The Black-White Gap in Earnings and Employment

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Abstract

In the US economy, black males on average receive lower earnings than their white counterparts. This difference in earnings, which it is often called the black-white gap in earnings, increases over the working life. At the same time, the probability of being employed is significantly lower for black than for equally educated white males. Notably, the black-white gap in employment is almost constant over the working life. These two facts suggest that the determination of the earnings gap is related to on-the-job human capital accumulation. In this paper, we put forward a model of on-the-job human capital accumulation with labor market frictions to quantitatively assess how much of the black-white earnings gap can be accounted for by differences in employment probabilities versus pre-market factors. Conditional on education, we find that the differences in employment probabilities between blacks and whites account for around 85% of the total earnings gap over the working life.

Keywords: Black-white differences; Human capital; Heterogeneity, Wage gap.

JEL Codes: J15, J24, J31, J64.

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1 Introduction

In the US economy, black men receive lower earnings than their white counterparts even within educational categories. This difference, which it is generally referred to as the black-white gap in earnings, has been widely studied. A significant part of the literature has tried to assess whether the gap can be accounted for by observable characteristics which include proxies for ability and schooling quality. The consensus is that there is a significant proportion of the gap in earnings that cannot be explained by observables.[1] Another relevant difference in labor market outcomes between black and white men is the disparity in employment rates. Black men present a lower employment rate than their white counterparts for all levels of education. This gap cannot be accounted for by observables either.[2]

When looking at earnings and employment gaps over the lifecycle, the differences present a striking pattern. While the gap in earnings increases over the lifecycle, the gap in employment is almost constant. These two facts suggest that the determination of the earnings gap could be related to on-the-job human capital accumulation. At the beginning of the working life, after formal education is completed, the gap in employment implies that white men have more opportunities to accumulate human capital on the job than black men. Hence, the gap in earnings increases with age. On top of the lack of opportunities to learn on the job, the gap in employment during the working life also implies that black men have less chances to receive the payoff of any given investment in human capital thereby reducing incentives to invest. Hence, the optimal decision for a forward looking individual is to invest less in human capital.

In this paper, we put forward a model of on-the-job human capital accumulation with labor market frictions to quantitatively assess how much of the black-white earnings gap can be accounted for by differences in employment probabilities versus pre-market factors. The model combines the Ben-Porath (1967) structure of human capital accumulation in Huggett, Ventura, and Yaron (2006) with labor market frictions that allow us to assess which labor market transitions are relevant for the gap in earnings. We calibrate the model to replicate the earnings distribution of blacks and whites over the lifecycle. We perform counterfactual simulations to determine which part of the gap in earnings can be accounted for by differences in employment probabilities between blacks and whites. We find that, conditional on the education distribution observed in the data, differences in employment probabilities account for around 85% of the total earnings gap over the working life. We also use the model to disentangle the role of opportunities to invest in human capital on-the-job versus incentives to invest in human capital. We find that incentives play a quantitatively more important

[1] See Neal and Johnson (1996) and Lang and Manove (2011).

[2] See Ritter and Taylor (2011).

role than opportunities.

This paper is related to the extensive literature that looks at possible explanations of the black-white gap in earnings.[3] In contrast to Bowlus and Eckstein (2002) or Decreuse and Tarasonis (2016), we do not pose a theory of discrimination to explain the black-white gap in earnings and employment.[4] Instead, we document how these gaps evolve over the working life and assess the role of human capital accumulation to reconcile the patterns observed in these two outcomes. Our aim is two-folded. First, we look at the black-white gaps from a lifecycle perspective and provide a set of facts than can shed light on the determinants of the gaps. Second, we highlight a mechanism, namely human capital accumulation on the job, that is quantitatively relevant but has been overlooked by the existing literature.

2 Empirical Analysis

We use the monthly files of the Current Population Survey (CPS) from 1976 to 2015 to construct a synthetic panel. To construct the earnings profiles in Figure 1, we extract year and cohort fix effects. We also control for all observable characteristics in the CPS, that is, education, marital status, geographic location, occupation, and number of children in the household. We choose to focus on individuals between 23 and 60 years old to avoid distortions generated by men enrolled in full-time education or in retirement.

[3] See Charles and Guryan (2011) and Lang and Lehmann (2012) for excellent reviews of the literature.

[4] This does not mean we claim discrimination might not play a role. Discrimination could well be a reason behind differential transitions in and out of employment. For instance, Bertrand and Mullainathan (2004) find in a field experiment that white names receive 50% more callbacks for interviews.

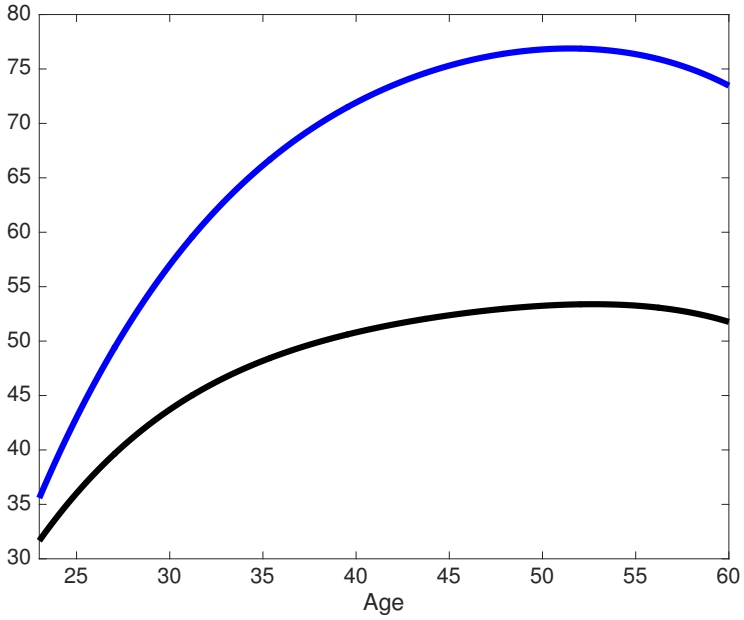

Figure 1: Normalised earnings profile over working life. Adjusted CPS 1976-2015. **Black** and **White** men 23-60 years old. The data is normalised by setting the average earnings of white college graduates at 60 years old to 100. The sample is adjusted, using matching, so that blacks and whites present similar observable characteristics within education groups.

Figure 1 shows that the earnings gap between blacks and whites is sizable and increases over the working life. While at the beginning of working life white men earn roughly 17% more than black men, by the end of the working life this difference increases to around 42%. Figure 2 shows that the gap in the employment rate between blacks and whites is also sizable. White men present an employment rate that is about 15 percentage points higher than that of black men. However, this difference does not vary much over the working life, it only decreases slightly towards the end.

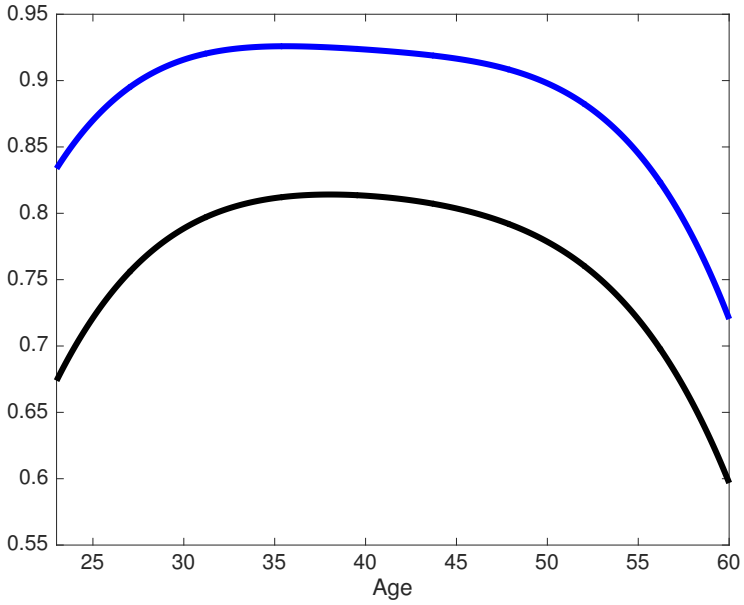

Figure 2: Employment rate over working life. Adjusted CPS 1976-2015. **Black** and **White** men 23-60 years old. The sample is adjusted, using matching, so that blacks and whites present similar observable characteristics within education groups.

These two facts suggest that human capital accumulation play a crucial role in determining the earnings gap between blacks and whites. Consider an economy in which earnings have no dynamic component, that is, in any given period, the earnings of an individual are solely determined by static variables such as his age, education, or geographical location. In such an environment, a constant differential in employment over the lifecycle necessarily implies a constant earnings gap as well. However, once human capital accumulation enters the picture and there is scope for initial differences to accumulate over time, the constant difference in employment rates can be consistent with an increasing gap in earnings.

3 The Model

We extend the Ben-Porath (1967) model in Huggett, Ventura, and Yaron (2006) introducing heterogeneity in race and education levels, as well as allowing for labor market frictions. Time is discrete and each agent participates in the labor market for N periods. At the beginning of his working life, each agent is characterized by his race (g), level of education (e), learning ability (a), and initial level of human capital (h_1). While human capital evolves endogenously over the working life, we assume that race, level of education, and learning

ability remain constant. In each period j, an agent can be employed or non-employed.[5] To model labor market frictions we assume that employed agents lose their employment with probability $d_j^{g,e}(h)$ and non-employed agents find employment with probability $f_j^{g,e}(h)$.

Agents seek to maximize the present value of earnings over their working life. The value function of an employed agent of race r and education level e, at age j, is given by:

$$W_j^{g,e}(h;a) = \max_{l,h'} \quad wh(1-l) + \frac{1}{1+r}[d_j^{g,e}(h)N_{j+1}^{g,e}(\cdot) + (1-d_j^{g,e}(h))W_{j+1}^{g,e}(\cdot)] \tag{1}$$

$$\text{s.t.} \qquad h' = h(1-\delta^{g,e}) + a(hl)^{\alpha^{g,e}} \tag{2}$$

$$d_j^{g,e}(h) = 1 - e^{-h\theta_j^{g,e}} \tag{3}$$

$$l \in [0,1] \tag{4}$$

Equation (1) states that the value of earnings in the current period is given by the product of the wage rate (w), the current level of human capital (h), and the time allocated to work ($1-l$). Agents discount the future at rate $\frac{1}{1+r}$, where r denotes the exogenous interest rate of the economy. The accumulation of human capital for the next period is given by Equation (2). The amount of time invested in human capital is denoted by l. If an agent invests no time in human capital ($l=0$), his human capital depreciates at a constant rate δ. In order to increase the stock of human capital next period, the agent needs to choose a level of investment in human capital that offsets depreciation. Learning ability a controls the productivity of investments in human capital. For any level of current human capital, agents with higher learning ability need to devote less time to human capital accumulation than agents with lower learning ability to achieve any given increase in human capital next period.

Non-employed workers suffer human-capital loses because human capital cannot be acquired out of employment. The value function of a non-employed worker of race g and education level e, at age j, is given by:

$$N_j^{g,e}(h;a) = \frac{1}{1+r}[f_j^{g,e}(h)W_{j+1}^{g,e}(h';a) + (1-f_j^{g,e}(h))W_{j+1}^{g,e}(h';a)] \tag{5}$$

$$\text{s.t.} \qquad h' = h(1-\delta^{g,e}) \tag{6}$$

$$f_j^{g,e}(h) = 1 - e^{-h\lambda_j^{g,e}} \tag{7}$$

We set the terminal value of working life to zero. The solution of the problem of an agent

[5] We do not differ between unemployment and out of the labor force. This is a common approach chosen when modelling males as it is a phenomenon which is less prevalent than among females.

can be represented using a policy function for how much time an employed agent devotes to investing in human capital each period, denoted by $l_j^{g,e}(h;a)$. Given the policy function for time invested in human capital, computing the present value of earnings and the trajectory of the human capital stock over the working life is trivial.

In this model, there are two set of factors that determine the optimal time to invest in human capital. The first set of factors are the parameters that affect the low of motion for human capital (Equation 2). We refer to this set of factors, plus the initial level of human capital, as pre-market factors. The second set of factors that crucially affect the human capital investment decision are the employment probabilities (both the probability to find and lose employment, Equations 3 and 7). In this model, employment is both an opportunity and an incentive to invest in human capital. Employment is an opportunity because non-employed agents cannot invest in human capital and only see their human capital depreciate. Employment is also an incentive as, in each period of employment, investing in human capital represents a trade-off between current and future earnings. Agents forgo current earnings in order to receive higher (discounted) earnings in the future. Hence, an agent that is currently employed takes into account his employment prospects in the future when deciding how much human capital to accumulate.

3.1 Initial Distributions

Within each race-education group, there is a distribution of agents along learning ability and human capital. In order to solve the model, one needs to know the shape of this distribution at the beginning of the lifecycle. We assume that, for each group, the distribution of ability and initial human capital is given by a bivariate lognormal distribution:

$$\Psi^{g,e} = \ln \mathcal{N}(\mu_a^{g,e}, \mu_h^{g,e}, \sigma_a^{g,e}, \sigma_h^{g,e}, \sigma_{ah}^{g,e}), \tag{8}$$

where $\mu_a^{g,e}$ is the mean learning ability, $\mu_h^{g,e}$ is the mean level of initial human capital, $\sigma_a^{g,e}$ is the standard deviation of learning ability, $\sigma_h^{g,e}$ is the standard deviation of human capital, and $\sigma_{ah}^{g,e}$ is the covariance between learning ability and the initial level of human capital.

4 Calibration

4.1 Earnings

To calibrate the model, we need to set up race groups and education levels that have a counterpart in the data. We define two race groups, blacks (b) and whites (w), and four education levels, less than high school ($-HS$), high school graduates (HS), some college (SC), and college graduates and beyond ($C+$). The model time span is from age 23 to 60. A model period is one month.

		Black				White			
		-HS	HS	SC	C+	-HS	HS	SC	C+
Depreciation rate	δ	0.015	0.013	0.013	0.013	0.013	0.013	0.014	0.012
Human capital technology	α	0.699	0.702	0.698	0.700	0.704	0.699	0.696	0.691
Mean learning ability	μ_a	0.185	0.172	0.181	0.179	0.155	0.170	0.188	0.182
S.d. learning ability	σ_a	0.033	0.028	0.027	0.025	0.036	0.030	0.033	0.038
Mean intial human capital	μ_h	36.400	43.713	45.541	41.412	35.400	51.900	49.587	39.247
S.d. initial human capital	σ_h	22.793	19.519	25.496	21.950	33.261	20.855	27.199	25.972
Correlation	ρ_{ah}	0.604	0.834	0.813	0.876	0.717	0.722	0.751	0.896

Table 1: Benchmark parameter values.

We set the interest rate r to 4% and normalize the wage rate to unity. We calibrate the rest of the parameters of the model to minimize the distance between the moments of the data and the moments generated by the model using simulated method of moments with an equally weighted diagonal matrix. Since the only price in the model, the interest rate, is set up independently from the calibration exercise this implies that there are no general equilibrium effects. Hence, the calibration of the parameters for each race-education group can be performed independently. The parameters for the benchmark calibration are presented in Table 1.

4.2 Employment

To be written.

4.3 Model Fit

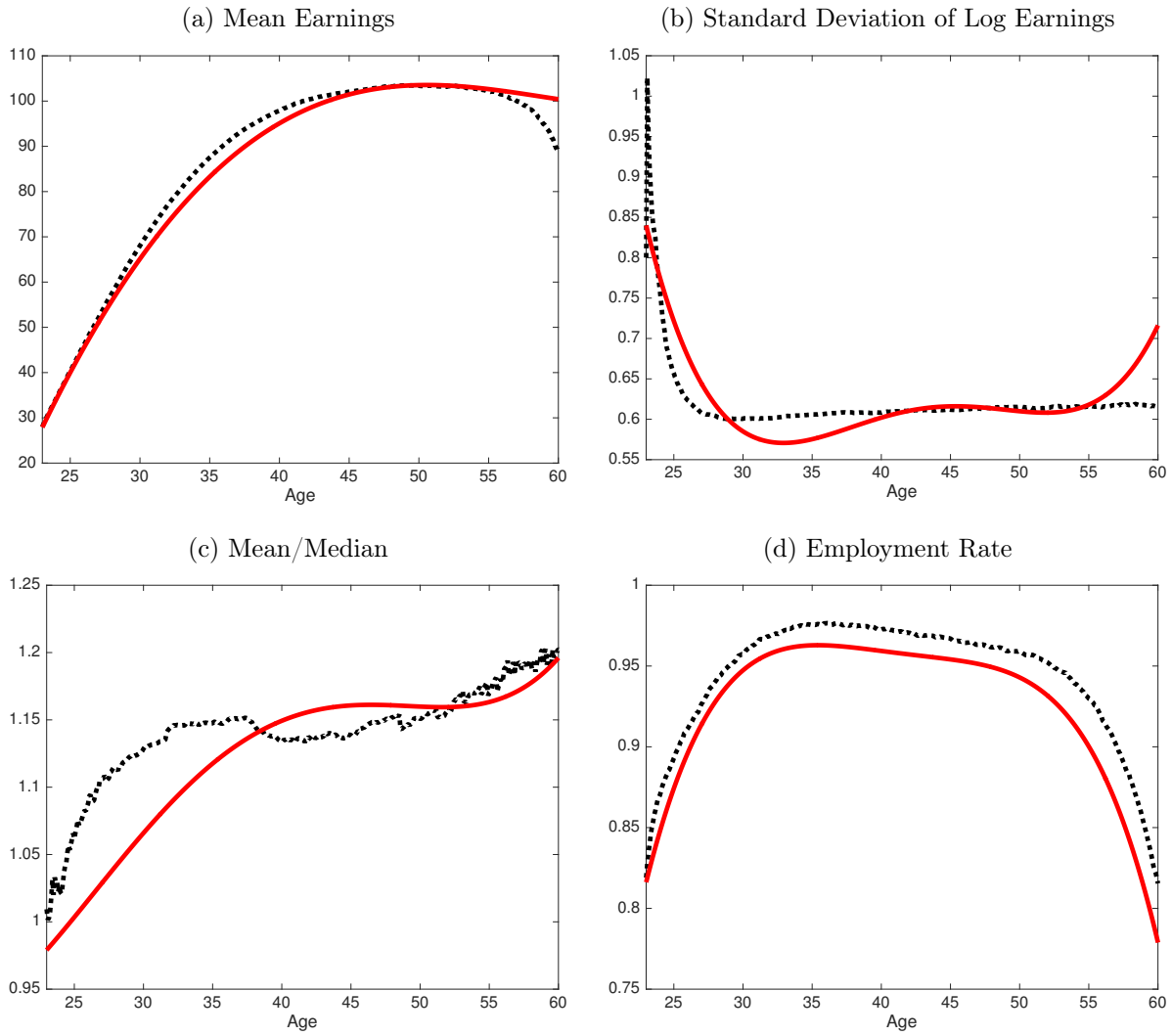

Figure 3: Model fit for whites with college education and beyond. The solid line corresponds to the data. The discontinuous line corresponds to the model.

The calibrated parameters of the model are chosen to reduce the distance between the distribution of earnings over the lifecycle implied by the model and in the data. We use three moments to compare the two distributions: the mean of earnings, the standard deviation of log earnings, and the ratio of mean over median. Figure 3 displays the performance of the model in comparison with the data for these three moments and for the employment rate. We impute the probability of an employed agent to become unemployed and vice-versa directly from the data. This implies that the evolution of the employment rate over the lifecycle in the model is exogenous and dictated by the transitions observed in the data.

The model does a good job capturing the profile of mean earnings over the lifecycle. It exaggerates the decrease in earnings at the end of lifecycle because we impose that after the age of 60 no agent can work instead of including an endogenous retirement decision. Hence, agents start decreasing their investments in human capital in anticipation of the end of the working life. Given the little structure imposed on heterogeneity within race-education groups, the model does a good job at matching the patterns in dispersion and skewness of the distribution of earnings over the lifecycle, at least for most race-education groups. The performance of the model for the remaining race-education groups can be found in Appendix A.

5 Counterfactual Exercises

5.1 The Role of Employment Probabilities

In order to assess the quantitative importance of employment probabilities in determining the black-white gap in earnings, we simulate a series of counterfactual exercises in which we create a group of agents that is endowed with the pre-market factors (depreciation rate, human capital technology, learning ability, and initial human capital) of black men but face the labor market prospects of white men. We simulate the performance of this counterfactual group over the lifecycle and then compare their outcomes with the outcomes of the simulated black and white groups.[6]

In this section, we present the results of three counterfactual exercises (displayed in Figures 4, 5, and 6). In the first exercise (Figure 4) we assess the quantitative importance of the probability to find employment in determining the earnings gap. Counterfactual agents are endowed with the pre-market factors of black men but their employment prospects over the working life are the outcome of combining the probability to find employment of white men and the probability to lose employment of black men. We find that 17% of the total gap in earnings over the working life can be accounted for by differences in the probability to find employment.

[6] All our estimates keep the education decisions of black men observed in the data constant.

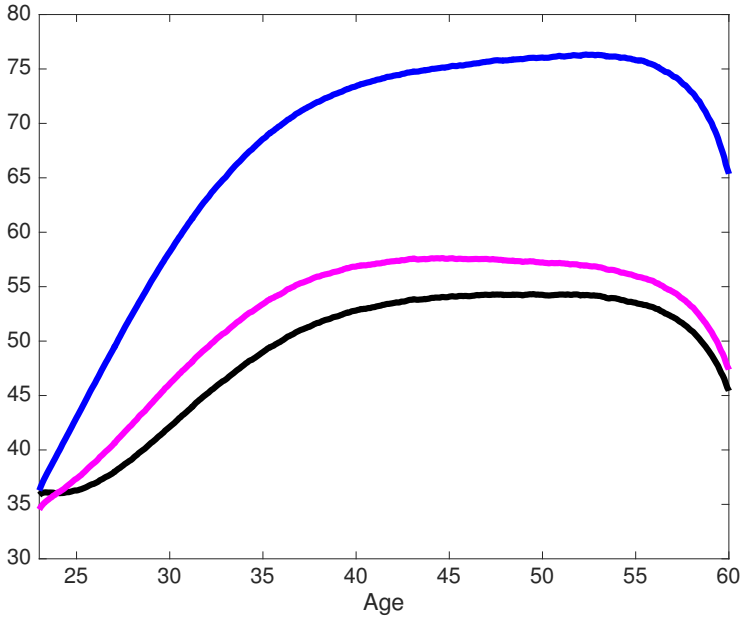

Figure 4: Simulated earnings profile for **Black** and **White** men 23-60 years old. The **magenta** line combines the pre-market factors of black men and the probability to find employment of white men.

The second counterfactual exercise (Figure 5) is the mirror image of the first exercise but for the probability to lose employment. In this exercise, counterfactual agents are endowed with the pre-market factors of black men and their employment prospects over the working life are the outcome of combining the probability to find employment of black men and the probability to lose employment of white men. In this case, we find that the differences in the probability to find a job between black and white men account for around 73% of the total gap in earnings over the working life.

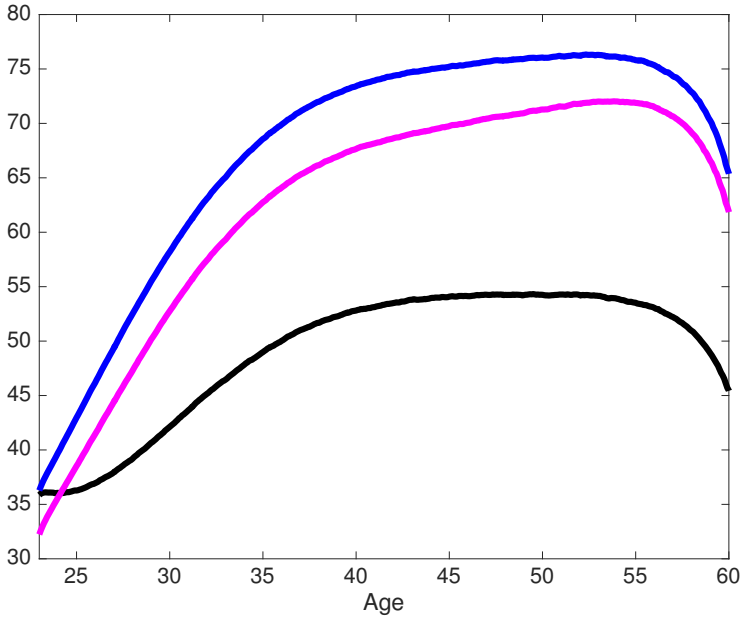

Figure 5: Simulated earnings profile for **Black** and **White** men 23-60 years old. The **magenta** line combines the pre-market factors of black men and the probability to lose employment of white men.

Finally, the third counterfactual exercise (Figure 6) is the combination of the first and the second. Counterfactual agents are endowed with the pre-market factors of black men while they face the employment prospects of white men, that is, both the probability to find employment and the probability to lose employment. We find that, overall, differences in employment probabilities account for around 85% of the total gap in earnings over the working life.

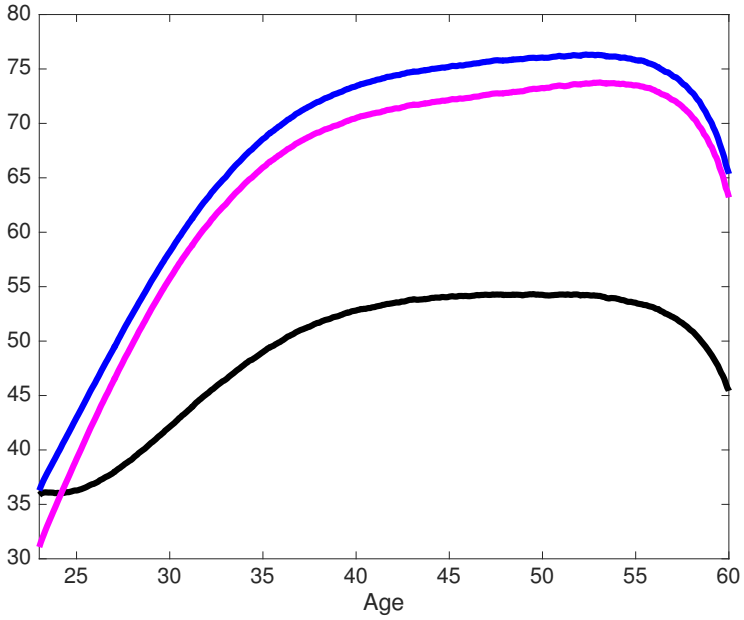

Figure 6: Simulated earnings profile for **Black** and **White** men 23-60 years old. The **magenta** line combines the pre-market factors of black men and the employment transitions of white men.

5.2 The Role of Incentives versus Opportunities

As discussed in Section 3, in our model the role of employment is two-folded. On the one hand, employment is an opportunity to accumulate human capital as non-employed agents only see their human capital depreciate. On the other hand, (future) employment determines the incentives for an agent to forgo current earnings for higher (discounted) earnings later in life as only employed agents can transform their human capital in earnings. In this section, we perform a counterfactual exercise to disentangle the quantitative role of these two mechanisms in determining the earnings gap between blacks and whites over the working life.

In order to tackle this question, we simulate the life of counterfactual agents that face the incentives to accumulate human capital of black men but receive the employment opportunities of white men. In order to do so, we perform the counterfactual exercise in two stages. In the first stage, we compute the decision rules of black men keeping their expected employment opportunities over the life cycle as those of black men. In the second stage, we use these decision rules to simulate the working life of counterfactual agents that experience the employment probabilities of white men but decide about the time invested in human capital using the decision rules of black men.

Figure 7 displays the result of this counterfactual exercise. We find that around 31%

of the total gap in earnings can be accounted for differences in employment opportunities between blacks and whites, while 54% can be accounted for differences in incentives to invest in human capital.[7]

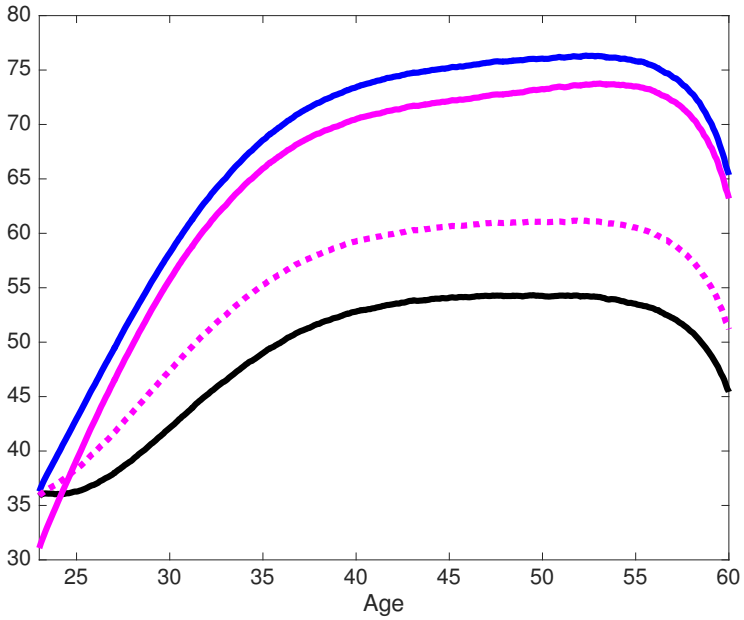

Figure 7: Simulated earnings profile for **Black** and **White** men 23-60 years old. The **magenta** line combines the pre-market factors of black men and the employment transitions of white men. The **dashed** line combines the decision rules of black men with the employment opportunities of white men.

6 Conclusions

To be written.

[7]Note that the sum of these two percentages is 85%, that is, the percentage of the total gap in earnings that can be accounted for by differences in employment probabilities.

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A Model Fit

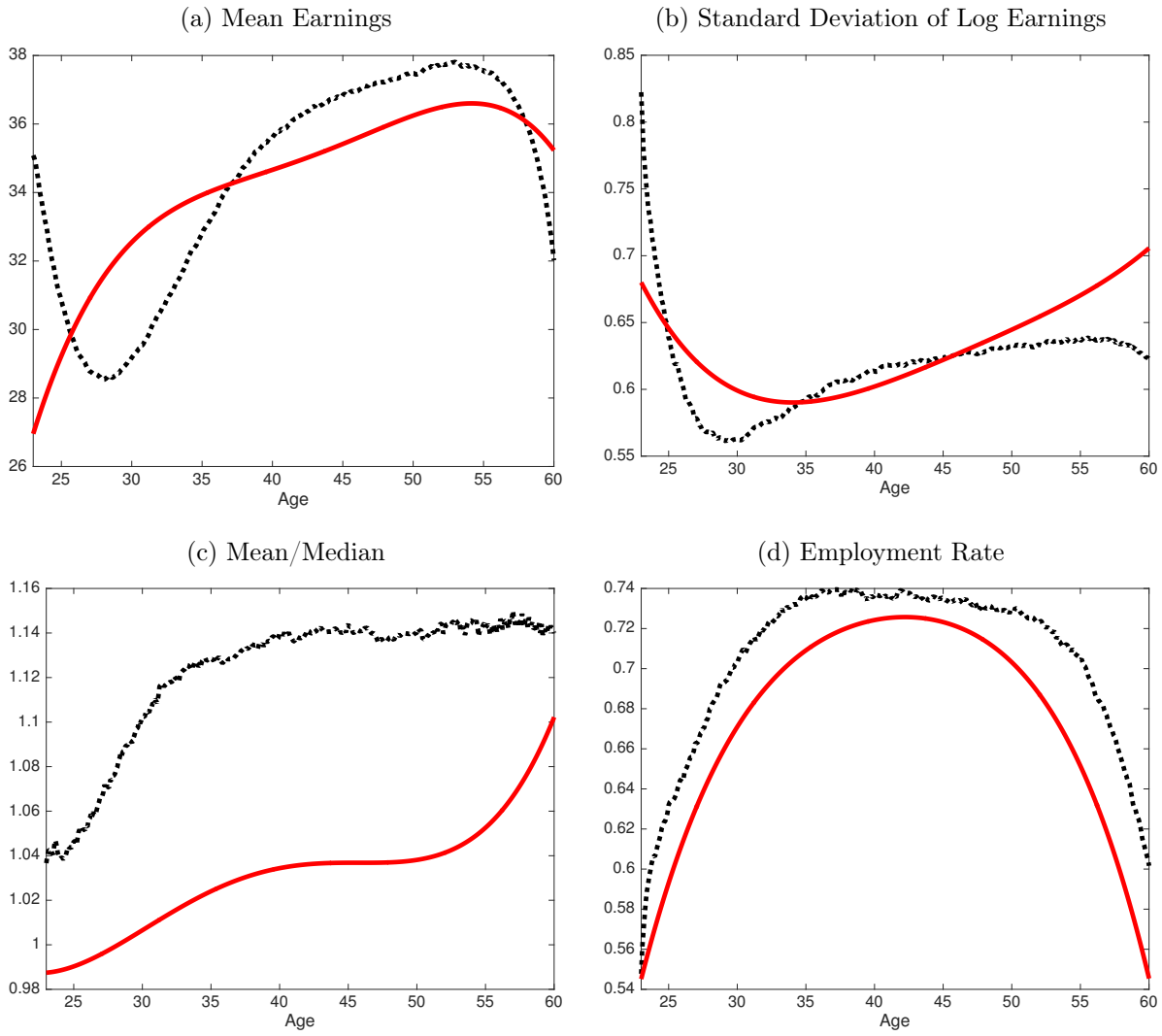

Figure 8: Model fit for blacks without high school degree. The solid line corresponds to the data. The discontinuous line corresponds to the model.

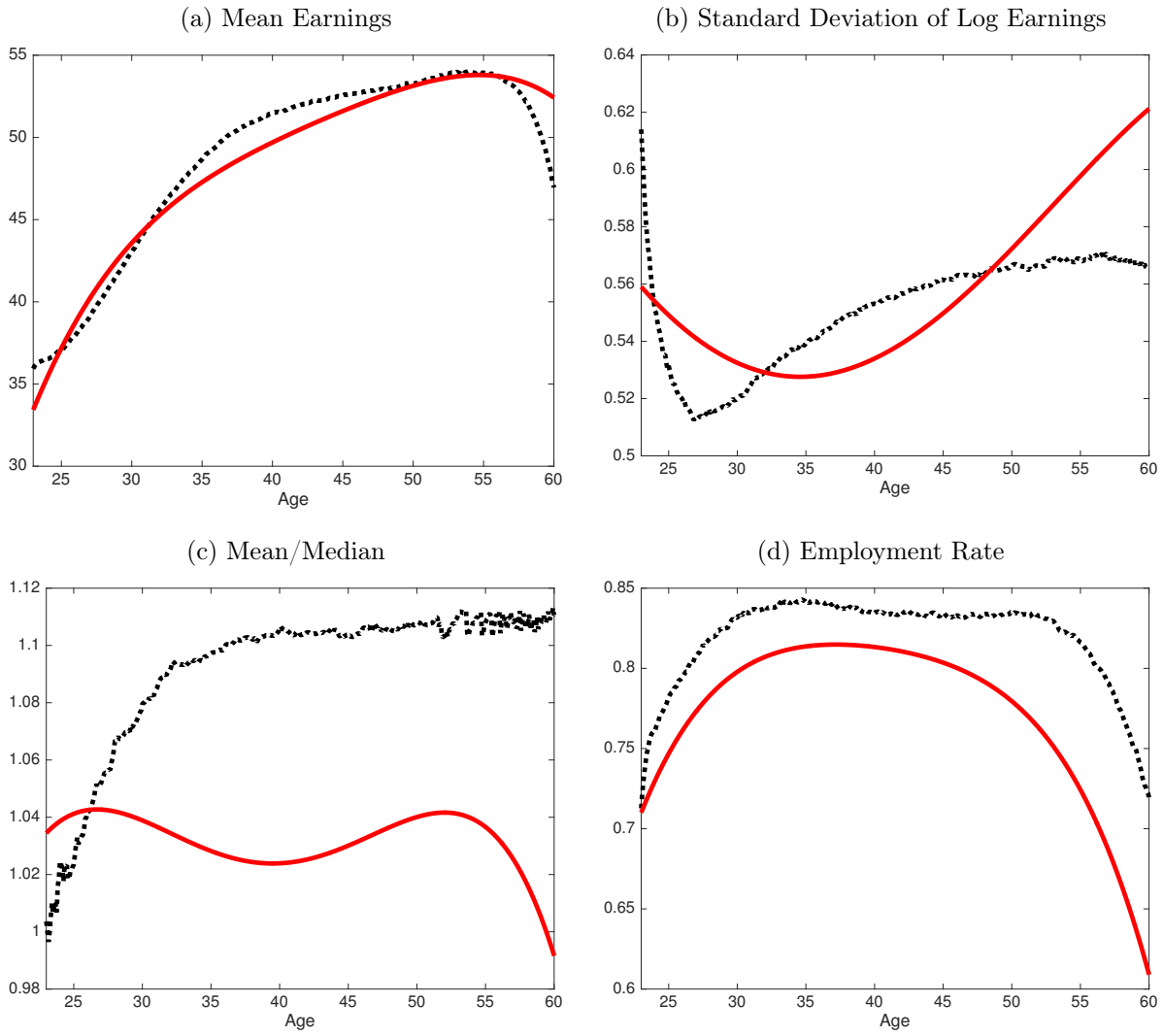

Figure 9: Model fit for blacks with high school degree. The solid line corresponds to the data. The discontinuous line corresponds to the model.

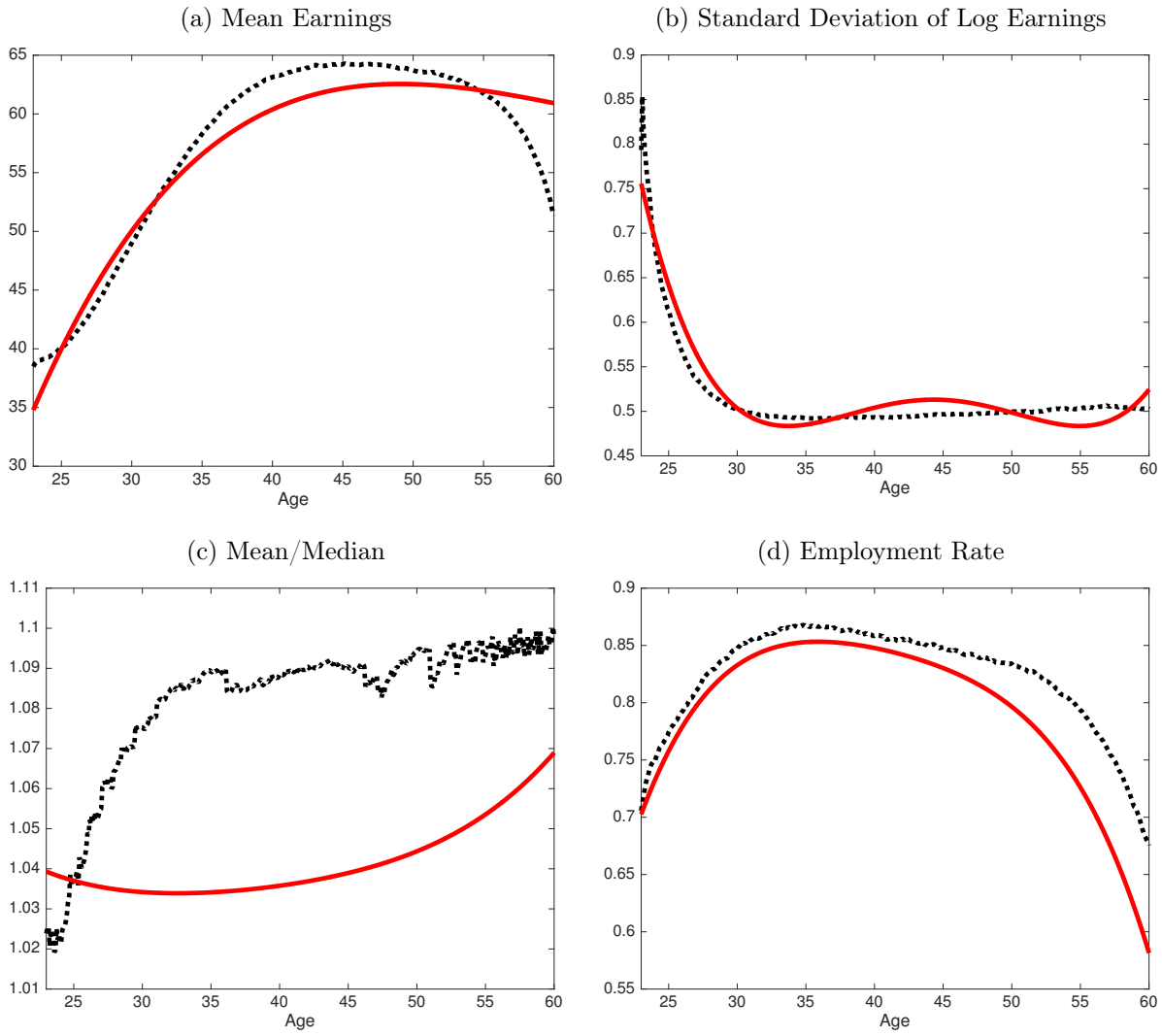

Figure 10: Model fit for blacks with some college education. The solid line corresponds to the data. The discontinuous line corresponds to the model.

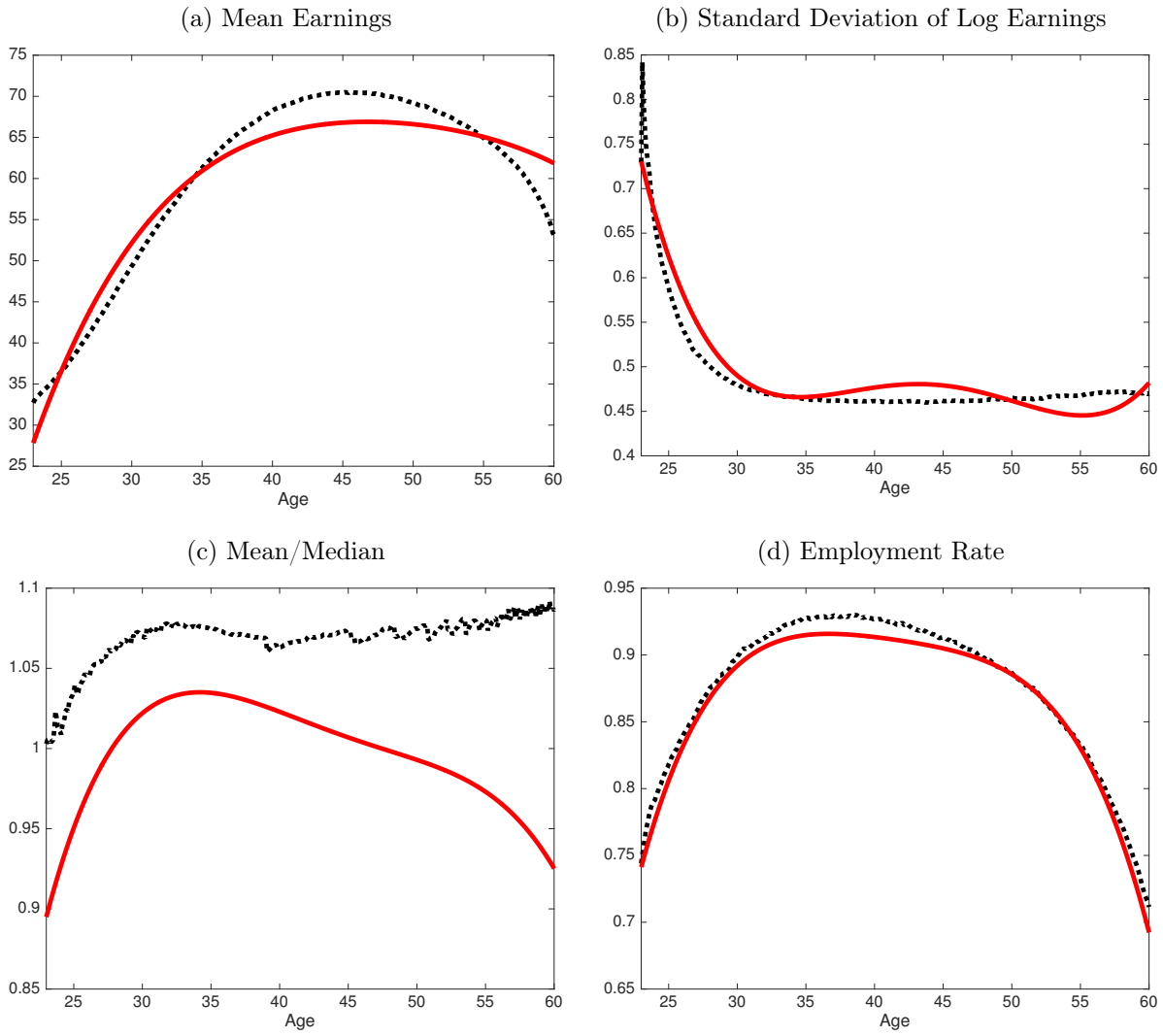

Figure 11: Model fit for blacks with college education and beyond. The solid line corresponds to the data. The discontinuous line corresponds to the model.

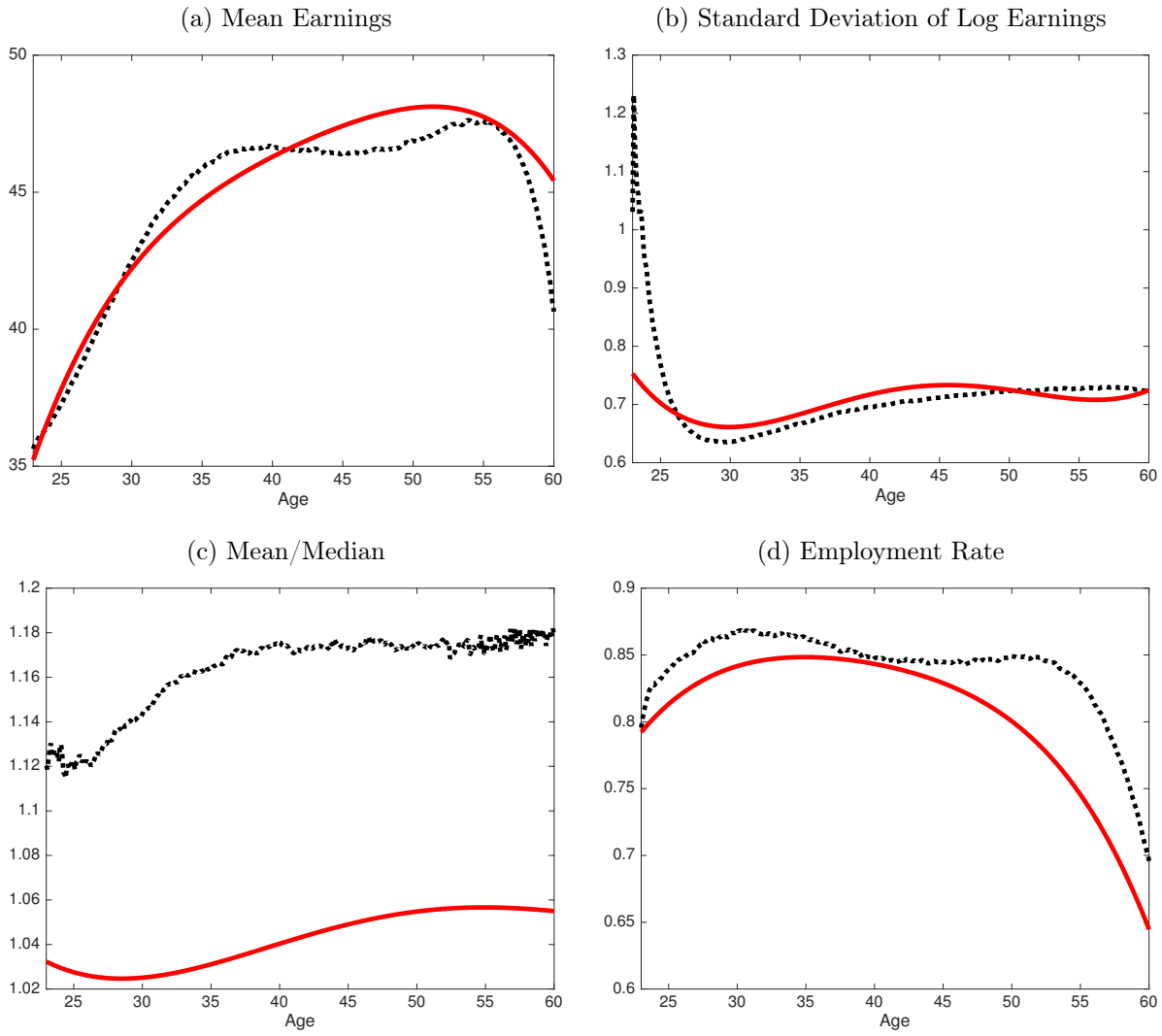

Figure 12: Model fit for whites without high school degree. The solid line corresponds to the data. The discontinuous line corresponds to the model.

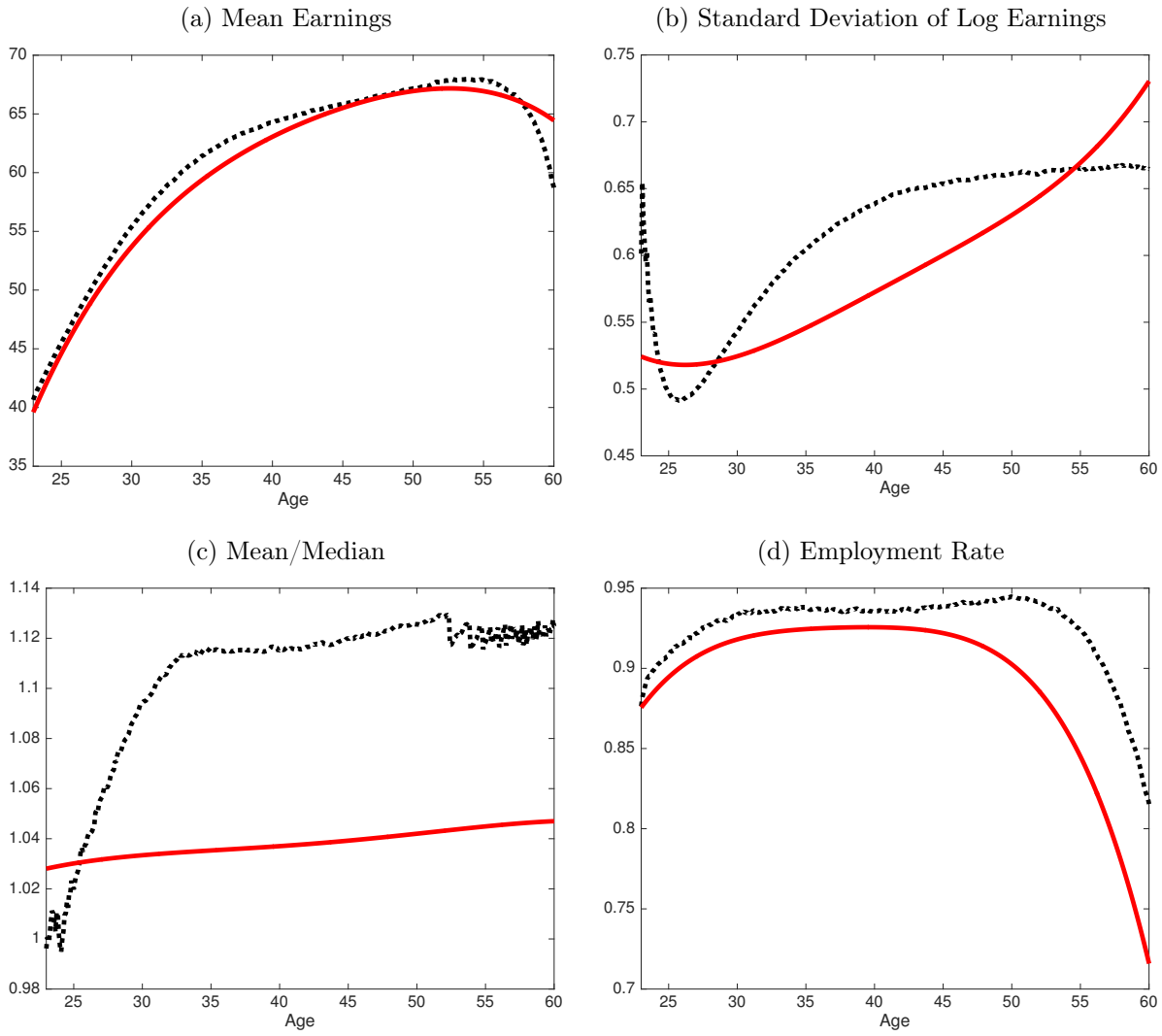

Figure 13: Model fit for whites with high school degree. The solid line corresponds to the data. The discontinuous line corresponds to the model.

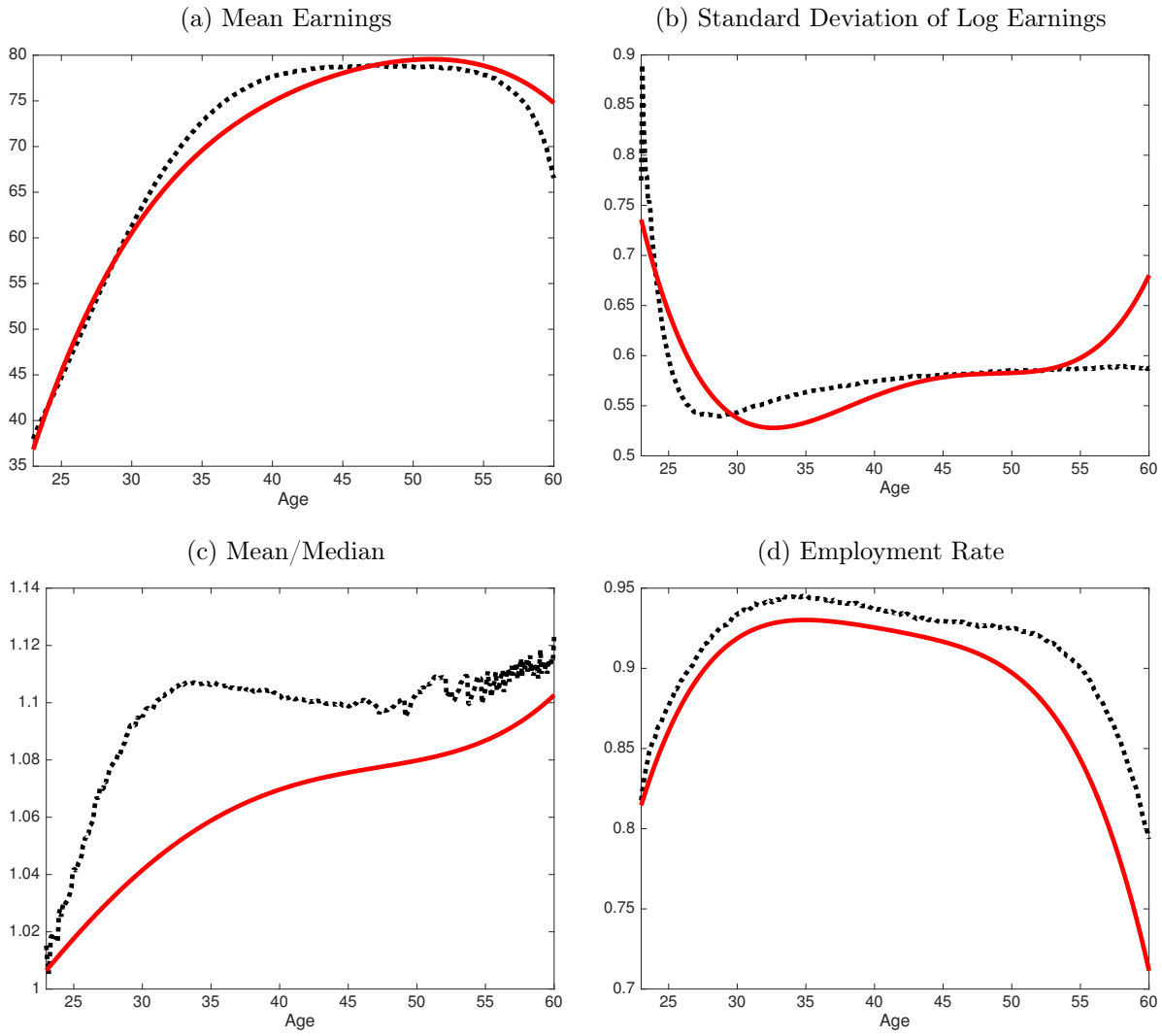

Figure 14: Model fit for whites with some college education. The solid line corresponds to the data. The discontinuous line corresponds to the model.