergence in the United States throughout the past century. Our findings confirm that structural transformation has played a significant role in the convergence of southern incomes with northern incomes at the aggregate level over the last century, while it played a negligible role after 1990.

However, the racial decomposition exercise in this paper suggests that there is a significant amount of heterogeneity between black and white workers in both the size of regional convergence and the role of structural transformation. For black workers, southern incomes converged to northern incomes much more than white workers, and the convergence is mainly because of the South–North convergence of within-sector incomes. For white workers, the size of the South–North wage convergence is a third of that among black workers, and it is almost entirely explained by structural transformation. We attribute the greater decline in regional income differentials among the black workers, along with the limited role of structural transformation therein, to the faster decline in discrimination in the South vs. the North, which stems from the fact that initial discrimination levels were substantially higher in the South than in the North.

Our research highlights the importance of studying the heterogeneous effects of structural transformation among different US demographic groups, particularly with regard to race. When certain demographic groups are overrepresented in specific sectors within specific regions (such as black workers in agriculture in the South), and when they experience disproportionate changes in income compared to other groups, the quantitative significance of structural transformation in driving regional convergence varies significantly for that particular group. In this case, studying regional income convergence and structural transformation based solely on aggregate population figures masks the substantial heterogeneity between the two largest racial groups in the United States. Relying solely on evidence from the entire population would greatly overstate the importance of the effect of the structural transformation for black workers.

This paper has several limitations. First, we do not attempt to further dissect the component of within-industry effects, which has been shown to be crucial in understanding the income convergence (or divergence) between the South and the North among black workers from 1940 to 1990, as well as among all workers from 1990 to 2020. Factors such as the accelerated decline in racial discrimination in the South over the past half-century, as well as the faster pace of skill-biased technological change among white workers in the North over the past 30 years, could potentially explain these trends. Second, even though our robustness checks considering migrants confirm the original results, our exercise does not deal with the potential selection of migrants and general equilibrium effects on residents. Those limitations are topics that remain to be explored in future research.

## DATA AVAILABILITY STATEMENT

Data is available at https://doi.org/10.15456/jae.2024133.1504216237.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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