

# Worker Diversity and Wage Growth Since 1940

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Since 1940 the average worker has become older, more educated, more likely to be a woman, less likely to be White, and slightly less likely to be single. How has this evolution of the average worker affected wage growth, that is, the wage of the average worker? We conduct two sets of experiments: First, we decompose wage growth between a “growth effect” and a “distribution effect.” The former measures the effect of a change in the wage function, associating wages with worker types; the latter measures the effect of the changing distribution of worker types. Both effects contribute significantly to wage growth. Second, we evaluate the contribution of changing marginal distributions of these worker types one at a time: Aging and education enhanced wage growth, while the increased participation of women and non-White workers deterred wage growth—the latter effect being a direct implication of gender and racial wage gaps. (JEL J11, J21, J31)

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## 1 INTRODUCTION

The wage rate of the typical American worker is the subject of countless discussions in the press and academic circles. Growth of the wage rate is often associated with the performance of the labor market, and when compared with inflation it is an indicator of the purchasing power of workers. In this article, we take a long-run perspective and discuss the evolution of the real U.S. wage rate since 1940.

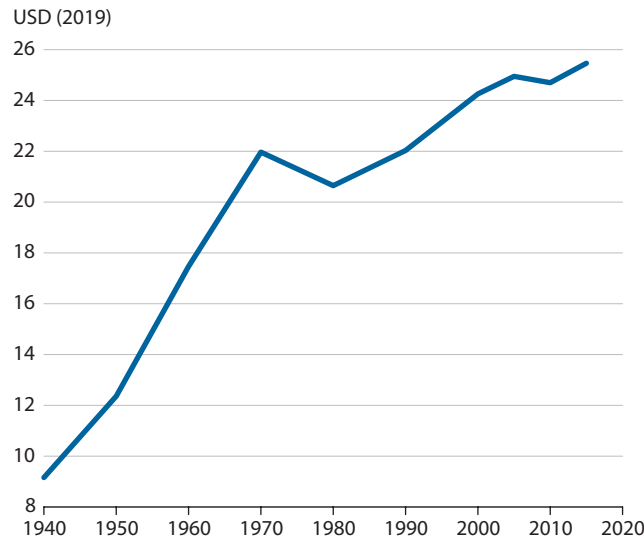
Figure 1 shows the real wage rate (i.e., labor earnings per hour, or hourly wages) for the average U.S. worker from 1940 to 2015. The average growth is 1.4 percent per year during this period, but it is not constant. The average wage rate slowed down (and even declined) at the start of the 1970s, which corresponds to the so-called “productivity slowdown.” It took two decades before the wage rate reached its 1970 value again. Another decline occurred between 2005 and 2010 and corresponds to the Great Recession. Figure 1 also emphasizes a

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**Figure 1**

**Average Hourly Wage Rate**



SOURCE: IPUMS and authors' calculations.

long-lasting stagnation over recent decades: The wage rate more than doubled between 1940 and 1970, whereas in the 40 years after 1970 it increased by only 12 percent.

Our goal is to present a series of exercises to describe wage growth in the United States, or the lack thereof. We use the word “describe” on purpose: We do not seek to “explain” wage growth; that is, our analysis does not indicate causal factors behind changes in the real wage rate. Our motivation stems from the observation that the “average worker” paid the hourly wages represented in Figure 1 is not the same in the 2010s as the average worker in the 1980s or the 1940s. Specifically, we show the extent to which the average worker in the 2010s is older, more educated, more likely to be a woman, less likely to be White, and slightly less likely to be single than the average worker in the 1940s. Therefore, changes in the average hourly wages represented in Figure 1 reflect both changes in the hourly wages of various types of workers and changes in the type composition of workers. We quantify the contributions of these two components of wage growth.

We start with a description of the data in Section 2. We use data on the number of workers by type (i.e., by age, education, sex, race, and marital status), wage income, and hours worked. Our sources are the decennial U.S. Census and the American Community Survey. In Section 3, we present the distribution of worker types and discuss how it has changed over the years. We also present and discuss the evolution of the wage rate for each type of worker.

Our analysis and results are in Section 4. We first decompose wage growth between the contribution of the hourly wages per type and that of the distribution of types (Section 4.1). We call the former the growth effect and the latter the distribution effect. We find that both

effects play a noticeable role at different points in time: The growth effect tends to be the largest component of wage growth during periods of fast economic growth, while the distribution effect is the largest component during periods of slow economic growth. The distribution effect results, in part, from slow-moving demographic trends (e.g., aging) and is, therefore, quite stable over time. We apply the same decomposition to each sex-race subgroup and discuss the growth rate of wages across these subgroups. In Section 4.2 we present a different type of exercise to assess the effects of the changing distribution of worker types along specific margins. We ask, for example, what the evolution of the wage rate would have been if the age distribution of workers had remained at its 1940 values throughout the sample period. We repeat this analysis for the effects of education, sex, race, and marital status, respectively. We find that the increasing proportion of female workers dampened wage growth because women tend to be paid less than men; thus, as the average worker has become more likely to be a woman, average wage growth has been slowing down. Similarly, we find that wage growth has been enhanced as the average worker has become older and more educated and dampened as the average worker has become less likely to be White. The fact that the average worker has become slightly less likely to be single implies slightly higher wage growth.

Our article relates to a vast literature documenting and explaining wage inequality. If there were no inequality, say if men and women were paid exactly the same wages, then the increasing proportion of working women would have no effect on the hourly wages of the average worker. The same argument can be made for age, race, and marital status. Thus, the importance of the changing distribution of worker types for wage growth emanates directly from the presence of wage inequality across these characteristics. The point of our article is to quantify these effects and argue that they are of significance. For the interested reader, see the following (far-from-exhaustive) list of papers on inequality (with references to even more papers): Ben-Porath (1967) provides a theory of wage growth over the life cycle, thereby explaining wage inequality by age. Heckman, Lochner, and Taber (1998), Huggett, Ventura, and Yaron (2006, 2011), and Guvenen and Kuruscu (2010) also use the Ben-Porath model to discuss wage inequality and the college premium. Goldin (1992) analyzes the gender wage gap in earnings. Katz and Murphy (1992), Card and Lemieux (2001), and Bowlus and Robinson (2012) discuss wage differences across education groups. Restuccia and Vandenbroucke (2013) and Daly et al. (2017) discuss wage growth and Black-White inequality in the United States.

## 2 DATA

The analysis in this article is based on decennial U.S. Census data from 1940 to 2010 and from the American Community Survey (ACS) for the years 2005 and 2015. The data are available from the Minnesota Population Centers Integrated Public Use Microdata Series (IPUMS).<sup>1</sup>

The data contain the following information for each individual: year, age, sex, race, employment status (*empstat*), marital status (*marst*), education (*educ*), and wage and salary income (*incwage*). The data also contain information on hours worked: *hrswork2* and *uhrswork*. The variable *hrswork2* corresponds to “hours worked last week.” It is intervalled and available from 1940 to 2000. The variable *uhrswork* corresponds to “usual hours worked per

week.” It is available starting in 1980. We build an hours-worked variable by using the middle point of each interval of hrswork2 from 1940 to 1990. For the years 2000, 2005, 2010, and 2015, we first construct intervals replicating the same intervals as the hrswork2 variable, then take the middle point.

Our analysis is restricted to employed (empstat = 1) individuals. The earnings variable (incwage) reports a person’s total pre-tax wage and salary income for the previous year. Top-coded observations are excluded, as well as observations with \$0 earnings. Earnings are converted to 2019 dollars using the consumer price index.

We create the following categories. For age we consider six groups: 18-24, 25-34, 35-44, 45-54, 55-64, and 65-74 years of age. We index age by  $a \in \{1, \dots, 6\}$ . For education, we consider six groups: (i) 8th grade or below ( $\text{educ} \leq 2$ ); (ii) 9th to 11th grade ( $3 \leq \text{educ} \leq 5$ ); (iii) 12th grade ( $\text{educ} = 6$ ); (iv) one to three years of college ( $7 \leq \text{educ} \leq 9$ ); (v) four years of college ( $\text{educ} = 10$ ); and (vi) five or more years of college ( $\text{educ} = 11$ ). We index education by  $e \in \{1, \dots, 6\}$ . For sex we consider two groups: (i) male ( $\text{sex} = 1$ ) and female ( $\text{sex} = 2$ ). We index sex by  $s \in \{1, 2\}$ . We consider three racial groups: (i) White ( $\text{race} = 1$ ); (ii) Black ( $\text{race} = 2$ ); and (iii) other ( $\text{race} > 2$ ). We index race by  $r \in \{1, 2, 3\}$ . Finally, for marital status, we consider three groups: (i) married ( $\text{marst} = 1, 2$ ); (ii) separated, divorced, or widowed ( $\text{marst} = 3, 4, 5$ ); and (iii) single ( $\text{marst} = 6$ ).<sup>2</sup> We index marital status by  $m \in \{1, 2, 3\}$ .

We use the notation  $N_t(a, e, s, r, m)$  to denote the number of workers in year  $t$  in a particular age, education, sex, race, and marital status cell. Similarly, we use  $E_t(a, e, s, r, m)$  to refer to annual earnings of such workers (in 2019 U.S. dollars) and we use  $H_t(a, e, s, r, m)$  to refer to weekly hours. We define hourly earnings, which we refer to simply as wages, as

$$W_t(a, e, s, r, m) = \frac{E_t(a, e, s, r, m)}{50 \times H_t(a, e, s, r, m)}.$$

### 3 THE DISTRIBUTION OF WORKERS AND WAGES

In this section, for each year, we construct the distribution of worker types and compute the wages of each worker type.

The proportion of workers of type  $(a, e, s, r, m)$  in year  $t$  is

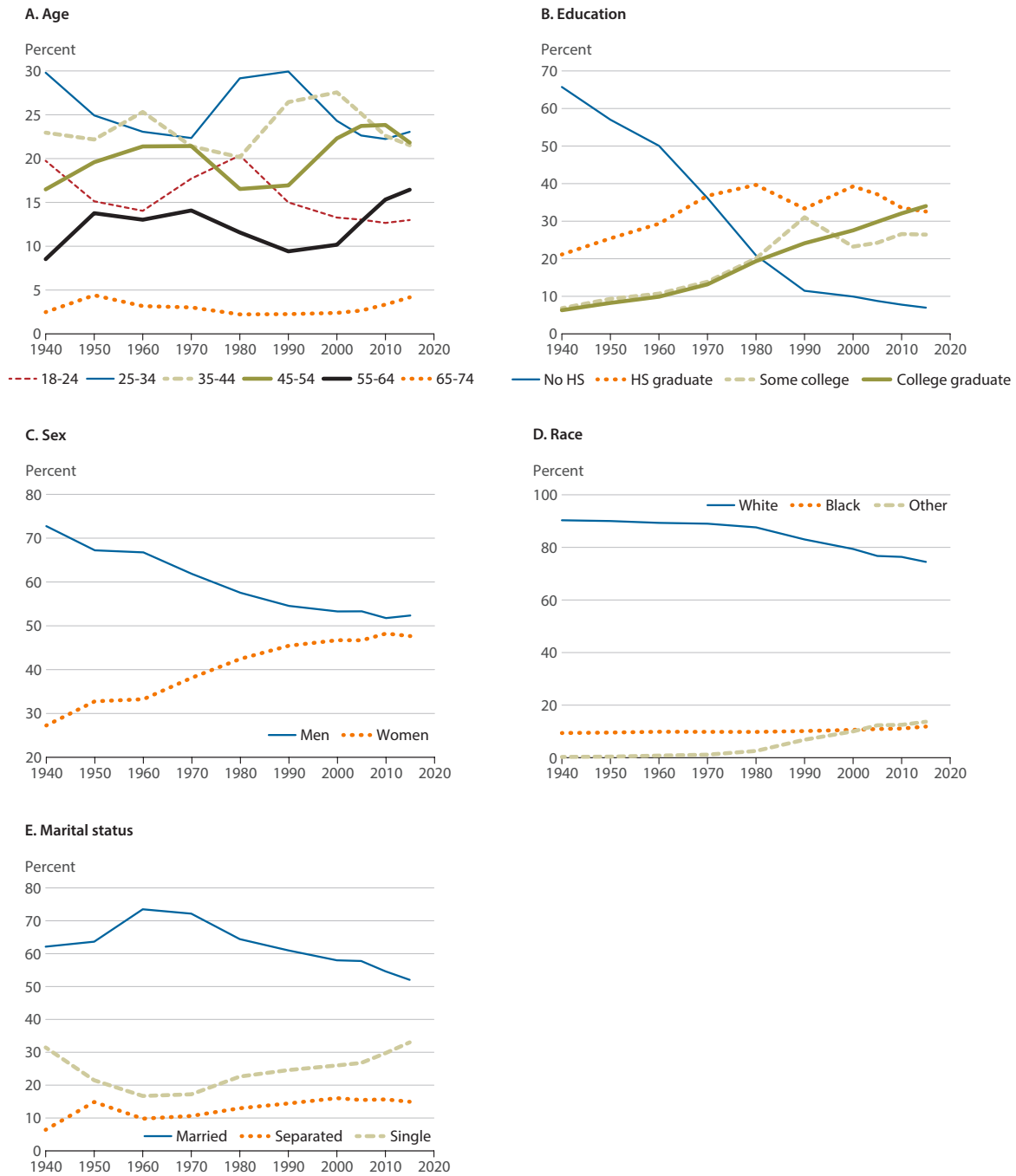
$$(1) \quad F_t(a, e, s, r, m) = \frac{N_t(a, e, s, r, m)}{\sum_{\{a, e, s, r, m\}} N_t(a, e, s, r, m)}.$$

The marginal distribution of age at date  $t$  is

$$(2) \quad A_t(a) = \sum_{\{e, s, r, m\}} F_t(a, e, s, r, m).$$

We compute, similarly, the marginal distribution of education,  $E_t(e)$ ; sex,  $S_t(s)$ ; race,  $R_t(r)$ , and marital status,  $M_t(m)$  (Table 1). Panel A of Figure 2 shows the distribution of workers by age group. Consider, for instance, the proportion of workers 18-24 years of age. The general downward trend is a manifestation of the aging of the U.S. population and its workforce. The

**Figure 2**  
**Marginal Distributions**



NOTE: Each figure indicates the proportion (in percent) of a particular category of workers in the employed population. The data for these figures are presented in Table 1.

SOURCE: IPUMS and authors' calculations.

**Table 1****The Distribution of Workers by Categories (percent)**

Year	Age						Education			
	18-24	25-34	35-44	45-54	55-64	65-74	No HS	HS graduate	Some college	College graduate
1940	19.7	29.8	23.0	16.5	8.5	2.5	65.7	21.1	6.8	6.3
1950	15.1	24.9	22.2	19.6	13.8	4.4	57.0	25.4	9.3	8.2
1960	14.0	23.1	25.3	21.4	13.0	3.2	50.1	29.3	10.7	9.9
1970	17.7	22.3	21.4	21.4	14.1	3.0	36.2	36.8	13.9	13.2
1980	20.4	29.2	20.2	16.5	11.6	2.2	20.9	39.7	20.1	19.4
1990	15.0	29.9	26.4	16.9	9.4	2.3	11.5	33.4	31.0	24.1
2000	13.3	24.3	27.6	22.3	10.2	2.4	9.9	39.3	23.2	27.6
2005	13.0	22.6	25.1	23.7	12.8	2.7	8.8	37.2	24.2	29.8
2010	12.7	22.2	22.6	23.8	15.3	3.3	7.8	33.6	26.6	32.1
2015	13.0	23.1	21.5	21.8	16.4	4.2	7.0	32.6	26.4	34.0

Year	Sex		Race			Marital status		
	Men	Women	White	Black	Other	Married	Separated	Single
1940	72.7	27.3	90.3	9.4	0.3	62.1	6.4	31.5
1950	67.2	32.8	90.0	9.6	0.4	63.6	14.9	21.5
1960	66.8	33.2	89.3	9.9	0.8	73.5	9.8	16.7
1970	61.8	38.2	89.0	9.8	1.2	72.2	10.6	17.2
1980	57.5	42.5	87.6	9.8	2.6	64.4	13.0	22.6
1990	54.5	45.5	83.0	10.1	6.8	61.0	14.4	24.6
2000	53.3	46.7	79.4	10.6	10.0	58.0	16.0	26.0
2005	53.3	46.7	76.7	10.9	12.3	57.8	15.5	26.8
2010	51.8	48.2	76.4	11.1	12.5	54.6	15.7	29.7
2015	52.3	47.7	74.5	11.8	13.7	52.0	15.0	33.0

NOTE: "Other" means neither White nor Black; "Separated" means either separated, divorced, or widowed.

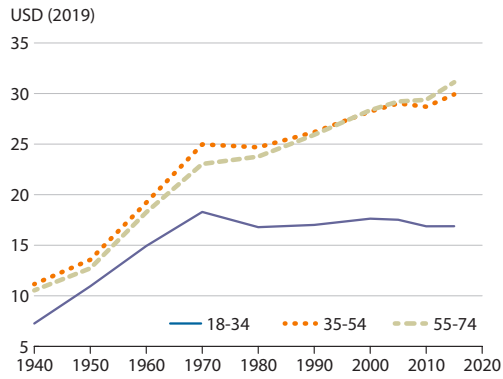
SOURCE: IPUMS and authors' calculations.

interruption in this trend, notably by the peak in 1980, results from the Baby Boom, which implies an abnormal abundance of young workers 18-24 years of age.<sup>3</sup> Panel B shows the distribution of workers by educational attainment. The general increase in the educational attainment of the U.S. population implies that the proportion of workers with a college degree increased, while the proportion of workers without a high school degree decreased. Panel C shows that women account for an increasing fraction of workers during this period, reflecting an increase in the labor force participation of women.<sup>4</sup> Panel D shows that the fraction of

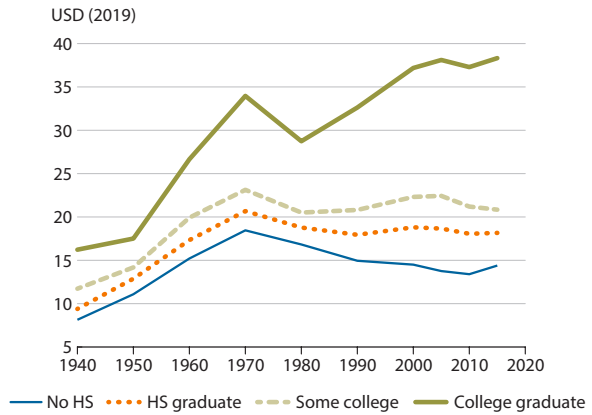
**Figure 3**

**Hourly Wages by Categories of Workers**

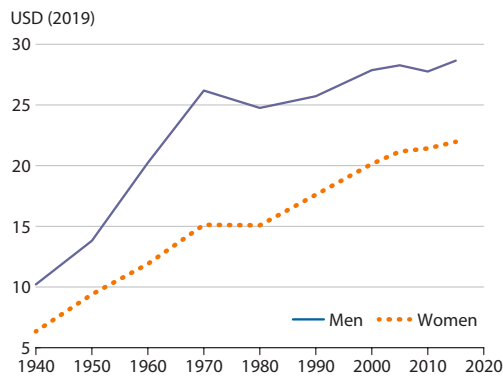
**A. Wage by age**



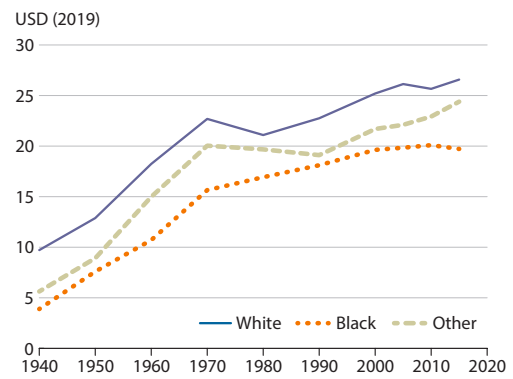
**B. Wage by education**



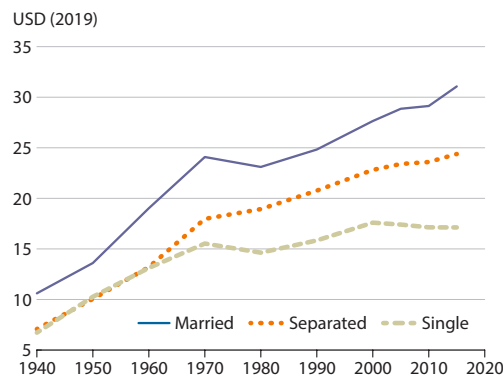
**C. Wage by sex**



**D. Wage by race**



**E. Wage by marital status**



NOTE: The data for these figures are presented in Table 2.

SOURCE: IPUMS and authors' calculations.

**Table 2**  
**Hourly Wages (2019, USD)**

Year	Age				Education			
	All	18-34	35-54	55-74	No HS	HS graduate	Some college	College graduate
1940	9.2	7.3	11.2	10.5	8.1	9.4	11.7	16.2
1950	12.4	10.9	13.6	12.7	11.1	12.9	14.2	17.5
1960	17.5	14.9	19.2	18.3	15.2	17.3	19.9	26.7
1970	22.0	18.3	25.0	23.0	18.5	20.7	23.1	34.0
1980	20.6	16.8	24.7	23.8	16.8	18.8	20.5	28.7
1990	22.0	17.0	26.2	25.9	14.9	17.9	20.8	32.6
2000	24.3	17.6	28.2	28.4	14.5	18.8	22.3	37.2
2005	24.9	17.5	29.0	29.2	13.8	18.7	22.4	38.1
2010	24.7	16.9	28.7	29.4	13.4	18.1	21.2	37.3
2015	25.5	16.9	29.9	31.1	14.4	18.2	20.8	38.3

Year	Sex		Race			Marital status		
	Men	Women	White	Black	Other	Married	Separated	Single
1940	10.2	6.3	9.7	3.9	5.6	10.6	7.1	6.7
1950	13.8	9.4	12.9	7.6	8.9	13.6	10.1	10.3
1960	20.2	11.9	18.2	10.7	15.0	19.0	13.2	13.1
1970	26.2	15.1	22.7	15.6	20.0	24.1	18.0	15.5
1980	24.8	15.1	21.1	16.9	19.7	23.1	18.9	14.6
1990	25.7	17.6	22.8	18.1	19.1	24.8	20.8	15.8
2000	27.9	20.1	25.2	19.6	21.7	27.6	22.8	17.6
2005	28.3	21.2	26.1	19.8	22.1	28.9	23.4	17.4
2010	27.8	21.4	25.7	20.1	22.9	29.1	23.6	17.1
2015	28.7	22.0	26.6	19.7	24.4	31.1	24.4	17.1

NOTE: "Other" means neither White nor Black; "Separated" means either separated, divorced or widowed.  
 SOURCE: IPUMS and authors' calculations.

White workers has been declining since 1940, and Panel E shows that the proportion of workers that are single first decreased from 1940 to 1970 and then rose. The main message from Figure 3 is that the average worker has noticeably changed since 1940. To be precise, the average worker is older, more educated, more likely to be a woman, less likely to be White, and slightly less likely to be single.

Figure 3 shows average wages by categories of workers (the percentages of workers are in Table 2). Older workers tend to earn more than younger workers (Panel A), more-educated workers earn more than less-educated workers (Panel B), men earn more than women



(Panel C), White workers earn more than workers of other races, and Black workers earn the least (Panel D). Finally, and perhaps less well known, married workers tend to earn more than single or separated workers (Panel E). Note, in all panels, that the 1970 slowdown was a turning point. Panel A reveals that after 1970 wage growth mostly benefited older workers, while wage growth stagnated for younger workers. Similarly, Panel B reveals that the wages of college-educated workers kept growing after the 1970s, while wages for the least-educated workers stagnated or even decreased. Women’s wages appear to have recovered better than men’s wages after the 1970s, indicating a closing of the gender wage gap (see Panel C). Black workers’ wages did not decrease during the slowdown (see Panel D), unlike wages for other races. In the 2000s, however, Black workers’ wages diverge from those of White and other non-White workers. Finally, the gap between single and married workers widens after the 1970s, accelerating in the 2000s.

## 4 ANALYZING THE EVOLUTION OF WAGES

### 4.1 The Growth and Distribution Effects

The average hourly wage shown in Figure 1, denoted  $\omega_t$ , is given by

$$(3) \quad \omega_t = \sum_{a,e,s,r,m} W_t(a,e,s,r,m)F_t(a,e,s,r,m).$$

In this section, we ask how much of the growth in  $\omega_t$  can be ascribed to changes in  $W_t(a,e,s,r,m)$ —the growth effect—and how much can be ascribed to changes in  $F_t(a,e,s,r,m)$ —the distribution effect.

To understand our decomposition, it simplifies notations to write  $\omega_t$  as  $\omega_t = T(W_t, F_t)$ , where  $T$  is the mean operator applied to the function  $W_t$  against the distribution  $F_t$ . Note the following identities:

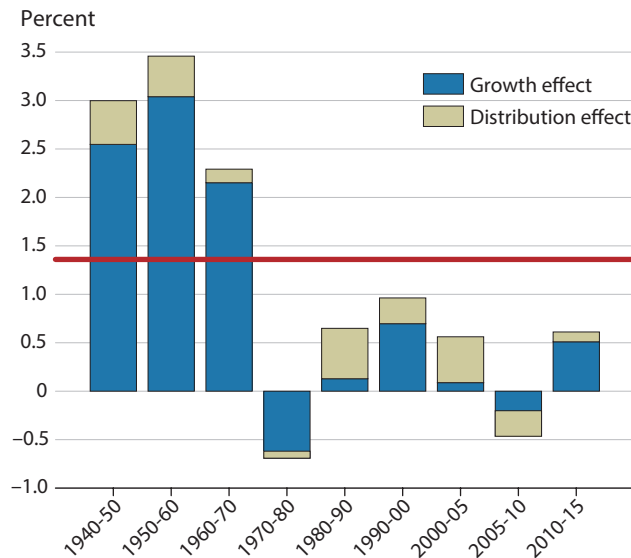
$$\begin{aligned} \omega_{t+1} - \omega_t &= T(W_{t+1}, F_{t+1}) - T(W_{t+1}, F_t) + T(W_{t+1}, F_t) - T(W_t, F_t), \\ &= T(W_{t+1}, F_{t+1}) - T(W_t, F_{t+1}) + T(W_t, F_{t+1}) - T(W_t, F_t). \end{aligned}$$

Summing these two lines, rearranging, and dividing by  $\omega_t$  yields a decomposition of the growth rate of the average hourly wage:

$$(4) \quad \frac{\omega_{t+1} - \omega_t}{\omega_t} = \frac{1}{2\omega_t} \left[ \overbrace{\left( T(W_{t+1}, F_{t+1}) - T(W_{t+1}, F_t) \right) + \left( T(W_t, F_{t+1}) - T(W_t, F_t) \right)}^{\text{Distribution effect}} \right] + \frac{1}{2\omega_t} \left[ \underbrace{\left( T(W_{t+1}, F_t) - T(W_t, F_t) \right)}_C + \underbrace{\left( T(W_{t+1}, F_{t+1}) - T(W_t, F_{t+1}) \right)}_D \right]_{\text{Growth effect}}$$

**Figure 4**

**The Decomposition of Wage Growth**

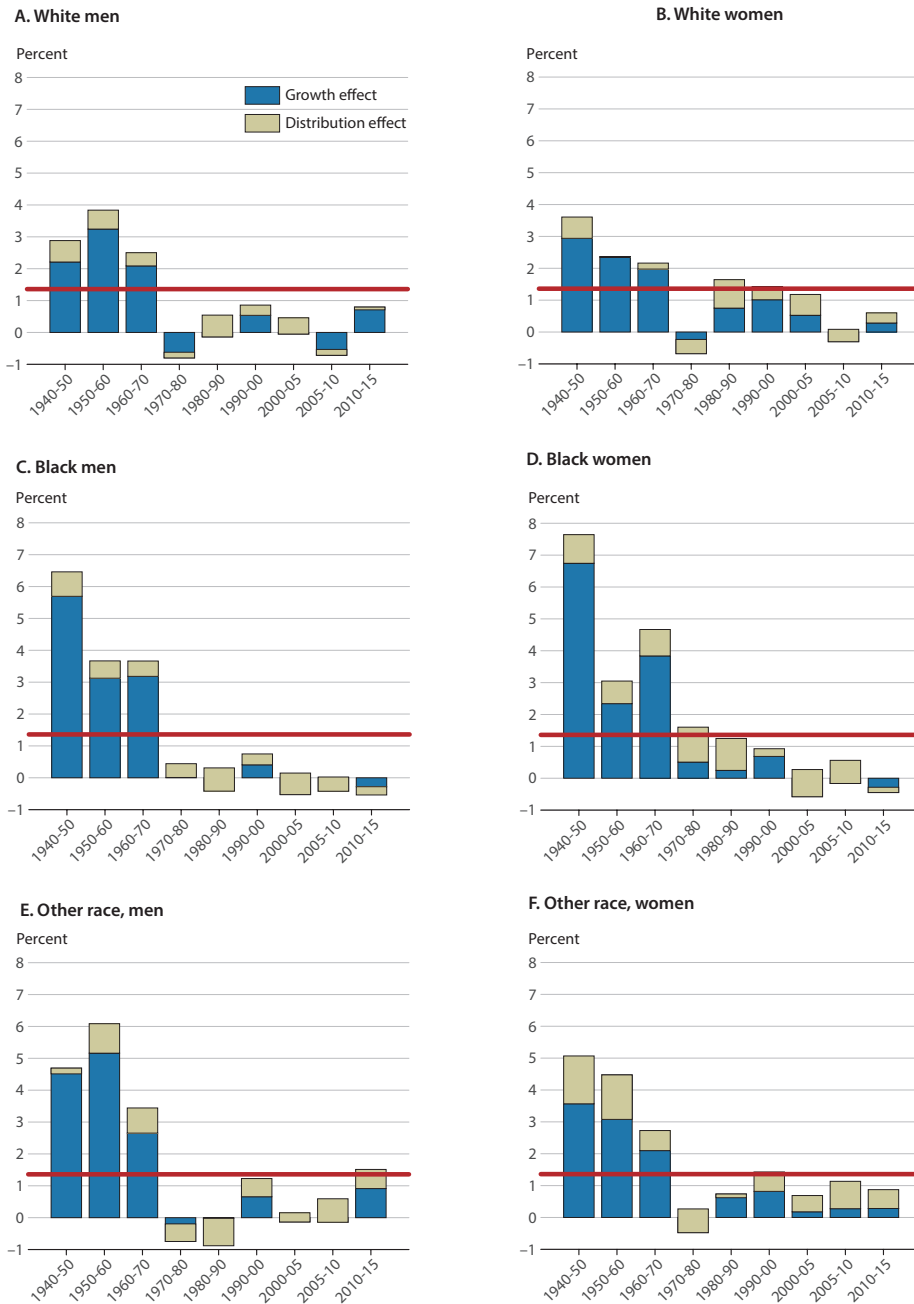


NOTE: The height of each bar indicates the annualized growth rate of the average wage during the corresponding period. The two colors indicate the contributions of the change in the distribution of workers by types (the distribution effect) and the change in the wage rate given worker types (the growth effect), respectively. The horizontal red line indicates the average growth rate (over the period 1940-2015) of the wage rate of the entire population of workers. SOURCE: IPUMS and authors' calculations.

In this expression, the term A indicates the change in  $\omega_t$  that can be ascribed to a change in the distribution of types from  $F_t$  to  $F_{t+1}$ , holding the wage function (i.e., the wage per type) constant at its date- $t+1$  value. The term B measures the effect of a change in the distribution of types, but this time holding the wage function constant at its date- $t$  value. The average of the two terms A and B constitutes the effect of  $F$ , that is, the distribution effect. The same logic applies to the effect of  $W$ , that is, the growth effect.

Figure 4 shows our results. The height of each bar indicates the annualized growth rate of  $\omega_t$  during each period. Note how different wage growth was before and after 1970: The first three decades of the sample period were times of fast wage growth, while the rest were marked by slow wage growth. The negative growth rates during the 1970-80 and 2005-10 periods correspond to the decline in  $\omega_t$  visible in Figure 1. The two colors indicate the contributions of the change in the distribution of worker types (the distribution effect) and the change in the wage rate given worker types (the growth effect). The main message from Figure 4 is that both effects contribute significantly to the growth rate. During the first three decades, 1940-50, 1950-60, and 1960-70, the distribution effect accounted for 15, 12, and 6 percent of the growth in wages, respectively.<sup>5</sup> During the periods 1980-90, 1990-2000 and 2000-05, it accounted for 80, 27, and 84 percent, respectively.

**Figure 5**  
**The Decomposition of Wage Growth**



NOTE: The height of each bar indicates the annualized growth rate of the average wage during the corresponding period. The two colors indicate the contributions of the change in the distribution of workers by types (the distribution effect) and the change in the wage rate given worker types (the growth effect). The horizontal red line indicates the average growth rate (over the period 1940-2015) of the wage rate of the entire population of workers.

SOURCE: IPUMS and authors' calculations.

**Table 3****Hourly Wages (2019, USD) and Annualized Rate of Growth (percent) by Sex-Race Subgroup**

Year	A. Hourly wages (2019, USD)					
	White men	Black men	Other men	White women	Black women	Other women
1940	10.7	4.6	5.7	6.9	2.7	5.1
1950	14.3	8.7	9.0	9.9	5.8	8.5
1960	21.0	12.6	16.5	12.5	7.9	11.6
1970	27.0	18.2	23.3	15.5	12.6	15.2
1980	25.4	19.0	22.9	15.1	14.8	15.6
1990	26.8	19.6	20.9	17.8	16.7	16.6
2000	29.2	21.1	23.7	20.5	18.3	19.1
2005	29.9	21.3	23.9	21.8	18.6	19.8
2010	29.1	21.3	24.6	21.9	19.1	21.0
2015	30.1	20.8	26.5	22.5	18.8	21.9

Years	B. Annualized rate of growth (percent)					
	White men	Black men	Other men	White women	Black women	Other women
1940-50	2.9	6.5	4.5	3.6	7.6	5.1
1950-60	3.8	3.7	6.1	2.3	3.0	3.1
1960-70	2.5	3.7	3.4	2.2	4.7	2.7
1970-80	-0.6	0.4	-0.2	-0.2	1.6	0.3
1980-90	0.5	0.3	-0.9	1.6	1.2	0.6
1990-2000	0.9	0.7	1.2	1.4	0.9	1.4
2000-05	0.5	0.1	0.2	1.2	0.3	0.7
2005-10	-0.5	0.0	0.6	0.1	0.6	1.1
2010-15	0.7	-0.5	1.5	0.6	-0.3	0.9

NOTE: "Other" means neither White nor Black.

SOURCE: IPUMS and authors' calculations.

It is interesting to note that the growth effect is noticeably more variable than the distribution effect. Thus, during a period of strong economic growth, as in the first three decades, the growth effect plays the dominant role. As the economy slows down, however, the distribution effect changes little and, therefore, its contribution becomes relatively more important. This occurs because the growth effect reflects economic conditions likely to change faster than the trends, some of them demographic, underlying the distribution effect. The distribution effect does not reflect only demography, however. The increasing labor force participation of women, for example, resulted from economic considerations (see Greenwood, Seshadri, and Yorukoglu, 2005), but these are likely to be slow-moving changes, hence the relative stability of the distribution effect.

In Figure 5 we present the results of calculations similar to those in Figure 4, for each sex-race subgroup instead of all workers simultaneously. We first compute wages and the distribution of workers by age, education, and marital status for each sex-race subgroup; we then decompose wage growth as described by equation (4). Table 3 reports wages and their annualized growth rates for each subgroup. In the Figure 5 decomposition, the distribution effect, therefore, is the joint effect of education, age, and marital status on a given sex-race subgroup, and a few points emerge. First, the general pattern observed for the average wage (see Figure 4) is repeated in each subgroup. Namely, the contribution of the growth effect is the strongest in periods of fast economic growth. Second, the first part of the sample period—before 1970—was a period of fast wage growth for all and, in particular, for non-White workers: The wage growth of non-White workers equaled or exceeded that of White workers during the 1940-1970 period. Since the wages of non-White workers had been, on average, below those of White workers (see Panel D of Figure 3), this was a period during which wage inequality across races must have decreased. Note also that since the 1970s, White and Black men have not experienced wage growth above 1 percent. The sex-race subgroups experiencing the highest average wage growth since the 1970s is non-Black women: 0.8 percent per year for both White women and women of other races.

The decomposition just described comes with a word of caution: Our assessment of the distribution effect, for instance, comes from holding the wages per worker type constant and computing the effect of changing only the distribution of worker types (equation (4)). We do not know, however, if the distribution of worker types would have changed as it actually did had the wages per type not changed. For instance, would women have entered the labor force as they did if wages had not changed? Would workers have acquired the education they did? Similarly, when we assess the growth effect, we hold the distribution of worker types fixed and change only the wages per type. We do not know if holding the distribution of worker types fixed would have affected the wages per type. Absent a theory of wage determination as well as education choices, labor force participation, etc., we cannot answer these questions. Thus, the results presented in Figure 2 should be viewed as indicative of the respective strengths of the growth and distribution effects, not definite measurements.

#### 4.2 Counterfactual Experiments

The message from Section 4.1 is that changes in  $F_t$  played a significant role in the evolution of the average wage rate over the years. But what are the contributions of specific marginal distributions? In this section, we propose a set of counterfactual experiments to answer this question.

We start by computing the distribution of education, sex, race, and marital status conditional on age. We denote this distribution  $Q_t^A(e, s, r, m | a)$ , which is given by

$$Q_t^A(e, s, r, m | a) = \frac{F_t(a, e, s, r, m)}{A_t(a)}.$$

Similarly, we compute the distribution of age, sex, race, and marital status conditional on education as

$$Q_t^E(a, s, r, m | e) = \frac{F_t(a, e, s, r, m)}{E_t(e)},$$

and likewise for  $Q_t^S$ ,  $Q_t^R$ , and  $Q_t^M$ . Recall that the average wage in year  $t$  is  $\omega_t$  (see equation (3)). We now compute the average wage that would have prevailed if the age distribution had remained at its 1940 values:

$$\omega_t^A = \sum_{\{a, e, s, r, m\}} W_t(a, e, s, r, m) A_{1940}(a) Q_t^A(e, s, r, m | a).$$

Note that, by construction,

$$\omega_{1940} = \omega_{1940}^A$$

since  $A_{1940}(a) Q_{1940}^A(e, s, r, m | a) = F_{1940}(a, e, s, r, m)$ . For any year  $t \neq 1940$ , the difference between  $\omega_t$  and  $\omega_t^A$  is due to the marginal age distribution remaining fixed at its 1940 values in the computation of  $\omega_t^A$ . Suppose, for instance, that  $\omega_t$  is above  $\omega_t^A$  in year  $t \neq 1940$ . This can be interpreted as a positive effect of the changing age distribution on the average wage in year  $t$ : The actual wage  $\omega_t$  is above  $\omega_t^A$  because the age distribution is not the same in year  $t$  as in 1940.

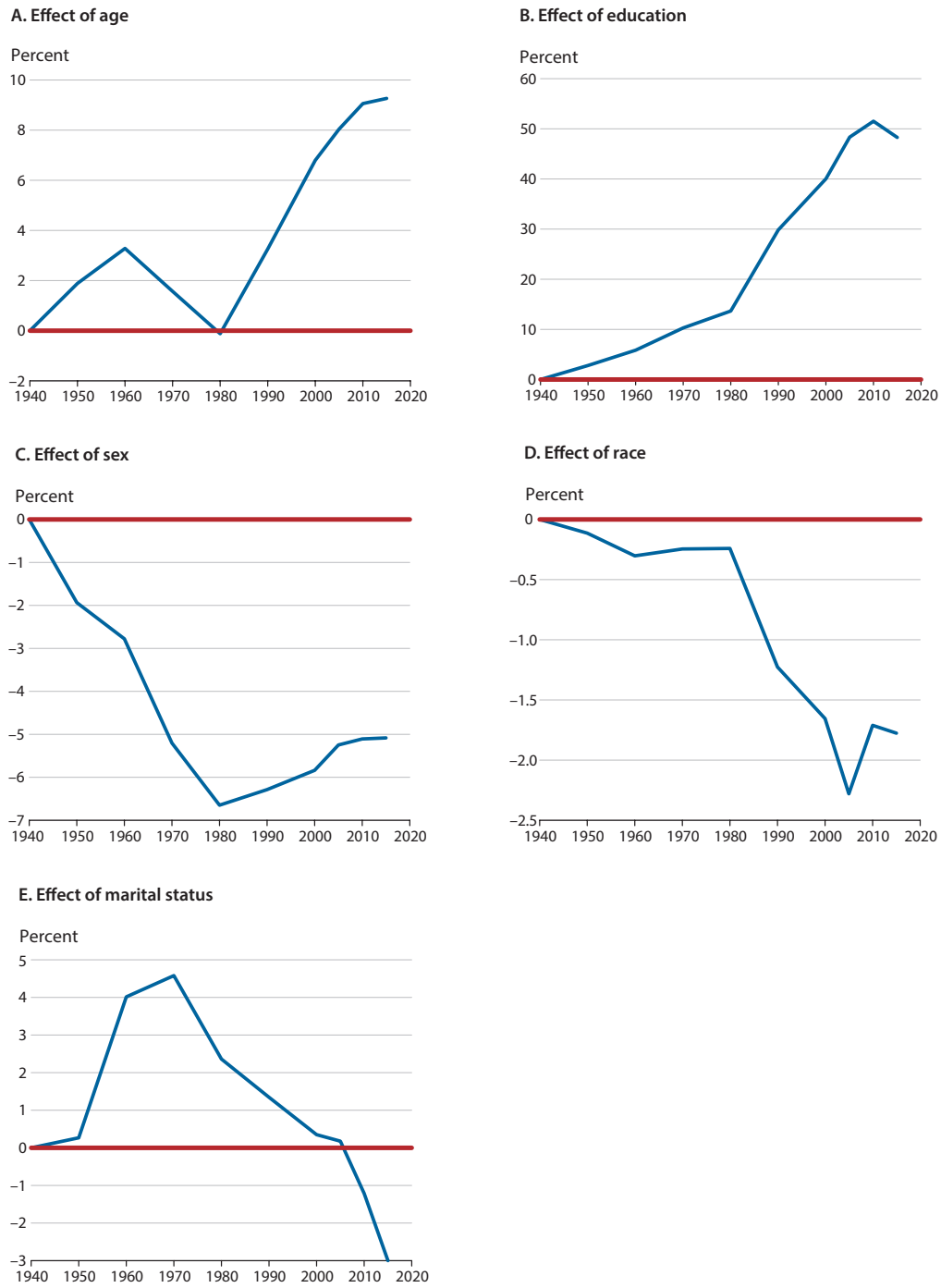
Figure 6 plots  $100 \times (\omega_t / \omega_t^A - 1)$  in Panel A,  $100 \times (\omega_t / \omega_t^E - 1)$  in Panel B, etc. In Panel A, the trend in wages is increasing and above 0; that is, the average wage since 1940 has been higher than what it would have been if the age distribution had remained at its 1940 values. This can be understood by noting, as Panel A shows, that older workers tend to earn higher wages than younger workers. Since the working population is on average becoming older, this is a force toward the average wage getting higher. Holding the age distribution fixed from 1940 to 2015 at its 1940 values implies that the average worker remains younger and therefore earns less. Quantitatively the effect is not negligible: If the age distribution was fixed, all else equal, the wage rate of the average worker would have been 9 percent lower in 2015.

As shown in Panel A, notably, from 1960 to 1980 the actual wage,  $\omega_t$ , tended toward the counterfactual wage,  $\omega_t^A$ . This is the effect of the Baby Boom: The inflow of an abnormally large number of young workers lowered the average wage. Note also that in 1980 the two wages  $\omega_t$  and  $\omega_t^A$  are almost at the same levels as in 1940. Contrary to 1940, however, the equality between  $\omega_t$  and  $\omega_t^A$  in 1980 is not by construction. It results because the proportions of young workers were almost the same on these two dates, as shown in Panel A of Figure 3.

Figure 6 plots  $100 \times (\omega_t / \omega_t^E - 1)$  in Panel B. The trend in wages is increasing. That is, the average wage since 1940 has been higher than it would have been if the education distribution had remained at its 1940 values. This results because educational attainment has increased over time (see Panel B of Figure 2), and more-educated workers tend to earn more than less-educated workers (see Panel B of Figure 3). In addition, in the counterfactual experiment, more than 60 percent of workers do not have a high school diploma in 2015. (The actual number is less than 10 percent.) Similarly, in the counterfactual, there are fewer high school graduates and college graduates in 2015 than in the data; as a result, the actual average wage in 2015 is 50 percent above the counterfactual.

Figure 6 plots  $100 \times (\omega_t / \omega_t^S - 1)$  in Panel C. The trend in wages based on the sex distribution is decreasing; that is, the average wage since 1940 has been lower than what it would have

**Figure 6**  
**Counterfactual Experiments**



SOURCE: IPUMS and authors' calculations.

been if the sex distribution of workers had remained at its 1940 values. To understand this, recall that Panel C of Figure 2 shows an increasing proportion of female workers: Slightly over 25 percent of workers were female in 1940, while almost 50 percent were in 2015. Panel C of Figure 3 also shows that female workers receive lower wages than male workers. Thus, in the counterfactual experiment, the average wage is higher than in the data because the average worker in the counterfactual is more likely to be a male and to earn a higher wage. Note that the negative impact the changing sex distribution has on wages decreases after 1980, even though the proportion of female workers is not slowing down. The average wage in 1980 is about 6.5 percent below what it would have been under the counterfactual of a fixed (25 percent) proportion of female workers; by 2010, however, the gap is about 5 percent smaller. Thus, Panel C indicates a closing of the gender wage gap after 1980.

Figure 6 plots  $100 \times (\omega_t / \omega_t^R - 1)$  in Panel D. As for the sex distribution, the trend in wages based on race is decreasing; that is, the average wage since 1940 has been lower than what it would have been if the race distribution had remained at its 1940 values. Panel D of Figure 2 shows that the proportion of White workers has fallen from 90 percent in 1940 to just over 70 percent in 2018 and that the proportions of Black workers and workers of other races have increased over the same period. This data, coupled with the data from Panel D of Figure 3 that shows that White workers tend to make the most money of all races, shows the progression of racial diversity in the distribution of workers is consistent with a lower average wage. Holding the race distribution fixed at 1940 implies that the average workers would remain more likely to be White and would earn more. Note, however, that the negative impact of the change in the race distribution has been lessening since the early 2000s.

Lastly, Figure 6 plots  $100 \times (\omega_t / \omega_t^M - 1)$  in Panel E. The effect of holding the marital status distribution at its 1940s values is non-monotonic—because changes in the marital status distribution are not monotonic, as Figure 2 reveals. Since married workers tend to have higher wages (Panel E of Figure 3), and since the average worker was more likely to be married in 1970 than in 1940, the effect of the marital status distribution is positive and increasing through 1970. To put it differently, the actual wage was higher than the counterfactual wage because the average counterfactual worker was more likely to be single than the actual average worker between 1940 and 1970. The same logic applies in the opposite direction after 1970: The average worker is becoming more likely to be single—like the average worker in 1940.

The conclusions we draw from Figure 6 are subject to the same qualifications noted for Figures 4 and 5. Take the comparison between  $\omega_t$  and  $\omega_t^A$ , for example. We interpret  $\omega_t^A$  as the wage that would have prevailed if neither the age distribution nor the wage function had changed after 1940. It is, however, possible that the wage function would have changed, that is, that workers of a given type would have been paid differently in a world where the Baby Boom had not occurred. Once again, the results presented in Figure 6 should be viewed as indicative rather than definitive measurements.



## 5 CONCLUDING REMARKS

We presented an analysis of the average wage rate (labor earnings per hour) from 1940 to 2015. We emphasized that the average worker’s characteristics changed significantly during this period, and we proposed simple calculations that are informative about the effects of such changes. Our findings are as follows. First, the growth rate of wages can be decomposed between a “growth effect” and a “distribution effect.” The former measures the effect of a change in the wage function that associates wages with worker types; the latter measures the effect of the changing distribution of worker characteristics. We find that both effects contribute significantly to overall wage growth. Second, we evaluate the contributions of different aspects of the changing distribution of worker characteristics. The average worker is (i) older, which contributes to higher wage growth; (ii) more educated, which also contributes to higher wage growth; (iii) less likely to be a man, which contributes to lower wage growth; (iv) less likely to be White, which contributes to lower wage growth; and (v) only slightly less likely to be single, which contributes to slightly higher wage growth.

Our findings should be viewed as indicative rather than definitive measurements—because we assume that the wage function and the distribution of workers are independent objects. In other words, we have neither a theory of wage determination nor a theory of worker characteristics (female labor force participation, educational attainment, etc.). ■

## NOTES

- <sup>1</sup> Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek. Integrated Public Use Microdata Series: Version 7.0. Minneapolis: University of Minnesota, 2017; <https://doi.org/10.18128/D010.V7.0>.
- <sup>2</sup> Single is equivalent to never married.
- <sup>3</sup> The peak of the Baby Boom was in the late 1950s. Thus, by the late 1970s there was an abnormal abundance of workers in their early 20s.
- <sup>4</sup> Note that the increased labor force participation of women is not what Panel C shows. Labor force participation includes, by definition, the unemployed. Panel C refers only to employed workers; but an increased rate of participation of women also implies an increased proportion of women among employed individuals.
- <sup>5</sup> Take, for example, the 1940-50 decade:  $\omega$ , grew at annual rate of 3.5 percent between 1940 and 1950. The growth effect was 3 percent, and the distribution effect was 0.5 percent. Thus, the contribution of the distribution effect was  $0.5/3.5 \approx 15$  percent.

## REFERENCES

- Ben-Porath, Yoram. “The Production of Human Capital and the Life-Cycle of Earnings.” *Journal of Political Economy*, 1967, 75(4), pp. 352-65; <https://doi.org/10.1086/259291>.
- Bowlus, Audra J. and Robinson, Chris. “Human Capital Prices, Productivity, and Growth.” *American Economic Review*, 2012, 102(7), pp. 3483-515; <https://doi.org/10.1257/aer.102.7.3483>.
- Card, David and Lemieux, Thomas. “Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis.” *Quarterly Journal of Economics*, 2001, 116(2), pp. 705-46; <https://doi.org/10.1162/00335530151144140>.
- Daly, Mary; Hobijn, Bart and Pedtke, Joseph H. “Disappointing Facts About the Black-White Wage Gap.” Federal Reserve Bank of San Francisco *Economic Letter*, 2017, 26, pp. 1-5.

## Peake and Vandenbroucke

- Goldin, Claudia. *Understanding the Gender Gap: An Economic History of American Women*. Oxford University Press, 1992.
- Greenwood, Jeremy; Seshadri, Ananth and Yorukoglu, Mehmet. "Engines of Liberation." *Review of Economic Studies*, 2005, 72(1), pp. 109-33; <https://doi.org/10.1111/0034-6527.00326>.
- Guvener, F. and Kuruscu, B. "A Quantitative Analysis of the Evolution of the U.S. Wage Distribution, 1970-2000," in *NBER Macroeconomics Annual 2009*. Volume 24. University of Chicago Press, 2010, pp. 227-76; <https://doi.org/10.1086/648297>.
- Heckman, J.J.; Lochner, L. and Taber, C. "Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Labor Earnings with Heterogeneous Agents." *Review of Economic Dynamics*, 1998, 1(1), pp. 1-58; <https://doi.org/10.1006/redy.1997.0008>.
- Huggett, M.; Ventura, G. and Yaron, A. "Human Capital and Earnings Distribution Dynamics." *Journal of Monetary Economics*, 2006, 53(2), pp. 265-90; <https://doi.org/10.1016/j.jmoneco.2005.10.013>.
- Huggett, M.; Ventura, G. and Yaron, A. "Sources of Lifetime Inequality." *American Economic Review*, 2011, 101(7), pp. 2923-54; <https://doi.org/10.1257/aer.101.7.2923>.
- Katz, Lawrence F. and Murphy, Kevin M. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics*, 1992, 107(1), pp. 35-78; <https://doi.org/10.2307/2118323>.
- Restuccia, Diego and Vandenbroucke, Guillaume. "A Century of Human Capital and Hours." *Economic Inquiry*, 2013, 51(3), pp. 1849-66; <https://doi.org/10.1111/j.1465-7295.2012.00497.x>.