The Persistent Effects of Decreasing Labor-Market Discrimination: Evidence from WWII policies*

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Abstract

We show that interventions that reduce labor-market discrimination can effectively improve the economic circumstances of Black families, long after the intervention ceases. We study this in the context of the WWII defense production effort. Government war contracts not only increased demand for labor, but also explicitly barred racial discrimination in hiring. This led to increased hiring of Black workers into skilled positions, raising their wages. Migration towards locations with greater contracts further amplified these effects. Altogether war policies explain 25% of the reduction in the racial wage gap between 1940 and 1950. These effects on employment and earnings persist through at least 1970, long after war contracts and requirements of non-discrimination ceased, and generated intergenerational effects, increasing the educational attainment of the next generation of Black children.

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1 Introduction

Racial disparities in labor-market outcomes in the U.S. have improved little over the last fifty years. In 2021 the unemployment rate of Black men was double that of white men and, among the employed, Black men earned 27% lower wages. After marked improvements in the 1940s and 1960s (see Figure 1), the racial wage gap has contracted little since 1980 despite substantial investments in education policy aimed at reducing these inequities. Importantly, while we observe improvements in the wages of Black workers during expansions, since 1980 these pro-cyclical gains have been transitory in nature (Juhn, 2000). Thus a key policy question is to Understand which factors lead to persistent improvement in the absolute and relative economic standing of Black workers.[1]

In this paper we study the impact of Federal policies during WWII on the economic outcomes of Black workers and their children, and investigate their persistence. The largest improvements in the consumption and welfare of the Black population since 1940 occurred during the 1940s (Brouillette et al., 2021).[2] It is well documented that wartime access to semi-skilled jobs *accounts for* Black workers' absolute and relative wage increases in the 1940s (Margo, 1995; Collins, 2000).[3] This occupational shift was enhanced by Federal policy limiting discrimination in employment among firms receiving WWII production contracts (Collins, 2001) and by Black worker migration from the South to the North (Boustan, 2009).

We study the effects of WWII contracts. The federally funded domestic war production effort, totaling \$3.1 trillion (2014\$), significantly increased private labor demand. Firms receiving contracts were also required to follow federal anti-discriminatory rules. We show that wartime spending increased labor demand and, in combination with anti-discriminatory policies, led employers to hire Black workers in skilled occupations and raised their wages. Black migration towards regions where these new opportunities became available further improved their labor-market outcomes. Although these policies ended with the war, their effects persisted for decades. This occurred because—unlike other expansionary periods— WWII expansion was accompanied by anti-discriminatory policy. We show that in fact WWII policies *caused* a decline in discrimination during the

[1]For a detailed analysis of long-run trends in Black-white wage gaps see Bayer and Charles (2018).

[2]A substantial literature has focused on explaining the improvements that took place in the 1960s. Researchers have attributed the shrinking of the gap to economic expansion, increasing educational attainment among Black individuals (Smith and Welch, 1989; Card and Krueger, 1992), affirmative action and the rise of anti-discrimination policies (e.g., Donohue and Heckman, 1991; Miller, 2017), and the rise in the minimum wage (Derenoncourt and Montialoux, 2019).

[3](Ferrara, 2020) shows that mortality during the war also led to occupational upgrading among Black workers.

1940s. This decline in discrimination helps explain a large share of the labor-market improvements previously documented in the literature, and more importantly rationalize their persistence.

We proceed in three steps. First, we document the effects of the war defense production effort on local labor-market outcomes of adult workers and on the educational attainment of the next generation. Using a difference in differences (DD) approach, we show that metropolitan areas with higher WWII contract expenditures per capita also had larger improvements in labor-market outcomes of Black men. In areas at the 90th percentile of war contract spending per capita, the wages of Black workers rose nine log points more than in areas at the 10th percentile between 1940 and 1950. The wages of Black workers in areas receiving more contracts were higher for at least two more decades. These gains occurred because Black men gained access to skilled jobs previously unavailable to them, and this access persisted beyond the war, until the 1960s.

By contrast, we find no (negative or positive) effects of war contract expenditures on the average outcomes of white men, or on women of any race, consistent with previous findings that areas receiving funds did not, in general, grow faster after the war.[4] Our estimated DD effects are not driven by endogenous allocation of war contracts and are robust to instrumenting for contract allocation. The DD results are not due to changes in skill composition caused by migration; however, migration to higher-wage regions due to war contracts substantially amplified the impact of war spending on the racial wage gap (see Section 7.2).

We also document important spillovers to children. War spending led to significant increases in the educational attainment of Black children: the high school graduation rates of Black boys (girls) in areas at the 90th percentile of war spending increased 6.3 (4.8) percentage points more than in areas at the 10th percentile. We find no impact on the high school graduation rates of white children. Thus, war spending increased the intergenerational mobility of Black families as well.

Second, we investigate why these policies generated *persistent* improvements. We use the Becker model of employer taste-based discrimination, extended to incorporate worker self-selection into industries and occupations as in the Roy model. The qualitative model considers the following two factors in explaining persistent regional reductions in the racial wage gap: *(i)* compositional shifts in production to industries and occupations in which Black workers were employed more intensively and *(ii)* a decline in discrimination.

[4] The null effects for women are also consistent with previous work showing that women's gains in the labor market during WWII as a result of mobilization were mostly temporary (Acemoglu et al., 2004; Goldin, 1991).

The model generates a range of testable implications. We find that the persistent effects in the data are most consistent with declines in discrimination in the Becker-Roy model.

Why did these policies lead to a persistent reduction in discrimination? Our data show that increases in labor demand did not improve long-run outcomes in the absence of anti-discriminatory policies, consistent with Juhn (2000). Rather, both increases in labor demand and civil rights pressure were necessary. This is consistent with historical accounts. Moreover, the persistence owes in part to declines in institutional discrimination, as manifest in the integration of unions towards the end of the war: Areas with more war production witnessed greater increases in union membership, particularly among Black workers, which also lasted for decades.

Third, we quantify the effects of war policies on aggregate outcomes. We build and calibrate a quantitative general equilibrium model—extending Hsieh et al. (2019)'s model to incorporate many regions linked by trade and migration—to measure the impact of war spending policies on the aggregate racial wage gap between 1940 and 1950. We find that war contracts explain 25% of the overall reduction in the racial wage gap over this period (5.6% out of the total 22.6% between 1940 and 1950). To put this in perspective, this 5.6% decline is more than the entire contraction of the wage gap in the forty years between 1980 and 2020. We then use the model to decompose the mechanisms generating these aggregate effects. We find that the vast majority of the effects of war contracts are driven by reductions in discrimination within skilled occupations in the defense industry. These otherwise local effects were amplified by the migration of Black workers to regions receiving war funding.

Our work makes several contributions. First, it contributes to existing research examining the role of discrimination in labor markets, first discussed in the seminal work of Becker (1957). While existing résumé and audit studies document discrimination in call back rates, they cannot assess the role of discrimination in explaining national wage gaps, nor can they show how specific policies affect labor-market discrimination, as we do.[5] In this way, our paper is closer to that of Charles and Guryan (2008) who test a prediction of the Becker model using observed measures of discrimination. Our theoretical results are more general than the Becker model and allow us to identify changes in discrimination from changes in labor-market outcomes without relying on measures of racial animosity, which are often not available.

Second, while there is descriptive work showing the importance of skill upgrading in the 1940s for Black men, this work does not empirically trace its origin to war contracts,

[5]Recent efforts to document discrimination in the labor market include many excellent audit studies, e.g. Bertrand and Mullainathan (2004); Kline et al. (2021).

nor does it assess the role of discrimination in explaining these changes. In this respect, our work is the first to combine a structural model with well-identified DD causal estimates to show how declines in labor-market discrimination explain changes in aggregate racial gaps, as suggested by Lang and Spitzer (2020). In doing so, we are able to link previously documented facts—wage increases, skill upgrading, migration —into a single cohesive narrative and to assess quantitatively the role of discrimination. In spirit, our work is similar to Hsieh et al. (2019), who quantify the impact of reductions in discrimination on aggregate outcomes. Our identification of reductions in discrimination builds on their insight. Hsieh et al. (2019) use national changes in labor allocations across occupations by race to identify changes in labor-market discrimination. While we use similar variation within regions, we additionally leverage plausibly exogenous variation across regions receiving different amounts of war contracts.

Our final and perhaps most important contribution is to document the persistent effects of these policies on the labor-market outcomes of adults and on the human capital of their children. Research on the events that took place in the 1940s has not documented any persistent effects for Black workers or shown spillovers onto the next generation.[6] Previous work on racial gaps in education has typically focused on supply side changes. The quality and quantity of schooling increased substantially for Black children in the South (Card and Krueger, 1992; Collins and Margo, 2003; Aaronson and Mazumder, 2011; Carruthers and Wanamaker, 2017). The GI Bill (created for WWII veterans) also increased Black educational levels (Turner and Bound (2003)). We document another reason why the education level of Black children increased in the post-war years: increased demand due to the improved labor-market outcomes of their parents. While Margo (1995) and Smith and Welch (1989) showed that educational gains by Black workers played a role in explaining the closing of the racial gap in wages in the 1940s, we provide evidence of the reverse relationship as well: the closing of the racial gap in adult wages increased the subsequent educational attainment of Black children. Although Margo (1993) hypothesized that improved labor-market outcomes for Black workers during the war ultimately improved the education of Black children, to our knowledge we are the first to document empirically that war expenditures raised high school graduation rates for Black students. We conclude that when strong labor demand is accompanied by further reductions in institutional discrimination, this can lead to lasting improvements in the labor-market outcomes of Black workers, with important intergenerational impacts as well.

[6] Garin and Rothbaum (2022) find that new plants developed by the US government during the war (roughly 15% of war spending) did generate intergenerational effects for white families. They find no effects on Black families.

2 1940s Background

In 1940, prime-age Black men earned half as much as their white counterparts, largely due to their disproportionate concentration in lower-paid industries and, within those industries, in lower-paid occupations (Wright, 1986), not differences in pay within jobs (Billips, 1936; Frazier and Perlman, 1939). 79% of Black men were employed in unskilled occupations or as farmers, compared to 38% of white men. Location or educational differences cannot fully explain this occupational segregation as our work (Appendix Section C.2), as well as that of Margo (1995), demonstrates.

Overt discrimination of firm owners played a role in the occupational segregation of Black workers. At the onset of WWII, 51% of war manufacturers reported they did not and would not employ Black workers.[7] Unions also discriminated, with Black men barred from joining many unions or forced into segregated "Jim Crow" locals, which prevented them from obtaining jobs in many skilled blue collar professions. This was particularly true in AFL-affiliated craft unions, such as the Machinists' union.[8]

WWII transformed the American labor market in three main respects. First, the dramatic increase in federal expenditures greatly increased labor demand. The U.S. spent roughly $3.1 trillion (2014 $) on war-related production, roughly 40% of GDP each year in 1943, 1944, and 1945, creating the largest increase in expenditure in U.S. history (Appendix Figure A.3). This was four times larger than "New Deal" expenditures meant to alleviate the Great Depression (Fishback and Kachanovskaya, 2015). Military equipment contracts accounted for 85% of this spending; new production facilities accounted for the rest.

Second, military enlistments dramatically decreased labor supply. About 15.8 million working-age men (roughly 40% of the male labor force in 1940) served in the military during WWII. Additionally, about half a million men died during the war, permanently reducing the labor force by 1.3%.

Third, the government enacted several important anti-discrimination measures to ensure maximum labor force utilization. President Roosevelt issued Executive Order 8802 (1941) asserting: "I do hereby reaffirm the policy of the United States that there shall be no discrimination in the employment of workers in defense industries or government because of race, creed, color, or national origin." The order also established the Committee on Fair Employment Practice (FEPC) to encourage industries receiving government con-

[7] President's Committee on Fair Employment Practice. "First Report, July 1943-December 1944." Washington, D.C., 1945.

[8] See Appendix Table A2 for example unions with discriminatory membership policies. For an in depth discussion of the difficult relationship between labor unions and Black workers, see Whatley (1991).

tracts to hire minorities. These requirements applied to firms receiving WWII contracts but not to others. Collins (2001) shows that the share of Black workers employed in defense industries increased in places with more FEPC intervention, suggesting that these orders were effective.[9]

3 Empirical approach and data

In this section we outline our DD empirical approach to identify the effects of WWII contracts, we describe our data sources, and provide evidence on the wartime effects of the contracts.

3.1 Empirical approach

We assess whether outcomes changed differentially after the war in areas that received more contracts relative to those that received less, conditional on covariates. Our strategy compares outcomes in places with similar manufacturing employment shares that differ based on how easily their manufacturing base could be converted into war production. This is a difference-in-difference approach where the treatment varies in intensity with the size of war contracts. Specifically we estimate the following equation, separately by race:

$$Y_{rt} = \beta_1 WarExp_r \times Post_t + \beta_2 Draft_r \times Post_t + Post_t + \gamma_r + X_{rt}\rho + \varepsilon_{rt} \tag{1}$$

where Y is the outcome for a given metro area r and in a given census year t.[10] We follow 146 metro areas and investigate four outcomes: the share of workers employed in skilled occupations, (log of) the average wage, (log of) population, and the prime-age employment rate.[11] The main independent variable of interest, $WarExp_r \times Post_t$, is the total cumulative war contract spending per capita in metro area r ($WarExp_r$) interacted with a post-war indicator that equals one in 1950 ($Post_t$). We include metro fixed effects (γ_r), a post-war indicator ($Post_t$), and metro-area characteristics in 1940 interacted with a post-war indicator (X_{rt}), which most importantly controls for manufacturing intensity. Regressions are weighted by the population of the relevant race and standard errors are

[9] Some firms receiving war contracts also received management training (Bianchi and Giorcelli, 2020).

[10] Metro areas are based on Census definitions. They consist of groups of counties. The primary qualification is that the county grouping contains a city of at least 50,000 people.

[11] In 1950 these 146 metro areas covered 55% of the U.S. population and 50% of the Black population. More than 90% of the Black population living outside of the South lived in metro areas. In our robustness checks we replicate our results using two alternative geographic aggregations (states and commuting zones) so as to include the entire population.

corrected for heteroskedasticity.[12]

The coefficient of interest is β_1, which represents the causal effect of local war spending on outcomes. The identification assumption is that conditional on manufacturing (and other baseline) covariates, the areas that received greater WWII expenditures would have been on the same trajectory as those receiving smaller amounts. This assumption would be violated if pre-existing trends differ (i.e., if WWII contracts went to places on different trajectories) or if areas that received higher expenditures were affected by other factors that are correlated with expenditures. Existing work provides evidence in favor of our assumption: Despite its scope and scale, WWII spending did not significantly affect local per capita economic development (Lewis, 2007; Fishback and Cullen, 2013; Jaworski, 2017; Brunet, 2018; Li and Koustas, 2019), though it did increase local populations.[13] This suggests that there were no other factors correlated with expenditures affecting the broad trajectories of areas receiving more contracts.[14] We conduct several checks to confirm that our identification assumption is reasonable, most importantly by checking pre-trends. In addition, we present IV estimates from a Bartik instrument based on industrial composition across markets and the national industrial composition of war contracts.

3.2 Data

WWII contract expenditures. Data on war contract expenditures by county come from the War Production Board's Major War Supply Contracts and Major War Facilities Projects, Jun 1940-September 1945.[15] War contracts (excluding food and food processing) worth over $50,000 are assigned to the county of the primary production plant. Electrical machinery, transportation, automotive, and iron/steel production account for 61% of expenditures. War contracts were less likely to be distributed to the South and more likely to be distributed to the Northeast, Midwest, and West (Figure A.4). These expenditures typically went to urban rather than rural areas. War contracts decreased sharply with the end of the war falling from 39% of GDP in 1945 to less than 10% by 1947.[16] Requirements of

[12]Our results are the same if we cluster standard errors at the metro level instead. Because we only have two time periods, one before and one after, adjusting for heteroskedasticity is appropriate (Bertrand et al., 2004).

[13]Consistent with the null effects on economic growth Brunet (2018) finds a small state-level fiscal multiplier for WWII expenditures of 0.25-0.30.

[14]An exception is Garin (2019) who finds persistent positive effects specifically when large new manufacturing plants were located in smaller communities.

[15]Data from the 1947 County Data Book, available through ICPSR 02896 (Haines and ICPSR, 2010).

[16]There was another, smaller increase in expenditures with the Korean War. At their highest, expenditures rose only to 15% of GDP in 1953 (Appendix Figure A.3.). The Korean War began after the 1950 Census.

non-discrimination associated with war contracts also ceased after the war.

Average war contract spending per capita across metropolitan areas was about $1,830 per person in 1940 dollars, with a standard deviation $1,715 across metro areas. For comparison, GDP per capita in 1940 was only $779. Figure A.5 shows a very skewed distribution of expenditures. All metro areas received at least some war contracts, but there is significant variation in size: 50% received less than $1,280 per capita, while almost 10% received $4,000 per capita or more (Panel A). This substantial variation in expenditures persists even after we condition on 1940 city-level characteristics, including percent employed in manufacturing, percent Black, and the predicted enlistment rate (Panel B).

Labor-market and education data. Our primary outcomes of interest come from 1920-1970 individual-level census data from IPUMs (Ruggles et al., 2020) aggregated to the race-sex-metro-year level. The individual data contains information on occupation and school enrollment for all census years. Employment is available starting in 1930. Education and wage earnings are reported starting in 1940.[17]

We define skilled occupations as individuals reporting an occupation falling under "Profession, Technical"; "Managers, Officials, and Proprietors"; "Clerical and Kindred"; "Sales workers"; "Craftsmen"; or "Operatives" categories.[18] We refer to the share of employed persons in these occupations as the "share skilled" throughout the paper. Prime-age employment is defined as the percentage of men ages 25-54 who are currently employed. The yearly wage is total wage earnings in the previous year for people who were wage-earning employees at the time of the Census.[19]

Other data. We create draft rates using the WWII Army Enlistment Records. Because draft rates might be affected by war expenditures, we use predicted draft rates based on 1940 demographics. Reassuringly, our results are robust to controlling for either the observed or the predicted draft rate. See Appendix B.2 for more details. We digitized reports on the extent of labor shortages during WWII from the monthly Labor Market Reports compiled by the War Manpower Commission (1945). Data on employment in war-related industries during WWII comes from ES-270 reports.

[17] In the 1950 1% sample, some of these outcomes were asked only of sample-line persons and are available for a small share of the population. To improve metro-level variables derived from the smaller 1950 census data, we digitized metro-level aggregates from the 1950 Census Volumes on occupation and income distributions by race and gender.

[18] Skilled occupations include occupational codes 000-093 and 200-690 under the 1950 IPUMS occupational coding scheme. Given our focus on metro areas, our results are not sensitive to whether farm owners are defined as skilled. Technically, some of these jobs could be considered "semi-skilled" jobs, but we grouped them all into a skilled category for conciseness throughout the paper. Occupational upgrading by Black workers was mainly from unskilled to semi-skilled jobs during this time.

[19] In 1940 individuals were only asked about wage income, so self-employed or business income is excluded. The majority of individuals excluded by the wage-earning employee restriction are farmers.

3.3 Determinants of WWII contracts and their wartime effects

To investigate which metro areas received more war contracts, we regress expenditures per capita on 1940 metro characteristics and predicted army enlistment rates. To facilitate comparison, we standardize all variables to have mean zero and a standard deviation of one. As expected, manufacturing is the main determinant of war expenditures (column 1 Table 1). Both the share employed in manufacturing and the (log of) manufacturing output per capita in 1940 are positive and statistically significant predictors of war production expenditures. Importantly, other measures of economic activity, like the share unemployed or the share employed in skilled occupations, do not predict expenditures. Neither does the share of the population that is Black. But as expected, the draft rate negatively and significantly predicts expenditures.[20] Overall our findings are consistent with those reported previously in the literature. Previous work shows that war contracts were allocated across the U.S. primarily based on existing industrial capacity. Contracts were not affected by political considerations (Rhode et al., 2018) nor were they targeted to places with more available labor (Brunet, 2018).

The table also shows that during the war, war contract expenditures led to greater labor shortages at the local level. A standard deviation increase in war contract expenditures in a local metropolitan area is predicted to result in a 0.469 standard deviation increase in the number of months of severe labor shortages, conditional on the predicted enlistment rate, which is also independently associated with labor shortages (column 2 of Table 1). While historical accounts describe these shortages, we are the first to provide empirical evidence that contracts led to labor shortages.

Finally we show that as expected, war contract expenditures increased the employment of Black and white workers in the defense industry during the war years (Appendix Table A5). We now turn to our primary focus: the persistent effects of war contracts.

4 Empirical labor-market effects: 1940-1950

Figure 2 presents preliminary evidence of the persistent effects of war expenditures on labor-market outcomes through 1950. This is already five years after the conclusion of the war, the cessation of war contracts, and the rescinding of the requirements of non discrimination.

[20] As does the predicted share; see Appendix Table A4. Individuals working in key war production sectors were more likely to be exempted from the draft. Reduced labor supply also could have resulted in smaller contracts.

Changes in the share of skilled employment are presented in Panel A for Black men and white men separately. The blue diamonds indicate changes between 1940 and 1950. Metro areas that received higher expenditures saw a larger, positive and statistically significant increase in the share of Black workers employed in skilled occupations. The same is not true of white workers. As the dark circles show, war expenditures were not associated with increases in the share employed in skilled occupations for Black workers prior to the war (1930-1940), providing preliminary evidence for the validity of our identifying assumption of parallel pre-trends.

Expenditures were also associated with large and statistically significant increases in wages of Black workers from 1940 to 1950 (Panel B). White workers also appear to have benefited from expenditures, though the association for them is much weaker. There is no Census wage question prior to 1940 to examine wage pre-trends.

There was substantial Black (and to a lesser extent white) migration during this period related to WWII expenditures. While Black workers had started migrating North earlier in the century (after WWI), Panel C of the figure shows that WWII expenditures redirected Black migrants towards cities with large war contracts. These cities were not receiving disproportionate numbers of migrants between 1930 and 1940, but saw very large increases in their Black populations starting in the 1940s.[21] For example Detroit, which received a very large share of WWII contracts, saw its non-white population rise from 150,790 in 1940 to 213,345 by 1944.[22]

These preliminary results are confirmed in Table 2, where we estimate equation (1). Regression analysis allows us to control for census-region-specific time trends and to weigh by the relevant population of interest. We find positive and statistically significant effects of expenditures on the share employed in skilled occupations, on wages, and on the log of population for Black workers. These results hold even when we control for baseline characteristics, including the predicted draft rate and the manufacturing share, both of which predict expenditures (column 2). The effects on white workers in columns 3 and 4 are smaller in magnitude and there is no effect on occupational upgrading.[23] In all cases we can reject (at the 5% level) the null hypothesis that the effects are the same for

[21] This result is consistent with Boustan (2009) and Derenoncourt (2019); see Appendix Section D.5.

[22] The 1944 figures come from a special census and are reported by the UAW-CIO research department in "Discrimination against Negroes in Employment 1942-7" Box 9, Folder 9-24, UAW Research Department, Archives of Reuther Library.

[23] One interpretation is that occupational segregation did not decrease and white men upgraded *within* the skilled category. We show in Appendix Table A9 that war expenditures decreased occupational segregation indexes: occupational distributions became more similar even at more granular levels. This result is consistent with limited wage increases for white men. Appendix Table A12 shows Black increases are concentrated in "Operatives" and "Craftsmen" occupational categories.

Black and white workers. Thus, war contracts reduced racial gaps in wages and skilled employment shares five years after war contracts ended.

The magnitudes of these changes for Black workers are economically meaningful. The share of Black workers in skilled occupations increased by 4.8 percentage points more in metro areas at the 90th percentile of expenditures compared with metro areas at the 10th percentile, representing a 14.7% increase relative to the mean in 1940. Similarly, the wage gains for Black workers were 9.3 log points (9.7% higher wages relative to the mean in 1940), which is higher than the estimated effects of an additional year of school at the time.[24]

War spending significantly increased migration to these areas for white workers (1.8 log points per $1000 in war spending) and more so for Black workers (4.2 log points). Thus the war effort appears to have improved labor-market outcomes of Black workers in two ways: first, by increasing the wages of Black workers already residing in these metropolitan areas and second by inducing migration into these areas. We consider the relative importance of these two factors in full general equilibrium in the quantification exercise presented in Section 7.

The last panel of the table shows that expenditures were not associated with significant changes in prime-age employment rates for either Black or white workers. Although defense employment of all groups rose significantly during the war, these effects did not persist to 1950 (Figure A.6). Consistent with previous work, we confirm these contracts were a temporary labor demand shock and did not result in different per capita economic trajectories for the receiving cities.

Threats to identification. Our main identification assumption is that cities receiving large contracts would be on similar trends as cities receiving small contracts, conditional on manufacturing levels. A first check is to test the sensitivity of the findings to adding other baseline covariates interacted with a post WWII indicator. These include the predictors of expenditures, namely manufacturing and predicted enlistment rate, and a vector of other controls from the 1940 census (share of men employed in agriculture, share Black, and average years of education). Figure A.7 presents the coefficient on $WarExp_r \times Post_t$ for a number of alternative specifications, separately for white and Black men. The coefficients are not very sensitive to the inclusion of any control. The figure shows that results hold within regions and are not driven by the North or the South specifically.

A second check is to examine pre-trends in the outcomes. War expenditures do not predict changes in outcomes from 1920 to 1930 or 1930 to 1940 (Figure A.7).

[24]OLS estimates of the returns to schooling at the time for all men range from 5% (Goldin and Katz, 2000) to 8% (Clay et al., 2012). Returns to schooling were typically lower for Black men in this time period.

IV approach. We adopt a second identification strategy and instrument for WWII expenditures. We make use of firm-level data on war contracts collected by Li and Koustas (2019) to predict expenditures at the city level based on detailed industrial composition at the local level and national expenditures by industry. This standard Bartik approach relies on a different identification assumption. Following the logic of Borusyak et al. (2019), it assumes that war expenditures across industries at the national level during WWII are as good as randomly assigned, conditional on shock-level observables.[25] Using this approach, we find that predicted expenditures are a strong predictor of actual expenditures, with an F statistic in excess of 30.

The IV estimates (Appendix Table A10 Column 3) are statistically indistinguishable from the DD coefficients for the share skilled and wages in columns 1 and 2. The IV estimates are larger for the effect on the log of the male population.[26]

The role of worker composition. Given the increase in the Black population in areas receiving WWII contracts, a natural question is whether the occupation and wage effects we observe are due to changes in the composition of workers. Our evidence suggests this is not the case. Columns 2 and 4 of Table A6 show that results are very similar when we exclude potential interstate migrants.[27] We also show in Appendix Figure A.9 that war expenditures are not associated with statistically significant changes in the share of (Black or white) prime-age men with high school degrees between 1940 and 1950.[28] Finally, Figure A.7 shows that occupational upgrading and wage increases also occurred within education and age groups.

Oaxaca-Blinder decompositions can also be informative about the extent to which changes in the distribution of workers across regions, occupations, and industries affected the wage gap. The results of such a decomposition (in Appendix C.3) are consistent with those reported in Margo (1995) and suggest that occupational upgrading—along with wage compression across education groups and occupations—are the main sources of relative wage increases for Black workers during this period, confirming that composi-

[25]See Appendix Section D.3 for more detailed discussion.

[26]For both the share skilled and wages, we cannot reject the null hypothesis of exogeneity for war expenditure per capita. Therefore, we prefer the efficient OLS estimator. The coefficients for wages for 1940-1950 are small, but there are large standard errors, likely due to the very small number of Blacks workers in the 1950 census, which recorded wages only for sample line persons (less than 0.5% of the population). The results for 1940-1960, which use a larger 5 percent sample with wages show that the wage results are very similar on the IV specification.

[27]We define a potential interstate migrant as any individual who is living in a different state than their state of birth and who is not living with a child born in their current residence state before April 1, 1942. The regression is at the individual level, clustered at the metro-year level, and controls for age, marital status, and whether born in the South.

[28]Prime-age men ages 25-54 would not have been affected by the increase in high school graduation associated with war contracts that we document below.

tion effects play a small role.[29]

Altogether these results suggest that migration and the possible changes in composition it may have generated are not the main sources of the wage and occupation changes we estimate. Rather, war expenditures increased the wages of workers already residing there (and also wages of migrants). Of course, whereas migration does not drive our difference-in-difference empirical results, it may play an important role in generating aggregate effects; we investigate this possibility in Section 7.

Other robustness checks. The choice of weights does not affect the estimated coefficients (Figure A.7). Our results are also robust to alternative levels of geographic aggregation such as commuting zones and states (Appendix Table A11.)

Women. WWII expenditures did not affect women in the long run (Figure A.7), consistent with the findings by Goldin (1991) and Rose (2018).[30] This result is surprising given that the employment of women substantially increased during the war (Appendix Table A5). There are several reasons for the difference between women and Black male workers. First, the executive orders banned discrimination on "race, creed, color, or national origin" but not on gender. Second, the large baby boom that occurred after the war resulted in many women exiting the labor force. Finally, historical accounts show that firms and unions gave preference to returning soldiers in the post WWII period. Historian Stephen Meyer writes that in the car industry "after World War II ended, gender solidarity prevailed over racial solidarity when managers and white workers accepted black men and purged white women from American auto plants."[31]

Defense and non-defense industries. It is unclear ex-ante whether non-defense industries would be affected by WWII contracts: they were indirectly affected by demand shocks (a point we return to below) but were not directly subject to the anti-discrimination policies attached to the contracts. Figure A.7 shows that the results are much larger in magnitude within the defense industry. This finding is consistent with Collins (2000)'s evidence from the Palmer survey showing that Black progress was mostly concentrated

[29]While general equilibrium implications of labor reallocation are absent from this approach, they are incorporated in our structural model in Section 7.

[30]Other work that leverages variations in the draft rate finds some evidence of persistent effects for women, for example Acemoglu et al. (2004) and more recently Goldin and Olivetti (2013) who do find some persistent effects for white women with no children.

[31]Meyer, Stephen. 2004. "The Degradation of Work Revisited: Workers and Technology in the American Auto Industry, 1900-2000." *Automobile in American Life and Society*. http://www.autolife.umd.umich.edu/Labor/L_Overview/L_Overview6.htm (accessed June 29, 2021). In her book Kesselman (1990) writes "Research has demonstrated that while the wartime labor shortage created opportunities for women, lasting change was inhibited by the government, unions, and media, and management." For a discussion of how unions treated women after the war see Loos (2005) and references therein.

in defense industries.

5 Persistent effects of WWII expenditures

Did the effects of the war expenditures persist beyond 1950? In this section we investigate this question in two ways. First, we use the same approach to extend our results to the 1920 to 1970 period. Second, we study intergenerational effects on education.

5.1 Long-term effects of expenditures 1920-1970

To investigate the long-term effects of expenditures, we estimate the following regression, after stacking the data for all census years 1920 to 1970:

$$Y_{rt} = \sum_{r \neq 1940} \beta_r WarExp_r \times \mathbb{I}_{t=j} + \gamma_r + \alpha_t + X_{rt}\rho + \varepsilon_{rt} \tag{2}$$

Here, Y_{rt} is either the log of average wages or the share in skilled occupations, $WarExp_r$ is total war expenditure per capita for metro r and is interacted with a dummy for each decade other than 1940, which serves as the reference period. For the long-term analysis, we define metro boundaries based on 1990 commuting zones to account for increasing suburbanization after 1950.[32] All other controls are defined as before and interacted with Census year indicators.

The estimated coefficients for each decennial census year are presented in Figure 3. War expenditures were negatively correlated with the share of employment in skilled occupations among Black workers in 1920 and 1930, though not statistically significantly so. The effects of expenditures becomes positive and significant in 1950 and 1960 and remain positive (though insignificant) in 1970 (Panel A). The effect on wages for Black workers (Panel B) is also positive and significant from 1950 through 1970. Expenditures have small and statistically insignificant effects for white workers for occupational upgrading and wages in all years.

One concern is that the results maybe be exclusively driven by the direct experience that Black men gained during the war. We investigate this directly by focusing on younger cohorts who would have been too young to have gained significant work experience during the war (ages 18-24 in 1950 or 18-34 in 1960). We compare them to similarly aged men in 1940. The point estimates (Table A7) for these young men are very similar to our main

[32]For example, metro areas expanded due to "white flight" to suburban counties in the 1950s and 1960s; see Boustan (2010).

results. Therefore, Black workers without war experience were also able to access higher paying occupations for many years after the war.[33]

5.2 Intergenerational effects on schooling

Could war spending have intergenerational effects? We answer this by estimating its impact on the schooling of the next generation. With the increase in labor demand during the war, one might expect school enrollment to have declined. Indeed, enrollment did temporarily decline during the war.[34] But the war production effort increased income for Black workers after the war, reducing the need for their offspring to work at young ages, and potentially increasing their schooling. WWII funds might have also indirectly affected local school spending or residential segregation by race, increasing Black families' access to better-resourced schools.

To investigate schooling effects, we first estimate the effects of war expenditures on school enrollment among 16-18 year olds across metropolitan areas between 1940 and 1950. We estimate our main DD equation (1), but with school attendance at the individual level as the outcome, and with errors clustered at the metro-year level. We focus on 16-18 year old children because almost all children in metropolitan areas, including Black children, report attending school at ages 14-15 in 1940.[35]

We find that the school attendance of Black boys increased more in areas with greater war contracts (Appendix Table A14), as evidenced by the positive and statistically significant coefficient on $WarExp_m \times Post_t$ for Black boys. The results are positive for Black girls, though about half the size and not statistically significant. The results hold if we exclude the South (Panel B), ruling out the possibility that the effects are driven by improvements in the quality of Southern schools serving Black children (Card and Krueger, 1992). There is no effect on white boys or girls in any specification.[36]

This analysis suffers from two limitations. First, the results only pertain to the few cohorts included. Second the sample in 1950 is small – only sample-line persons were

[33] These results are consistent with Collins (2000)'s findings using the retrospective Palmer Survey for six cities, who writes "it was not the training that made war-industry jobs in 1944 especially valuable to blacks later in the decade, but rather it was the continued access to the high wages associated with continuous employment in such industries relative to the wages in the other industries in which blacks were likely to work."

[34] We verified that high school enrollment and graduation rates decreased nationally during WWII using data provided by Claudia Goldin, coming from the Biennial Reports of the Commissioner of Education.

[35] In 1940, 88% (60%) of Black children ages 14-15 (16-17) attended school.

[36] In Appendix Table A15 we repeat this exercise for 1940 to 1960 and also find positive impacts on the school attendance of Black boys. As a falsification exercise, we repeat the analysis for 1930 to 1940 and find no effects (as expected) in Appendix Table A16.

asked about schooling. Thus, we present results from an alternative approach that uses completed schooling reported in the 1960 Census, a 5% sample in which all individuals were asked about years of education. With this data, we estimate the following equation,

$$Y_{irgc} = \sum_{j \neq 1939} WarExp_r \times \mathbb{I}_{c=j} \times \left(\gamma_c + \beta_c \times \mathbb{I}_{g=Black}\right) + \gamma_{rg} + \gamma_{tg} + X_{irgc}\rho + \varepsilon_{irgc} \quad (3)$$

where Y_{irgc} is a dummy equal to one if individual i of race g and graduation cohort c living in metropolitan area r graduated from high school. WWII expenditures are interacted with cohort dummies and a dummy for Black race. A cohort is defined as a three-year age group, based on expected high school graduation year. Individuals graduating high school during 1939-1941 serve as the reference group as their schooling decision was unaffected by WWII defense production. To minimize the effects of migration, we restrict the sample to non-Southern metropolitan areas and drop individuals who have moved between states in the previous five years.[37]

We estimate this regression separately by gender. In Figure 4 we plot the coefficient for $WarExp_r \times \mathbb{I}_{c=j} \times \mathbb{I}_{g=Black}$ which identifies the impact of war expenditures on Black children relative to white children for a given cohort. There is a clear increase in the share of Black boys graduating high school and a similar increase for Black girls, albeit noisier, starting with the 1942-44 graduating classes, but importantly, not before.[38] In contrast, higher war expenditures slightly lowered high school graduation rates for white children during and after WWII.

The magnitudes implied by the estimated coefficients are not trivial. The high school graduation rate for Black boys (girls) in metropolitan areas at the 90th percentile of expenditures is 6.3 (4.8) percentage points higher than the graduation rate in areas at the 10th percentile.

Why did schooling increase? We empirically investigate four potential mechanisms behind the positive impact of war spending on the schooling of Black children (see Appendix D.6): *(i)* changes in the returns to schooling, *(ii)* changes in public spending on schools, *(iii)* reductions in residential segregation, and *(iv)* increases in parental income. We find that war expenditures had no impact on the returns to school, overall or for

[37]There are two migration-related concerns. First, individuals who migrated to a metropolitan area after completing school might be counted as more (or less) treated than they actually were, which would attenuate estimates. Second, war expenditures could have differentially attracted more educated migrants among younger cohorts. To minimize these issues, we include a dummy for whether an individual was born in the South and interact with race dummies as well as a full set of cohort indicators. We also restrict the sample to non-Southern metropolitan areas since Southern metropolitan areas have substantially higher rates of within-state migration, making it more difficult to determine where someone likely received their education.

[38]Appendix Figure A.12 uses the 1940 Census to look at pre-trends across cohorts prior to WWII and finds little evidence of pre-trends for Black boys, though again finds noisier results for Black girls.

Blacks. We find no evidence that there was a change in school expenditures in cities that received more funds. Nor do we find that residential segregation fell in these cities. Thus, the most plausible mechanism is the change in family income.

6 Mechanisms

Why did war expenditures improve labor-market outcomes for Black workers more in regions receiving more funding for several decades thereafter? We consider three possible explanations. First, they could have shifted employment to industries and/or occupations that disproportionately benefited Black workers (a compositional change). Second, they could have reduced discrimination. Third, the underlying productivity of Black workers could have increased in these areas as a result of migration. We have already shown that changes in underlying productivity (i.e., educational attainment) induced by migration do not drive our difference-in-difference estimates, ruling out this third factor.[39] In this section we develop model-based empirical tests that would allow us to distinguish between the two remaining explanations.

6.1 Taste-Based Discrimination and Self Selection

We combine Becker's (1957) model of taste-based discrimination with Roy's (1951) model of self selection. This extended model preserves the key intuition from the Becker model but is more realistic (its predictions can be tested) and strictly more general. It allows for workers within each race to be heterogeneous, as in the Roy model. As a result, Black workers may work in all firms, including very discriminatory firms, if they happen to be sufficiently productive there. The model generates different empirical implications for each mechanism, which we test.

Setup. The set of goods is indexed by j, each of which is produced by a large number of identical firms. The set of workers is divided into two races (or labor groups, more generally), denoted by $g = \{a, b\}$.

As in the Roy model, workers have different productivities in different goods. Each worker chooses to produce the good that maximizes his earnings, which is simply the product of his efficiency units and the wage per efficiency unit w_{gj}, which is race g and good j specific. For analytic tractability, we assume that efficiency units are distributed Fréchet with shape parameter $\theta > 1$.

[39] We quantify the aggregate effects of migration in Section 7.

If producers of good j hire l_{gj} efficiency units of race g, then total revenue in good j is given by $A_j(l_{aj} + l_{bj})^\alpha$, where $A_j > 0$ is a labor demand shifter for good j (reflecting either productivity or demand for good j), and where $\alpha \in (0,1)$ ensures a positive and decreasing marginal revenue product of labor.

Following Becker's model of employer taste-based discrimination, producers are potentially discriminatory against race b, with $\tau_j \geq 1$ measuring the extent of discrimination of all good j producers. We order goods by the extent to which their producers discriminate, such that $j' > j \iff \tau_{j'} > \tau_j$. Employing l_{aj} efficiency units of race a is associated with a purely financial cost $l_{aj}w_{aj}$. Employing l_{bj} efficiency units of race b is associated with a cost $l_{bj}w_{bj}\tau_j$, of which $l_{bj}w_{bj}$ is financial, whereas $l_{bj}w_{bj}(\tau_j - 1)$ is the monetary equivalent of the utility cost borne by the producers, exactly as in Becker (1957).

Each firm treats marginal revenue and wages per efficiency unit as given. Total profit across all producers of good j is given by

$$\Pi_j(l_{aj}, l_{bj}) = A_j(l_{aj} + l_{bj})^\alpha - l_{aj}w_{aj} - l_{bj}w_{bj}\tau_i$$

This model differs from the standard Becker model of taste-based discrimination in two respects. First, it is more general: workers within each race are heterogeneous, as in the Roy model. In the limit, as $\theta \to \infty$, each worker is equally productive across all goods, as in the standard Becker model. Second, to avoid monopsony power, which is also not present in the Becker model, we assume that a large number of identical firms produce each good, each of whom treat w_{gj} as exogenous.

Equilibrium. Let π^L_{gj} be the endogenous share of all workers of race g hired in the production of good j and let s_{gj} be the endogenous share of all efficiency units hired in the production of good j that is supplied by race g. Finally, let $Wage_g$ be the average wage across all workers of race g, and define $\widetilde{\theta} \equiv (\theta - 1)(1 - \alpha) > 0$. With this notation we can now state the main proposition of interest, proven in Appendix E.1, which compares the effects on labor-market outcomes of changes in labor demand with the effects of changes in discrimination.

Proposition [Becker + Roy]. *The impact of changes in A_j on racial wage gaps and factor intensities are*

$$\frac{d\log(Wage_b/Wage_a)}{d\log A_j} = \frac{\pi^L_{bi} - \pi^L_{ai}}{1 + \widetilde{\theta}(1 - \sum_j \pi^L_{aj}s_{aj}) + \widetilde{\theta}(1 - \sum_j \pi^L_{bj}s_{bj})} \tag{4}$$

$$\frac{d\log(\pi^L_{bi}/\pi^L_{ai})}{d\log A_j} = -\theta\frac{d\log(Wage_b/Wage_a)}{d\log A_j} \tag{5}$$

The impact of changes in τ_j on racial wage gaps and factor intensities are

$$\frac{d\log(Wage_b/Wage_a)}{d\log\tau_j} = -\frac{\pi^L_{bi} + \widetilde{\theta}\left(s_{ai}\pi^L_{bi} + s_{bi}\pi^L_{ai}\right)}{1+\widetilde{\theta}(1-\sum_j \pi^L_{aj}s_{aj}) + \widetilde{\theta}(1-\sum_j \pi^L_{bj}s_{bj})} \tag{6}$$

$$\frac{d\log(\pi^L_{bi}/\pi^L_{ai})}{d\log\tau_j} = -\theta\mathbb{I}_{i=j} - \theta\frac{d\log(Wage_b/Wage_a)}{d\log\tau_j} \tag{7}$$

where $\mathbb{I}_{i=j}$ is an indicator that equals one if $i = j$ and zero otherwise.

First, consider the impact of an increase in labor demand for good j, A_j. This increases j's employment of both races proportionately at fixed wages, which raises aggregate labor demand relatively more for the race in which good j is initially intensive (good j is intensive in race b if and only if $\pi^L_{bj} > \pi^L_{aj}$). Since wages must adjust to clear labor markets, this raises the average wage of race b relative to race a if and only if $\pi^L_{bj} > \pi^L_{aj}$ (equation 4). Whichever direction relative wages move, relative employment of the two races within each good moves in the opposite direction, as producers move along their relative demand curves. These changes in factor intensities, however, are common across goods (equation 5).

Second, consider the impact of a decrease in discrimination in good j, τ_j. This directly increases the employment share of race b in good j, raising relative demand for race b at fixed wages. Labor-market clearing thereby requires an increase in the relative wage of race b (equation 6). This increase in the relative wage of race b reduces the employment share of race b in all goods other than good j, as producers move along their relative labor demand curves (equation 7).

In summary, an increase in labor demand for good j, A_j, raises the relative wage of race b if and only if the production of j is initially intensive in race b; and it has no differential effect on the relative employment of the two races in good j compared to any other good. In contrast, a reduction in discrimination in good j, τ_j, unambiguously raises the relative wage of race b and increases the share of race b's employment in good j compared to race a relative to all other goods.[40]

6.2 Discrimination?

To test these two predictions, we first calculate the intensity of each industry-occupation in Black labor in 1940 (assuming that the goods j in the model above correspond to industry i and occupation o pairs in the data). Black mean as a share of metro employment

[40] In Appendix E we provide a version of the above proposition in the basic Becker model.

in the defense industry and in skilled defense were only 4.9% and 2.6%, compared with 6.7% share of the metro labor force overall. Thus, both the defense industry and the skilled occupation in the defense industry were intensive in white, not Black, labor in 1940. Hence, if government expenditure only increased labor demand in the defense industry or in skilled occupations in the defense industry through 1950, without reducing discrimination, we should have expected a decline in the relative wage of Black workers in regions receiving more WWII contracts, the opposite of what we observe in the data. This is the first indication that the relevant mechanism was a reduction in discrimination, not a shift in employment to industries or industry-occupation pairs with higher initial Black employment shares.

Second, we calculate the change in Black employment intensity between 1940 and 1950 for each region and industry-occupation pair. We then test if this intensity increased more in the skilled occupations in defense in regions receiving more war contracts. Following equations (5) and (7), we estimate

$$\log\left(\frac{\pi^L_{riob,50}}{\pi^L_{rioa,50}}\right) - \log\left(\frac{\pi^L_{riob,40}}{\pi^L_{rioa,40}}\right) = \gamma_r + \beta G_r \mathbb{I}_{io} + \left[\gamma_{io}\right] + \iota_{rio}. \tag{8}$$

The dependent variable is the change over time in the log share of Black relative to white labor employed in industry-occupation *io* between 1940 and 1950. The fixed effect γ_r absorbs all common changes in factor intensities across industry-occupation pairs within region r, corresponding to the log change in the relative wage of Black and white workers on the right-hand side of equations (5) and (7). G_r is government WWII expenditure *per capita* allocated to region r and the indicator $\mathbb{I}_{io}$ takes the value one if the *io* pair corresponds to skilled defense and zero otherwise.

The coefficient of interest in regression (8) is β, which identifies the extent to which government expenditure increased the Black intensity of skilled defense. According to the theory, $\beta = 0$ if government expenditure had compositional effects alone whereas $\beta > 0$ if government expenditure reduced discrimination in skilled defense. To check robustness for national changes in racial intensity across industry-occupation pairs, we additionally estimate specifications in which we include industry effects, occupation effects, or industry*occupation effects.

The main identification assumption allowing us to identify β, and to interpret it as a change in discrimination, is that changes in productivities of Black relative to white workers in *rio* (region-industry-occupation) triplets are uncorrelated with G_r (conditional on a rich set of fixed effects that have been differenced out in equation 8).[41]

Table 5 displays our results. Across specifications, we find that β is positive and statistically significant.[42] Through the lens of the Becker model, this indicates that government wartime expenditure increased Black worker wages and the share of Black employment in skilled occupations through a reduction in discrimination in skilled occupations within the defense industry.

These results rely heavily on theory. To bolster our conclusion that discrimination fell, we now provide additional evidence from various sources.

6.3 Historical accounts of firm and union integration

Historical accounts and case studies indicate that two forces caused workplace integration during this period: pressure from civil rights activists and labor shortages. A case study of Boeing, a recipient of roughly $10 billion (2020 dollars) in WWII contracts, helps to illustrate this point.[43] In 1941, Boeing employed 29,000 workers, all of whom were white, prompting the NAACP to bring a complaint to the FEPC, which resulted in the hiring of 329 Black workers, representing only 1% of its workforce by 1943. Despite the small numbers, white workers protested.[44] Boeing pursued several alternatives to hiring more Black workers, including negotiating war deferments for its workforce and hiring women. In 1944, facing a severe labor shortage of 9,000 workers and continued pressure from civil rights activists, Boeing hired 1,600 Black workers (out of roughly 30,000 workers), all of whom joined the union, thereby ensuring their continued access to these

[41] One threat to identification would be if the unobserved characteristics of Black workers improved relative to white workers in regions receiving more spending. In our reduced-form analysis, we show that the same patterns of occupational upgrading occur within the set of non migrants (Figure A.7 and Table A6), that the average share of prime-age men who have a high school degree did not change between 1940 and 1950 as a result of government spending (Figure A.9), and that the same patterns of occupational upgrading occur within the set of workers too young to have benefited from wartime training (Table A7). Each of these facts suggests that migration and wartime job training did not affect the relative unobserved abilities of Black and white workers across regions, consistent with our identification assumption. A final threat to identification is that the unobserved characteristics of Black workers may have improved (relative to white workers in regions receiving more spending) *within* the skilled occupation in the defense industry. We test this hypothesis in Appendix Table A19, where we show that wartime spending did not increase the average education or age of Black or white workers in either skilled or unskilled occupations in defense—consistent with our identification assumption.

[42] β identifies the product of θ in equation (7) and the elasticity of discrimination in skilled defense with respect to government WWII expenditure. We estimate a similar regression in the structural model in Section 7. There, we further disaggregate workers into groups based on both race and education. Results are broadly robust.

[43] This account is based on the work of Meyers (1997) and Davenport (2006).

[44] Throughout the nation the integration of Black workers into the mostly white labor force was difficult. In 1943 there were at least 242 racial incidents in 47 cities due to racial frictions (Sitkoff, 1971).

jobs.

This account suggests a likely explanation for why employment and wage effects persisted long after the war: union integration. Prior to the war, unions explicitly denied Black workers entry into skilled jobs by refusing to grant membership, but labor shortages combined with civil rights activism led to the integration of the unions - an institutional change that persisted beyond the labor shortages and civil rights pressure of the war. Learning may have played a role in the integration of the unions, consistent with evidence on declines in discrimination in other settings.[45] Some unions integrated voluntarily (e.g. in the case of the aviation industry in Texas, see Abel, 2011), while others were forced to integrate by the courts (e.g shipyards in California, see Wollenberg 1981). Whether voluntary or due to legal pressure, once Black workers were admitted to unions, their access to higher paying jobs within the industry remained. In the next section, we provide further empirical support for these explanations.

6.4 Empirical evidence on the decline in discrimination

We now document the role of labor shortages, executive orders banning discrimination in firms receiving government contracts, and finally the integration of unions in explaining the estimated effects.

The role of labor shortages. We incorporate information on months of labor-market shortages by metropolitan area as determined and recorded by the US employment services during the war. Specifically, we re-estimate our main equation of interest, but interact WWII contracts with the number of months of severe labor shortages in each city. The coefficient on WWII contracts by itself becomes insignificant, but the interaction with shortages is positive and statistically significant (Table 3). This suggests that WWII contracts only improved labor-market outcomes for Black workers in places with labor shortages, as historians such as Wynn (1976) have concluded.

The roles of executive orders and associated civil rights activism. By comparing the effects of direct and indirect increases in demand due to war contracts we can assess the role of anti-discrimination policies. War contracts increased demand among the firms that received contracts (direct effects) and among firms that supplied the inputs to the

[45] Whatley (1990) finds that Cincinnati manufacturing firms during WWI exhibited state dependence – once they hire a Black worker they are more likely to hire Black workers in the future. Miller and Segal (2012) show that the effect of affirmative action quotas on police hiring persists even after the quotas are no longer mandatory. Miller (2017) shows similar evidence for private employers after they are no longer subject to federal contracting affirmative action policies. Finally Saez et al. (2019) find that subsidies for youth employment increased youth employment even after ending the policy due to a permanent decline in discriminatory job postings.

industries receiving defense contracts (indirect effects). For example, the direct demand for a B-17 bomber generates significant indirect demand for aluminium. However, the indirect suppliers were not bound by the executive orders and could not easily be targeted by civil rights activists and courts. If direct and indirect demand matter equally for Black outcomes, this suggests the executive orders and the civil rights efforts had little impact.

We present estimates of direct and indirect effects in Table 4. We measure the direct demand shock to each region as the sum across industries of the value of national industry wartime contracts, weighted by regional employment shares across industries. We measure the indirect demand shock similarly, but incorporating input-output linkages across sectors using historical Leontief input-output tables.[46] Direct shocks (column 1) and indirect shocks (column 2) are both associated with larger shares of Black workers in skilled jobs, when we consider their effects separately. But when we include them together (column 3) we find that only direct demand shocks led to improvements for Black workers. These results imply that labor demand shocks were not sufficient. Instead, the executive orders played an important role in converting labor demand shocks into improved labor-market outcomes for Black workers, consistent with the industry narratives.

The role of unions. From 1900 to 1935 unions had explicitly or implicitly discriminated against Black workers. This effectively barred them from obtaining well paid jobs and promotions in high paying manufacturing jobs. During the war, this changed. The research department of the UAW-CIO in 1944 reports, "In 1936 the Negro membership of trade unions was 150,000. Today there are upwards of three-quarters of a million Negroes organized into trade unions."[47] Union participation continued to rise after the war (Troy, 1965).

These drastic increases in unionization, particularly among Black workers, were tied to WWII contracts. To document this empirically, we take advantage of data newly collected by Farber et al. (2021), who compute unionization rates by state, year, and race from 1936 onward. We replicate their findings and show in Appendix Figure A.11 that areas that received more WWII contracts had higher unionization rates among workers, especially Black workers, from 1942 until 1950.[48]

Altogether, these results are consistent with the historical narratives and suggest a real decline in institutional prejudice in the form of union membership increases, which can explain why the effects of war contracts persisted for so many years. This integra-

[46] See Appendix D.4 for details of both measures.

[47] UAW Research Department, Box 9, Folder 9-24. Discrimination Against Negroes in Employment 1942-7. Archives of the Reuther Library.

[48] This is consistent with other historical evidence. Unions grew substantially among firms receiving WWII grants, including in the United Auto Worker union (UAW) (Troy, 1965).

tion however was only possible by the combination of severe labor shortages and legal efforts—facilitated by executive orders barring discrimination—that took place during the war.

7 Quantification

We have shown that WWII contracts and the associated requirement of nondiscrimination played a significant role in improving the labor-market outcomes of Black workers and the educational attainment of their offspring by comparing changes in outcomes across regions. But how much of the aggregate changes in this period can WWII expenditures account for? And how much of these improvements can be ascribed to changes in discrimination? Finally how important is migration for driving these aggregate impacts? To answer these questions, we develop and calibrate a general equilibrium model.

7.1 Model and Parametrization

We employ a quantitative variant of our simple qualitative Becker-Roy model of Section 6.1 designed to match our empirical setting. This quantitative model is more general along many margins: there are many regions, regions trade with each other and workers can migrate between regions, workers are binned into many labor groups (rather than assuming exactly two groups), and workers in different labor groups can be differentially productive (e.g., a more educated worker might provide more efficiency units than a less educated worker, and this might be particularly true in skilled jobs). In addition, we alter the assumption of the Becker model that employers pay a utility cost to hire workers against whom they discriminate. We instead assume that employers who discriminate lose some share of labor when hiring workers against whom they discriminate. In this respect, our structural model builds on Hsieh et al. (2019).[49]

Here, we sketch the model's assumptions and the parametrization. Details are provided in Appendix F.

Model Setup Overview. Aggregate consumption in each region, C_{rt}, is produced combining the consumption of each industry i, C_{rit}, according to a Cobb Douglas production function. To incorporate trade between regions, we assume that consumption of industry i in each region r, C_{rit}, is itself a CES aggregator of industry i output produced in each region j, C_{jrit}, with elasticity of substitution ρ. That is, we use an Armington model of trade

[49] In Appendix E.3 we provide a proposition showing that the qualitative impacts of changes in labor demand and discrimination are identical to those in Proposition [Becker + Roy].

in industry output, with costless trade. Industry market clearing requires that industry i output in each region r, Y_{rit}, must equal its consumption summed across all regions: $Y_{rit} = \sum_j C_{rjit}$.

Industry i output in each region r, Y_{rit}, is itself a CES combination of the local output of all industry-specific occupations, Y_{riot}, with elasticity of substitution η. Output of industry-occupation io in region r is simply the sum of net output across all the workers employed there, where the net output a worker z in group g if employed in io in region r is $T_{riogt}\varepsilon_{ziot}$. The parameter T_{riogt} combines both the systematic productivity of group g in this region and job, as well as the cost of discrimination: we express the cost of discrimination borne by the firm owner in terms of the share of output that is lost. That is, if a Black and white worker are each capable of producing 1 unit of io output in region r, but firm owners discriminate against Black workers there, then firm owners receive less than 1 unit of output from the Black worker, with the percentage decline in output being determined by the level of discrimination. We assume that the worker-job-specific value of ε_{ziot} is drawn independently from a Fréchet distribution with shape parameter $\theta > 1$.

Finally, each worker chooses where to live to maximize her expected utility. The utility of a worker z living in region r and working in industry-occupation io is given by the product of an amenity from living in region r times an amenity from working in io times the worker's real wage. The amenity from residing in region r is given by the product of a systematic component, U_{rgt}, and an idiosyncratic preference shock, ε^U_{zr}, which is distributed Fréchet with shape parameter $\nu > 1$. The amenity from working in io within region r is given by A_{riog}. We assume that each worker first draws her preference shocks across regions and chooses her region, and then draws her productivity shocks across industry-occupation pairs and chooses her industry-occupation.

Mapping theory to data. We map industries and occupations in the model, i and o, to the two aggregate industries (defense and non-defense) and the two aggregate occupations (skilled and unskilled) defined in our empirical work above. We map labor groups in the model, g, to four labor groups in the data defined by the intersection of two education levels (at least some high school and no high school) and two races (Black workers and others, referred to as "white workers").[50] Regions in the model, r, correspond to the 146 metropolitan areas used in our empirical work, and time, t, to the years 1940 and 1950.[51]

[50]The majority of Black workers and many white workers did not have any high school education in 1940. We do not assume that a given reported education implies an equivalent productivity across races; see, e.g., Boustan (2009) and Carruthers and Wanamaker (2017).

[51]We have also considered an alternative in which we map regions in the model to commuting zones in the data. The benefit of this alternative approach is that commuting zones cover the entire mainland United States. The benefits of using metropolitan areas are that the vast majority of Black workers living outside of the South in the 1940s lived in metropolitan areas and that the quantification better aligns with our baseline

Estimation of government spending effects overview. We calibrate the model elasticities, θ, ρ, η, and ν in Appendix F.4.2. Here, we outline how we estimate the anti-discriminatory effects of government spending. In Appendix F.4.3 we parameterize net productivities, T_{riogt}, and amenity values, U_{rgt}, as time-varying functions of government wartime expenditure per capita, G_r.[52] Here, we provide a brief overview of the approach to estimate the key subset of government spending effects. Details are provided in the Appendix.

The model implies there is a simple equilibrium relationship between G_r and the share of group g's labor in industry-occupation io within region r at time t, denoted by π^L_{riogt}. The relationship is almost identical to the estimating equation (8) displayed in Section 6.2. Hence, the identification assumptions are identical to those stated in Section 6.2. Unlike regression (8), here we estimate not only the impact of government expenditure on Black worker intensity in the skilled occupation in the defense industry, but also in the unskilled occupation in the defense industry.

The model also implies there is a related, simple equilibrium relationship between G_r and the share of group g living in region r at time t, denoted by π^N_{rgt}. According to this equation, differential changes between 1940 and 1950 in the allocations of Black and white workers (relative to that predicted by the observed changes in wages) across regions receiving different amounts of war contracts identify the anti-discriminatory effects of government contracts on amenities. The identification assumption is that, conditional on fixed effects, the differential changes in amenities of Blacks (relative to whites) in regions receiving more government contracts that would have occurred in the absence of government spending are uncorrelated with government contracts.

We find that government spending during World War II had substantial anti-discriminatory effects. Regions receiving more contracts experienced a substantial reduction in racial discrimination in the labor market—although limited to skilled occupations within defense industries—and became more attractive places for Black workers to live, conditional on wages.

empirical results. In spite of these differences, results are very similar across the two quantifications; for example the aggregate impact of wartime spending accounts for approximately 30% (25%) of the total decline in the racial wage gap between 1940 and 1950 in the commuting zone (metropolitan area) quantification.

[52] We also allow the amenity associated with working in io within region r, A_{riog}, to vary over time with G_r. This allows us to match the relationship between G_r and changes in average wages within each $riog$. However, in our calibration we set A_{riog} constant across time since observed changes in wages within $riog$ cells match our model's predictions (that arise from the assuming that idiosyncratic productivities are distributed Fréchet) without time-varying amenities across io pairs within r.

7.2 Aggregate results

We use the model to quantify *(i)* the total impact of government wartime spending on aggregate improvements in the labor-market outcomes of Black workers over this period; *(ii)* the extent to which these effects of wartime spending are driven by reductions in discrimination; and *(iii)* the importance of migration.

First, we calibrate our model to match 1940 data and feed into our model the estimated changes in net productivities and amenities (as well as observed changes in aggregate populations by group). Upon feeding in these shocks, we solve the model for the 1950 equilibrium, holding all other parameters at their 1940 levels. Given the counterfactual 1950 equilibrium, we measure the aggregates of interest.

Table 6 reports our results. The first column reports the change in the share of Black relative to white workers in skilled occupations and the percent (ln) change in the wage of Black relative to white workers in the actual data between 1940 and 1950 aggregated across the 146 metropolitan areas. The second column reports the changes in these outcomes caused by wartime expenditure according to the model. Wartime spending causes a 2.7 percentage point decline in the difference between the share of white and Black workers employed in skilled jobs between 1940 and 1950, about a third of the total decline of 8.2 percentage points in the data. Wartime spending causes a 5.6% decline in the relative wage of white to Black workers between 1940 and 1950, which is a quarter of the total decline of 22.6% in the data. The third column reports the changes in these outcomes caused by the anti-discriminatory impacts of wartime expenditure. Almost all of the aggregate effects of wartime spending on the Black-white wage and skilled-employment gaps are caused by the anti-discriminatory effects of wartime spending. This result confirms the results of Section 6.2 in a richer environment.

The last two columns report the changes in these outcomes caused by wartime expenditure if there were no migration between 1940 and 1950.[53] While migration has only a small impact on the change in the relative share of Black workers in skilled occupations, it has a large effect on the aggregate contraction of the Black-white wage gap. In particular, without migration the impact of government spending on the wage gap would have been a third smaller. The intuition is straightforward. Government spending reduces discrimination, thereby improving real wages and amenities for Black workers initially living in metro areas receiving more spending per capita. Migration spreads these benefits more widely, as workers initially living elsewhere migrate towards regions receiving more spending. Thus, migration increases the aggregate impact of spending on Black

[53]In this case, we increase the population of each group g in each region r proportionately, to match the observed increase in the aggregate population of group g.

labor-market outcomes.[54]

8 Conclusion

Black workers experienced unprecedented improvements in their absolute and relative status in the 1940s. Leveraging both local labor-market comparisons and a structural model, we document that WWII contracts and their associated anti-discriminatory requirements were responsible for a substantial part of these gains. The contracts increased labor demand at a time when labor supply fell due to the draft. In addition, the president's Executive orders created a political and legal framework that allowed civil rights activists to demand employment and promotion of Black workers among firms receiving government contracts. Historians are divided regarding the relative role of these forces (Abel, 2011). Most acknowledge the importance of labor shortages and dismiss the role of the FEPC, while others give greater importance to the executive orders and the efforts of civil rights activists. This paper argues based on new evidence that these two forces complemented each other and that each alone was insufficient.

The effects of these WWII events persisted long-term: In labor markets that received more contracts, Black workers continued to earn higher wages and work in higher skilled occupations until at least 1970. This contrasts with more recent settings in which Black worker gains in tight labor markets are transitory. We provide evidence that a key difference in the 1940s was that the temporary rise in labor demand (and fall in labor supply) coincided with anti-discriminatory policy. This combination led to a persistent decline in discrimination, manifested in the desegregation of unions.

Importantly we find that these labor-market gains translated into higher educational achievement among Black children. Greater income among the parents is the most likely mechanism for these increases. Thus, we conclude that labor-market policies can have important intergenerational effects. Much of the existing literature and policy debate on racial gaps in schooling focuses on disparities in educational inputs for Black and white children. Our findings suggest that efforts to reduce the racial gap in schooling should also consider interventions that address existing discrimination in the labor market.

Our results have important implications for today. Systematic racial discrimination in hiring is still prevalent in the private sector (Kline et al., 2021). The US is also experiencing

[54]This result is consistent with Boustan (2009), yet differs in two respects. First, it incorporates general equilibrium adjustments in response to the massive migration that occurred. Second, it identifies the impact on the aggregate racial wage gap of only that portion of migration that was causally induced by government war policies.

severe labor shortages. We show that anti-discriminatory policy during such shortages can have large and persistent effects on racial wage gaps.

References

Aaronson, Daniel and Bhashkar Mazumder, "The effect of Rosenwald schools on Black achievement," *Journal of Political Economy*, 2011, *119* (5), 821–888.

Abel, Joseph, "African Americans, labor unions, and the struggle for fair employment in the aircraft manufacturing industry of Texas, 1941-1945," *The Journal of Southern History*, August 2011, *77* (3), 595–638.

Acemoglu, Daron, David Autor, and David Lyle, "Women, war and wages: The effect of female labor supply on the wage structure at mid-century," *Journal of Political Economy*, 2004, *112* (3), 497–551.

Bayer, Patrick and Kerwin Kofi Charles, "Divergent Paths: A new perspective on earnings differences between Black and white men since 1940," *The Quarterly Journal of Economics*, 2018, *133* (3), 1459–1501.

Becker, Gary S., *The Economics of Discrimination*, Chicago: University of Chicago Press, 1957.

Bertrand, Marianne and Sendhil Mullainathan, "Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination," *American Economic Review*, 2004, *94* (4), 991–1013.

__, Esther Duflo, and Sendhil Mullainathan, "How much should we trust differences-in-differences estimates?," *The Quarterly Journal of Economics*, 2004, *119* (1), 249–275.

Bianchi, Nicola and Michela Giorcelli, "Not all management training is created equal: Evidence from the Training Within Industry program," Working Paper 2020.

Billips, Robert S., "Hourly entrance rates of common laborers in 20 industries, July 1936," *Monthly Labor Review*, 1936, *44* (4), 938–952.

Bishop, John, "Why the apathy in American high schools," *Educational Researcher*, 1989, *18* (1), 6–10.

Borusyak, Kirill, Peter Hull, and Xavier Jaravel, "Quasi-experimental shift-share research designs," Working Paper 2019.

Boustan, Leah Platt, "Competition in the promised land: Black migration and racial wage convergence in the North, 1940-1970," *Journal of Economic History*, 2009, *69* (3), 755–782.

__, "Was postwar suburbanization 'White Flight'? Evidence from the black migration," *Quarterly Journal of Economics*, 2010, *125* (1), 417–443.

Brouillette, Jean-Felix, Charles I. Jones, and Peter J. Klenow, "Race and economic well-being in the United States," Working Paper 2021.

Brunet, Gillian, "Stimulus on the home front: The state-level effects of WWII spending," Working Paper 2018.

Burstein, Ariel, Eduardo Morales, and Jonathan Vogel, "Changes in between-group inequality: Computers, occupations, and international trade," *American Economic Journal: Macroeconomics*, 2019, *11* (2), 348–400.

Card, David and Alan Krueger, "School quality and Black-white relative earnings: A direct assessment," *The Quarterly Journal of Economics*, 1992, *107* (1), 151–200.

Carrington, William J. and Kenneth R. Troske, "On measuring segregation in samples with small units," *Journal of Business and Economic Statistics*, 1997, *15* (4), 402–409.

Carruthers, Celeste K. and Marianne H. Wanamaker, "Separate and unequal in the labor market: Human capital and the Jim Crow wage gap," *Journal of Labor Economics*, 2017, *35* (3), 655–692.

Charles, Kerwin Kofi and Jonathan Guryan, "Prejudice and wages: An empirical assessment of Becker's The Economics of Discrimination," *Journal of Political Economy*, 2008, *116* (5), 773–809.

Clay, Karen, Jeff Lingwall, and Melvin Stephens, "Do schooling laws matter? Evidence from the introduction of compulsory attendance laws in the United States," Working Paper 18477 2012.

Collins, William, "African-American economic mobility in the 1940s: A portrait from the Palmer Survey," *Journal of Economic History*, 2000, *60* (3), 756–781.

_ , "Race, Roosevelt, and wartime production: Fair employment in World War II labor markets," *The American Economic Review*, 2001, *91* (1), 272–286.

Collins, William J., "The Great Migration of Black Americans from the US South: A guide and interpretation," Working Paper 27268 2020.

_ **and Marianne H. Wanamaker**, "Selection and income gains in the Great Migration of African Americans," *American Economic Journal: Applied*, 2014, *6* (1), 220–252.

_ **and Robert A. Margo**, "Historical perspectives on racial differences in schooling in the United States," Working Paper 9770 2003.

Commission, U.S. Government War Manpower, *The Labor Market*, Reports and Analysis Service, 1945.

Cutler, David M., Edward L. Glaeser, and Jacob L. Vigdor, "The rise and decline of the American ghetto," *Journal of Political Economy*, 1999, *107* (3), 455–506.

Derenoncourt, Ellora, "Can you move to opportunity? Evidence from the Great Migration," Working Paper 2019.

_ **and Claire Montialoux**, "Minimum wages and racial inequality," Working Paper 2019.

Donohue, John J. and James Heckman, "Continuous versus episodic change: The impact of civil rights policy on the economic status of Blacks," *Journal of Economic Literature*, 1991, *29* (4), 1603–1643.

Duncan, Otis and Beverly Duncan, "A methodological analysis of segregation indexes," *American Sociological Review*, 1955, *20* (2), 210–217.

Eckert, Fabian, Adres Gvirtz, and Michael Peters, "A consistent county-level crosswalk for US spatial data since 1790," Working Paper 2018.

Fajgelbaum, Pablo D., Eduardo Morales, Juan Carlos Suarez Serrato, and Owen Zidar, "State taxes and spatial misallocation," *The Review of Economic Studies*, 2019, *86* (1), 333–376.

Farber, Henry S., Daniel Herbst, Ilyana Kuziemko, and Suresh Naidu, "Unions and inequality over the twentieth century: New evidence from survey data," *The Quarterly Journal of Economics*, 2021, *136* (3), 1325–1385.

Ferrara, Andreas, "World War II and Black economic progress," Working Paper 2020.

Fishback, Price and Joseph A. Cullen, "Second World War spending and local economic activity in US counties, 1939-58," *The Economic History Review*, 2013, *66* (4), 975–992.

Fishback, Price V. and Valentina Kachanovskaya, "The multiplier for federal spending in the states during the Great Depression," *The Journal of Economic History*, 2015, *75* (1), 125–162.

Frazier, Edward K. and Jacob Perlman, "Entrance rates of common laborers, July 1939," *Monthly Labor Review*, 1939, *46* (12), 1450–1465.

Galle, Simon, Andres Rodriguez-Clare, and Moises Yi, "Slicing the pie: Quantifying the aggregate and distributional effects of trade," Working Paper 2018.

Garin, Andy, "Public investment and the spread of 'good-paying' manufacturing jobs: Evidence from World War II's big plants," Working Paper 2019.

— **and Jonathan Rothbaum**, "The Long-Run Impacts of Public Industrial Investment on Regional Development and Economic Mobility: Evidence from World War II," Working Paper 2022.

Goldin, Claudia, "The role of World War II in the rise of women's employment," *American Economic Review*, 1991, *81* (4), 741–756.

— **and Claudia Olivetti**, "Shocking Labor Supply: A Reassessment of the Role of World War II on Women's Labor Supply," *American Economic Review*, 2013, *103* (3), 257–262.

— **and Lawrence Katz**, "Education and income in the early 20th century: Evidence from the Prairies," *The Journal of Economic History*, 2000, *60* (3), 782–818.

— **and Robert Margo**, "The Great Compression: The wage structure in the United States at mid-century," *The Quarterly Journal of Economics*, 1992, *107* (1), 1–34.

Haines, Michael R. and ICPSR, "Historical, Demographic, Economic, and Social Data: The United States, 1790-2002," 2010.

Head, Keith and Thierry Mayer, "Gravity equations: Workhorse, toolkit, and cookbook," in G. Gopinath, E. Helpman, and K. Rogoff, eds., *Handbook of International Economics*, Vol. 4, Elsevier, 2014, chapter 3, pp. 131–195.

Hsieh, Chang-Tai, Erik Hurst, Charles I. Jones, and Peter J. Klenow, "The allocation of talent and U.S. economic growth," *Econometrica*, 2019, *87* (5), 1439–1474.

Jaworski, Taylor, "World War II and the industrialization of the American South," *The Journal of Economic History*, 2017, *77* (4), 1048–1082.

Juhn, Chinhui, "Black-White Employment Differential in a Tight Labor Market," in Robert Cherry and William M. Rodgers III, eds., *Prosperity For All? The Economic Boom and African Americans*, Russell Sage Foundation, 2000, pp. 88–109.

Kesselman, Amy, *Fleeting opportunities: Women shipyard workers in Portland and Vancouver during World War II and reconversion*, New York: State University of New York Press, 1990.

Kline, Patrick M., Evan K. Rose, and Christopher R. Walters, "Systemic Discrimination Among Large U.S. Employers," NBER Working Papers 29053, National Bureau of Economic Research, Inc July 2021.

Lafotune, Julien, Jesse Rothstein, and Diane W. Schanzenbach, "School finance reform and the distribution of student achievement," *American Economic Journal: Applied Economics*, 2018, *10* (2), 1–26.

Lang, Kevin and Ariella Kahn-Lang Spitzer, "Race discrimination: An economic perspective," *Journal of Economic Perspectives*, 2020, *34* (2), 68–89.

Lewis, Robert, "World War II manufacturing and the postwar Southern economy," *Journal of Southern History*, 2007, *73* (4), 837–866.

Li, Zhimin and Dmitri Koustas, "The long-run effects of government spending on structural change: Evidence from Second World War defense contracts," *Economics Letters*, 2019, *178*, 66–69.

Loos, Shoshana, "Women and unions during World War Two: How social climate affected women's labor participation in World War Two," Working Paper 2005.

Margo, Robert, "Explaining Black-white wage convergence, 1940-1950," *ILR Review*, 1995, *48* (3), 470–481.

Margo, Robert A., "Explaining Black-white wage convergence 1940-1950: The role of the Great Compression," Working Paper 44 1993.

Miller, Amalia R. and Carmit Segal, "Does temporary affirmative action produce persistent effects? A study of Black and female employment in law enforcement," *The Review of Economics and Statistics*, 2012, *94* (4), 1107–1125.

Miller, Conrad, "The persistent effect of temporary affirmative action," *American Economic Journal: Applie Economics*, 2017, *9* (3), 152–190.

Reardon, Sean F., "The widening academic achievement gap between the rich and the poor: New evidence and possible explanations," in Greg J. Duncan and Richard J. Murnane, eds., *Whither opportunity? Rising Inequality, Schools and Children's Life Chances*, Russell Sage Foundation, 2011, chapter 5, pp. 91–116.

— , **Ericka S. Weathers, Erin M. Fahle, Heewon Jang, and Demetra Kalogrides**, "Is separate still unequal? New evidence on school segregation and racial academic achievement gaps," Working Paper 19-06 2019.

Rhode, Paul W., James M. Snyder Jr., and Koleman Stumpf, "The Arsenal of Democracy: Production and politics during WWII," *Journal of Public Economics*, 2018, *166*, 145–161.

Rose, Evan, "The rise and fall of female labor force participation during World War II in the United States," *The Journal of Economic History*, 2018, *78* (3), 1–39.

Roy, Andrew D., "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 1951, *3*, 135–146.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek, "IPUMS USA: Version 10.0 [dataset]," 2020.

Saez, Emmanuel, Benjamin Schoefer, and David Seim, "Hysteresis from employer subsidies," Working Paper 26391 2019.

Sitkoff, Harvard, "Racial militancy and interracial violence in the Second World War," *The Journal of American History*, 1971, *58* (3), 661–681.

Smith, James and Finis Welch, "Black economic progress after Myrdal," *Journal of Economic Literature*, 1989, *27* (2), 519–564.

System, U.S. Selective Service, *Special Monographs of the Selective Service System*, Washington, D.C.: Government Printing Office, 1956.

Taubman, Paul, "Role of Parental Income in Educational Attainment," *The American Economic Review*, 1989, *79* (2), 57–61.

Troy, Leo, *Trade union membership, 1897-1962*, NBER, 1965.

Turner, Sarah E. and John Bound, "Closing the gap or widening the divide: The effects of the G.I. Bill and World War II on the educational outcomes of Black Americans," *Journal of Economic History*, 2003, *63* (1), 145–177.

Whatley, Warren, "Getting a foot in the door: Learning, state dependence, and the racial integration of firms," *The Journal of Economic History*, 1990, *50* (1), 43–66.

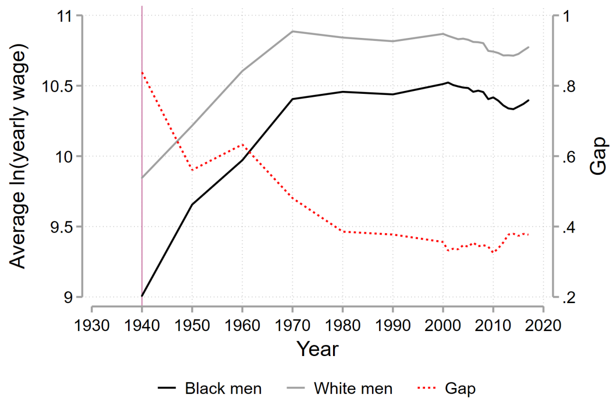
— , "African American strikebreaking from the Civil War to the New Deal," *Social Science History*, 1991, *13*.

Wright, Gavin, *Old South New South: Revolutions in the Southern economy since the Civil War*, Basic Books, 1986.

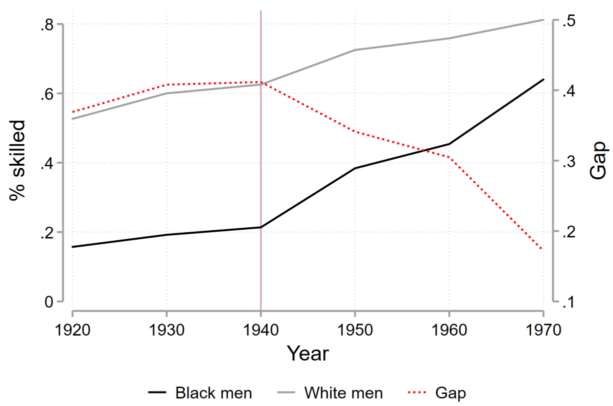
Wynn, Neil A., *The Afro American and the Second World War*, Holmes and Meier Publishers, 1976.

Figure 1: Long-term trends in Black-White gaps

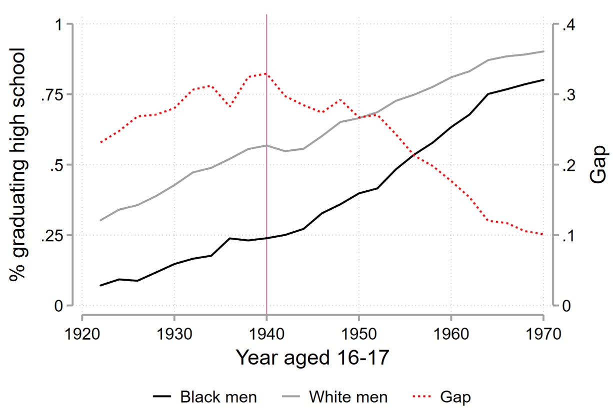
Panel A: Average (log of) wages



Panel B: Share in skilled occupations



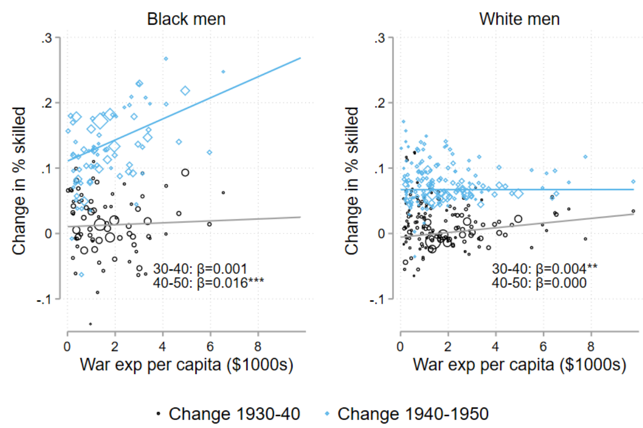
Panel C: Share graduating HS



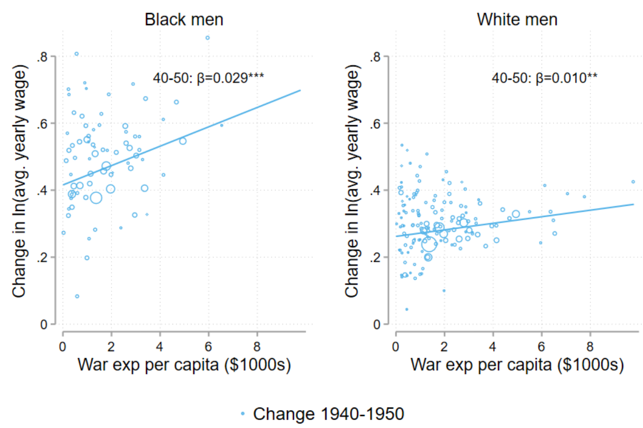
Note: Share skilled is the share of employed men who are not farmers, laborers, or service workers. Wages are total wage earnings (2017 dollars) in the previous year for men ages 25-54 who are currently employees. Share graduating high school is based on share completing at least twelve years of school by age 35. Data from Census and ACS samples for 1920-2017 accessed from IPUMS (Ruggles et al., 2020).

Figure 2: Raw changes in outcomes by metro area

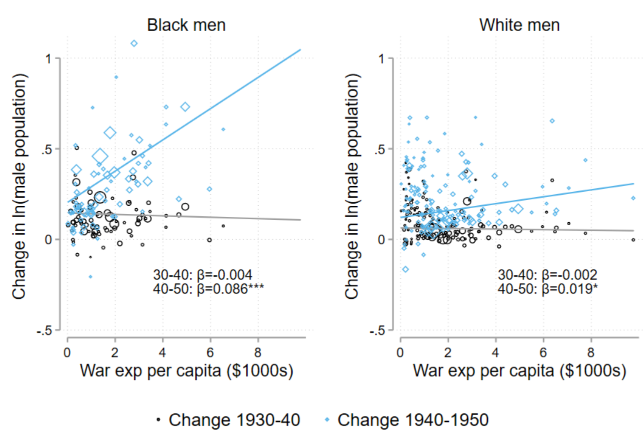
Panel A: Share in skilled occupations



Panel B: ln(Average yearly wage)



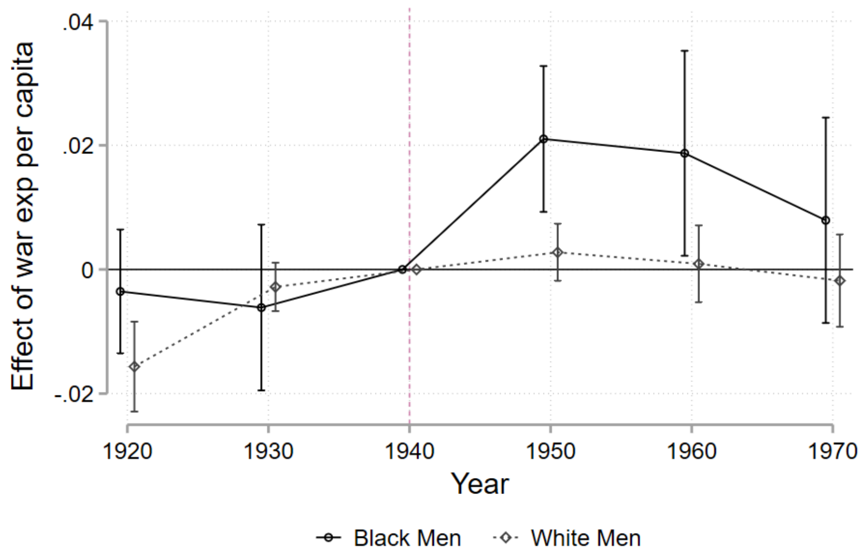
Panel C: ln(Male population)



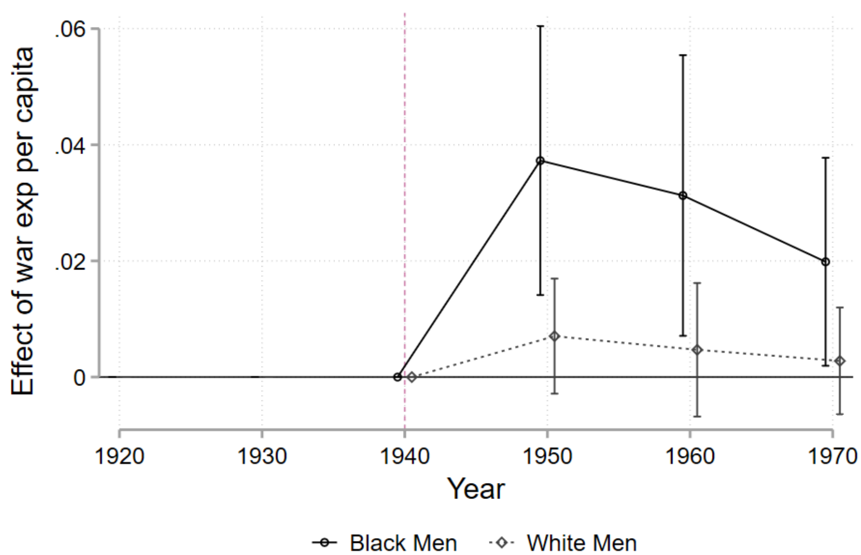
Note: Each point represents a metropolitan area. Metro areas with a relevant population of less than 2500 are omitted for visual clarity but are included in regressions. There is no wage data in the 1930 Census. Data is from 1930 Census (5%), 1940 Census (100%), and 1950 Census (1%) samples. Regressions are weighted by the relevant population, and robust SEs are used. *p<.1; **p<.05; ***p<.01

Figure 3: Long-term impacts of war expenditures (1920-1970)

Panel A: Share in skilled occupations



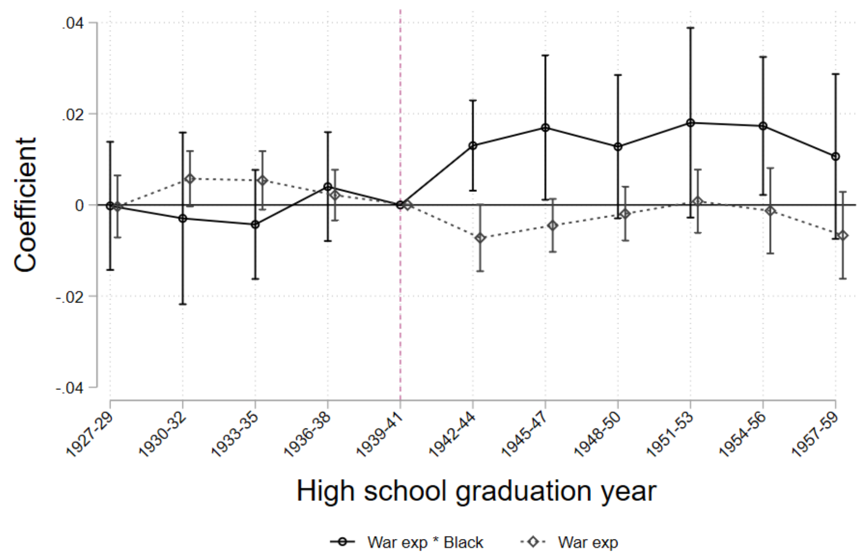
Panel B: ln(Average yearly wage)



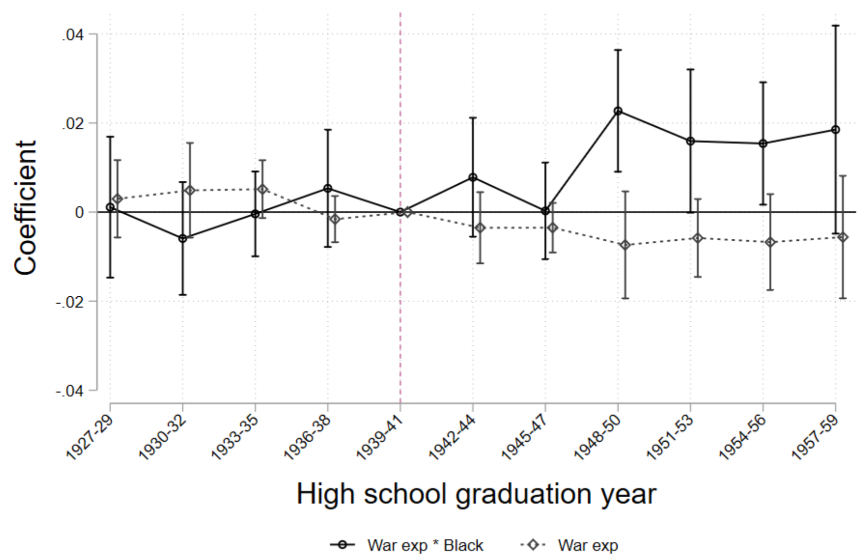
Note: See equation (2) for the basic specification; regressions are run separately for Black and white men, but the coefficients are plotted on the same graph. Controls include aggregate Census division, share employed in manufacturing, share employed in agriculture, share Black, and years of education in the first available year; each is interacted with a full set of year indicators; omitting the base year (1940). Commuting zone boundaries for metropolitan areas are used instead of 1940 and 1950 metropolitan area definitions due to changing metropolitan area boundaries over time. This results in some metropolitan areas being combined or dropped, leaving 135 commuting zones. Data comes from the 1920-1970 Census samples.

Figure 4: Effects of war expenditures on high school graduation rates

Panel A: Boys



Panel B: Girls



Note: See equation (3) for the estimating equation. Intervals are 95% confidence intervals. Cohorts are grouped by expected graduation year, and the sample excludes the South and individuals who are not living in metropolitan areas or who have moved to a state other than their birth state in the previous five years. Graduating high school is defined as having completed 12 years of schooling in 1960. Fixed effects include metro-race FE and cohort-race FE. Other controls interacted with race include indicators for whether born in the South interacted with race and cohort indicators. Results are similar if controls for veteran status are included. Data comes from the 1960 Census (5% sample).

Table 1: Predictors of per capita war expenditure

	(1) War exp per capita	(2) Months of labor shortages 1942-44
War exp per capita		0.469***
		(0.103)
Predicted draft rate	-0.174***	0.181**
	(0.064)	(0.090)
ln(Avg yearly wage)	0.012	-0.168
	(0.140)	(0.127)
% Agriculture	0.021	-0.237*
	(0.141)	(0.136)
% Government	0.078	0.277***
	(0.153)	(0.071)
% Manufacturing	0.397***	0.135
	(0.139)	(0.107)
ln(Mfg. value added per capita)	0.176**	0.104
	(0.081)	(0.099)
% Skilled	0.151	-0.067
	(0.176)	(0.147)
% Unemployed	-0.042	-0.149*
	(0.089)	(0.080)
% Black	0.039	0.146
	(0.075)	(0.115)
ln(Population)	-0.027	0.060
	(0.077)	(0.090)
Northeast	0.021	0.008
	(0.095)	(0.106)
Midwest	0.034	0.080
	(0.146)	(0.112)
West	0.111	0.365***
	(0.097)	(0.101)
R2	0.33	0.46
N	146	132

Note: An observation is a metro area, and all variables are as of 1940 and have been standardized to have $\mu = 0$ and $\sigma^2 = 1$. The denominator for percentage variables is the number of employed men except for the % unemployed for which it is the number of men in the labor force. Omitted aggregate Census division category is the South. War expenditure per capita in 1940 dollars. Months of labor shortages are percentage of months 1942-1944 with acute labor shortages according to Labor Market Reports. Only 132 of the 146 metro areas are identified in these reports. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table 2: Effect of war expenditures (1940-1950)

	(1)	(2)	(3)	(4)
	Black Men		White Men	
	Basic	Controls	Basic	Controls
Panel A: Share skilled				
War exp per capita * Post	0.010**	0.013***	-0.001	0.000
	(0.004)	(0.005)	(0.001)	(0.001)
Mean Y - 1940	0.33	0.33	0.77	0.77
Mean Y - 1950	0.48	0.48	0.83	0.83
Panel B: ln(Average yearly wage)				
War exp per capita * Post	0.030**	0.025**	0.007*	0.006*
	(0.011)	(0.012)	(0.003)	(0.004)
Mean Y - 1940	6.59	6.59	7.30	7.30
Mean Y - 1950	7.09	7.09	7.58	7.58
Panel C: ln(Male population)				
War exp per capita * Post	0.047***	0.042**	0.014**	0.018***
	(0.016)	(0.018)	(0.006)	(0.006)
Mean Y - 1940	10.80	10.80	13.25	13.25
Mean Y - 1950	11.22	11.22	13.36	13.36
Panel D: Prime-age employment rate				
War exp per capita * Post	-0.004	-0.005	-0.004**	-0.002
	(0.004)	(0.005)	(0.001)	(0.002)
Mean Y - 1940	0.80	0.80	0.87	0.87
Mean Y - 1950	0.84	0.84	0.92	0.92
Metro areas	146	146	146	146
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	-	X	-	X
Draft control	-	X	-	X

Note: Sample is 146 metro areas. See equation (1) for the basic specification. War expenditure is $1000s per capita. Share skilled is the share of employed men who are not farmers, laborers, or service workers. Wages are total wage earnings in the previous year for men who are currently employees. Prime-age employment is the share of men ages 25-54 who are employed. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Metro area definitions are based on 1940 and 1950 Census Bureau definitions. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table 3: Labor shortages, war expenditures, and the share of workers in skilled occupations (1940-1950)

	(1)	(2)	(3)	(4)	(5)	(6)
		Black men			White men	
War exp per capita * Post	0.013**		-0.001	-0.000		0.003**
	(0.005)		(0.008)	(0.001)		(0.001)
Labor shortage % * Post		0.062***			-0.007	
		(0.012)			(0.006)	
War exp per capita * Labor shortage % * Post			0.016**			-0.003**
			(0.007)			(0.001)
Observations	252	252	252	264	264	264
Mean war exp per capita	1.93	1.93	1.93	1.93	1.93	1.93
% of months with labor shortage	0.21	0.21	0.21	0.21	0.21	0.21
Metro FE	X	X	X	X	X	X
Division-Year FE	X	X	X	X	X	X
Baseline controls	X	X	X	X	X	X
Draft control	X	X	X	X	X	X

Note: The outcome is share of employed Black men in skilled occupations. Sample is 132 metro areas with data on labor shortages. Months of labor shortages are percentage of months 1942-1944 with acute labor shortages according to Labor Market Reports. War expenditure is $1000s per capita. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table 4: Skill upgrading and direct vs. indirect expenditure (1940-1950)

	(1) Direct demand	(2) Indirect demand	(3) Both
Direct value add * Post	0.078***		0.073***
	(0.021)		(0.022)
Indirect value add * Post		0.070	0.028
		(0.043)	(0.043)
Mean Y - 1940	0.33	0.33	0.33
Mean Y - 1950	0.48	0.48	0.48
Metro areas	146	146	146
Mean war exp per capita	1.83	1.83	1.83
Metro FE	X	X	X
Division-Year FE	X	X	X
Controls	X	X	X

Note: The outcome is share of employed Black men in skilled occupations. See Appendix Section D.4 for a discussion of how the direct and indirect value added measures are created. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, predicted draft rate and share Black. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. All values are in 1940 dollars. Regressions are weighted by employed Black population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table 5: Effect of war expenditures on Black intensity of skilled defense work (reduction in discrimination)

	(1)	(2)	(3)	(4)
β	0.162***	0.117***	0.139***	0.169***
	(0.019)	(0.023)	(0.017)	(0.040)
Observations	405	405	405	405
R-squared	0.276	0.304	0.282	0.332
γ_r	X	X	X	X
γ_i	-	X	-	-
γ_o	-	-	X	-
γ_{io}	-	-	-	X

Note: An observation is an r, i, o cell and only includes individuals living in metro areas. War expenditure is $1000s per capita. Occupational shares are shares of employed men. Regressions are weighted by black employment in 1940 in the *rio* cell. Standard errors are clustered at the r level. *p<.1; **p<.05; ***p<.01

Table 6: Ability of war expenditure shocks to explain aggregate changes in race gaps

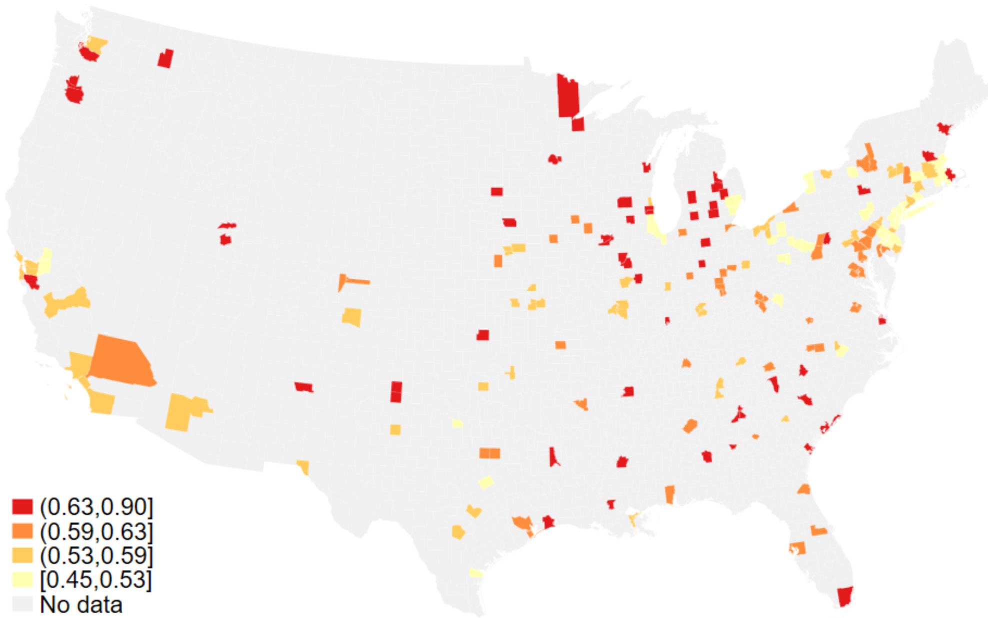
	(1)	(2)	(3)	(4)	(5)
	Actual	Model		Model - No migration	
	Total	All shocks	Anti-discrim. only	All shocks	Anti-discrim. only
Change in black-white gap in share skilled:					
Δ1940-50	-0.082	-0.027	-0.026	-0.023	-0.023
% explained		*32.6%*	*32.1%*	*28.5%*	*28.3%*
Change in black-white gap in ln(avg. yearly wage):					
Δ1940-50	-0.226	-0.056	-0.058	-0.038	-0.040
% explained		*25.0%*	*25.5%*	*16.9%*	*17.8%*

Note: Sample are men living in one of 146 metro areas. Column 1 is the actual change in the gap between Black and white men. Column 2 gives the change in the gap due to all war expenditure shocks. Column 3 gives the change in the gap due to anti-discriminatory shocks. % explained is the percent of the actual change that can be explained by the given shocks. Columns 4 and 5 repeat columns 2 and 3 except with the migration channel removed. Share skilled is the share of employed men who are not farmers, laborers, or service workers. Wages are total wage earnings (1940 dollars) in the previous year for men who are currently employees. Primary data sources are 1940 (100%) and 1950 (1%) Census samples.

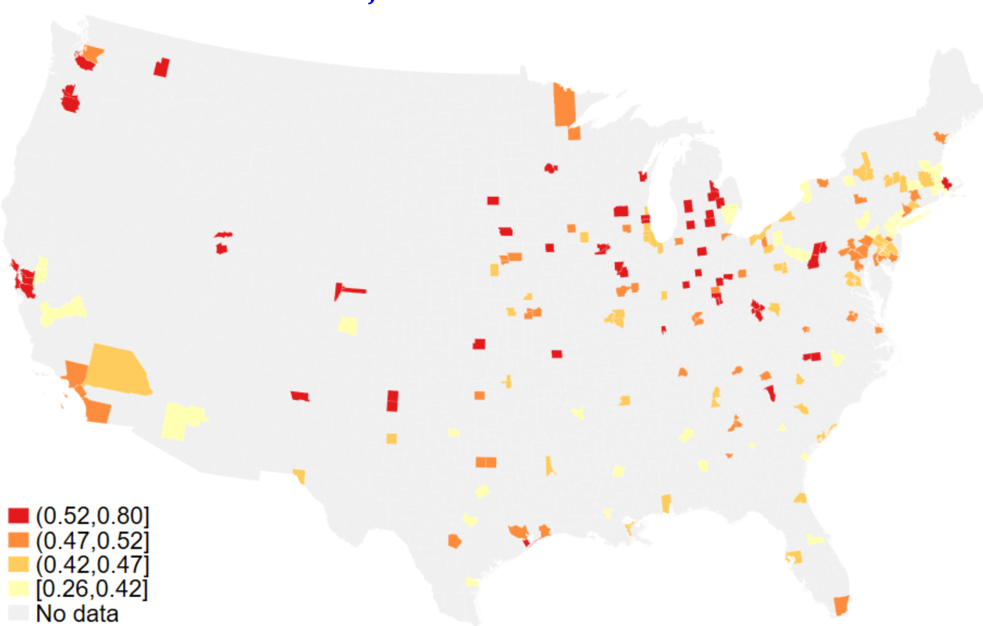
A Appendix Tables and Figures

Figure A.1: Black vs. white men occupational dissimilarity index by metro area (1940)

Panel A: Unadjusted

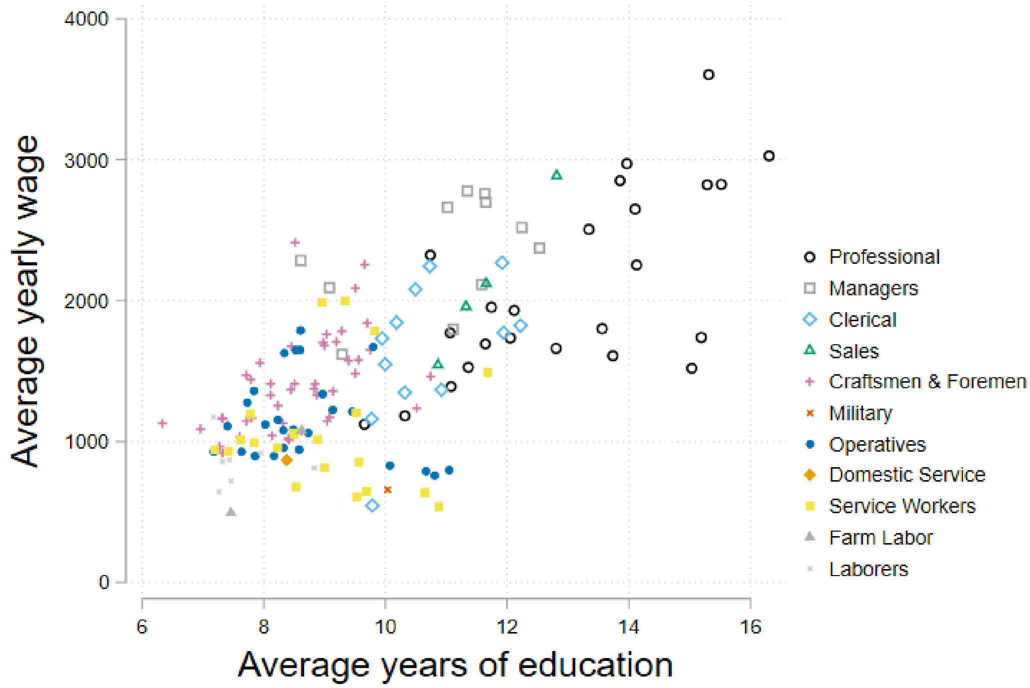


Panel B: Adjusted for randomness and education



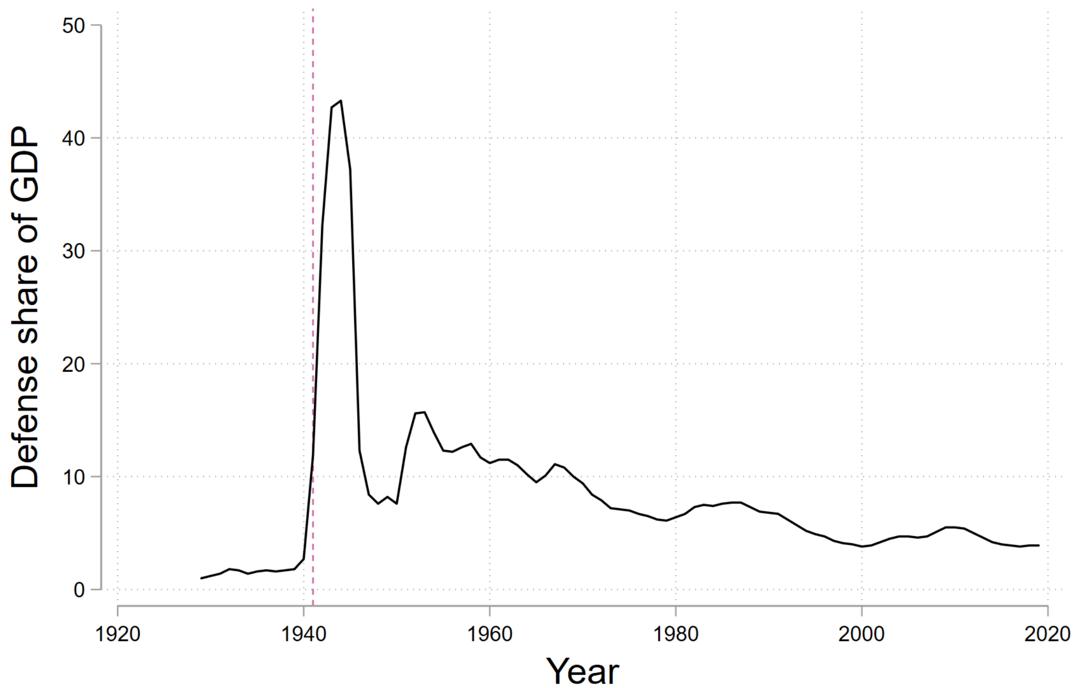
Note: For 146 metro areas, as defined by the Census Bureau in 1940 and 1950. Panel A presents unadjusted occupational dissimilarity indices, while Panel B adjusts for education (5 groups) and randomness. For more details on the creation of these measures, please see Appendix Section C.2.

Figure A.2: Average yearly wage and years of education by occupation for white men (1940)



Note: Each point is an occupation from the 1950 Census occupational coding scheme with at least 10,000 employed white men. Average yearly wage is average total wage earnings within the occupational group (1940 dollars) in the previous year for men who are currently employees.

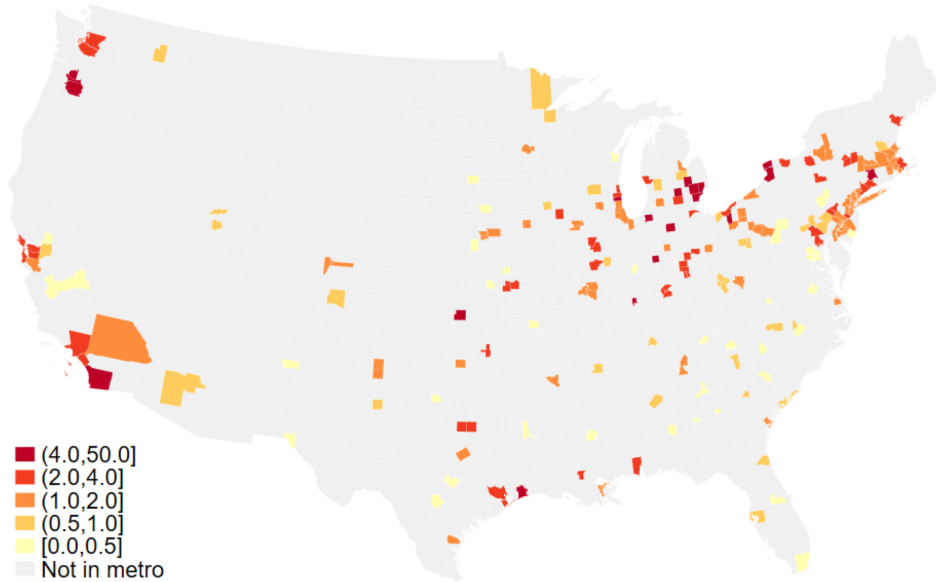
Figure A.3: Defense expenditures as a share of GDP



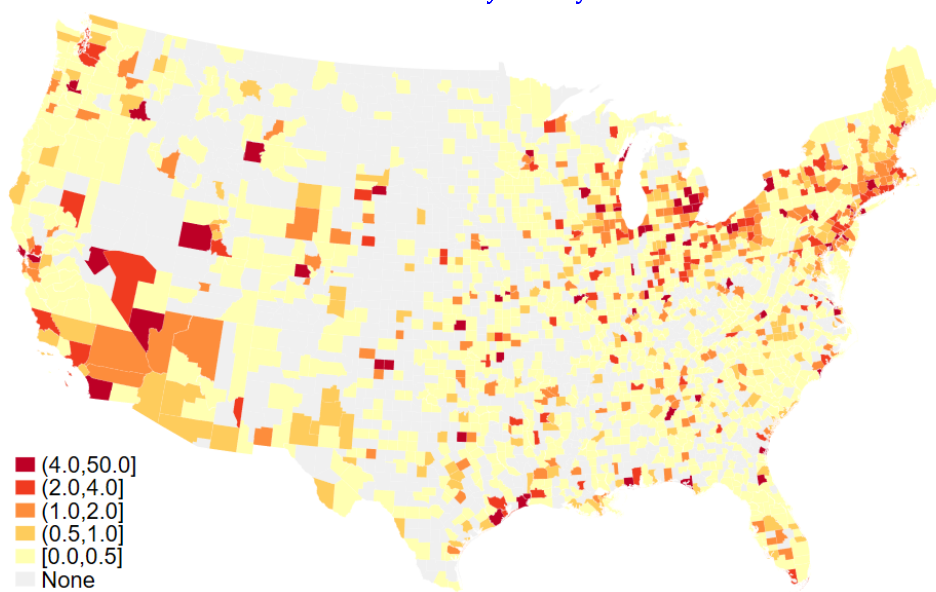
Note: Data is from U.S. Bureau of Economic Analysis series "Shares of gross domestic product: Government consumption expenditures and gross investment: Federal: National defense [A824RE1A156NBEA]," retrieved from FRED.

Figure A.4: WWII expenditures per capita ($1000s, 1940)

Panel A: By metro

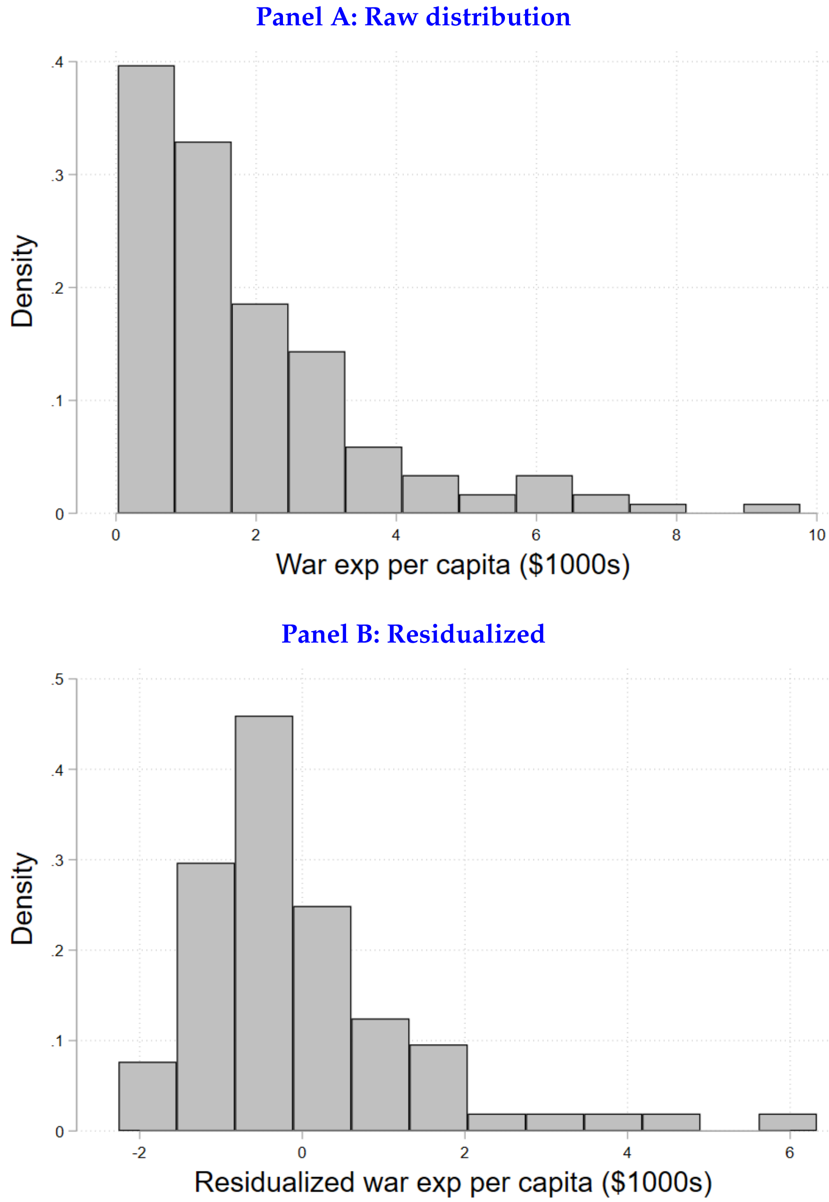


Panel B: By county



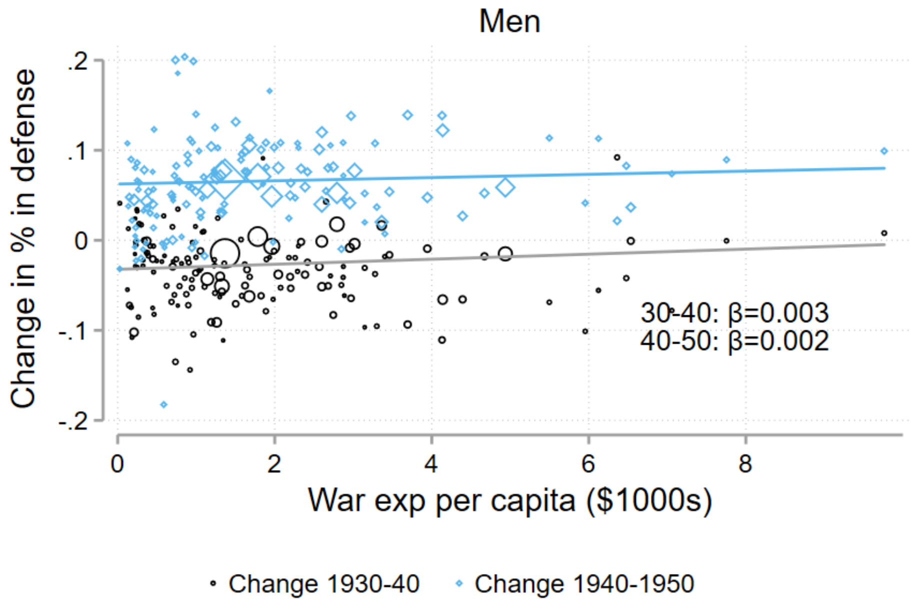
Note: Includes 146 metropolitan areas, which are county groupings based on 1950 Census definitions. The primary qualification is containing a city with population above 50,000. 55% of the population live in metropolitan areas in 1950. War expenditures per capita are total war expenditures divided by the 1940 population. Total war expenditures comes from the 1947 County Data Book. The mean war expenditure across metropolitan areas is $1,831 with standard deviation of $1,715 (1940 dollars).

Figure A.5: Distribution of WWII expenditures per capita by metropolitan area ($1000s, 1940)



Note: Includes 146 metropolitan areas, which are county groupings based on 1950 Census definitions. War expenditures per capita are total war expenditures divided by the 1940 population. Controls include region fixed effects, share of employed men in manufacturing, in agriculture, share Black, and predicted draft rate based on demographics. Total war expenditures comes from the 1947 County Data Book. The mean war expenditure across metropolitan areas is $1,831 with standard deviation of $1,715 (1940 dollars).

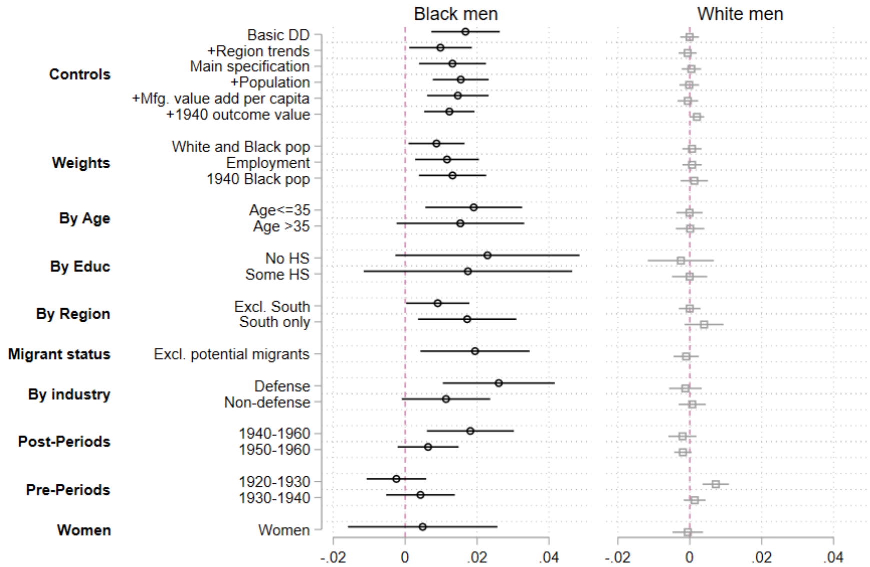
Figure A.6: Raw changes in share of employed men in defense industries by metro area



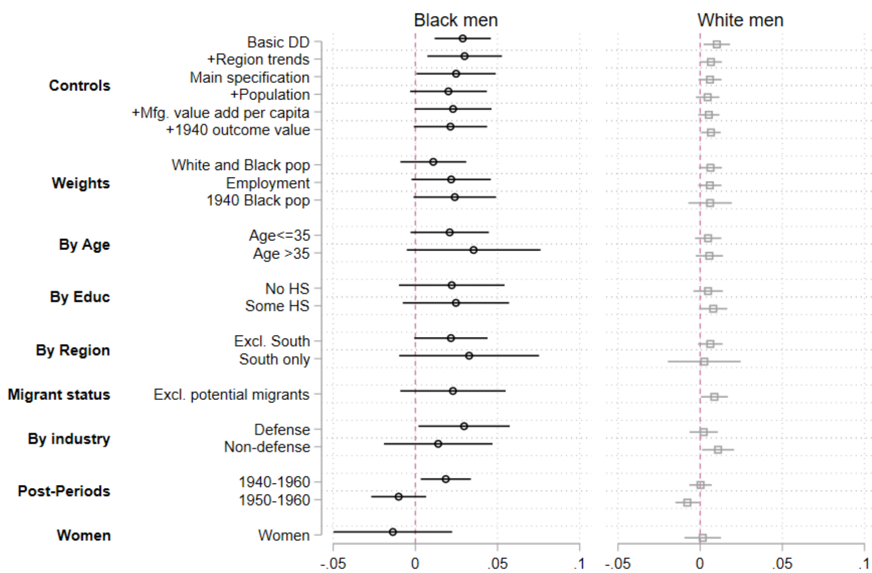
Note: Each point represents a metropolitan area. Defense industries include Mining, Manufacturing, Transportation, and Government. Data is from 1930 Census (5%), 1940 Census (100%), and 1950 Census (1%) samples. Regressions are weighted by population, and robust SEs are used. *p<.1; **p<.05; ***p<.01

Figure A.7: Robustness of effects of war expenditures on main outcomes

Panel A: Share in skilled occupations

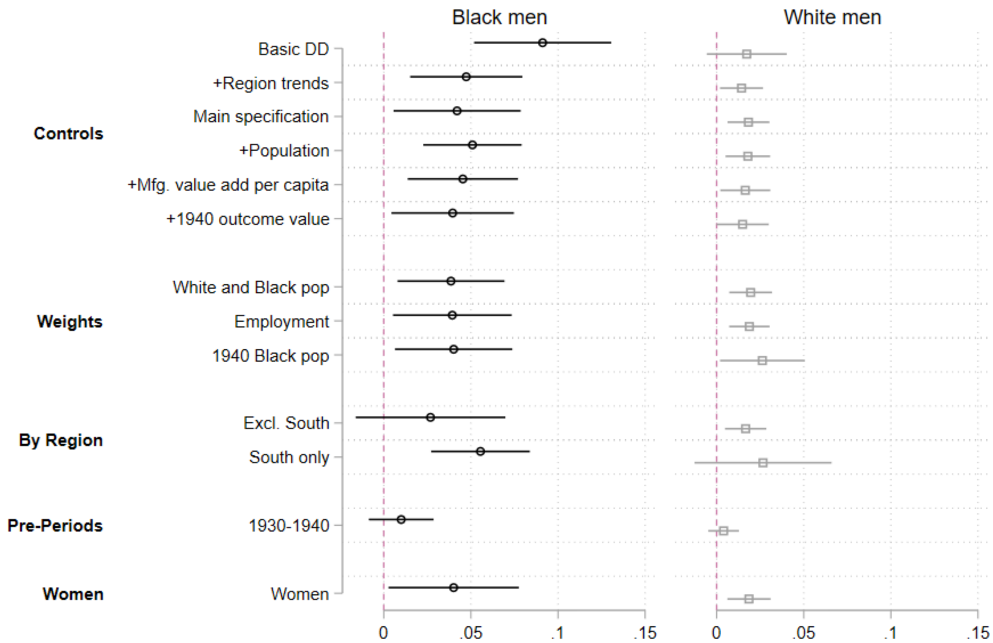


Panel B: ln(Average yearly wage)



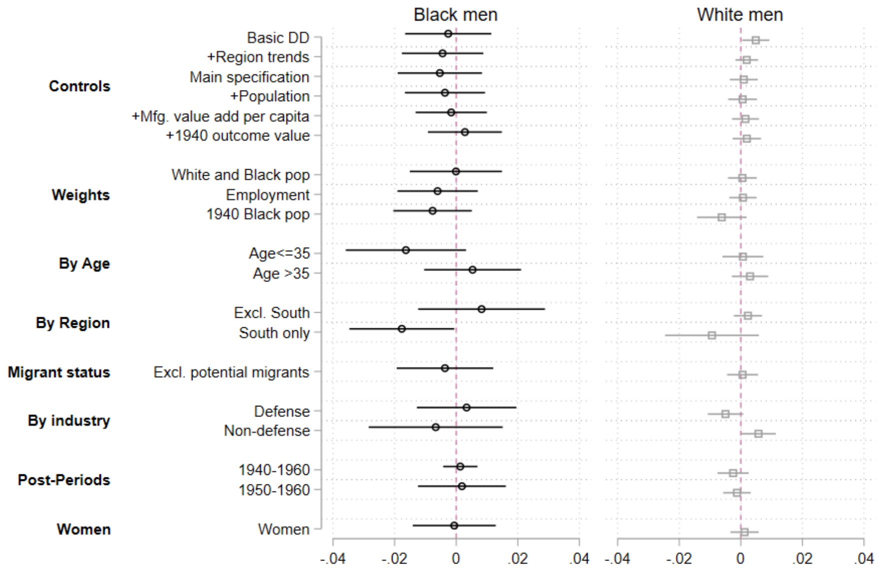
Note: See equation (1) for the basic specification. Intervals are 95% confidence intervals. All controls are interacted with an indicator for post. "Main specification" is our standard specification with controls for region, average years of education, share in manufacturing, share in agriculture, share Black, and predicted draft rate. "+Population" adds controls for the (log of) total population and Black population in 1940. "+1940 outcome value" adds controls for 1940 share employed, share skilled, and (log of) average yearly wage. "Excl. potential migrants" means excluding individuals in 1950 who were not born in their current state of residence and are not living with a child eight years or older born in the current state of residence. There are 146 metropolitan areas, and data comes from the 1920-1960 Census samples.

Figure A.8: Robustness of effects of war expenditures on ln(male population)



Note: See equation (1) for the basic specification. Intervals are 95% confidence intervals. All controls are interacted with an indicator for post. "Main specification" is our standard specification with controls for region, average years of education, share in manufacturing, share in agriculture, share Black, and predicted draft rate. "+Population" adds controls for the (log of) total population and Black popuation in 1940. "+1940 outcome value" adds controls for 1940 share employed, share skilled, and (log of) average yearly wage. "Excl. potential migrants" means excluding individuals in 1950 who were not born in their current state of residence and are not living with a child eight years or older born in the current state of residence. There are 146 metropolitan areas, and data comes from the 1920-1960 Census samples.

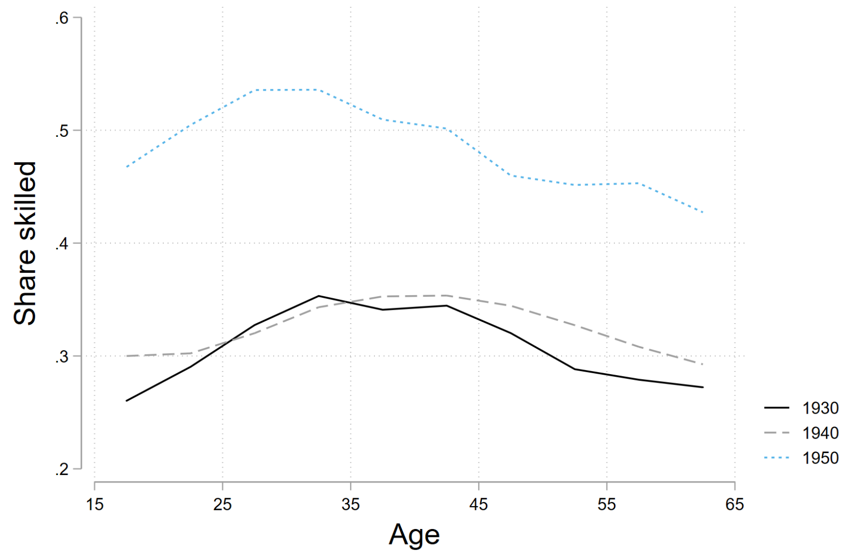
Figure A.9: Effect of war expenditures on share of prime-age men who completed high school



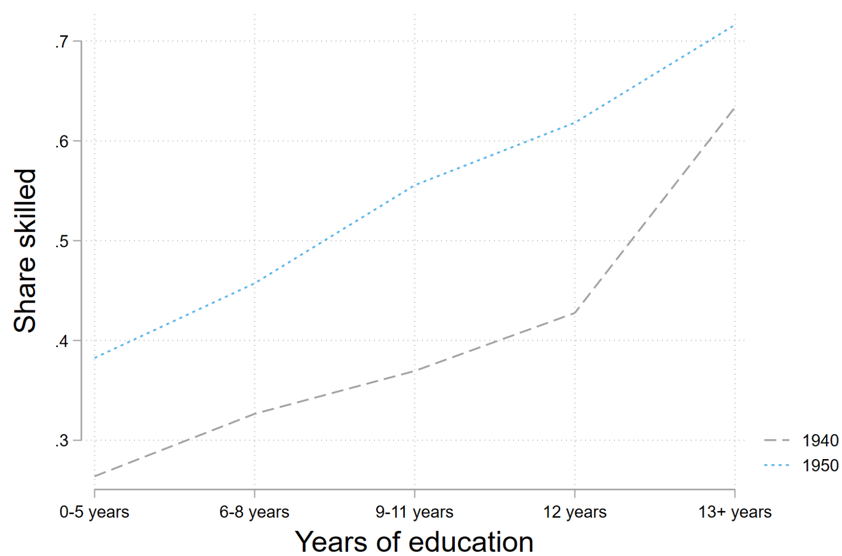
Note: See equation (1) for the basic specification. Intervals are 95% confidence intervals. All controls are interacted with an indicator for post. "+Base controls" is our standard specification with controls for region, average years of education, share in manufacturing, share in agriculture, share Black, and predicted draft rate. "+Population" adds controls for the (log of) total population and Black population in 1940. "+Baseline outcomes" adds controls for 1940 share employed, share skilled, and (log of) average yearly wage. "Excl. potential migrants" means excluding individuals in 1950 who were not born in their current state of residence and are not living with a child eight years or older born in the current state of residence. There are 146 metro areas, and data comes from the 1940-1960 Census samples.

Figure A.10: Black occupational upgrading by age and education

Panel A: By age

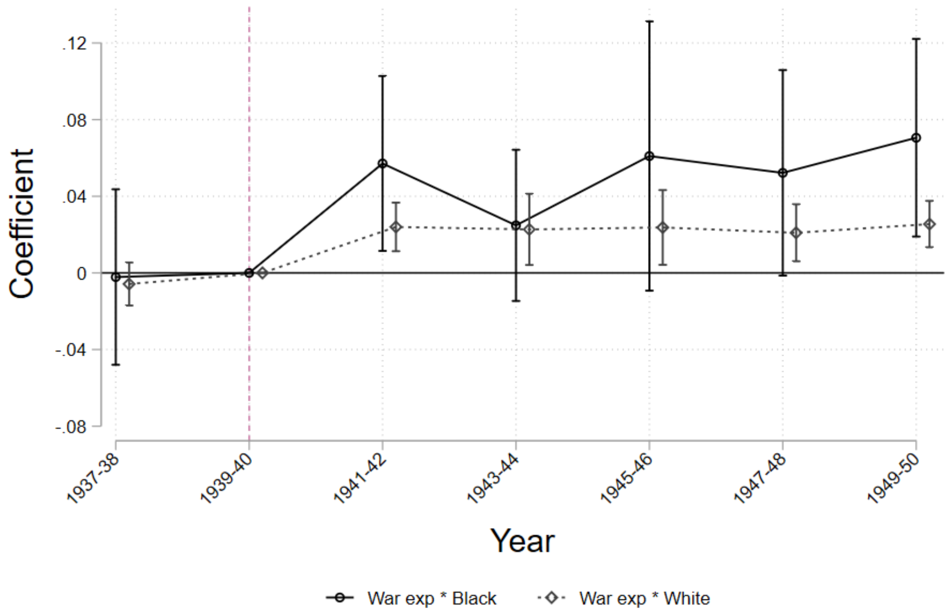


Panel B: By education



Note: Sample is employed men living in metro areas. The figure shows the share of employed Black men in skilled occupations for each education and age grouping by Census year. Data comes from the 1930 (5%), 1940 Census (100%), and 1950 (1%) samples.

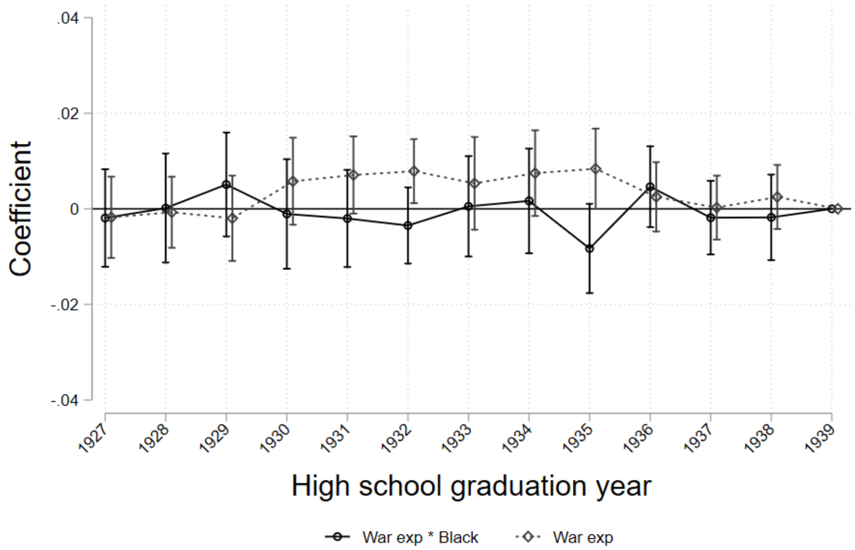
Figure A.11: Effect of war expenditures on unionization rates by race



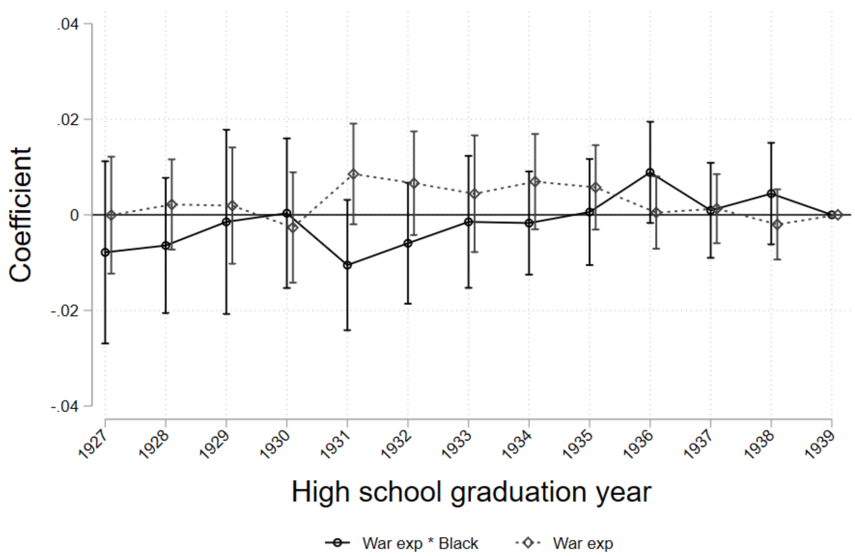
Note: The estimating equation is (for individual i, in year t, in state $r(i)$): $Union_{it} = \sum_{r \neq 1939}(\beta_r^{Bl} WarExp_r \times \mathbb{I}_{t=j} \times Black_{it} + \beta_r^{Wh} WarExp_r \times \mathbb{I}_{t=j} \times White_{it}) + \gamma_{r(i)}^{Bl} + \gamma_{r(i)}^{Wh} + \alpha_t^{Bl} + \alpha_t^{Wh} + X_{rt}\rho + \varepsilon_{it}$. The graph shows the estimates for β_r^{Wh} and β_r^{Bl} with 95% confidence intervals (SEs are clustered at the state level). In practice, time fixed effects are allowed to vary separately for the South. The sample is restricted to non-farmers and male respondents. Data is from the Gallup polls from Farber et al. (2021). If re-estimated in a simple DD framework, then coefficient on $WarExp_r \times Post_t \times Black_{it}$ is 0.029 higher than white men and the difference is statistically significant at the 5% level.

Figure A.12: Pre-trends in high school graduation rates (1940 Census)

Panel A: Boys



Panel B: Girls



Note: See equation (3) for the estimating equation. Intervals are 95% confidence intervals. Cohorts grouped by expected graduation year and the sample excludes the South. Graduating high school is defined as having completed 12 years of schooling in 1960. Fixed effects include metro-race FE and cohort-race FE. Other controls interacted with race include include whether born in the South interacted with cohort indicators. Results are similar if controls for veteran status are included. Data comes from the 1940 Census (100% sample; 5% sub-sample for whites).

Table A1: Occupational distribution for Black and white men in 1940 and 1950

	Black men		White men	
	1940	1950	1940	1950
Professional	1.9	1.9	5.8	7.4
Farmers	19.6	13.0	13.5	10.2
Managers	1.4	2.0	9.9	11.1
Clerical	1.1	2.7	6.9	6.5
Sales	0.6	1.0	6.2	6.5
Craftsmen & Foremen	4.3	7.6	15.6	19.2
Military	0.2	2.6	0.7	2.4
Operatives	12.0	20.8	17.9	19.7
Domestic Service	2.9	0.8	0.3	0.1
Service Workers	11.7	13.1	5.8	5.8
Farm Laborer	18.5	10.8	7.0	4.4
Laborers	25.8	23.6	10.6	6.8

Note: Occupational distribution is for employed men in 1940 and is not limited to men in metro areas. Data is from the 1940 Census (100%).

Table A2: Example unions policies toward Black workers during the Great Depression

Union
Example unions explicitly or effectively barring Blacks
Blacksmiths, Drop Forgers and Helpers', Brotherhood of
Boilermakers, Iron Shipbuilders and Helpers of America, International Brotherhood of
Carmen of America, Brotherhood of Railway
Clerks, Freight Handlers, Express and Station Employees, Brotherhood of Railway and Steamship
Conductors, Brotherwhood of Dining Car
Conductors Order of Sleeping Car
Conductors of America, Order of Railway
Electrical Workers, International Brotherhood of
Engineers, Grand International Brotherhood of Locomotive
Fireman and Enginemen, Brotherhood of Locomotive
Flint Glass Workers
Granite Cutters, International Association of
Journeyman Tailors
Machinists, International Association of
Mail Association. Railway
Maintence of Way Employees, Brotherhood of
Masters, Mates and Pilots, National Organization
National Rural Letter Carriers' Association
Neptune Association
Plasterers Union
Plumbers and Steam Fitters, United Association of Journeyman
Railroad Workers, American Federation of
Sheet Metal Workers
Switchmen's Union of North America
Telegraphers, Order of Railroad
Telegraphers, Union of America, Commercial
Train Dispatchers Association, American
Wire Weavers' Protective Association, American
Yardmasters of North America, Railroad
Example unions with segregated Locals
Carpenters and Joiners Unions
Painters, Decorators and Paperhangers
Hotal and Restaurant Workers

Note: Union policies are taken from "The Negro Year Book: An annual Encyclopedia of the Negro, 1937-1938" by Monroe Work and Jessie Guzman. The list is not complete.

Table A3: Most over and under represented occupations for Black men, conditional on education and location (living in metro, 1940)

	Top 15 over-represented			Top 15 under-represented	
	Occupation	$\frac{Actual}{Expected}$		Occupation	$\frac{Actual}{Expected}$
1	Janitors and Porters	3.35	1	Tool Makers	0.05
2	Clergymen	2.93	2	Motormen	0.06
3	Private Household Workers	2.77	3	Mechanical Engineers	0.06
4	Elevator Operators	2.64	4	Civil Engineers	0.09
5	Musicians	2.22	5	Electrical Engineers	0.09
6	Service Workers, Except Private Household	2.14	6	Other Technical Engineers	0.10
7	Cooks	2.07	7	Bookkeepers	0.10
8	Recreation Workers	1.97	8	Salesmen, Wholesale	0.10
9	Teachers	1.91	9	Salesmen, Manufacturing	0.10
10	Laborer - Construction	1.86	10	Tinsmiths, Coppersmiths, and Sheet Metal Workers	0.11
11	Laundry Workers	1.86	11	Locomotive Engineers	0.11
12	Waiters and Bartenders	1.82	12	Printing Craftsmen	0.12
13	Mail Carriers	1.8	13	Foremen, Durable Goods	0.15
14	Laborer - Other	1.79	14	Foremen, Non-Durable Goods	0.15
15	Laborer - Primary Metal	1.77	15	Designers and Draftsmen	0.15

Note: For employed men living in metro areas in 1940. Expected employment is based on random assignment within educational group (5 groups) and location. For more details, see Appendix Section C.2. Occupation groupings are based on aggregations used in 1950 Census publications. Data is from the 1940 Census (100%).

Table A4: Relationship between actual and predicted draft rate

	(1) Predicted draft rate	(2) Draft rate	(3) War exp per capita	(4) War exp per capita
Predicted draft rate		0.258**	-0.174***	
		(0.107)	(0.064)	
Draft %				-0.150*
				(0.081)
ln(Avg yearly wage)	0.006	-0.026	0.012	0.007
	(0.153)	(0.136)	(0.140)	(0.138)
% Agriculture	0.390**	0.158	0.021	-0.008
	(0.176)	(0.188)	(0.141)	(0.139)
% Government	0.164**	-0.113	0.078	0.039
	(0.074)	(0.104)	(0.153)	(0.137)
% Manufacturing	0.240**	0.085	0.397***	0.377**
	(0.115)	(0.140)	(0.139)	(0.145)
ln(Mfg. value added per capita)	-0.174*	-0.091	0.176**	0.186**
	(0.097)	(0.090)	(0.081)	(0.073)
% Skilled	-0.034	0.213	0.151	0.188
	(0.196)	(0.187)	(0.176)	(0.172)
% Unemployed	0.251**	0.168	-0.042	-0.051
	(0.100)	(0.102)	(0.089)	(0.096)
% Black	0.077	0.094	0.039	0.043
	(0.165)	(0.152)	(0.075)	(0.075)
ln(Population)	-0.006	0.131	-0.027	-0.007
	(0.074)	(0.090)	(0.077)	(0.078)
Northeast	-0.085	0.245*	0.021	0.069
	(0.144)	(0.142)	(0.095)	(0.094)
Midwest	-0.520***	0.111	0.034	0.121
	(0.129)	(0.159)	(0.146)	(0.146)
West	-0.224*	-0.171	0.111	0.116
	(0.114)	(0.112)	(0.097)	(0.097)
R2	0.43	0.36	0.33	0.33
N	146	146	146	146

Note: An observation is a metro area, and all variables have been standardized to have $\mu = 0$ and $\sigma^2 = 1$ and are based on 1940 values. The denominator for percentage variables is the number of employed men except for the % unemployed for which it is the number of men in the labor force. Omitted regional category is the South. War expenditure per capita in 1940 dollars. For a discussion of the draft measures see Appendix Section B.2. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A5: Effect of war expenditures on defense industry employment (1940-1944)

	Black	White	Men	Women
War exp per capita (1940)	0.034***	0.056***	0.052***	0.065***
	(0.011)	(0.009)	(0.009)	(0.012)
Mean change	.06	-.05	-.09	.07
Mean War Exp PC (1000s)	1.83	1.83	1.83	1.83
Region FE	X	X	X	X
Baseline controls	X	X	X	X
Draft control	X	X	X	X
Metro areas	146	146	146	146

Note: Sample is 146 metro areas. The outcome is the change in the share employed in defense industries. See Appendix Section D.1 for more details. War expenditure is $1000s per capita. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) Census sample and ES-270 reports. Metro area definitions based on 1940 and 1950 Census Bureau definitions. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A6: Effect of war expenditures excluding potential interstate migrants (1940-1950)

	(1)	(2)	(3)	(4)
	Black Men		White Men	
	All	Excl. potential migrants	All	Excl. potential migrants
Panel A: Skilled occupation				
War exp per capita * Post	0.016***	0.022***	0.000	-0.001
	(0.003)	(0.005)	(0.001)	(0.001)
Mean Y - 1940	0.33	0.33	0.77	0.77
Mean Y - 1950	0.48	0.47	0.83	0.83
N - 1940	1,266,428	1,266,428	878,830	878,830
N - 1950	24,346	12,843	244,073	180,184
Panel B: ln(Yearly wage)				
War exp per capita * Post	0.026**	0.018*	0.002	0.003
	(0.010)	(0.011)	(0.003)	(0.003)
Mean Y - 1940	6.27	6.27	6.91	6.91
Mean Y - 1950	7.32	7.25	7.83	7.84
N - 1940	994,843	994,843	679,658	679,658
N - 1950	5,163	2,331	53,641	36,900
Panel C: Prime-age employment				
War exp per capita * Post	-0.003	-0.007**	-0.002	-0.002*
	(0.003)	(0.003)	(0.001)	(0.001)
Mean Y - 1940	0.80	0.80	0.87	0.87
Mean Y - 1950	0.84	0.86	0.92	0.93
N - 1940	1,164,169	1,164,169	703,935	703,935
N - 1950	20,597	10,134	184,570	135,342
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	X	X	X	X
Individual controls	X	X	X	X

Note: Regression at the individual level and only includes men living in one of 146 metro areas. See equation (1) for the basic specification. War expenditure is $1000s per capita. Excluding potential interstate migrants means excluding individuals in 1950 who were not born in their current state of residence and are not living with a child eight years or older born in the current state of residence. For employed men, a skilled occupation is defined as all occupations except farmers, laborers, or service workers. Wages are total wage earnings (1940 dollars) in the previous year for men who are currently employees. Prime-age employment is whether men ages 25-54 are employed. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Individual controls include a cubic in age, whether born in the South, and whether married. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. All values are in 1940 dollars. Regressions weighted by sampling weights. Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A8: Effect of war expenditures on school expenditures and residential segregation (1940-1950)

	(1)	(2)	(3)	(4)
	Education		Residential segregation	
	ln(Exp. per capita)	$\ln(\frac{Blackstudents}{Blackteachers})$	Dissimilarity	Isolation
Panel A: All metros				
War exp per capita * Post	0.010	0.022	-0.003	0.001
	(0.009)	(0.047)	(0.007)	(0.024)
N	242	198	86	86
Panel B: Excluding South				
War exp per capita * Post	0.011	0.095	-0.008	-0.022
	(0.010)	(0.072)	(0.006)	(0.026)
N	172	98	60	60
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	X	X	X	X
Draft control	X	X	X	X

Note: Full sample is 146 metro areas; educational expenditures is available for only 121 metro areas. See equation (1) for the basic specification. Residential segregation indices are from Cutler et al. (1999) and are only available for 43 of our metro areas. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Regressions weighted by Black population; results are similar if unweighted estimates are used. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A7: Effect of war expenditures on occupational upgrading for younger cohorts

	(1)	(2)	(3)	(6)	(6)	(6)
		Black Men			White men	
	1940-50	1940-50	1940-60	1940-50	1940-50	1940-60
	All	Ages 18-24	Ages 18-34	All	Ages 18-24	Ages 18-34
War exp per capita * Post	0.017***	0.020**	0.014***	0.000	0.000	-0.003
	(0.003)	(0.008)	(0.004)	(0.001)	(0.002)	(0.002)
Mean Y - 1940	0.33	0.30	0.32	0.77	0.71	0.77
Mean Y - 1950	0.48	0.46	0.51	0.83	0.80	0.82
N - 1940	1,266,428	174,103	527,464	878,830	120,470	348,777
N - 1950	24,346	3,697	45,740	244,073	31,266	165,113
Mean war exp per capita	1.83	1.83	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X	X	X
Division-Year FE	X	X	X	X	X	X
Baseline controls	X	X	X	X	X	X
Draft control	X	X	X	X	X	X
Indiv controls	X	X	X			

Note: Regression at the individual level and only includes men living in one of 146 metro areas. See equation (1) for the basic specification. For employed men, a skilled occupation is defined as all occupations except farmers, laborers, or service workers. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Individual controls include a cubic in age, whether born in the South, and whether married. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites), 1950 (1%), and 1960 (5%; 40% sub-sample for whites) Census samples. Regressions weighted by sampling weights. Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A9: Effect of war expenditures on occupational segregation (1940-1950)

	(1)	(2)	(3)	(4)
	Occ dissimilarity index		ln(Occ dissimilarity index)	
	Basic	Adjusted	Basic	Adjusted
Panel A: All metros				
War exp per capita * Post	-0.007**	-0.008**	-0.013**	-0.017**
	(0.003)	(0.003)	(0.005)	(0.007)
N	270	270	270	270
Panel B: Excluding South				
War exp per capita * Post	-0.008**	-0.010**	-0.015**	-0.020**
	(0.003)	(0.004)	(0.006)	(0.008)
N	172	172	172	172
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	X	X	X	X
Draft control	X	X	X	X

Note: Full sample is 146 metro areas; occupational segregation indices are only available for 135 metro areas. See equation (1) for the basic specification. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A10: Effect of war expenditures on Black men with Bartik IV approach (1940-1950)

	(1) OLS - Controls	(2) OLS - IV Controls	(3) IV - IV Controls
Panel A: Share skilled (1940-50)			
War exp per capita * Post	0.013***	0.016***	0.015**
	(0.005)	(0.004)	(0.007)
Endogeneity test P-value			0.90
Panel B: Share skilled (1940-60)			
War exp per capita * Post	0.018***	0.021***	0.027*
	(0.006)	(0.006)	(0.016)
Endogeneity test P-value			0.45
Panel C: ln(Average yearly wage) (1940-50)			
War exp per capita * Post	0.025**	0.022**	0.004
	(0.012)	(0.011)	(0.019)
Endogeneity test P-value			0.13
Panel D: ln(Average yearly wage) (1940-60)			
War exp per capita * Post	0.018**	0.015**	0.024
	(0.008)	(0.007)	(0.020)
Endogeneity test P-value			0.42
Panel E: ln(Male population) (1940-50)			
War exp per capita * Post	0.042**	0.050***	0.089***
	(0.018)	(0.017)	(0.029)
Endogeneity test P-value			0.03
Panel F: ln(Male population) (1940-60)			
War exp per capita * Post	0.044	0.060***	0.113**
	(0.028)	(0.023)	(0.045)
Endogeneity test P-value			0.03
Metro areas	146	146	146
Mean war exp per capita	1.83	1.83	1.83
Metro FE	X	X	X
Division-Year FE	X	X	X
1st stage F-stat	-	-	32.26

Note: See equation (1) for the basic specification. For a discussion of the Bartik instrument, please see Appendix Section D.3. War expenditure is $1000s per capita. Occupational shares are shares of employed men. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Metro area definitions based on 1940 and 1950 Census Bureau definitions. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A11: Effect of war expenditures on Black men by geography (1940-1950)

	(1) Metro Controls	(2) CZ - Metros Controls	(3) CZ - All Controls	(4) State Controls
Panel A: Share skilled (1940-50)				
War Exp PC * Post	0.013***	0.023***	0.017***	0.020*
	(0.005)	(0.006)	(0.004)	(0.010)
Mean Y - 1940	0.33	0.28	0.22	0.22
Mean Y - 1950	0.48	0.44	0.38	0.38
Panel B: Share skilled (1940-60)				
War Exp PC * Post	0.018***	0.020**	0.011*	0.025
	(0.006)	(0.009)	(0.006)	(0.024)
Mean Y - 1940	0.33	0.28	0.22	0.22
Mean Y - 1950	0.51	0.48	0.45	0.45
Panel C: ln(Average yearly wage) (1940-60)				
War Exp PC * Post	0.018**	0.022*	0.024**	0.070**
	(0.008)	(0.012)	(0.010)	(0.034)
Mean Y - 1940	6.59	6.50	6.35	6.38
Mean Y - 1950	7.42	7.36	7.25	7.26
Geo areas	146	134	722	049
Mean war exp per capita	1.83	1.39	0.49	1.01
Geo FE	X	X	X	X
Division-Year FE	X	X		X

Note: See equation (1) for the basic specification. War expenditure is $1000s per capita. Occupational shares are shares of employed men. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Metro area definitions based on 1940 and 1950 Census Bureau definitions; commuting zones are 1990 definitions; SEAs are based on 1950 Census Bureau definitions. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A12: Effect of war expenditures on Black occupational composition

	(1) Professional	(2) Farmers	(3) Managers	(4) Clerical	(5) Sales	(6) Craftsmen	(7) Operatives	(8) Domestic service	(9) Service worker	(10) Farm labor	(11) Laborer
War exp per capita * Post	-0.001	-0.001	-0.000	0.001	-0.000	0.002	0.015***	-0.002	-0.005	-0.003*	-0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.005)	(0.001)	(0.003)	(0.002)	(0.006)
Mean Y - 1940	0.03	0.02	0.02	0.02	0.01	0.07	0.18	0.04	0.22	0.04	0.34
Mean Y - 1950	0.02	0.01	0.03	0.05	0.01	0.10	0.26	0.01	0.20	0.02	0.27
Observations	284	284	284	284	284	284	284	284	284	284	284
Mean war exp per capita	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X	X	X	X	X	X	X	X
Division-Year FE	X	X	X	X	X	X	X	X	X	X	X
Baseline controls	X	X	X	X	X	X	X	X	X	X	X
Draft control	X	X	X	X	X	X	X	X	X	X	X

Note: Sample is 146 metro areas. See equation (1) for the basic specification. War expenditure is \$1000s per capita. Occupational shares are shares of employed men. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Metro area definitions based on 1940 and 1950 Census Bureau definitions. All values are in 1940 dollars. Regressions are weighted by relevant population. Robust standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table A13: Oaxaca-Blinder ln(yearly wage) decomposition

	ln(Wage) gap		Δ1940-50		
	1940	1950	Pure change	Price change	Total change
Overall	0.63	0.38			-0.25
Explained	0.37	0.22	-0.03	-0.11	-0.14
Education	0.14	0.08	-0.01	-0.06	-0.06
Occupation	0.21	0.13	-0.03	-0.04	-0.07
Industry	0.05	0.02	-0.01	-0.02	-0.03
Region	0.02	0.01	-0.01	0.00	-0.01
Age	-0.04	-0.01	0.02	0.01	0.03
Unexplained	0.26	0.16			-0.10

Note: Sample includes Black and native born white men who are wage earners. See Appendix Section C.3 for more detail. Education includes years of education interacted with division of birth and dummies for high school and college completion. Occupation includes dummies for ten aggregate occupational groupings. Industry includes dummies for twelve aggregated industry groupings. Region includes dummies for nine Census divisions. Age includes a cubic polynomial in age. "Explained" gaps evaluated at coefficients for white men. "Pure" change captures compositional changes, while "price' captures changing coefficients. Data comes from 1940 (100%; 5% sub-sample for white men) and 1950 (1%) Census samples.

Table A14: Effect of war expenditures on school attendance (1940-1950)

	(1)	(2)	(3)	(4)
	Black Children		White Children	
	Boys, 16-18	Girls, 16-18	Boys, 16-18	Girls, 16-18
Panel A: All metros				
War exp per capita * Post	0.029**	0.014	-0.001	-0.001
	(0.014)	(0.013)	(0.003)	(0.003)
N - Pre	127,085	144,710	81,192	81,192
N - Post	502	531	4,341	4,341
Panel B: Excluding South				
War exp per capita * Post	0.045***	0.017	-0.000	-0.000
	(0.017)	(0.011)	(0.004)	(0.004)
N - Pre	56,707	62,974	68,712	68,712
N - Post	264	276	3,506	3,506
Mean Y - Pre	0.50	0.50	0.65	0.61
Mean Y - Post	0.54	0.57	0.69	0.64
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro-Age FE	X	X	X	X
Division-Year-Age FE	X	X	X	X
Draft control	X	X	X	X

Note: Regression at the individual level and only includes children living in one of 146 metro areas. See equation (1) for the basic specification. School is an indicator for whether the child attended any school in the past month (1940) or two months (1950). Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Regressions weighted by sample line weights. Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A15: Effect of war expenditures on school attendance (1940-1960)

	(1)	(2)	(3)	(4)
	Black Children		White Children	
	Boys, 16-18	Girls, 16-18	Boys, 16-18	Girls, 16-18
Panel A: All metros				
War exp per capita * Post	0.012*	0.003	0.001	0.001
	(0.007)	(0.005)	(0.004)	(0.004)
N - Pre	127,085	144,710	81,192	81,192
N - Post	11,578	12,713	40,630	40,630
Panel B: Excluding South				
War exp per capita * Post	0.018**	0.004	-0.002	-0.002
	(0.008)	(0.007)	(0.005)	(0.005)
N - Pre	56,707	62,974	68,712	68,712
N - Post	6,340	7,169	32,181	32,181
Mean Y - Pre	0.50	0.50	0.65	0.61
Mean Y - Post	0.66	0.62	0.76	0.70
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro-Age FE	X	X	X	X
Division-Year-Age FE	X	X	X	X
Draft control	X	X	X	X

Note: Regression at the individual level and only includes children living in one of 146 metro areas. See equation (1) for the basic specification. School attendance is an indicator for whether the child attended any school in the past month (1940) or two months (1960). Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1960 (5%; 40% sub-sample for whites) Census samples. Regressions weighted by sample line weights. Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A16: Placebo effect of war expenditures on school attendance (1930-1940)

	(1)	(2)	(3)	(4)
	Black Children		White Children	
	Boys, 16-18	Girls, 16-18	Boys, 16-18	Girls, 16-18
Panel A: All metros				
War exp per capita * Post	-0.004	0.000	0.000	0.000
	(0.006)	(0.005)	(0.002)	(0.002)
N - Pre	4,983	6,119	73,194	73,194
N - Post	127,085	144,710	81,192	81,192
Panel B: Excluding South				
War exp per capita * Post	-0.013	0.004	-0.002	-0.002
	(0.008)	(0.005)	(0.003)	(0.003)
N - Pre	2,034	2,414	63,215	63,215
N - Post	56,707	62,974	68,712	68,712
Mean Y - Pre	0.38	0.38	0.50	0.46
Mean Y - Post	0.50	0.50	0.65	0.61
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro-Age FE	X	X	X	X
Division-Year-Age FE	X	X	X	X
Draft control	X	X	X	X

Note: Regression at the individual level and only includes children living in one of 146 metro areas. See equation (1) for the basic specification. School attendance is an indicator for whether the child attended any school in the past six months (1930) or month (1940). Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1930 (5%) and 1940 (100%; 5% sub-sample for whites) Census samples. Regressions weighted by sample line weights. Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A17: Estimation of model shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor	Adj. income		Adj. labor		Adj. income		Adj. labor
	$\ln \pi^L_{riogt}$	riot	rit	r	r	riot	rit	r
β_1			0.004				0.005	
			(0.010)				(0.030)	
β_2		0.010				0.004	0.009	
		(0.029)				(0.029)	(0.030)	
β_3	0.014					-0.030	0.011	
	(0.035)					(0.034)	(0.039)	
β_4	0.115***					0.117***	0.103***	
	(0.040)					(0.038)	(0.039)	
β^U_1					-0.018**			-0.017**
					(0.007)			(0.007)
β^U_2				0.054**				0.042**
				(0.022)				(0.021)
Observations	3,494	3,622	3,622	3,622	3,622	3,622	3,622	3,622
R-squared	0.991	0.990	0.988	0.995	0.992	0.990	0.988	0.992
γ_{riog}	X	X	X	X	X	X	X	X
γ_{iogt}	X	X	X	-	-	X	X	-
γ_{riot}	X	-	-	-	-	-	-	-
γ_{rgt}	X	-	-	-	-	-	-	-
γ_{rit}	-	X	-	-	-	X	-	-
γ_{gt}	-	-	-	X	X	-	-	X
γ_{rt}	-	-	-	X	-	-	-	-
Draft control	-	-	-	-	X	-	-	X

Note: An observation is an r, i, o, t, g cell and only includes individuals living in metro areas. Columns 1 estimates (63) using employment to measure allocations across io within r. Columns 2 and 6 estimate (69) and (68); the column heading riot refers to the dependent variable being an adjusted measure of labor income at the *riot* level. Columns 3 and 7 estimate (72) and (71); the column heading rit refers to the dependent variable being an adjusted measure of labor income at the *rit* level. Column 4 estimates (65), column 5 estimates (66), and column 8 estimates (64). Predicted draft rate is based on 1940 demographics. Primary data sources are 1940 (100%) and 1950 (1%) Census samples. Regressions are weighted by cell population. Standard errors are clustered at the *rt* level. *p<.1; **p<.05; ***p<.01

Table A18: Effect of war expenditures on returns to education - Actual vs. model predicted (1940-1950)

	(1)	(2)	(3)	(4)
	Actual		Model	
	ln(Yearly wage)	Skilled	ln(Yearly wage)	Skilled
War exp per capita * Education $\geq$ 9 years * Post	-0.006	-0.001	0.002	-0.001
	(0.014)	(0.016)	(0.010)	(0.007)
War exp per capita * Post	0.021*	0.017**	0.028***	0.018***
	(0.012)	(0.008)	(0.005)	(0.002)
Education $\geq$ 9 years * Post	-0.022	-0.026	-0.002	0.001
	(0.036)	(0.031)	(0.029)	(0.020)
War exp per capita * Education $\geq$ 9 years	-0.009*	-0.012***	-0.027***	-0.009***
	(0.005)	(0.004)	(0.007)	(0.005)
Education $\geq$ 9 years	-0.044***	0.170***	0.192***	0.143***
	(0.015)	(0.010)	(0.021)	(0.014)
Observation Level	Individual	Individual	rgt	rgt
N - Pre	978,057	1,243,358	258	258
N - Post	5,163	5,925	258	258
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	X	X	X	X
Draft control	X	X	X	X
Individual controls	X	X	-	-

Note: We estimate the following equation:

$$Y_{irt} = \beta_1 E_{irt} + \beta_3 E_{irt} \times Post_t + \beta_2 Exp_r \times Post_t + \beta_4 E_{irt} \times Exp_r + \beta_5 E_{irt} \times Exp_r \times Post_t + Post_t + \gamma_r + X_{irt}\rho + \varepsilon_{irt}$$

where E_{irt} is an indicator for whether the individual completed at least some high school. We use whether the individual completed at least some high school so we can directly compare with model predictions. Results are similar if years of education is used instead. Regression at the individual level for columns (1) and (2) but at metro-education group level for columns (3)-(4). Only includes men living in one of 146 metro areas. Wages are total wage earnings (1940 dollars) in the previous year for men who are currently employees. Individual controls include a cubic in age, whether born in the South, and whether married. Primary data sources are 1940 (100%; 5% sub-sample for whites) and 1950 (1%) Census samples. Regressions weighted by sample line weights ((1)-(2)) or employed population ((3)-(4)). Standard errors clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

Table A19: Effect of war expenditures on wages, education, and age within group, industry, occupation, and region

	(1) ln(Avg. wage)	(2) Avg. education	(3) Avg. age
β_1	-0.002	-0.003	0.069
	(0.008)	(0.025)	(0.211)
β_2	-0.000	-0.014	0.005
	(0.009)	(0.022)	(0.184)
β_3	-0.001	-0.005	0.101
	(0.014)	(0.096)	(0.370)
β_4	0.008	0.043	0.252
	(0.016)	(0.066)	(0.507)
Observations	3,530	3,530	3,530
R-squared	0.980	0.997	0.960
γ_{riog}	X	X	X
γ_{iogt}	X	X	X
γ_{rgt}	X	X	X

Note: Note: An observation is an r, i, o, t, g cell and only includes individuals living in metro areas. The estimating equation is

$$Y_{riogt} = \gamma_{rgt} + \gamma_{iogt} + \gamma_{riog} + G_r \mathbb{I}_t \mathbb{I}_i \left(\beta_1 + \beta_2 \mathbb{I}_o + \beta_3 \mathbb{I}_g + \beta_4 \mathbb{I}_g \mathbb{I}_o\right) + \iota_{riogt}$$

defining Y_{riogt} as either the the log average wage (column 1), average years of education (column 2), or average age (column 3) within each region-industry-occupation-year ($riogt$) cell. Regions are the 146 metro areas (using 1940 and 1950 Census Bureau definitions), there are two occupations (skilled and unskilled) and two industries (defense and non-defense). Regressions are weighted by cell population. Standard errors are clustered at the rt level. *p<.1; **p<.05; ***p<.01

Table A20: Evaluating actual estimated changes versus model data

	(1)	(2)	(3)	(4)
	Share skilled		ln(Avg yearly wage)	
	Black	White	Black	White
Panel A: Actual data				
War exp per capita * Post	0.013***	0.000	0.025**	0.006*
	(0.005)	(0.001)	(0.012)	(0.004)
Panel B: Model-generated data				
War Exp PC * Post	0.017***	0.001***	0.028***	0.006***
	(0.002)	(0.000)	(0.004)	(0.000)
Metro areas	146	146	146	146
Mean war exp per capita	1.83	1.83	1.83	1.83
Metro FE	X	X	X	X
Division-Year FE	X	X	X	X
Baseline controls	X	X	X	X
Draft control	X	X	X	X

Note: Sample is 146 metro areas. Wages are total wage earnings in the previous year for men who are currently employees. Baseline controls are 1940 variables interacted with a post indicator: average years of education, share employed in manufacturing, share employed in agriculture, and share Black. Draft control is predicted draft rate based on 1940 demographics. Primary data sources are 1940 (100%) and 1950 (1%) Census samples. Metro area definitions based on 1940 and 1950 Census Bureau definitions. Regressions are weighted by the relevant population. Standard errors are clustered at the metro-year level. *p<.1; **p<.05; ***p<.01

B Data Appendix

B.1 Census data

Individual Census records. The primary source of Census data are individual Census records from Ruggles et al. (2020). We use the 100% 1920, 5% 1930, 100% 1940, 1% 1950, 5% 1960, and 1% 1970 (metro) samples. Due to data and processing considerations, we take a 2% random sample of whites and 20% sub-sample of Blacks from the 1920 Census. Similarly, for the 1940 Census we use a 5% random sample of whites and for the 1960 we use a 40% sub-sample for whites (resulting in a 2% sample). Individuals in institutional group quarters are excluded.

Metro areas: Metro areas are based on the IPUMS variable "metaread." These are county based measures. Definitions vary slightly over time, but the basic qualification is the county must contain a city of at least 50,000 people or integrated with another county containing a qualifying city. Metro areas could expand or contract over time. Counties are identified in the 1940 and earlier samples, so a consistent county based definition is applied. Metro definitions were relatively unchanged between 1940 and 1950. There were more significant changes in the 1960 and 1970 Censuses. Several metro areas that were split between 1950 and 1960 are re-aggregated to maintain comparability. For long-term analysis (1920-1970), consistent metro definitions are imposed by using 1990 commuting zone boundaries. Earlier geographic boundaries (counties for 1940 and earlier, SEAs for 1950, PUMAs for 1960, and 1970 county groups for 1970) are crosswalked to commuting zones based on Eckert et al. (2018). Observations are weighted based on the geographic overlap between their geographic region and the commuting zone of interest.

Employment: Employment status is based on the IPUMS variable "empstat." This variable is not available in 1920. The reference period varies slightly across Censuses. In 1930 an individual is counted as employed if they were working on the most recent regular working day. In 1940 and later, an individual was counted as employed if they worked at all during the reference week. Prime-age employment is used as an outcome measure due to concerns about how the labor force and unemployment are measured across years. Prime-age workers are defined as individuals ages 25-54. Prime-age male employment is defined as the share of men in this age range who are employed.

Occupation and industry: Occupation and industry are coded using the 1950 Census coding system. Skilled occupations are defined as occupations falling in the following categories: "Professional, Technical"; "Managers, Officials, and Proprietors"; "Clerical and Kindred"; "Sales workers"; "Craftsmen"; or "Operatives" categories. This corresponds to occupational codes 000-093, 200-690 under the 1950 IPUMS occupational coding scheme. Semiskilled or skilled blue-collar occupations are a sub-category of skilled occupations that fall under the "Craftsmen" or "Operatives" categories. Occupational shares are constructed using currently employed individuals who are aged 14+.[55]

Defense industry is defined as mining, manufacturing, transportation, and government industries, following Collins (2001). These industries were most likely to be included in the War Manpower Commissions defense industry employment reports. These industries correspond to 1950 IPUMS industry codes 203-239, 306-499, 506-568, 906-946. Following Acemoglu et al. (2004), key defense industries are defined as durable goods manufacturing industries, and these correspond to IPUMS 1950 industry codes 326-388.

Employee: A worker is defined as an employee based on the IPUMS variable "classwkrd." Employees are defined as individuals who are currently in the labor force and have classwkrd codes 20-28, which corresponds to categories "Works on Salary," "Wage/salary, private," and "Wage/salary, government."

Wage income: Yearly wage income is created using the IPUMS variable "incwage". This variable comes from the Census question asking for each person's total pre-tax wage and salary income. This question was first introduced in 1940. Yearly wage income is specifically payments for work done as an employee; it excludes self-employment income or personal business income. This restriction is especially relevant for farmers. Unfortunately, the 1940 Census did not ask for information on business or other sources of income. The wage income sample is restricted to individuals who are (1) are employees at the time of the Census, (2) are employed at the time of the Census, and (3) their primary occupation is not farmer or unpaid family farm laborer. Only sample line respondents were asked about wage income in the 1950 Census.

An additional issue is how to deal with top-coded values or implausibly low earnings totals. We follow Goldin and Margo (1992) by multiplying top-coded values by 1.4 and recoding as missing values that are less than 1/2 the minimum weekly wage. This corresponds to weekly earnings below $6 in 1940, $8 in 1950, $20 in 1960 and $28 in 1970.

Education: Years of education is created based on the IPUMS variable "educ". Individuals with five or more years of college are all coded as having seventeen years of education. Individuals with twelve years of completed schooling are assumed to have completed high school. This question was first asked in the 1940 Census. Only sample line respondents were asked about

[55] Results are robust to using share of all individuals in the labor force instead.

highest completed grade in the 1950 Census.

The IPUMS variable "school" is used to classify whether a child is currently attending school. The question changed slightly across Census years but was relatively consistent from 1940 to 1950. The main changes across Censuses are (1) length of retrospective reference period and (2) qualifying educational institutions. The retrospective reference periods are: previous four months in 1920, previous six months in 1930, previous month in 1940, and previous two months for 1950 and on. Qualifying educational institutions are: any type of school in 1920, any school or night school in 1930, any school and night school/extension programs if part of a regular school system in 1940 and 1950, any school that advances a person towards high school or college degree in 1960. Across all years the respondent has to indicate only whether the person has attended a qualifying institution in the reference period; they do not need to regularly attend. Only sample line respondents were asked about school attendance in the 1950 Census.

Census aggregates. Census aggregates are taken from published Census volumes. County population totals by age and race are taken from ICPSR 02896 (Haines and ICPSR, 2010). Manufacturing output and value added from the Census of Manufactures are taken from the same source. We also digitized new metro-level data from the 1950 Census. The only individual level data available for 1950 is the 1% sample. This means we limited Black observations for metro areas with small Black populations. From Volume II of the 1950 Census of Population we digitize the following: Table 77, which has total employment for each metro by race-sex-occupation, Table 83, which has total employment for each metro by race-sex-industry, and Table 87, which has total counts for each metro by race-sex-income bin, as well as the median income by race and sex. We use this data rather than totals from individual counts whenever possible. For heterogeneity analysis (e.g., by age or education), we rely on the individual Census data.

B.2 Draft rate

Creating a predicted draft rate. We use a predicted draft rate rather than actual draft or enlistment rate. A predicted draft rate is created for each metro area by using draft records to identify national draft rates by group and then applying these draft rates to the baseline demographics for each metro in 1940.

The drawback of the predicted draft measure as a control is that it will not control for all sources of variation in draft rates. For example, some areas might have had stricter draft boards or a higher share of individuals who did not meet minimum military standards. However, we believe we are capturing the largest source of exogenous variation in draft rates. If the predicted draft rate does not affect our estimates, then it is less likely these smaller sources of variation would meaningfully alter our results.[56]

Our primary source of draft data are the WWII Army Enlistment Records provided by the National Archives and Records Administration. This data series contains the records of about nine million men and women who enlisted in the U.S. Army. The records typically contain the serial number, name, place of residence, place and date of enlistment, education, occupation, marital status, and race of the enlistee. There are several gaps in the records. First, the data is only for the U.S. Army, so it excludes other service branches, such as the Navy (although the Air Force was still part of the Army during WWII). Second, some records are known to be missing. Finally, some of the scanned records are unusable due to poor scans.

The secondary source of data if from the Selective Service System (1956). We digitized tables reporting total inductions and enlistments by service branch, month, and race. This data identifies

[56]Our results are also robust to using the actual draft rate. Results available upon request.

how many inductions are not captured in the individual enlistment data for each month. We re-weight the individual observations by the number of records missing in their enlistment month. For example, if the individual records cover half of total inductions in a given month then the observed inductions will be given double the weight. Implicitly, this also assumes that individuals drafted into the Navy in any given month have similar characteristics to individuals drafted into the Army in the same month, conditional on race. The reason we re-weight the observations within a month is that draft eligibility and probabilities changed throughout the war. For example, initially individuals younger than 21 were not eligible for the draft, but later in the war the minimum age eligibility was reduced to 18. We condition on race because there is evidence the Army was much more willing to accept Black men than the Navy.[57]

Only records of enlistments between January 1940 and December 1945 are included. Individuals who are younger than 17 or older than 45 at time of enlistment are dropped. We restrict the sample to individuals who were drafted based on their serial codes. Serial codes that start with three or four indicate that the individual was drafted.

We next find the total number of individuals drafted each year by demographic group. We create demographic cells using race, year of birth, nativity, and marital status. All of these variables were important determinants of draft probabilities.

The next step is to create draft rates by demographic group and year. We use 1940 Census data to determine the population in each demographic cell. Most of the characteristics are time-invariant, except for marital status. Marital status was one of the key determinants for whether someone was drafted. There is also significant variation across metro areas in typical age at marriage and marriage rates. We create marriage hazard rates using marriage rates across cohorts in 1940. We then follow each cohort from 1940 to 1945; first applying the marriage hazard rate and then subtracting the number of individuals who enlisted each year. For the next year, we apply the marriage hazard rate to the remaining single individuals and repeat the process. Therefore, for each year we have the number of married and single individuals for each demographic group in each cohort. To create the draft rate for that year and demographic group, we then take the total number of individuals drafted and divide by the population in each given demographic group.

The final step is to apply these draft rates to each metro. We follow a similar process to the above to generate the number of married and single individuals for each demographic group in each year, using metro specific marriage hazard rates for whites and a national rate for Blacks. We use a national rate for Blacks because some metro areas have small Black populations, making it difficult to calculate metro specific hazard rates. Once we have the number of individuals in each demographic group for each year we apply the national draft rates for that group and aggregate to create the total number of individuals drafted in each metro. We then divide by the male population ages 15-64 in 1940.

We also create an actual draft rate measure for comparison and to see if our predicted draft rate does predict the actual draft rate. When calculating the actual draft rate, we scale the denominator by an estimate of the population growth between 1940 and 1943. We do this to account for the fact that a large number of people migrated during the first part of the war. Without this correction, using 1940 population as a denominator would lead to higher draft rates in areas with higher net in-migration. Since war expenditure increase migration (see Appendix Section D.5) this would create a positive correlation between draft rate and war expenditures.

Results. Appendix Table A4 shows that our predicted draft rate is a strong predictor of the actual draft rate. Therefore, it seems as though it is a valid measure of draft intensity. Table A4 shows that both the predicted and actual draft rate are negatively correlated with war expenditures.

[57] Black men served almost exclusively in mess units for much of the war in the Navy.

Moreover, the predicted draft rate is positively correlated with labor shortages, even conditional on war expenditures. This correlation provides evidence that our predicted draft variable has the expected consequence on labor supply.

B.3 Other data

We supplement the above data with several additional data sources.

Labor shortage data. We digitized reports on the extent of labor shortages during WWII by month. These reports were from the monthly Labor Market Reports compiled by the War Manpower Commission. These classified labor markets by whether they were facing labor shortages. Labor shortages were defined based on comparing expected hiring to the number of people expected to be looking for work, combined with subjective adjustments by government officials.

We create our measure of labor-market shortages by taking the percentage of months between 1942 and 1944 that the labor market experienced severe labor shortages (on the map this corresponded to labor markets with completely shaded circles). About 20% of metro-month observations were coded as severe labor shortages.

Defense industry employment during WWII. The War Manpower Commission regularly surveyed employers in war industries or critical labor markets on their employment. These surveys were ES-270 reports. These reports did not cover the entire labor market but did cover a large share of war industry employment. For more details and examples of usage in other research, please see Collins (2001) or Rose (2018).

C Labor-Market Context

C.1 Occupational distribution and changes 1940-50

First, some notes on occupational categories. The aggregate occupational categories are "Profession, Technical"; "Farmers"; "Managers, Officials, and Proprietors"; "Clerical and Kindred"; "Sales workers"; "Craftsmen"; "Operatives"; "Domestic Service"; "Service"; "Farm Laborer"; and "Laborer". Appendix Figure A.2 shows the average wages and education for white men by occupation. The occupations are colored based on which aggregate occupational category they belong to. It is clear that occupations in the "Domestic Service"; "Service"; "Farm Laborer"; and "Laborer" pay significantly less on average and also employ workers with lower education levels.

Appendix Table A1 shows the occupational distribution for white and Black men in 1940 and 1950. Several facts are immediately clear. First, Black and white men have very different occupational distributions, with Black men being concentrated in unskilled occupations. As seen in Appendix Figure A.2, these are the occupations with the lowest pay and lowest education. Secondly, the occupational distribution for Black men significantly changed between 1940 and 1950, with large increases in the "Craftsmen" and "Operatives" categories. These observations are consistent with Collins (2000). The occupational distribution for white men changed as well but to a much lesser extent. These results are consistent with the finding of occupational upgrading for Black men in Collins (2000). These facts provide preliminary motivation for our focus on the impact of WWII expenditures on occupational upgrading for Black men.

C.2 Occupational segregation

An immediate question is to what extent these occupational differences between Black and white men can be explained by differences in education or location. For example, Black men were much more likely to live in the South and less likely to live in metro areas and had significantly less education on average. However, there are plenty of examples of explicit discrimination, for example Appendix Table A2 lists a number of unions with explicit or effective bars on Black membership. There are two interesting questions to ask: first, which occupations seem to be most segregated, and second, which metro areas seem to be most segregated?

First, we compare segregation across occupations by looking at the expected number of Black workers, based on random allocation within education group and region, and compare it to the actual number of workers. We restrict the sample to men living in metro areas who are employed at the time of the Census. We define education groups as 0-5 years, 6-8 years, 9-11 years, 12-15 years, and 16+ years. Following Margo (1995), we account for school quality differences by multiplying years of education by 0.85 for Black men born in the South with less than 15 years of education. This adjustment roughly corresponds to the difference in average school term length between Blacks and whites in segregated Southern schools during the 1920s. Occupations are defined using the occupation and industry categories in Table 77 of the state breakouts in the 1950 Census Volume II. The number of expected Black workers is calculated by:

$$Expected_o = \sum_r \sum_e \left(\frac{Black_{re}}{Pop_{re}} * Positions_{ore}\right)$$

Where $\frac{Black_{re}}{Pop_{re}}$ is the share of Black men within region r and educational group e and $Positions_{ore}$ is the number of positions in occupation o held by men in region r and educational group e. To get a measure of the gap for each occupation we then divide by the actual number of Black men observed in occupation o. Appendix Table A3 reports the occupations with the top fifteen largest and smallest ratios of expected vs. actual employment.

A second question of interest is comparing occupational segregation across regions. A natural index to measure occupational segregation is the Duncan index (Duncan and Duncan, 1955). The Duncan index is defined as:

$$Duncan_r = \sum_o \left|\frac{Black_{or}}{Black_r} - \frac{White_{or}}{White_r}\right|$$

Fundamentally, this index is a measure of "evenness," i.e., how evenly are Black men distributed across occupations. There are two related issues with this metric. First, if Black men are a small percentage of the population or many occupations have few positions then there will be substantial deviations from evenness due to pure chance as noted in Carrington and Troske (1997). Secondly, this metric does not distinguish between differences due to education versus occupational segregation. While occupational segregation can cause educational differences, our focus here is on occupational segregation conditional on education.

We can adjust the Duncan index by estimating the expected Duncan index, $E[Duncan_r]$, if workers are allocated randomly across jobs conditional on education and calculating the adjusted index:

$$Duncan_r^{Adj} = \frac{1}{2}\frac{Duncan_r - E[Duncan_r]}{1 - E[Duncan_r]}$$

We calculate $E[Duncan_r]$ by simulating fifty random occupational distributions for each metro area where the number of Black individuals in each occupation and education group is simulated using binomials where the probability of "success" is the share of Black men within the relevant education group.

Appendix Figure A.1 displays a map where the shading corresponds to the value of the adjusted Duncan index. The primary results are that there is substantial occupational segregation and that the segregation is not limited to the South.

C.3 Oaxaca-Blinder decomposition

Another way of examining the labor-market context is to decompose wage differences in an Oaxaca-Blinder framework. We can decompose the aggregate wage gap into the portion that can be explained by differences in observables and the portion that cannot be explained by observables. The cross-sectional regression of (log of) wage on observables is:

$$Y_i = \beta X_i + \varepsilon_i$$

Evaluating the OLS estimate at the mean values gives:

$$\bar{Y} = \widehat{\beta}\bar{X}$$

The difference between Black and white outcomes can be decomposed into:

$$\bar{Y}^{Wh} - \bar{Y}^{Bl} = \underbrace{\widehat{\beta^{Wh}}(\bar{X}^{Wh} - \bar{X}^{Bl})}_{\text{Observables}} + \underbrace{(\widehat{\beta}^{Wh} - \widehat{\beta}^{Bl})\bar{X}^{Bl}}_{\text{Unobservables}}$$

where the first term gives the portion of the wage gap that can be explained by observable differences and the second portion cannot be explained by observable characteristics.[58] For 1940 and 1950, we regress (log of) wages on a set of variables for education (years of education interacted with region of birth, whether graduated high school, whether graduated college), occupation (indicators for eleven aggregate occupation categories), industry (indicators for twelve aggregate industry categories), region, and a cubic in age. The resulting decompositions are given in the first two columns of Appendix Table A13. We restrict the sample to native born men living in metro areas.

There are several key results. First, there is a large wage gap, but it declines significantly between 1940 and 1950 - declining from 0.63 log points in 1940 to 0.38 log points in 1950. Second, education and occupation differences are the most important observable factors. Third, there is still a large portion of the gap that cannot be explained by observable characteristics.

We can take this decomposition a step further and decompose the changes between 1940 and 1950. We focus on decomposing the change in the explained gap into a "price" effect and "pure" effect. The price effect is due to changing coefficient values that benefit one race relatively more than the other (changes in β). The pure effect is due to relative changes in observables (changes in $\bar{X}$).

[58] We evaluate the gap at the coefficient values for white men. We could have evaluated the gap at the coefficients for Black men or some combination of the two, but alternative approaches do not change our qualitative findings.

$$\Delta_{40-50}\widehat{\beta^{Wh}}(\bar{X}^{Wh}-\bar{X}^{Bl}) = \underbrace{\widehat{\beta^{Wh,50}}(\Delta_{40-50}\bar{X}^{Wh}-\Delta_{40-50}\bar{X}^{Bl})}_{\text{Pure}} + \underbrace{\Delta_{40-50}\widehat{\beta}^{Wh}(\bar{X}^{Wh,40}-\bar{X}^{Bl,40})}_{\text{Price}}$$

The results are given in the last three columns of Appendix Table A13. Overall, education and occupation changes explain most of the decline in the wage gap due to observables. The change in the gap due to education is almost entirely due to price effects (lower returns to education). On the other hand, the change in the gap due to occupation is due to both price effects (relatively higher returns for occupations with more Black men) and pure effects (Black men changing occupation). The price effects are consistent with the finding in Margo (1995) of wage compression across education groups and occupations that relatively benefited Black men. However, we also observe meaningful changes in the wage gap due to changes in the occupational composition of Black men, which is consistent with occupational upgrading.

D Robustness and Supplementary Analysis

D.1 Impact of war expenditures on labor-market outcomes during WWII

ES-270. Our main analysis looks at changes between 1940 and 1950, but it is also instructive to look at how war expenditures impacted employment during the war. The first way we can analyze the impact during the war is to look at the impact on employment in war industries using the ES-270 reports. For more discussion on the data, please see Appendix Section B.3. We use our standard difference-in-differences strategy, and our outcome is the share employed in defense industries. There are several issues with this outcome variable. First, not all establishments are included in the ES-270 reports. Second, we do not have a concurrent estimate of the employed population. Finally, the ES-270 data is split by race or gender but not by race and gender.

Despite these issues, it is still useful to look at the impact of war expenditures on outcomes during the war. First, our hypothesized mechanism requires employment changes during the war so if we do not see concurrent effects then we might question our results. Secondly, it is useful to compare the impact on whites and Blacks during the war. If there are effects on both during the war but only on Blacks after the war, then it strengthens the hypthesis that it is due to changes in discrimination rather than experience gained during the war.

Appendix Table A5 has the results. Higher war expenditure is strongly associated with higher defense industry employment for Blacks and whites. Therefore, it seems war expenditures did affect both Blacks and whites during the war.

D.2 Short-term labor-market outcomes

Geographic unit of analysis. Another concern is that our results might be dependent on the geographic unit of analysis. We repeat our main Table (Table 2) but for states and commuting zones. The results for states are presented in Appendix Table A11. In both cases our findings are similar to our main results at the metro level.

Occupational segregation. Another interpretation consistent with our results on occupational upgrading is that white men changed occupations within the skilled occupation group and Black men moved into those vacated occupations. In this scenario there is no decrease in occupational segregation. Therefore we want to check to see if the occupational distribution of Black men and white men became more similar in areas with higher war expenditures at a more granular level. We use two measures for occupational segregation. First, we use a Duncan index to measure deviations from evenness. Second, we use an adjusted Duncan index that is deviations from the expected evenness after accounting for randomness. We use our standard difference-in-differences approach:

$$Y_{rt} = \beta_1 WarExp_r \times Post_t + \beta_2 Draft_r \times Post_t + Post_t + \gamma_r + X_{irt}\rho + \varepsilon_{irt} \quad (9)$$

The results are presented in Appendix Table A9. Higher war expenditures are associated with lower occupational segregation for both measures. Therefore, it does seem as though the occupational composition for white and Black men became more similar in places with higher expenditures.

Excluding likely migrants. Our results could potentially be explained by selective migration. Black men with better skills and/or education could have migrated to metropolitan areas with higher war expenditures. They then stayed in these metropolitan areas after the war, which could explain higher wages and occupational upgrading. In order to test this theory, we re-run our main results but exclude potential interstate migrants in 1950. We define potential interstate migrants as anyone who was born in a different state than their state of residence and does not have a child eight years or older born in their current state of residence. If they have a child who was eight years or older and born in the same state, then it is likely they did not move to their current state after WWII started. We validate this approach using the 1940 Census, which asked for the place of residence five years prior and find it is highly accurate in identifying non-migrants.[59]

We use our standard difference-in-differences approach, except at the individual level with additional controls for age (cubic polynomial), marital staus, and region of birth:

$$Y_{irt} = \beta_1 WarExp_r \times Post_t + \beta_2 Draft_r \times Post_t + Post_t + \gamma_r + X_{irt}\rho + \varepsilon_{irt} \quad (10)$$

The results are presented in Table A6. The results excluding potential migrants are very similar to our main results. Therefore, it does not seem as though our results can be solely explained by selective migration.

Impact on younger cohorts. One potential explanation for the persistence of our results is that Black men gained valuable work experience during World War II, leading to persistent productivity improvements. If this explains the persistence, then workers who move to metropolitan areas with higher war expenditures or future generations would not benefit from the accumulated experience. A way to test this explanation is to see occupational gains for cohorts who were too young to have gained significant experience during the war.

Men who are ages 18-24 in 1950 would have been 18 or younger in 1944[60] and therefore would have not been able to accumulate significant experience or would have done so at the cost of reduced education. We compare 18-24 year olds in 1950 versus 1940 and then repeat the exercise using 18-34 year olds in 1960 versus 1940. We use our standard difference-in-differences approach, except at the individual level with additional controls for age, marital staus, and region of birth:

$$Y_{irt} = \beta_1 WarExp_r \times Post_t + \beta_2 Draft_r \times Post_t + Post_t + \gamma_r + X_{irt}\rho + \varepsilon_{irt} \quad (11)$$

The results are presented in Table A7. The coefficients for the full sample and the restricted age

[59] The 1950 Census asks only for the place of residence one year prior. Validation results available upon request.

[60] War expenditures were ramping down in 1945.

samples are very similar. Therefore, the results can be explained purely by the experience gained during the war. One note of caution when interpreting the results is that younger cohorts could have benefitted from increased education; however, results are similar if education is included as a control.

Who upgraded? A natural question is who upgraded? Our robustness Figure A.7 provides some preliminary evidence that upgrading occurred across demographic groups. At an aggregate level, we can examine how occupational upgrading varied with age or educational status. Appendix Figure A.10 shows the share of men who are in skilled occupations by age for 1930, 1940, and 1950. The shares are roughly constant between 1930 and 1940, but then there is a major shift between 1940 and 1950. The most interesting finding is that the upgrading occurred in all age groups. This suggests that changes in discrimination, rather than compositional changes, might be important. Similar results can be seen when looking at upgrading by educational groups. The upgrading occurred for all educational groups, with the smallest changes for the highest education group. Again, large changes in occupational skill level even for the lowest levels of education (0-5 years) is most consistent with declines in discrimination rather than compositional changes.

A related question is what occupations within the skilled category did Black men enter? Table A12 gives the relationship between war expenditures and changes in employment shares for 11 aggregate occupation categories. Black men left domestic service, service worker, farm labor, and common laborer occupations and primarily entered operative and craftsman occupations (semi-skilled / skilled blue-collar). These occupations are both very common in manufacturing, which was the key defense industry.

D.3 Instrumental variable analysis

One major potential concern is that war expenditures be endogenous with respect to the labor-market outcomes for Black men. While there does not appear to be significant pre-existing trends (see Figure 2), there might be other potential issues. For example, there could be reverse causality; areas where many Black men upgraded might have had the capacity to receive more war contracts. Therefore, we check if the results are similar when using a Bartik instrument. The basic idea is to predict war expenditures using the baseline industry employment by location interacted with the national (leave-out) expenditures by industry.

We use firm-level data on the total value of war contracts from Li and Koustas (2019). We then allocate these contracts to 1950 Census industry codes using supplemental data from Bianchi and Giorcelli (2020). 1940 Census industry employment totals are used to convert the expenditures for industry i into expenditures per worker ($WarExpPerWorker_i$). Next, we create the baseline number of workers in each industry for each location ($Workers_{ir}$). The predicted shock for each region is:

$$IV_r = \frac{1}{Pop_r} \sum_i WarExpPerWorker_i * Workers_{ir}$$

We then predict war expenditures per capita in a first stage using IV_r. In practice, we use the leave-out version of $WarExpPerWorker_i$, i.e., for each region r we construct the measure excluding contracts and workers in region r.

The key identification assumption is that the "shocks," $WarExpPerWorker_i$, are as good as randomly assigned, conditional on covariates. Note that this does not require the exogeneity of exposure shares. The key potential threat to identification is if the industries that are more likely to receive war expenditure shocks were also industries that were more likely to receive some unobservable shock that caused skill upgrading for Blacks.

It is likely that the shocks are not as good as randomly assigned since manufacturing industries were more likely to receive contracts. Therefore, following the advice in Borusyak et al. (2019), we control for the initial share in manufacturing, the initial share in durable goods manufacturing, and the share of workers in the labor force.

The results are presented in Appendix Table A10. The OLS with standard controls are presented in column 1 and the OLS with the additional IV controls are presented in column 2. The IV results are in column 3. The first stage is very strong with an F-stat of over 30. The estimates for the effect on the share skilled are very similar to the OLS estimates. The estimates for the effect on wages are much noisier since the IV is less efficient.

The key result is the fact that we cannot reject the exogeneity of the war expenditures for either the share skilled or wages (see the endogeneity test p-values). We can reject exogeneity for the change in population, but in this case the IV estimates are significantly larger. Therefore, we do not believe there are significant endogeneity issues for our main OLS estimates.

D.4 Input-output analysis

War contracts represent the value of the final demand for industry output. The production of the final goods requires significant intermediate inputs. For example, the "direct demand" for a B-17 generates significant "indirect demand" for aluminum. We assign war contracts from Li and Koustas (2019) to 1958 SIC industry codes using supplemental data from Bianchi and Giorcelli (2020). The industry codes are assigned based on the pre-war industry of the firm receiving the contract. This gives the "direct demand" by industry.

We use historical benchmark BLS input-output tables to calculate the indirect demand.[61] We use the 1958 table, but results are similar using the 1947 table instead.[62] These tables give direct purchases from each industry i required to produce one dollar of output in industry j. Let A be the input-output table and d be the vector of direct demand. Then the direct demand industries will need to purchase Ad inputs to produce their output. But these input producers need to purchase their own inputs to produce the output, which adds the additional demand $A(Ad)$. This process can be continued iteratively, and it can be shown that the total gross output, g, required from all industries to produce direct demand d is:

$$g = (I - A)^{-1} d$$

Where I is an identify matrix. Therefore, the direct demand is d and the indirect demand is given by $(g - f)$. Finally, we convert the direct and indirect demand to value added by multiplying by the value added share for each industry.

The final step is assigning the industry-level shocks to metro areas. We divide the direct and indirect industry demand shocks by the number of workers in the industry in 1940. The shocks are then allocated to metro areas by multiplying the number of workers in each metro in each industry by the industry shocks to get the total shock. It is then converted to a per capita figure by dividing on the population in the metro.

[61] See https://www.bea.gov/industry/historical-benchmark-input-output-tables.

[62] We use the 1958 table because the 1947 table requires additional assumptions and imputations to convert to standardized industries.

D.5 Effect of war expenditures on migration

First, the migration of Black families cannot be understood without discussing the Great Migration. This overview paragraph draws heavily from Collins (2020), an excellent review of economic research on the Great Migration. Prior to WWI, around 90% of Black individuals lived in the South. Over the next six decades, millions migrated out of the South until less than half of Black individuals lived in the South in 1970. This migration took place in two waves. The first started due to labor shortages during WWI[63] and ended with the Great Depression. The second was precipitated by WWII and ended in the 1960s. Collins and Wanamaker (2014) show that migrants had large earning gains. Migrants also had major impacts on the receiving Northern cities. Boustan (2009) shows how migrants impacted the labor-market outcomes of Black and white workers in the North. Large influxes of new migrants also reduced intergenerational mobility for Black individuals (Derenoncourt, 2019). Finally, Black migrants also caused "white flight" to the suburbs (Boustan, 2010).

World War II expenditures were an important influence on the decision to migrate. Boustan (2010) and Derenoncourt (2019) instrument for migrant flows to Northern cities by using pre-existing migration networks interacted with "push" shocks in Southern counties. One of these shocks they use is war expenditures per capita. They find that war expenditures do predict migrant outflows, with higher expenditure areas associated with less out-migration. For this project, our concern is how war expenditures worked as a "pull" factor – i.e., were migrants more likely to go to areas with higher war expenditures. War expenditures are strongly associated with population increases for Black men between 1940 and 1950 but not between 1930 and 1940. For white men they are not strongly associated in 1940 to 1950 but there is a negative association in the pre-period that might indicate a positive impact relative to the existing trend. Appendix Figure A.8 provides the effect of war expenditures on migration for a variety of specifications.

D.6 Education of the next generation

School attendance 1930-40 and 1940-60. We repeat our analysis of the effect of war expenditures on school enrollment for the periods 1930-40 and 1940-60 instead of 1940-50. We follow our main difference-in-differences approach.

The results for 1930-40 are presented in Appendix Table A16. We do not see any significant relationship between war expenditures and changes in school enrollment. Therefore, there does not seem to be significant positive pre-trends or a slight negative trend.

The results for 1940-60 are presented in Appendix Table A15. We see a positive relationship between war expenditures and schooling for Black boys but no significant effect for Black girls. This result is consistent with our 1940-50 results that find stronger impacts on Black boys. The effect size is smaller, which does indicate the effect could fade with time. An alternative explanation could be that attendance of 16-18 year olds increased with time, reducing our ability to measure the treatment effect because there are fewer potential "switchers."

High school graduation rates. One concern with the effect of war expenditures on high school graduation rates (Figure 4) is the potential presence of pre-trends. The 5% sample for 1960 might not have sufficient power to rule out pre-trends. One alternative is to conduct the same analysis using the 1940 Census to see if there were pre-existing trends. Appendix Figure A.12 shows these results. For boys, the coefficients on "War exp * Black" seem to be consistently close to zero. For

[63] Labor shortages were caused due to war demands combined with the sudden halt to European immigrant flows – see Collins (1997).

girls, there is little evidence of a positive trend in the years immediately leading up to WWII. There is potentially some trend in the early 1930s at the onset of the Great Depression that is driven by differential changes in the education of white girls. These results are consistent with our estimates for girls being noisier and less likely to be statistically significant than our estimates for boys.

Why did schooling increase? We consider four potential mechanisms behind the positive impact of war spending on the schooling of Black children: i) changes in the returns to schooling, ii) changes in public spending on schools, iii) reductions in residential segregation and iv) increases in parental income. First, we investigate whether war expenditures affected the returns to school using a Mincerian wage equations where we interact whether a Black individual completed at least some high school with $WarExp_m \times Post_t$. Appendix Table A18 shows this triple difference is statistically insignificant: War expenditures did not increase returns to schooling (column 1). This is consistent with the fact that returns to school declined during the "Great Compression" period (Goldin and Margo, 1992) and not because of changing selection into schooling (Bishop, 1989). The table also shows that there were no changes in the extent to which education allowed Black children to access high skilled occupations (column 2). Thus, higher returns to school do not explain the increased investment in school that we document.

Next, we examine school expenditures. The fact that white children are not positively affected by WWII contracts suggests there were no major changes in education policy or expenditures in cities with greater expenditures. We verify this by estimating equation (1), but replacing the outcome with the log of education expenditures per capita. The results in Table A8 show there were no significant increases in education expenditures in cities with more war expenditures.[64]

To investigate if there were changes in residential segregation, we look at whether war expenditures affected two indices of segregation: the dissimilarity index and the isolation index from Cutler et al. (1999).[65] We observe no declines in residential segregation associated with war expenditures using either one, as shown in Table A8.

Overall, the most plausible mechanism appears to be the change in family income. Previous work has shown that parental income remains the most important predictor of children's educational achievement, even more so than parental education (Reardon, 2011). Recent analysis of the strong association between racial segregation and racial achievement gaps concludes that the gap is completely accounted for by racial differences in poverty rates (Reardon et al., 2019). This is true even after years of increasing public expenditures on schools that serve lower income students (Lafotune et al., 2018).

Given this, it should not be surprising that declines in workplace discrimination that led to substantial increases in the earned income of Black families would result in increases in the educational achievement of their children. A move from the 10th to the 90th percentile of war expenditures is associated with an absolute (not relative to whites) increase in wages of 9.4% and an absolute (not relative to whites) increase in the share of Black boys graduating high school of 3.6%.[66] If we assume all of the increases in schooling are due to greater incomes, then this implies an elasticity of 1.0 for Black boys (0.5 for Black girls). This is broadly consistent with analyses based on more contemporary data of an outsized role of parental income in explaining educational

[64] Unfortunately there is no data at the sub-city level that would allow us to investigate whether expenditures or quality of school increase in Black neighborhoods.

[65] The index of dissimilarity is defined for metropolitan area r as $Dissim_{rt} = \frac{1}{2} \sum_{i=1}^{N} | \frac{Black_{irt}}{Black_{rt}} - \frac{White_{irt}}{White_{rt}} |$ where i is a residential area. The isolation index is defined as $Isol_{rt} = \frac{\sum_{i=1}^{N} \frac{Black_{irt}}{Black_{rt}} \frac{Black_{irt}}{Pop_{irt}} - \frac{Black_{rt}}{Pop_{rt}}}{\min(\frac{Black_{rt}}{Pop_{irt}},1) - \frac{Black_{rt}}{Pop_{rt}}}$.

[66] The share of Black boys graduating high school for the 1942-1959 cohorts was 38.6%, excluding the South. For Black girls it was 44.8%.

outcomes of children.[67]

E Qualitative Theory Appendix

In Section E.1 we prove the Proposition displayed in Section 6.1. In Section E.2 we display and prove a version of this proposition in the Becker model (without incorporating the Roy model). Finally, in Section E.3, we display and prove...

E.1 Becker + Roy Model

The number of efficiency units of race g employed producing good i is

$$l_{gi} \equiv l_g(w_{gi}) = \gamma N_g w_{gi}^{\theta-1} \Phi_g^{\frac{1-\theta}{\theta}}$$

where N_g is the number of workers of race g and where $\Phi_g \equiv \sum_j w_{gj}^{\theta}$. The average wage across workers in race g is

$$Wage_g = \gamma \Phi_g^{\frac{1}{\theta}}$$

where γ is a constant. This wage is common across goods. We also have

$$\pi_{gj}^{L} = \frac{w_{gj}^{\theta}}{\Phi_g} \tag{12}$$

Finally, profit maximization for each producer yields $\Pi_j = 0$ and $w_{aj} = w_{bi}\tau_j$. Together, these yield

$$w_{bj}^{\theta(1-\alpha)+\alpha} = \frac{A_j}{\tau_j^{\alpha}} \left(\gamma N_a \Phi_a^{\frac{1-\theta}{\theta}} \tau_j^{\theta} + \gamma N_b \Phi_b^{\frac{1-\theta}{\theta}} \tau_j \right)^{\alpha-1} \tag{13}$$

Labor demand shocks. Log differentiating (13) with respect to A_i, we obtain

$$\frac{d\log w_{bj}}{d\log A_i} = \frac{1}{1+\widetilde{\theta}} \mathbb{I}_{j=i} + \frac{\widetilde{\theta}}{\theta(1+\widetilde{\theta})} \left(s_{aj} \frac{d\log \Phi_a}{d\log A_i} + s_{bj} \frac{d\log \Phi_b}{d\log A_i} \right) \tag{14}$$

where $\mathbb{I}_{j=i}$ is an indicator function that equals one if $j = i$ and zero otherwise, where $\widetilde{\theta} \equiv (1-\alpha)(\theta-1) > 0$, and where

$$s_{aj} \equiv L_a \Phi_a^{\frac{1-\theta}{\theta}} \tau_j^{\theta} \Big/ \left(L_a \Phi_a^{\frac{1-\theta}{\theta}} \tau_j^{\theta} + L_b \Phi_b^{\frac{1-\theta}{\theta}} \tau_j \right)$$

[67] Existing work based on more recent data has generated estimates of parental income elasticities with respect to years of completed schooling of their children (not high school completion) that range from 3 to 80% (Taubman, 1989). Our estimates are on the higher end, which may be due to (1) the extremely low levels of schooling at this time among Black families, (2) the different definition of the outcome (high school completion) or (3) the effect of aggregate income shocks possibly differing from family-specific income shocks (for example, by generating peer effects).

is the share of j's efficiency units that are race a and $s_{aj} + s_{bj} = 1$. We also have

$$\frac{d \log Wage_g}{d \log A_i} = \sum_j \pi^L_{gj} \frac{d \log w_{gj}}{d \log A_i} \tag{15}$$

where $\pi^L_{gj} \equiv w^{\theta}_{gj}/\Phi_g$ is the share of total employment of race g (in bodies, not efficiency units) across all j that is within j. Combining (14) and (15) yields

$$\frac{d \log Wage_b}{d \log A_i} = \frac{1}{1+\widetilde{\theta}(1-k_b)} \pi^L_{bi} + \frac{\widetilde{\theta}(1-k_b)}{1+\widetilde{\theta}(1-k_b)} \frac{d \log Wage_a}{d \log A_i}$$

where we have defined

$$k_g \equiv \sum_j \pi^L_{gj} s_{gj}$$

We similarly obtain

$$\frac{d \log Wage_a}{d \log A_i} = \frac{1}{1+\widetilde{\theta}(1-k_a)} \pi^L_{ai} + \frac{\widetilde{\theta}(1-k_a)}{1+\widetilde{\theta}(1-k_a)} \frac{d \log Wage_b}{d \log A_i}$$

Combining the previous equations we solve explicitly for changes in wages for both races as

$$\begin{aligned} \frac{d \log Wage_b}{d \log A_i} &= \frac{1+\widetilde{\theta}(1-k_a)}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)} \pi^L_{bi} + \frac{\widetilde{\theta}(1-k_b)}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)} \pi^L_{ai} \\ \frac{d \log Wage_a}{d \log A_i} &= \frac{1+\widetilde{\theta}(1-k_b)}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)} \pi^L_{ai} + \frac{\widetilde{\theta}(1-k_a)}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)} \pi^L_{bi} \end{aligned}$$

Combining these two equations yields equation (4). Finally, equation (5) follows directly from $\pi^L_{bi}/\pi^L_{ai} = (\tau_i)^{-\theta} \times (Wage_a/Wage_b)^{\theta}$.

Anti-discriminatory shocks. Log differentiating (13) with respect to τ_i, we obtain

$$\frac{d \log w_{bj}}{d \log \tau_i} = -\frac{(1+\widetilde{\theta} s_{aj})}{(1+\widetilde{\theta})} \mathbb{I}_{j=i} + \frac{\widetilde{\theta}}{\theta(1+\widetilde{\theta})} \left(s_{aj} \frac{d \log \Phi_a}{d \log \tau_i} + s_{bj} \frac{d \log \Phi_b}{d \log \tau_i} \right) \tag{16}$$

We also have

$$\frac{d \log Wage_g}{d \log \tau_i} = \sum_j \pi_{gj} \frac{d \log w_{gj}}{d \log \tau_i} \tag{17}$$

Equation (16) and $d \log \Phi_g = \theta d \log Wage_g$ yield

$$\pi^L_{bj} \frac{d \log w_{bj}}{d \log \tau_i} = \frac{-\pi^L_{bj}(1+\widetilde{\theta} s_{aj})}{1+\widetilde{\theta}} \mathbb{I}_{j=i} + \frac{\widetilde{\theta} \pi^L_{bj}}{1+\widetilde{\theta}} \left(s_{aj} \frac{d \log Wage_a}{d \log \tau_i} + s_{bj} \frac{d \log Wage_b}{d \log \tau_i} \right)$$

Summing across all j and combining with equation (17), we obtain

$$\frac{d \log Wage_b}{d \log \tau_i} = \frac{-(1+\widetilde{\theta} s_{ai})}{1+\widetilde{\theta}(1-k_b)} \pi^L_{bi} + \frac{\widetilde{\theta}(1-k_b)}{1+\widetilde{\theta}(1-k_b)} \frac{d \log Wage_a}{d \log \tau_i}$$

Since $\frac{d\log w_{aj}}{d\log\tau_i} = \frac{d\log w_{bj}}{d\log\tau_i} + \mathbb{I}_{j=i}$, we similarly obtain

$$\pi^L_{aj}\frac{d\log w_{aj}}{d\log\tau_i} = \frac{\widetilde{\theta}s_{bj}\pi^L_{aj}}{1+\widetilde{\theta}}\mathbb{I}_{j=i} + \frac{\widetilde{\theta}\pi^L_{aj}}{1+\widetilde{\theta}}\left(s_{aj}\frac{d\log Wage_a}{d\log\tau_i} + s_{bj}\frac{d\log Wage_b}{d\log\tau_i}\right)$$

Summing across all j and combining with equation (17), we obtain

$$\frac{d\log Wage_a}{d\log\tau_i} = \frac{\widetilde{\theta}s_{bi}\pi^L_{ai}}{1+\widetilde{\theta}(1-k_a)} + \frac{\widetilde{\theta}(1-k_a)}{1+\widetilde{\theta}(1-k_a)}\frac{d\log Wage_b}{d\log\tau_i}$$

Combining these expressions, we obtain an explicit solution the the change in the wage of each race,

$$\frac{d\log Wage_a}{d\log\tau_i} = \frac{\widetilde{\theta}s_{bi}(1+\widetilde{\theta}(1-k_b))}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)}\pi^L_{ai} - \frac{\widetilde{\theta}(1-k_a)(1+\widetilde{\theta}s_{ai})}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)}\pi^L_{bi}$$
$$\frac{d\log Wage_b}{d\log\tau_i} = \frac{-(1+\widetilde{\theta}s_{ai})(1+\widetilde{\theta}(1-k_a))}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)}\pi^L_{bi} + \frac{\widetilde{\theta}(1-k_b)\widetilde{\theta}s_{bi}}{1+\widetilde{\theta}(1-k_a)+\widetilde{\theta}(1-k_b)}\pi^L_{ai}$$

Combining these equations yields equation (6). Finally, equation (7) follows directly from $\pi^L_{bi}/\pi^L_{ai} = (\tau_i)^{-\theta} \times (Wage_a/Wage_b)^{\theta}$.

E.2 Becker Model

The assumptions of the Becker model are identical to those of the Becker + Roy model except: *(i)* each worker within a race is identical to all others with a unit productivity across all producers and *(ii)* there is a unique producer of each good.

We order producers such that $i' > i \Rightarrow \tau_{i'} > \tau_i$; higher-indexed producers are more discriminatory. Hence, in any equilibrium, if firm i hires only race a, then any firm more discriminatory than i hires only race a; and if firm i hires only race b, then any firm less discriminatory than i hires only race b. While an equilibrium is unique, it can take one of two forms given parameter values: one in which there exists a firm indifferent between hiring both races and another in which no such firm exists. In the first case, if firm i is the indifferent firm, then $Wage_a/Wage_b = \tau_i$. In this case, firm i's level of discrimination determines the racial wage gap. We refer to this as case $\mathcal{A}_1$ and let $\mathbb{I}_i$ denote an indicator function that equals one if i is the marginal firm indifferent between hiring both races. In the second case, if j is the most discriminatory firm hiring only race b and $j+1$ is the least discriminatory firm hiring only race a, then $Wage_a/Wage_b \in [\tau_j, \tau_{j+1}]$. In this case, the racial wage gap falls somewhere between these firms' levels of discrimination. We refer to this as case $\mathcal{A}_2$.

The following proposition describes how small changes in any firm's labor demand or discrimination affect equilibrium outcomes, where we define $\pi^L_{gi} \equiv l_{gi}/N_g$ as the share of race g workers hired in i. For compactness, we do not consider the knife-edge case in which parameters are such that a small change induces a switch between the two types of equilibria, $\mathcal{A}_1$ and $\mathcal{A}_2$.

Proposition [Becker]. *Small changes in A_i and τ_i affect racial wage gaps according to*

$$\frac{d\log(Wage_b/Wage_a)}{d\log A_i} = \begin{cases} 0 & \text{if } \mathcal{A}_1 \\ \pi_{bi} - \pi_{ai} & \text{if } \mathcal{A}_2 \end{cases}$$
$$\frac{d\log(Wage_b/Wage_a)}{d\log \tau_i} = \begin{cases} -\mathbb{I}_i & \text{if } \mathcal{A}_1 \\ -\pi_{bi} & \text{if } \mathcal{A}_2 \end{cases}$$

and do not affect any firm's employment share of one race relative to the other race except the marginal firm if $\mathcal{A}_1$.

In case $\mathcal{A}_1$ the proof is direct. Consider case $\mathcal{A}_2$. denote by $\mathcal{I}_a \equiv \{i \in \mathcal{I} | \tau_i > \tau^*\}$ the set of firms that hire only race a and by $\mathcal{I}_b \equiv \mathcal{I}/\mathcal{I}_a$ the set that hire only race b. Labor-market clearing conditions yield

$$Wage_a = \alpha N_a^{1-\alpha} \left(\sum_{i\in\mathcal{I}_a} A_i^{\frac{1}{1-\alpha}} \right)^{1-\alpha} \tag{18}$$

$$Wage_b = \alpha N_b^{1-\alpha} \left[\sum_{i\in\mathcal{I}_b} (A_i/\tau_i)^{\frac{1}{1-\alpha}} \right]^{1-\alpha} \tag{19}$$

Differentiating equations (18) and (19) with respect to A_i yields

$$d\log\frac{Wage_b}{Wage_a} = \left(\frac{l_{bi}}{N_b} - \frac{l_{ai}}{N_a}\right) d\log A_i$$

Similarly, differentiating equations (18) and (19) with respect to τ_i yields

$$d\log\frac{Wage_b}{Wage_a} = -\frac{l_{bi}}{N_b} d\log\tau_i$$

Proposition [Becker] conveys much of the *intuition* in Proposition [Becker + Roy] for how wages change in response to changes in productivity or discrimination. In both models, in response to an increase in producer i's productivity, wages weakly rise for race b relative to race a only if producer i is relatively intensive in race b labor. In response to a decline in discrimination in producer i, wages weakly rise for race b relative to race a only if producer i hires any of race b. Even for relative wages, the predictions of the Becker + Roy model improve on those of the Becker model, as they do not depend on whether we are in an equilibrium in which no firms hire both races or in an equilibrium in which a unique firm does (neither of these conditions are satisfied in the data).

For related reasons, Proposition [Becker] conveys none of the intuition in Proposition [Becker + Roy] for how relative employment shares across races change across producers in response to shocks.

E.3 A Simplified Version of the Quantitative Model

Consider a version of our quantitative model in Section 7 in which there is a unique industry (so we drop the industry subscript), a unique region (so we drop the region subscript), and two groups g (race a and race b). We denote the net productivity of race b as $T_{bo} = T'_{bo}/\tau_o$ for $\tau \geq 1$; in our comparative statics we will shock τ_o. This framework is a version of the model of Hsieh et al. (2019), simplified to have two labor groups.

Here, we use the appropriately simplified equations displayed in Appendix F. These are

$$\pi_{go}^L = \frac{(T_{go} P_o)^\theta}{\Phi_g}$$

where P_o is the output price of occupation o and where

$$\Phi_g = \sum_o (T_{go} P_o)^\theta$$

Occupation prices are determined in equilibrium by the following equation

$$\sum_g \gamma T_{go} \pi_{go}^{\frac{\theta-1}{\theta}} N_g = \mu_o P_o^{-\eta}$$

(where we have normalized $YP^\eta = 1$). Average wages are given by

$$Wage_g = \gamma \Phi_g^{\frac{1}{\theta}}$$

for a constant γ. In the notation of this framework, the labor demand shifter for occupation o is μ_o and discrimination is τ_o, which is embedded within T_{go}. Since this framework is a version of the model of Hsieh et al. (2019), simplified to have two labor groups, we refer to the following proposition as Proposition HHJK.

Proposition [HHJK]. *Small changes in A_j affect racial wage gaps and factor intensities as follows*

$$\frac{d\log(Wage_b/Wage_a)}{d\log \mu_o} = \frac{\pi_{bo}^L - \pi_{ao}^L}{\eta + (\theta-1)(1-\sum_o \pi_{ao}^L s_{ao}) + (\theta-1)(1-\sum_o \pi_{bo}^L s_{bo})} \tag{20}$$

$$\frac{d\log(\pi_{bj}^L/\pi_{aj}^L)}{d\log \mu_o} = \theta \frac{d\log(Wage_b/Wage_a)}{d\log \mu_o} \tag{21}$$

and small changes in and τ_j affect racial wage gaps and factor intensities as follows

$$\frac{d\log(Wage_b/Wage_a)}{d\log \tau_o} = \frac{\theta s_{bo}(\pi_{bo}^L - \pi_{ao}^L) - (\eta+\theta-1)\pi_{bo}^L}{\eta + (\theta-1)(1-\sum_o \pi_{ao}^L s_{ao}) + (\theta-1)(1-\sum_o \pi_{bo}^L s_{bo})} \tag{22}$$

$$\frac{d\log(\pi_{bj}^L/\pi_{aj}^L)}{d\log \tau_o} = -\theta \mathbb{I}_{j=o} - \theta \frac{d\log(Wage_b/Wage_a)}{d\log \tau_o} \tag{23}$$

To see the relationship between our quantitative and qualitative frameworks, note that the limits of equations (20) - (23) as $\eta \to 1$ equal the limits of equations (4) - (7) in Proposition [Becker + Roy] as $\alpha \to 0$. More generally, the economic insights are identical across the two propositions under the sufficient condition that $\eta \geq 1$, so that an increase in productivity in a given occupation raises employment there. In both Propositions, a decline in discrimination in a given job raises the relative wage of race b and increases the share of race b relative to race a employed in that job relative to all others; whereas in both Propositions an increase in labor demand in a given job raises the relative wage of race b if and only if that job was initially intensive in race b and does not differentially affect the share of race b relative to race a employed in that job relative to any other.

We prove Proposition HHJK in what follows.

Labor demand shocks. Define

$$s_{go} \equiv T_{go}\pi_{go}^{\frac{\theta-1}{\theta}} N_g \Big/ \left(\sum_{g'} T_{g'o}\pi_{g'o}^{\frac{\theta-1}{\theta}} N_{g'}\right)$$

as the share of output of occupation o produced by labor group g in the initial equilibrium. Log differentiating with respect to μ_o yields

$$\frac{d\log Wage_g}{d\log \mu_o} = \sum_j \pi_{gj}^L \frac{d\log P_j}{d\log \mu_o}$$

where

$$\frac{d\log P_j}{d\log \mu_o} = \frac{\theta-1}{\eta+\theta-1}\sum_g s_{gj}\frac{d\log Wage_g}{d\log \mu_o} + \frac{1}{\eta+\theta-1}\mathbb{I}_{j=o}$$

Combining the two previous equations (and using two labor groups), we obtain

$$\frac{d\log Wage_g}{d\log \mu_o} = \frac{1}{\eta+\theta-1}\pi_{go}^L + \frac{\theta-1}{\eta+\theta-1}\frac{d\log Wage_a}{d\log \mu_o}\sum_j \pi_{gj}^L s_{aj} + \frac{\theta-1}{\eta+\theta-1}\frac{d\log Wage_b}{d\log \mu_o}\sum_j \pi_{gj}^L s_{bj}$$

The previous equation holds for $g = a, b$, yielding a system of two equations in two unknowns

$$\frac{d\log Wage_a}{d\log \mu_o} = \frac{1}{\eta+y_a}\pi_{ao} + \frac{y_a}{\eta+y_a}\frac{d\log Wage_b}{d\log \mu_o}$$

and

$$\frac{d\log Wage_b}{d\log \mu_o} = \frac{1}{\eta+y_b}\pi_{bo} + \frac{y_b}{\eta+y_b}\frac{d\log Wage_a}{d\log \mu_o}$$

where we have again defined $k_g = \sum_o \pi_{go}^L s_{go}$ and where we have defined $y_g \equiv (\theta-1)(1-k_g)$. Solving that system yields explicit solutions for changes in the wage of each race

$$\frac{d\log Wage_a}{d\log \mu_o} = \frac{\eta+y_b}{\eta(\eta+y_a+y_b)}\pi_{ao}^L + \frac{y_a}{\eta(\eta+y_a+y_b)}\pi_{bo}^L$$

and

$$\frac{d\log Wage_b}{d\log \mu_o} = \frac{\eta+y_a}{\eta(\eta+y_a+y_b)}\pi_{bo}^L + \frac{y_b}{\eta(\eta+y_a+y_b)}\pi_{ao}^L$$

Combining these equations yields

$$\frac{d\log(Wage_b/Wage_a)}{d\log \mu_o} = \frac{\pi_{bo}^L - \pi_{ao}^L}{\eta + (\theta-1)(1-\sum_o \pi_{ao}^L s_{ao}) + (\theta-1)(1-\sum_o \pi_{bo}^L s_{bo})}$$

And we clearly have

$$\frac{d\log(\pi_{bo}^L/\pi_{ao}^L)}{d\log \mu_o} = \theta\frac{d\log(Wage_b/Wage_a)}{d\log \mu_o}$$

Anti-discriminatory shocks. Log differentiating with respect to μ_o yields

$$\frac{d\log Wage_g}{d\log \tau_o} = \sum_j \pi^L_{gj}\left(\frac{d\log P_j}{d\log \tau_o} + \frac{d\log T_{gj}}{d\log \tau_o}\right)$$

where

$$\frac{d\log P_j}{d\log \tau_o} = \frac{\theta-1}{\eta+\theta-1}\sum_g s_{gj}\frac{d\log Wage_g}{d\log \tau_o} + \frac{\theta}{\eta+\theta-1}s_{bj}\mathbb{I}_{j=o}$$

Combining the two previous equations (and using two labor groups), we obtain

$$\begin{aligned}\frac{d\log Wage_g}{d\log \tau_o} =& \frac{\theta}{\eta+\theta-1}\pi^L_{go}s_{bo} + \frac{\theta-1}{\eta+\theta-1}\frac{d\log Wage_a}{d\log \tau_o}\sum_j \pi^L_{gj}s_{aj} \\ &+ \frac{\theta-1}{\eta+\theta-1}\frac{d\log Wage_b}{d\log \tau_o}\sum_j \pi^L_{gj}s_{bj} - \pi_{bo}\mathbb{I}_{g=b}\end{aligned}$$

where $\mathbb{I}_{g=b}$ is an indicator function that equals one if $g=b$ and zero otherwise. The previous equation holds for $g=a,b$, yielding a system of two equations in two unknowns

$$\frac{d\log Wage_a}{d\log \tau_o} = \frac{\theta}{\eta+y_a}\pi^L_{ao}s_{bo} + \frac{y_a}{\eta+y_a}\frac{d\log Wage_b}{d\log \tau_o}$$

and

$$\frac{d\log Wage_b}{d\log \tau_o} = \frac{\theta}{\eta+y_b}\pi^L_{bo}s_{bo} + \frac{y_b}{\eta+y_b}\frac{d\log Wage_a}{d\log \tau_o} - \frac{\eta+\theta-1}{\eta+y_b}\pi^L_{bo}$$

Solving this system yields explicit solutions for changes in the wage of each race

$$\frac{d\log Wage_a}{d\log \tau_o} = \frac{\theta(\eta+y_b)}{\eta(\eta+y_a+y_b)}\pi^L_{ao}s_{bo} + \frac{\theta y_a}{\eta(\eta+y_a+y_b)}\pi^L_{bo}s_{bo} - \frac{y_a(\eta+\theta-1)}{\eta(\eta+y_a+y_b)}\pi^L_{bo}$$

and

$$\frac{d\log Wage_b}{d\log \tau_o} = \frac{\theta(\eta+y_a)}{\eta(\eta+y_a+y_b)}\pi^L_{bo}s_{bo} + \frac{\theta y_b}{\eta(\eta+y_a+y_b)}\pi^L_{ao}s_{bo} - \frac{(\eta+y_a)(\eta+\theta-1)}{\eta(\eta+y_a+y_b)}\pi^L_{bo}$$

Combining these equations yields

$$\frac{d\log(Wage_b/Wage_a)}{d\log \tau_o} = \frac{\theta s_{bo}(\pi^L_{bo}-\pi^L_{ao}) - (\eta+\theta-1)\pi^L_{bo}}{\eta+(\theta-1)(1-\sum_o \pi^L_{ao}s_{ao}) + (\theta-1)(1-\sum_o \pi^L_{bo}s_{bo})}$$

And we clearly have

$$\frac{d\log(\pi^L_{bj}/\pi^L_{aj})}{d\log \tau_o} = -\theta\mathbb{I}_{j=o} - \theta\frac{d\log(Wage_b/Wage_a)}{d\log \tau_o}$$

F Quantitative Appendix

F.1 Model Setup

At time t there is a continuum of workers indexed by $z \in \mathcal{Z}_t$, each of whom inelastically supplies one unit of labor. Workers are exogenously divided into a finite number of labor groups, indexed by g. The set of workers in group g is given by $\mathcal{Z}_{gt} \subseteq \mathcal{Z}_t$, which has mass N_{gt}. Workers choose in which region (indexed by r) to live and in which industry (indexed by i) and occupation (indexed by o) to work in order to maximize utility. Labor is the only factor of production. All markets are perfectly competitive and all factors are freely mobile across occupations, industries, and regions. We index by $\mathcal{Z}_{rgt}$ and $\mathcal{Z}_{riogt}$ the endogenous sets of workers in group g who choose to live in region r and who choose to live in region r and work in industry-occupation io at time t.

Production. Final good output is produced locally and is not traded, so that its consumption equals its production, both of which are denoted by C_{rt}. This final good is produced combining the services of industries according to a Cobb Douglas production function

$$C_{rt} = \prod_i C_{rit}^{\mu_i} \tag{24}$$

where $C_{rit} \geq 0$ is region r's consumption of industry i, $\mu_i \geq 0$, and $\sum_i \mu_i = 1$.[68] Consumption of industry i in region r is itself an aggregation across consumption of industry i purchased from all regions and is given by

$$C_{rit} = \left(\sum_j \mu_{jit}^{1/\rho} C_{jrit}^{(\rho-1)/\rho} \right)^{\rho/(\rho-1)} \tag{25}$$

where C_{jrit} is consumption of industry i in region r purchased from region j, $\mu_{jit} \geq 0$ is a demand shifter for industry i output produced in region j, and $\rho \geq 0$ is the elasticity of substitution across regions (which is common across industries and time).

Output of industry i in region r is given by

$$Y_{rit} = \left(\sum_o \mu_{riot}^{1/\eta} Y_{riot}^{(\eta-1)/\eta} \right)^{\eta/(\eta-1)} \tag{26}$$

where Y_{riot} is the output of occupation o used in the production of industry i in region r at time t, $\mu_{riot} \geq 0$ is a demand shifter for this occupation output, and $\eta \geq 0$ is the elasticity of substitution across occupations (which is common across industries and time). Occupation o output supplied in industry i is the sum of efficiency units, L_{riogt}, provided by all groups employed therein

$$Y_{riot} = \sum_g L_{riogt}. \tag{27}$$

A worker $z \in \mathcal{Z}_{rgt}$ supplies $T_{riogt}\varepsilon_{ziot}$ efficiency units of labor if employed in industry-occupation pair io in region r at time t, so that

$$L_{riogt} = \int_{\mathcal{Z}_{riogt}} T_{riogt}\varepsilon_{ziot} dz. \tag{28}$$

The parameter T_{riogt} is the systematic component of net productivity (productivity combined with

[68] During the war, most output of war industries is purchased by the government. We use the model to quantify the impact of government expenditures between 1940 and 1950, years in which government national defense expenditure shares were low at 2.7% and 7.6% of GDP in 1940 and 1950 respectively.

a discriminatory "wedge"). A high value of T_{riogt} represents a combination of high productivity of and/or low discrimination against group g in region r within industry-occupation io at time t. In what follows, we often refer to T_{riogt} as a "net productivity" for brevity. The parameter ε_{ziot} is the idiosyncratic component of productivity. Each worker is associated with a vector of ε_{ziot}, one for each io pair, allowing workers within $\mathcal{Z}_{rgt}$ to vary in their relative productivities across io pairs. We assume that each ε_{ziot} is drawn independently from a Fréchet distribution with cumulative distribution function $G(\varepsilon) = \exp\left(-\varepsilon^{-\theta}\right)$, where a higher value of $\theta > 1$ implies lower within-worker dispersion of efficiency units across io pairs.

Worker choices. We take as given the supply of worker types at the aggregate level and model their allocation across space and across industry-occupation pairs within each location. The utility of a worker z living in region r and working in industry-occupation io is given by the product of an amenity from living in region r times an amenity from working in io times the worker's real wage. The amenity from residing in region r is given by the product of a systematic component, U_{rgt}, and an idiosyncratic preference shock, ε^{U}_{zr}, which is distributed Fréchet with shape parameter $\nu > 1$. The amenity from working in io within region r is given by A_{riog}. The utility of worker z living in region r and working in industry-occupation io is $U_{rgt}\varepsilon^{U}_{zr}A_{riog}T_{riogt}\varepsilon_{ziot}P^{Y}_{riot}/P^{C}_{t}$, where P^{Y}_{riot}/P^{C}_{t} is the real wage per efficiency unit in io in region r at time t and where $T_{riogt}\varepsilon_{ziot}$ and $U_{rgt}\varepsilon^{U}_{zr}A_{riog}$ are the worker's efficiency units and amenity values (net of discrimination) if employed there.

We assume that each worker first draws her preference shocks across regions and chooses her region, and then draws her productivity shocks across industry-occupation pairs and chooses her industry-occupation.

Market clearing and trade. Goods markets and labor markets clear. We assume that occupation output and final goods are not traded. We assume that industrial output is traded freely across regions and that trade is balanced.

Discussion of modeling assumptions. We model three forms of discrimination: one reduces the amenity value for the Black population of living in some regions relative to others, U_{rgt}; one reduces the amenity value for Black workers in some jobs relative to others within a region r, A_{riog}; and the last one reduces the net productivity of Black workers in some jobs relative to others, T_{riogt}. Following Hsieh et al. (2019), we model the impact of labor-market discrimination on occupation allocations and wages in part as a "wedge" in an otherwise competitive labor market. This wedge, embedded within T_{riogt} and A_{riog}, reduces the perceived benefit to firms of employing Black workers; it is a reduced-form proxy consistent with a range of theoretical formulations of discrimination. For example, the wedge captures the fact that Black workers' productivity was reduced by threats and acts of violence. We allow this wedge to be affected by local government wartime expenditure.

We recognize that labor markets are not perfectly competitive and that this was especially so for the labor market Black workers faced in the 1940s: unions restricted hiring practices and firm owners and workers were subject to threats and violence for deviating from norms. Nevertheless, given our goal of providing an internally consistent framework for evaluating the macroeconomic effects of our reduced-form findings, we view building on the canonical macroeconomic model of discrimination—Hsieh et al. (2019)—to be the best choice. Moreover data to estimate specific micro-founded models of discrimination are not available.[69]

[69]For example, in order to estimate how government wartime spending affects taste-based discrimination, one would need survey data on white perceptions of Black workers both before and after WWII across all regions. Such data do not exist.

F.2 Equilibrium

Consumption. First, consider the consumption side. Because trade is costless and preferences are identical across regions, consumption prices are equalized across space.

Consumption of industry i in region r is given by

$$C_{rit} P^C_{it} = \mu_i P^C_t C_{rt} \tag{29}$$

where

$$P^C_t = \prod_i \left(\frac{P^C_{it}}{\mu_i} \right)^{\mu_i} \tag{30}$$

denotes the final good price and where P^C_{it} denotes the consumption price of industry i. Consumption of industry i from origin j in destination r is given by

$$C_{jrit} = \mu_{jit} \left(\frac{P^Y_{jit}}{P^C_{it}} \right)^{-\rho} C_{rit} \tag{31}$$

where P^Y_{jit} is the production price in region j of industry i and where the consumption price of industry i in all regions is

$$P^C_{it} = \left(\sum_j \mu_{jit} \left(P^Y_{jit} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{32}$$

Production. Next, consider the production side. Industry i profit maximization implies that in region r the output of industry-occupation io pair is given by

$$Y_{riot} = \mu_{riot} \left(\frac{P^Y_{riot}}{P^Y_{rit}} \right)^{-\eta} Y_{rit} \tag{33}$$

where Y_{rit} is the region r output of industry i, where the output price in region r of industry i is

$$P^Y_{rit} = \left(\sum_o \mu_{riot} \left(P^Y_{riot} \right)^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{34}$$

and where P^Y_{riot} denotes the region r output price of industry-occupation pair io.

The share of workers in group g and region r who choose to work in industry-occupation io, denoted by $\pi^L_{riogt} \equiv N_{riogt}/N_{rgt}$ (where N_{rgt} denotes the measure of group g workers who choose to live in region r and N_{riogt} the measure who additionally choose to work in io), is given by

$$\pi^L_{riogt} = \left(A_{riogt} T_{riogt} P^Y_{riot} \right)^{\theta} \Big/ \Phi_{rgt} \tag{35}$$

and where

$$\Phi_{rgt} \equiv \sum_{io} \left(A_{riogt} T_{riogt} P^Y_{riot} \right)^{\theta} \tag{36}$$

The total efficiency units supplied by group g in industry-occupation io in region r is

$$L_{riogt} = \gamma T_{riogt} \left(\pi^{L}_{riogt}\right)^{\frac{\theta-1}{\theta}} \pi^{N}_{rgt} N_{gt} \tag{37}$$

In equation (37), $\gamma \equiv \Gamma\left(1 - \frac{1}{\theta}\right)$ where Γ is the gamma function, and $\pi^{N}_{rgt} \equiv N_{rgt}/N_{gt}$ is the share of workers in group g who choose to live in region r and is given by

$$\pi^{N}_{rgt} = \left(U_{rgt}\Phi^{\frac{1}{\theta}}_{rgt}\right)^{\nu} \Big/ \left[\sum_{r'} \left(U_{r'gt}\Phi^{\frac{1}{\theta}}_{r'gt}\right)^{\nu}\right] \tag{38}$$

Finally, the average wage of group g in region r and job io is given by

$$Wage_{riogt} = \gamma \Phi^{\frac{1}{\theta}}_{rgt} \Big/ A_{riogt} \tag{39}$$

Market clearing. Region r's output of industry i must equal the sum of consumption across all regions for each ri pair

$$Y_{rit} = \sum_{j} C_{rjit} \tag{40}$$

Locally, markets must clear in each rio triplet

$$Y_{riot} = \sum_{g} L_{riogt} \tag{41}$$

Market clearing and balanced trade link production and consumption

$$P^{C}_{t} C_{rt} = \sum_{gio} Wage_{riogt} \pi^{L}_{riogt} N_{rgt} \tag{42}$$

Equilibrium. An equilibrium is a vector of consumption prices $\{P^{C}_{t}, P^{C}_{it}\}$, production prices $\{P^{Y}_{rit}, P^{Y}_{riot}\}$, aggregator $\{\Phi_{rgt}\}$ and wages $\{Wage_{riogt}\}$, quantities produced $\{Y_{rt}, Y_{rit}, Y_{riot}\}$, consumption levels $\{C_{rt}, C_{rit}, C_{jrit}\}$, and labor allocations $\left\{\pi^{N}_{rgt}, \pi^{L}_{riogt}, L_{riogt}\right\}$ for all region pairs jr, industries i, occupations o, and worker groups g that satisfy (29)-(42).

F.3 Decomposition

In this section, we provide the system of equations with which to solve for the implications of shocks and show how to measure these shocks. We define $\widehat{x} = x_{t+1}/x_t$ for any variable x; it is the relative value of a variable in a "new equilibrium" $(t+1)$ relative to in the initial equilibrium (t). The point of writing the system in changes is that it dramatically reduces the set of parameters we need to estimate to conduct our decomposition and counterfactuals.

In practice, the shocks that we feed into the system are changes across time in net productivity, T_{riogt}, in regional amenities, U_{rgt}, and in national populations, N_{gt}. Here, however, we allow for a more general set of shocks, additionally including shocks to demand across origin and industry pairs, μ_{jit}, changes in demand across occupations within industries, μ_{riot}, and changes in amenities for working in industry-occupation io within each region r, A_{riogt}. We show here that for given values of $\rho \neq 1$ and $\eta \neq 1$, it is without loss of generality to normalize μ_{jit} and μ_{riot} to be fixed over time, since any changes in these parameters can be absorbed by changes in T_{riogt} without affecting any results.

F.4 System in changes

We express our system of equations in changes as follows:

$$\widehat{P}_{it}^{C}\widehat{C}_{rit} = \widehat{P}_{t}^{C}\widehat{C}_{rt} \tag{43}$$

$$\widehat{P}_{t}^{C} = \prod_{i}\left(\widehat{P}_{it}^{C}\right)^{\mu_i} \tag{44}$$

$$\widehat{C}_{jrit} = \widehat{\mu}_{jit}\left(\frac{\widehat{P}_{jit}^{Y}}{\widehat{P}_{it}^{C}}\right)^{-\rho}\widehat{C}_{rit} \tag{45}$$

$$\widehat{Y}_{riot} = \widehat{\mu}_{riot}\left(\frac{\widehat{P}_{riot}^{Y}}{\widehat{P}_{rit}^{Y}}\right)^{-\eta}\widehat{Y}_{rit} \tag{46}$$

$$\widehat{P}_{it}^{C} = \left(\sum_{j} S_{jit}^{C}\widehat{\mu}_{jit}\left(\widehat{P}_{jit}^{Y}\right)^{1-\rho}\right)^{\frac{1}{1-\rho}} \tag{47}$$

where $S_{jit}^{C} \equiv \frac{\mu_{jit}(P_{jit}^{Y})^{1-\rho}}{\sum_r \mu_{rit}(P_{rit}^{Y})^{1-\rho}}$ denotes the share of each region's expenditure on industry i that is produced in region j

$$\widehat{P}_{rit}^{Y} = \left(\sum_{o} S_{riot}^{Y}\widehat{\mu}_{riot}\left(\widehat{P}_{riot}^{Y}\right)^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{48}$$

where $S_{riot}^{Y} \equiv \frac{\mu_{riot}\left(P_{riot}^{Y}\right)^{1-\eta}}{\sum_{o'} \mu_{rio't}\left(P_{rio't}^{Y}\right)^{1-\eta}}$ denotes region r's share of expenditure within industry i on occupation o

$$\widehat{\pi}_{rgt}^{N} = \frac{\left(\widehat{U}_{rgt}\widehat{\Phi}_{rgt}^{\frac{1}{\theta}}\right)^{\nu}}{\sum_{r'} \pi_{r'gt}^{N}\left(\widehat{U}_{r'gt}\widehat{\Phi}_{r'gt}^{\frac{1}{\theta}}\right)^{\nu}} \tag{49}$$

$$\widehat{\Phi}_{rgt} = \sum_{io} \pi_{riogt}^{L}\left(\widehat{A}_{riogt}\widehat{T}_{riogt}\widehat{P}_{riot}^{Y}\right)^{\theta} \tag{50}$$

$$\widehat{\pi}_{riogt}^{L} = \frac{(\widehat{A}_{riogt}\widehat{T}_{riogt}\widehat{P}_{riot}^{Y})^{\theta}}{\widehat{\Phi}_{rgt}} \tag{51}$$

$$\widehat{L}_{riogt} = \widehat{T}_{riogt}\left(\widehat{\pi}_{riogt}^{L}\right)^{\frac{\theta-1}{\theta}}\widehat{\pi}_{rgt}^{N}\widehat{N}_{gt} \tag{52}$$

$$\widehat{Wage}_{riogt} = \frac{\widehat{\Phi}_{rgt}^{\frac{1}{\theta}}}{\widehat{A}_{riogt}} \tag{53}$$

$$\widehat{Y}_{rit} = \sum_{j} s_{jt}\widehat{C}_{rjit} \tag{54}$$

where $s_{jt} \equiv \frac{C_{rjit}}{\sum_{j'} C_{rj'it}}$ is the share of region r's industry i output shipped to j

$$\widehat{Y}_{riot} = \sum_{g} s_{riogt} \widehat{L}_{riogt} \tag{55}$$

where $s_{riogt} \equiv \frac{L_{riogt}}{\sum_{g'} L_{riog't}}$ is the share of output in r of io produced by group g

$$\widehat{P}_t^C \widehat{C}_{rt} = \sum_{iog} v_{riogt} \widehat{Wage}_{riogt} \widehat{\pi}^L_{riogt} \widehat{\pi}^N_{rgt} \widehat{N}_{gt} \tag{56}$$

and where $v_{riogt} \equiv \frac{Wage_{riogt} \pi^L_{riogt} N_{rgt}}{\sum_{i'o'g'} Wage_{ri'o'g't} \pi^L_{ri'o'g't} N_{rg't}}$ is the share of total labor income in r that accrues to g within io.

The system has 14 equations (43)-(56) and unknowns:

$$\left\{ \widehat{P}^Y_{riot}, \widehat{P}^Y_{rit}, \widehat{\Phi}_{rgt}, \widehat{Wage}_{riogt}, \widehat{\pi}^L_{riogt}, \widehat{\pi}^N_{rgt}, \widehat{L}_{riogt}, \widehat{P}^C_{it}, \widehat{P}^C_t, \widehat{C}_{rt}, \widehat{C}_{rit}, \widehat{C}_{jrit}, \widehat{Y}_{riot}, \widehat{Y}_{rit} \right\}$$

Given shocks $\{\widehat{T}_{riogt}, \widehat{A}_{riogt}, \widehat{\mu}_{jit}, \widehat{\mu}_{riot}, \widehat{U}_{rgt}, \widehat{N}_{gt}\}$, elasticities $\{\rho, \theta, \eta, \nu\}$, and initial equilibrium shares $\{\mu_i, S^C_{jit}, S^Y_{riot}, \pi^L_{riogt}, \pi^N_{rgt}, s_{jt}, s_{riogt}, v_{riogt}\}$, we can solve for all changes using the previous system and a normalization. This algorithm requires that we have values for the elasticities, the shocks, and the initial equilibrium shares. We next describe how we choose these.

F.4.1 Calibrating the model to 1940 data

In constructing each share, we use data only from the regions that we are considering. As an example, if we require total labor income earned in industry i across all regions, then we sum total labor income earned in industry i across all regions in our sample (rather than across all regions in the U.S.). All data used in constructing shares is from the 1940 census.

μ_i: μ_i is the share of expenditure on industry i, which we assume is constant across time and regions. The numerator of μ_i is the sum of labor income (since labor is the only factor of production) across regions in industry i and the denominator is the sum of labor income across regions and industries.

S^C_{jit}: S^C_{jit} is the share of national industry i expenditure that is produced in region j. Since labor is the only factor of production and there is no trade with the outside world, the numerator is labor income earned in industry i in region j and the denominator is labor income earned in industry i summed across all regions.

S^Y_{riot}: S^Y_{riot} is the share of region r's labor income in industry i that is earned in occupation o. To measure S^Y_{riot}, the numerator is labor income earned within io in region r and the denominator is labor income earned within i in region r.

π^L_{riogt}: π^L_{riogt} is the share of employed men (part- and full-time) within region r for group g that is worked within io. The numerator of π^L_{riogt} is employment of group g in region r in io and the denominator is the sum of employment of group g in region r across all io pairs.

π^N_{rgt}: π^N_{rgt} is the share of the employed male population within group g that lives in region r. The numerator is the employed male population of g in r and the denominator is the employed male population of g across all regions.

s_{jt}: s_{jt} is the share of total labor income earned in region j. The numerator is labor income in j and the denominator is labor income across all regions.

s_{riogt}: s_{riogt} is the share of labor income in region r and industry-occupation io that is paid to group g. The numerator is labor income in region r and industry-occupation io that is paid to group g and the denominator is the sum of labor income in region r and industry-occupation io across all g.

v_{riogt}: v_{riogt} is the share of total labor income in r (across all g and across all io) that accrues to g within io. The numerator is the payment to g in io within r and the dominator is total labor payments in r across all g and all io.

F.4.2 Calibrating elasticities

While we estimate the key novel aspects of our theory (the impact of government spending), we calibrate four structural elasticities: θ, ρ, η, and ν. The parameter θ determines the elasticity of labor supply across io pairs within a region to changes in wages per efficiency unit. We set $\theta = 1.5$, in line with estimates in Burstein et al. (2019), Galle et al. (2018), and Hsieh et al. (2019).[70] The parameter ν determines the elasticity of population across regions to changes in real wages. We set $\nu = 1.5$, in line with a large literature estimating geographic labor mobility; see, e.g., the review in Fajgelbaum et al. (2019). The parameter ρ determines the trade elasticity across regions. We set $\rho = 4$, in line with a large literature both in international and intra-national trade; see, e.g., the review in Head and Mayer (2014). Finally, the parameter η determines the elasticity of substitution between the skilled and unskilled occupation within each industry.

We set $\eta = 11$, which allows us to match closely our difference-in-difference empirical results on wages and occupation upgrading by race in regions receiving more relative to less government spending when feeding in all estimated shocks. We do so as follows.

To choose the value of η, we calibrate the model to 1940 data, matching the initial shares described in F.4.1. Then we take the following steps.

i. We pick a value of η.

ii. We measure shocks, as described in F.4.3, where the value of two of these six shocks, β_1^T and β_2^T, depends on the choice of η.

iii. We feed into the model the government spending shocks (associated with all β^T and β^U parameters) and solve for the new equilibrium of the model.

iv. We estimate regressions of the form in (1) in Section 3.1 using actual data and, separately, using model-generated data, where the dependent variables, Y_{rt} are the share of employment in skilled occupations and the ln average wage of Black and white workers in each metro area and year (for 1940 and 1950).

v. For each of the four coefficients of interest in the data, $\beta^{data}_{1,race,Y}$, and in the model, $\beta^{model}_{1,race,Y}$, where Y indicates the dependent variable and $race$ indicates the sample, we construct the

[70] Burstein et al. (2019) and Galle et al. (2018) estimate the equivalent of our parameter θ leveraging exogenous variation in labor demand across occupations (Burstein et al., 2019) and industries (Galle et al., 2018) using exposure to computerization and the China shock, respectively. Hsieh et al. (2019) estimate the equivalent of our parameter θ to match the dispersion of wages.

sum of squared differences

$$\mathcal{L}(\eta) = \sum_{Y,race} \omega_{race}(\beta^{data}_{1,race,Y} - \beta^{model}_{1,race,Y})^2$$

where ω_{race} is a weight that we set to 1 if $race$ = white and we set to 2 if $race$ = Black, given our focus on explaining Black labor-market outcomes.

Finally, we iterate over values of η to minimize $\mathcal{L}(\eta)$. This procedure yields $\eta = 11$. Panels A and B of Appendix Table A20 display the resulting values of $\beta^{data}_{1,race,Y}$ and $\beta^{model}_{1,race,Y}$, respectively, that result from our baseline calibration.

F.4.3 Measuring shocks

We focus on shocks between the years 1940 and 1950. We measure changes in national (across the regions in our analysis) employed male populations, $\widehat{N}_{gt}$, directly from the data. We express (without loss of generality) the structural productivity, net of the discriminatory wedge, of group g in region r and industry-occupation io at time t as

$$\ln T_{riogt} = \gamma^T_{riog} + \gamma^T_{iogt} + G_r \mathbb{I}_t \mathbb{I}_i \left[\beta^T_1 + \beta^T_2 \mathbb{I}_o + \beta^T_3 \mathbb{I}_g + \beta^T_4 \mathbb{I}_o \mathbb{I}_g\right] + \iota^T_{riogt} \tag{57}$$

and the amenity value for group g of living in region r at time t as

$$\ln U_{rgt} = \gamma^U_{rg} + G_r \mathbb{I}_t [\beta^U_1 + \beta^U_2 \mathbb{I}_g] + \iota^U_{rgt} \tag{58}$$

In addition to the shocks incorporated in the body of the paper, we include three additional shocks:

$$\ln \mu_{rit} = \gamma^i_{ri} + \gamma^i_{it} + G_r \mathbb{I}_t \mathbb{I}_i \beta^i_1 + \iota^i_{rit} \tag{59}$$

$$\ln \mu_{riot} = \gamma^o_{rio} + \gamma^o_{iot} + G_r \mathbb{I}_t \mathbb{I}_i \left[\beta^o_1 + \beta^o_2 \mathbb{I}_o\right] + \iota^o_{riot} \tag{60}$$

$$\ln A_{riogt} = \gamma^A_{riog} + \gamma^A_{iogt} + G_r \mathbb{I}_t \mathbb{I}_i \left[\beta^A_1 + \beta^A_2 \mathbb{I}_o + \beta^A_3 \mathbb{I}_g + \beta^A_4 \mathbb{I}_o \mathbb{I}_g\right] + \iota^A_{riogt} \tag{61}$$

Here, we will show that it is without loss of generality to assume that β^i_1, β^o_1, and β^o_2 are all set to zero for given values of $\rho \neq 1$ and $\eta \neq 1$. We will also show that the data requires that the β^A parameters also be set to zero.

Industry-occupation amenity shocks. From equation (39) we have

$$\ln Wage_{riogt} = \ln \gamma - \ln A_{riogt} + (1/\theta) \ln \Phi_{rgt}$$

The previous expression and (61) yield

$$\ln Wage_{riogt} = \gamma_{rgt} - \gamma^A_{riog} - \gamma^A_{iogt} - G_r \mathbb{I}_t \mathbb{I}_i \left[\beta^A_1 + \beta^A_2 \mathbb{I}_o + \beta^A_3 \mathbb{I}_g + \beta^A_4 \mathbb{I}_o \mathbb{I}_g\right] - \iota^A_{riogt} \tag{62}$$

where $\gamma_{rgt} \equiv \ln \gamma + (1/\theta) \ln \Phi_{rgt}$. Taking changes across time in equation (62), *changes* in average wages within *riog* cells conditional on *rg* and *iog* fixed effects identify the impact of government spending on *changes* in industry-occupation amenities. Intuitively, in the absence of any changes in these amenities, we would find zero values of all β^A parameters in model-generated data given our assumption of Fréchet distributed idiosyncratic productivites. Estimating (62), we find that all four β^A coefficients are economically small (with absolute values ranging from 0.000 to 0.008) and statistically insignificant (the highest t-statistic is 0.5); see column 1 of Table A19. In summary, in the absence of any such changes in amenities, the assumption of Fréchet distributed idiosyncratic productivites for average wage changes matches our data well. Given this result, we impose that $A_{riogt} = A_{riog}$ throughout the remainder of the analysis.

Anti-discriminatory shocks. From (35), we have

$$\ln \pi^L_{riogt} = \theta \ln T_{riogt} + \theta \ln P^Y_{riot} - \ln \left(\sum_{i'o'} (T_{ri'o'gt} P^Y_{ri'o't})^\theta \right)$$

The previous expression and (57) yield

$$\begin{aligned} \ln \pi^L_{riogt} =& \theta\gamma^T_{riog} + \theta\gamma^T_{iogt} + G_r \mathbb{I}_t \mathbb{I}_i \left[\theta\beta^T_1 + \theta\beta^T_2 \mathbb{I}_o + \theta\beta^T_3 \mathbb{I}_g + \theta\beta^T_4 \mathbb{I}_o \mathbb{I}_g \right] \\ &+ \theta\iota^T_{riogt} + \theta \ln P^Y_{riot} - \ln \left(\sum_{i'o'} (T_{ri'o'gt} P^Y_{ri'o't})^\theta \right) \end{aligned}$$

The previous equation can be expressed in the form of our final estimating equation,

$$\ln \pi^L_{riogt} = \gamma_{rgt} + \gamma_{riot} + \gamma_{riog} + \gamma_{iogt} + \beta_3 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g + \beta_4 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g \mathbb{I}_o + \iota_{riogt} \tag{63}$$

where $\gamma_{rgt} \equiv -\ln \left(\sum_{i'o'} (T_{ri'o'gt} P^Y_{ri'o't})^\theta \right)$, $\gamma_{riot} \equiv \theta \ln P^Y_{riot} + G_r \mathbb{I}_t \mathbb{I}_i \left[\theta\beta^T_1 + \theta\beta^T_2 \mathbb{I}_o \right]$, $\gamma_{riog} \equiv \theta\gamma^T_{riog}$, $\gamma_{iogt} \equiv \theta\gamma^T_{iogt}$, $\iota_{riogt} \equiv \theta\iota^T_{riogt}$, $\beta_3 \equiv \theta\beta^T_3$, and $\beta_4 \equiv \theta\beta^T_4$. Differencing equation (63) appropriately yields equation (8), except with the addition of the term involving β_3.

According to the model, if government spending reduced discrimination in the unskilled occupation within the defense industry, then the share of Black workers within each level of education employed there would increase (compared to white workers) in regions receiving more money, i.e. $\beta_3 > 0$. And if government spending reduced discrimination even more within the skilled occupation in defense, then $\beta_4 > 0$. See column 1 of Table A17 for estimation results.

Equation (38) implies

$$\frac{1}{\nu} \ln \pi^N_{rgt} = \ln U_{rgt} + \frac{1}{\theta} \Phi_{rgt} + \gamma_{gt}$$

where $\gamma_{gt} \equiv -\frac{1}{\nu} \ln \left[\sum_{r'} \left(U_{r'gt} \Phi^{1/\theta}_{r'gt} \right)^\nu \right]$. Equation (39) implies

$$\frac{1}{\theta} \ln \Phi_{rgt} = \ln Wage_{riogt} - \ln \gamma + \ln A_{riog}$$

Combining the previous two expressions yields

$$\frac{1}{\nu} \ln \pi^N_{rgt} - \ln Wage_{riogt} = \ln U_{rgt} - \ln \gamma + \ln A_{riog} + \gamma_{gt}$$

The previous expression and (58) yield

$$\frac{1}{\nu} \ln \pi^N_{rgt} - \ln Wage_{riogt} = \tilde{\gamma}^U_{riog} + \gamma_{gt} + G_r \mathbb{I}_t [\beta^U_1 + \beta^U_2 \mathbb{I}_g] + \iota^U_{rgt} \tag{64}$$

where $\tilde{\gamma}^U_{riog} \equiv \gamma^U_{rg} + \ln A_{riog} - \ln \gamma$. The previous expression simplifies to our final estimating equation,

$$\frac{1}{\nu} \ln \pi^N_{rgt} - \ln Wage_{riogt} = \gamma_{riog} + \gamma_{gt} + \gamma_{rt} + \beta^U_2 G_r \mathbb{I}_t \mathbb{I}_g + \iota^U_{rgt} \tag{65}$$

where $\gamma_{rt} \equiv \beta_1^U G_r \mathbb{I}_t$. See column 4 of Table A17 for estimation results.

Compositional shock I: amenity parameter β_1^U. Having estimated (65) to identify β_2^U, we subtract $\widehat{\beta}_2^U G_r \mathbb{I}_t \mathbb{I}_g$ from both the left- and right-hand side of (64), and estimate

$$\frac{1}{\nu} \ln \pi_{rgt}^N - \ln Wage_{rgt} - \widehat{\beta}_2^U G_r \mathbb{I}_t \mathbb{I}_g = \gamma_{rg} + \gamma_{gt} + \beta_1^U G_r \mathbb{I}_t + \iota_{rgt}^U \tag{66}$$

See column 5 of Table A17 for the resulting estimate of β_1^U. In robustness, we also estimate β_U^1 and β_U^2 together in a single step by estimating (64) directly. Results of this robustness exercise are shown in column 8 of Table A17; these results are very similar quantitatively to our baseline results diplayed in columns 4 and 5.

Compositional shock II: productivity parameter β_2. From (33), we obtain

$$\ln\left(P_{riot}^Y Y_{riot}\right) = \ln \mu_{riot} + (1-\eta) \ln P_{riot}^Y + \eta \ln P_{rit}^Y + \ln Y_{rit}$$

From (35) and (39), we have

$$\ln P_{riot}^Y = \ln Wage_{riogt} + \frac{1}{\theta} \ln \pi_{riogt} - \ln T_{riogt} - \ln \gamma$$

Combining the previous two expressions yields

$$y_{riogt} = \frac{\theta}{1-\eta}\left[-\ln \mu_{riot} + (1-\eta) \ln T_{riogt} - \eta \ln P_{rit}^Y - \ln Y_{rit} + (1-\eta)\gamma\right] \tag{67}$$

where we have defined

$$y_{riogt} \equiv \frac{-\theta}{1-\eta} \ln\left(P_{riot}^Y Y_{riot}\right) + \theta \ln Wage_{riogt} + \ln \pi_{riogt}^L$$

Combining equation (67) with (57) and (60) yields

$$y_{riogt} = \gamma_{riog} + \gamma_{iogt} + \gamma_{rit} + \beta_2 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_o + \beta_3 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g + \beta_4 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g \mathbb{I}_o + \iota_{riogt} \tag{68}$$

where $\gamma_{rit} \equiv -\frac{\theta}{1-\eta}\eta \ln P_{rit}^Y - \frac{\theta}{1-\eta} \ln Y_{rit} + \theta\gamma - \frac{\theta}{1-\eta}\beta_1^o + \theta\beta_1^T$, $\iota_{riogt} \equiv -\frac{\theta}{1-\eta}\iota_{riot}^o + \theta\iota_{riogt}^T$, $\gamma_{riog} \equiv -\frac{\theta}{1-\eta}\gamma_{rio}^o + \theta\gamma_{riog}^T$, $\gamma_{iogt} \equiv -\frac{\theta}{1-\eta}\gamma_{iot}^o + \theta\gamma_{iogt}^T$, $\beta_2 \equiv -\frac{\theta}{1-\eta}\beta_2^o + \theta\beta_2^T$, $\beta_3 \equiv \theta\beta_3^T$, and $\beta_4 \equiv \theta\beta_4^T$. We subtract our estimates of $\widehat{\beta}_3 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g$ and $\widehat{\beta}_4 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g \mathbb{I}_o$ from the left- and right-hand sides of the previous expression to obtain

$$\tilde{y}_{riogt} = \gamma_{riog} + \gamma_{iogt} + \gamma_{rit} + \beta_2 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_o + \iota_{riogt} \tag{69}$$

where $\tilde{y}_{riogt} \equiv y_{riogt} - \widehat{\beta}_3 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g - \widehat{\beta}_4 G_r \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g \mathbb{I}_o$. We estimate β_2 using (69), and report results in column 2 of Table A17. In robustness, we estimate β_2, β_3, and β_4 using (68), and report results in column 6 of Table A17. Results in column 6 are very similar to those reported in columns 1 and 2.

Compositional shock III: productivity parameter β_1. Equations (29), (31), and (40) yield

$$P_{jit}^Y Y_{jit} = \mu_{jit}\left(P_{jit}^Y\right)^{1-\rho} \times \left(P_{it}^C\right)^{\rho-1} \mu_i \sum_r P_t^C C_{rt}$$

The previous expression and (34) yield

$$P_{jit}^{Y}Y_{jit} = \mu_{jit}\left(\sum_{o}\mu_{jiot}\left(P_{jiot}^{Y}\right)^{1-\eta}\right)^{\frac{1-\rho}{1-\eta}} \times \left(P_{it}^{C}\right)^{\rho-1}\mu_{i}\sum_{r}P_{t}^{C}C_{rt}$$

The previous expression and the definition of S_{jiot}^{Y}, which implies

$$\sum_{o}\mu_{jiot}\left(P_{jiot}^{Y}\right)^{1-\eta} = \frac{\mu_{jio't}\left(P_{jio't}^{Y}\right)^{1-\eta}}{S_{jio't}^{Y}} \quad \text{for any } o'$$

yield

$$P_{jit}^{Y}Y_{jit}\left(S_{jiot}^{Y}\right)^{\frac{1-\rho}{1-\eta}} = \mu_{jit}\mu_{jiot}^{\frac{1-\rho}{1-\eta}}\left(P_{jiot}^{Y}\right)^{1-\rho} \times \left(P_{it}^{C}\right)^{\rho-1}\mu_{i}\sum_{r}P_{t}^{C}C_{rt}$$

Combining the previous expression with (35) and (39), which imply

$$\ln P_{riot}^{Y} = \ln Wage_{riogt} + \frac{1}{\theta}\ln\pi_{riogt} - \ln T_{riogt} - \ln\gamma$$

yields

$$\begin{aligned}\ln(P_{jit}^{Y}Y_{jit}) + \frac{1-\rho}{1-\eta}\ln S_{jiot}^{Y} = \ln\mu_{jit} + \frac{1-\rho}{1-\eta}\ln\mu_{jiot} + \ln\left[\left(P_{it}^{C}\right)^{\rho-1}\mu_{i}\sum_{r}P_{t}^{C}C_{rt}\right] \\ + (1-\rho)\left[\ln Wage_{jiogt} + \frac{1}{\theta}\ln\pi_{jiogt} - \ln T_{jiogt} - \ln\gamma\right]\end{aligned}$$

which is equivalent to

$$B_{jiogt} = -\frac{\theta}{1-\rho}\ln\mu_{jit} - \frac{\theta}{1-\eta}\ln\mu_{jiot} + \gamma_{it} + \theta\ln T_{jiogt}$$

where $\gamma_{it} \equiv \theta\ln\gamma - \frac{\theta}{1-\rho}\ln\left[\left(P_{it}^{C}\right)^{\rho-1}\mu_{i}\sum_{r}P_{t}^{C}C_{rt}\right]$ and where

$$B_{jiogt} \equiv -\frac{\theta}{1-\rho}\ln(P_{jit}^{Y}Y_{jit}) - \frac{\theta}{1-\eta}\ln S_{jiot}^{Y} + \theta\ln Wage_{jiogt} + \ln\pi_{jiogt} \tag{70}$$

We substitute out $\ln\mu_{jit}$, $\ln\mu_{jiot}$ and $\ln T_{jiogt}$ using (57), (59), and (60) to obtain

$$B_{jiogt} = \gamma_{jiog} + \gamma_{iogt} + \beta_1 G_j\mathbb{I}_t\mathbb{I}_i + \beta_2 G_j\mathbb{I}_t\mathbb{I}_i\mathbb{I}_o + \beta_3 G_j\mathbb{I}_t\mathbb{I}_i\mathbb{I}_g + \beta_4 G_j\mathbb{I}_t\mathbb{I}_i\mathbb{I}_o\mathbb{I}_g + \iota_{jiogt} \tag{71}$$

where $\gamma_{iogt} \equiv \gamma_{it} - \frac{\theta}{1-\rho}\gamma_{it}^{i} - \frac{\theta}{1-\eta}\gamma_{iot}^{o} + \theta\gamma_{iogt}^{T}$, $\gamma_{jiog} \equiv -\frac{\theta}{1-\rho}\gamma_{ji}^{i} - \frac{\theta}{1-\eta}\gamma_{jio}^{o} + \theta\gamma_{jiog}^{T}$, $\iota_{jiogt} \equiv -\frac{\theta}{1-\rho}\iota_{jit}^{i} - \frac{\theta}{1-\eta}\iota_{jiot}^{o} + \theta\iota_{jiogt}^{T}$, $\beta_1 \equiv -\frac{\theta}{1-\rho}\beta_1^{i} - \frac{\theta}{1-\eta}\beta_1^{o} + \theta\beta_1^{T}$, $\beta_2 \equiv -\frac{\theta}{1-\eta}\beta_2^{o} + \theta\beta_2^{T}$, $\beta_3 \equiv \theta\beta_3^{T}$, and $\beta_4 \equiv \theta\beta_4^{T}$.

Subtracting from both sides of the previous expression the terms associated with β_2, β_3, and β_4 which we have previously estimated, we estimate

$$\tilde{B}_{jiogt} = \gamma_{jiog} + \gamma_{iogt} + \beta_1 G_j\mathbb{I}_t\mathbb{I}_i + \iota_{jiogt} \tag{72}$$

where

$$\tilde{B}_{jiogt} \equiv B_{jiogt} - \hat{\beta}_2 G_j \mathbb{I}_t \mathbb{I}_i \mathbb{I}_o - \hat{\beta}_3 G_j \mathbb{I}_t \mathbb{I}_i \mathbb{I}_g - \hat{\beta}_4 G_j \mathbb{I}_t \mathbb{I}_i \mathbb{I}_o \mathbb{I}_g$$

We report results of estimating regression (72)in column 3 of Table A17. In robustness, we estimate β_1, β_2, β_3, and β_4 all together using (71) and report results in column 7 of Table A17. Results in column 7 are very similar to those reported in columns 1, 2, and 3 as well as to those reported in column 6.