Accounting for Changing Returns to Experience*

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Abstract

To be written.
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1 Introduction

A growing literature documents that wage returns to experience change over the post-war period in the U.S.

Early: Katz and Murphy (1992) show that cross-sectional wage profiles get steeper between 1963-1987.

Later: change in perspective to longitudinal wage growth as a given cohort accumulates experience.

Kambourov and Manovskii (2009) find a flattening of experience profiles over birth cohorts 1950-1970.

Kong et al. (2015) document a similar flattening over cohorts 1915-1955.

Related, Card and Lemieux (2001) show that the college wage premium for young/old workers grows differently.

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Explanations

These findings have spawned a literature that seeks to explain time-varying returns to experience.

Two strands:

1. Changing price of experience: the old and young supply different labor inputs. As their relative supplies change over time, so does their relative price (Katz and Murphy, 1992; Card and Lemieux, 2001; Jeong et al., 2012)
2. Changing quantity of experience: the rate at which different cohorts accumulate human capital varies over time (Guvenen and Kuruscu, 2010; Kong et al., 2015)

Purpose of this paper Offer an alternative view: cohort effects.

Consider a simple model with only standard ingredients:

1. Constant skill biased technical change similar to Katz and Murphy (1992)
2. Fixed experience efficiency profiles
3. Cohort effects that vary with cohort schooling (similar in spirit to Hendricks and Schoellman (2014))

Show that this model goes a long way towards accounting for the observations highlighted in the literature.

Related Literature: Guvenen and Kuruscu (2010)

Jeong et al. (2012) account for changing experience wage profiles based on changing relative prices of experience and raw labor.

2 The Model

Aggregate production function: Output is produced from human capital augmented labor according to

$$Q_t = B_t \left[G_t^{\rho_{CG}} + (\mu_{CG,t} L_{CG,t})^{\rho_{CG}}\right]^{1/\rho_{CG}} \tag{1}$$

where

$$G_\tau = \left[\sum_{s=HSD}^{CD} (\mu_{s,t} L_{s,t})^{\rho_{HS}}\right]^{1/\rho_{HS}} \tag{2}$$

is a CES aggregator for unskilled labor (with less than a college degree).

Constant skill-biased technical change:

Following Katz and Murphy (1992), relative skill weights, $\mu_{s,t}/\mu_{HSG,t}$ are assumed to grow at constant rates.

2.1 Equilibrium

A competitive equilibrium consists of an allocation $\{h_{a,s,c}, l_{a,s,c}\}$ and skill prices $\{w_{s,t}\}$ that satisfy:

1. Skill prices equal marginal products (see (**??**)).
2. Given skill prices, households optimally choose on-the-job training to solve (**??**).
3. Labor markets clear:

$$H_{s,t} = \sum_{a=a_s}^{A} N_{s,c} h_{a,s,c} (\ell_{a,s,c} - l_{a,s,c}) \tag{3}$$

where it is understood that the cohort subscript refers to $c(a,t)$.

3 Data and Calibration

3.1 Data Moments

The data moments used in the calibration are constructed from the March CPS files for $1965 - 2011$ (King et al., 2010). The sample contains men born between 1935 and 1969. For each year, I calculate

1. $\hat{N}_{a,s,t}$: the mass of persons in each (age, school) cell;
2. $\hat{\ell}_{a,s,t}$: mean hours worked in each cell.
3. $\hat{w}_{a,s,t}$: median wage.

Details of the CPS data are described in Appendix A.

The age wage profiles implied by the $\hat{w}$ series form the calibration targets (details below).

Hours worked are used to set the model time endowments. This is done as follows +++

Fit a quartic to all hours data. Impose the same profile on all cohorts.

3.2 Calibration Algorithm

The following parameters are calibrated jointly:

- skill weights: $\omega_{s,t}$

The strategy: Compute the equilibrium for each set of parameters. Find the parameters that minimize the sum of squared deviations between log model wages (see (**??**)) and log median data wages.

Objective is

$$D = \sum_{a=20}^{60} \sum_{s=1}^{S} \sum_{c=1935}^{1969} \omega_{a,s,c} \left[\ln w_{a,s,c} - \ln \hat{w}_{a,s,c}\right]^2 \tag{4}$$

where it is understood that observations for which data do not exist ($t\,(a,c) < 1964$ or > 2010) are dropped.

weighted by the square root of the number of observations in each data cell (ω).

3.2.1 Skill prices

As described, the solution would be computationally costly.

Solving the household problem requires skill prices, but deriving skill prices from the model parameters requires a solution to the household problem. Thus, a fixed point problem would have to be solved for each set of parameters.

To reduce the computational cost, the algorithm searches over time paths for skill prices instead of skill weights.

Since skill prices are a smooth function of time, they can be approximated efficiently by a cubic spline with 82 nodes for each school group.

The algorithm then searches for the parameter values that minimizes $D + P$, where P penalizes skill price paths that are not consistent with constant skill-biased technical change.

Specifically, recover skill weights from aggregate labor supplies and skill prices using the aggregate production function (1). Construct the penalty function

$$P = \sum_s \sum_t resid_{s,t}^2 \tag{5}$$

where $resid_{s,t}$ is the residual of an OLS regression of $\ln p_{s,t} - \ln p_{HSG,t}$ on a constant time trend.

3.3 Estimation Results

Keep in mind that linear trends in age-efficiency profiles, cohort effects, skill weights, and skill prices are not identified.

Figure Figure 1a shows implied age-efficiency profiles. They have the usual hump-shaped form.

Figure 1b shows cohort effects relative to high school graduates. Large decline in relative cohort effects for college graduates during the expansion of educational attainment, roughly until the birth year 1950. Then flattening. Consistent with a narrative where expanding college education reduces the quality of college students.

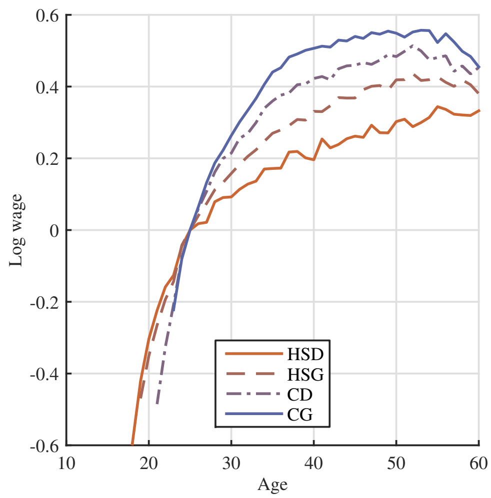
Figure 1c shows skill weights relative to HSG. Consistent with a constant time trend, except for HSD, where the trend growth rate increases after 1990.

3.4 Model Fit

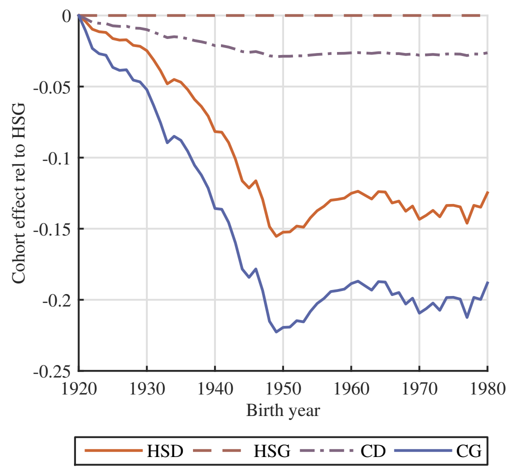
Show that model does a good job replicating age wage profiles for all cohorts and school groups.

Figure 1: Estimation Results

(a) Age-efficiency profiles



(b) Cohort effects



(c) Skill weights relative to HSG

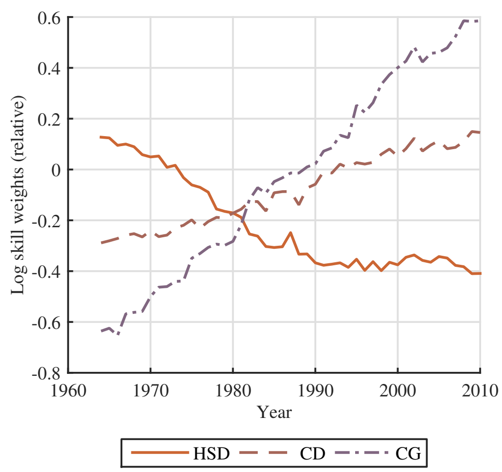


Table 1: Model Fit

	Mean	Std	Min	Max	N
HSD	0.68	0.20	0.03	0.95	61
HSG	0.75	0.31	-1.00	0.97	61
CD	0.71	0.33	-0.43	0.98	61
CG	0.78	0.27	-0.43	0.98	59

Notes: Each row shows quantiles of the distribution of R^2 across cohorts for one school group. N is the number of cohorts with sufficient data to calculate R^2.

Measure fit by $R^2 = 1 - RSS/TSS$ where RSS is the weighted sum of squared model residuals (model log median wage - data log median wage) and TSS is the weighted total sum of squared residuals in the data. Weights are square root of number of observations in each (age, school, cohort) cell.

Table 1 summarizes. Median R^2 ranges from +++ to +++. Visual comparison of model and data age-wage profiles in Appendix Appendix B.

Properties: fit is better for later cohorts. There are some low R^2 values, but even in these cases the model replicates the low frequency variation of log wages as cohorts age.

4 Results

This section examines to what extent the model accounts for time-series variation in returns to experience and related stats discussed in the Introduction.

4.1 Returns to Experience

To see changes in shapes more clearly, Figure 2 and Figure 3

show intercepts and slopes of cohort specific profiles. For all school groups, slopes have a U shape with min near 1950 birth cohort. Intercepts decline over most of the period.

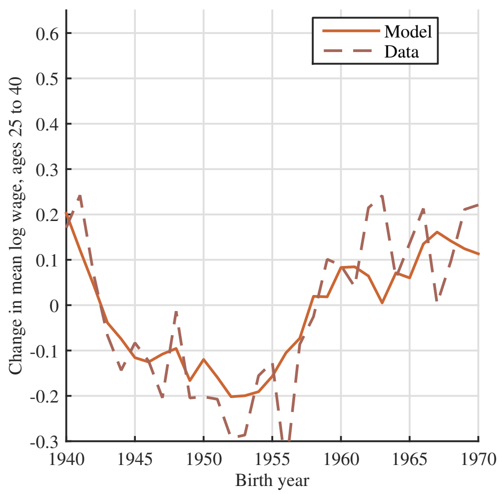
Intercepts and slopes are inversely related. During the expansion of U.S. education up to the cohorts born in the early 1950s, all wage profiles became flatter over time, while their intercepts increased. After the early 1950s birth cohorts, U.S. education growth essentially stopped. During this period, wage profiles became steeper with lower intercepts.

Figure Figure 4 shows cross-sectional returns to experience.

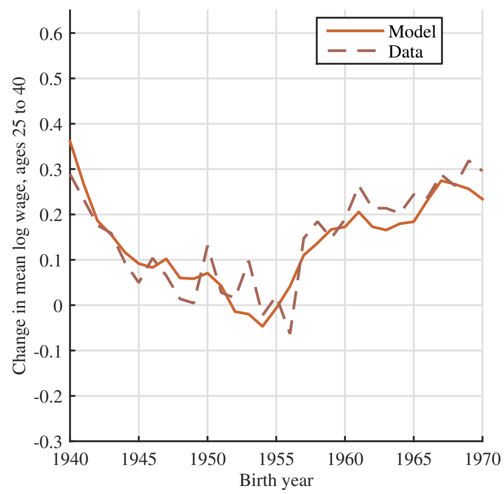
Broad features of the data are replicated, though not high frequency movements.

Figure 2: Cohort Returns to Experience

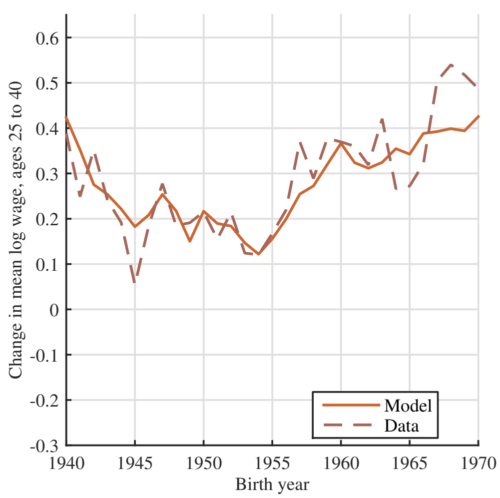
(a) HSD



(b) HSG



(c) CD



(d) CG

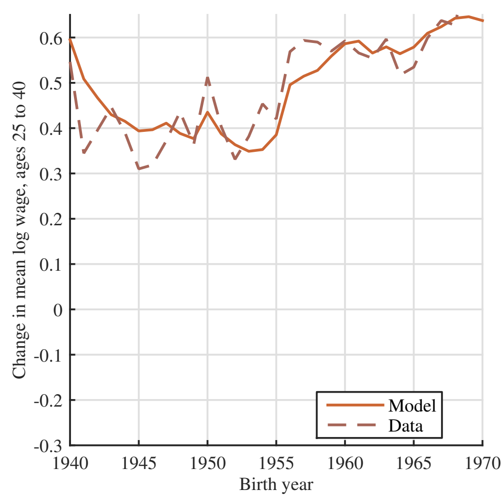


Figure 3: Cohort Returns to Experience

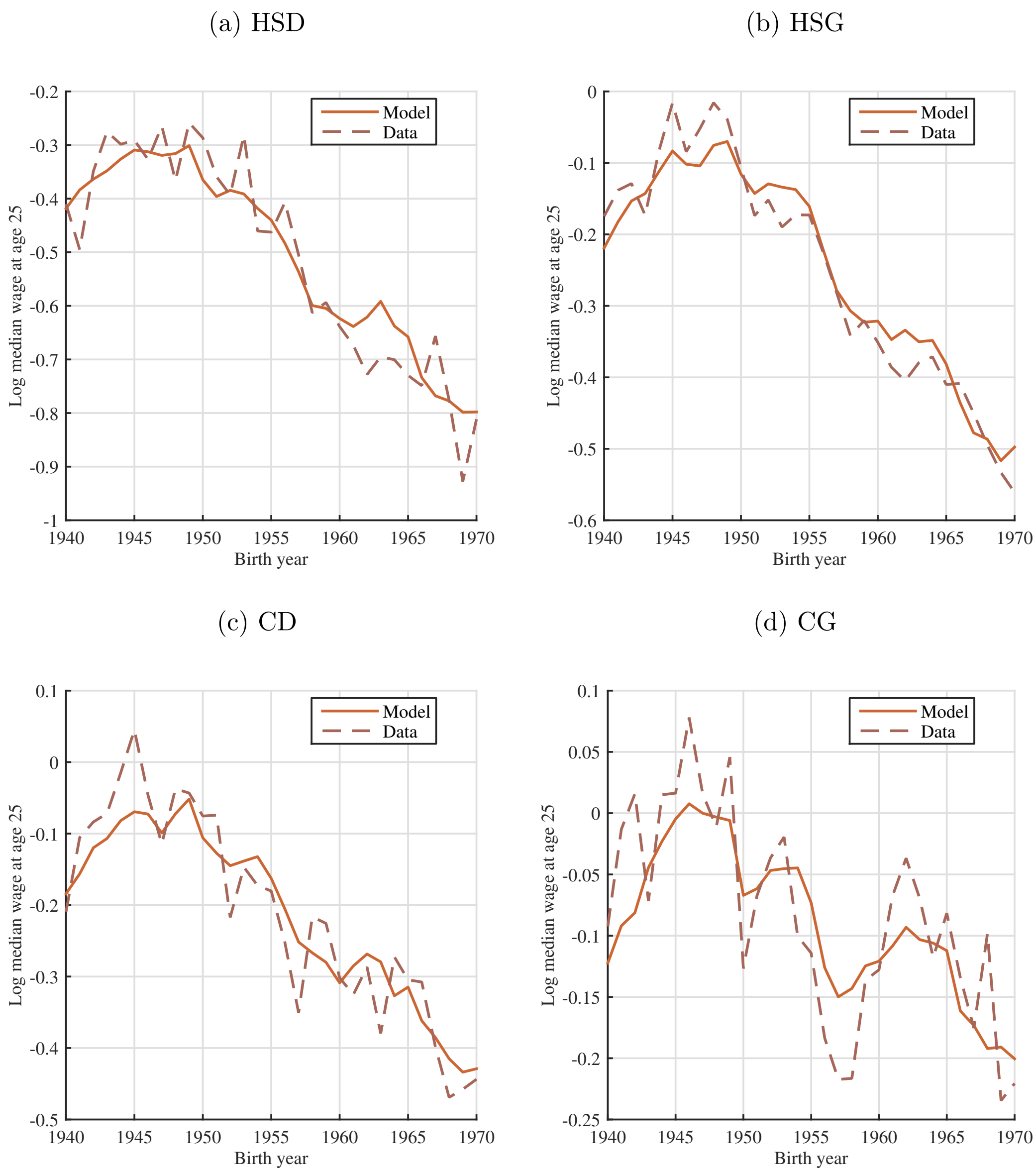
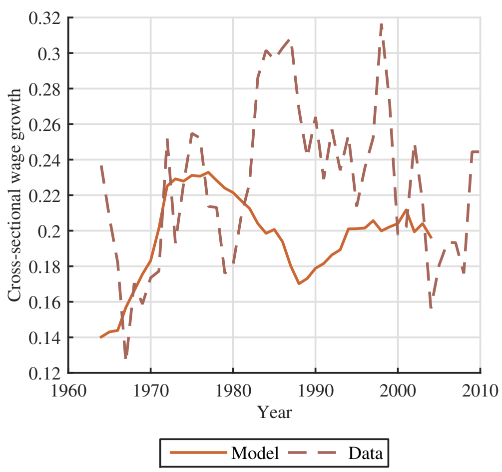
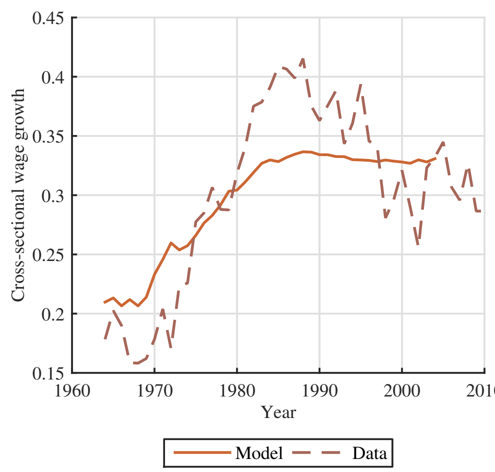


Figure 4: Cross-sectional Returns to Experience

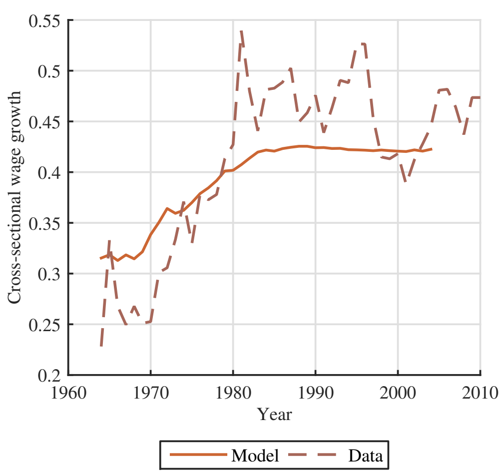
(a) HSD



(b) HSG



(c) CD



(d) CG

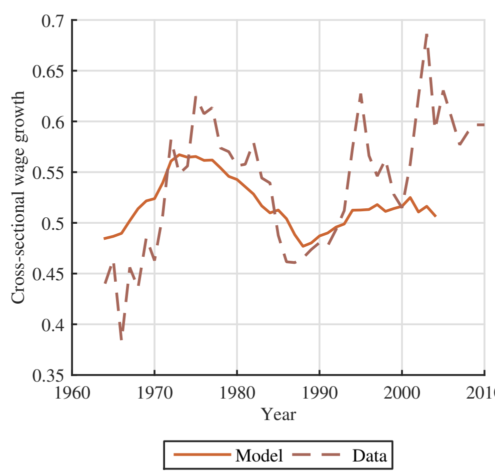
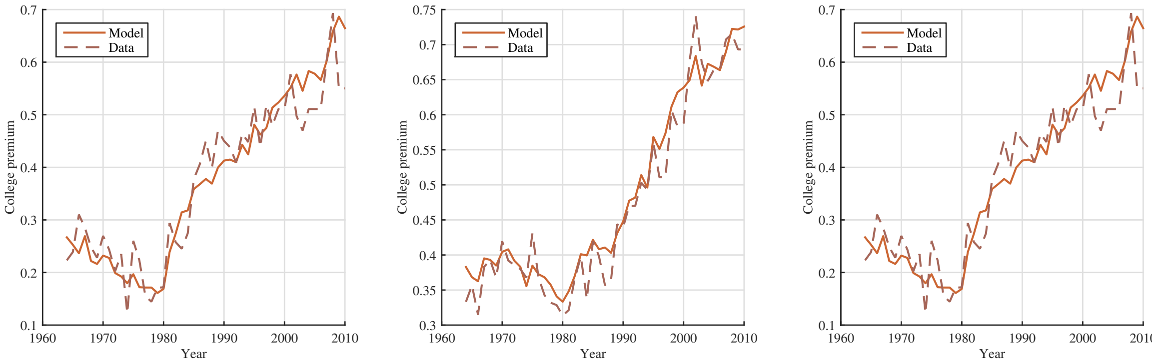


Figure 5: College Wage Premium

(a) Young workers (b) Middle-aged workers (c) Older workers



4.2 The College Wage Premium

Model not only replicates aggregate college premium, but also evolution by age.

Card and Lemieux (2001) document differential evolution for young workers (ages $26-35$) versus older workers (ages $45-60$).

without imperfect substitution or changing relative prices of different labor types supplied by each worker in different proportions.

5 Conclusion

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Table 2: Summary statistics for CPS data

Year	N	Avg N per cell	N range
1965	20106	162	24 - 372
1970	18600	150	34 - 279
1975	16702	135	40 - 264
1980	22892	185	55 - 378
1985	20703	167	48 - 371
1990	21896	177	47 - 466
1995	19770	159	42 - 318
2000	34568	279	51 - 528
2005	32528	262	39 - 439
2010	30235	244	38 - 473

Notes: N is the number of observations. Avg N per cell refers to the average number of observations in each (age, school) cell. N range shows the minimum and maximum number of observations in each cell. Cells cover age range 30-60.

A Appendix: CPS Data

Refer to general appendix for construction of individual variables.

A.1 Sample

CPS data are obtained from King et al. (2010). Summary information is provided in Table Table 2. The sample contains men between the ages of 18 and 65 observed in the $1965 - 2011$ waves of the March Current Population Survey. Persons are dropped if at least one of the following conditions are true:

1. weeks worked per year $< +++$
2. hours worked per week $< +++$
3. employment is either unpaid or in the armed forces
4. no valid wage information is provided (see below for details).

A.2 Individual Variables

The construction of individual variables is based on Bowlus and Robinson (2012).

Schooling: As discussed in Jaeger (1997), the coding of schooling changes in 1991. I use the coding scheme proposed in his tables 2 and 7 to recode HIGRADE and EDUC99 into the highest degree completed and the highest grade completed.

Hours worked per year are defined as the product of hours worked last week and weeks worked last year. Weeks worked per year are intervalled until 1975. Each interval is assigned the average of weeks worked in years after 1975 in the same interval. Until 1975, hours worked per week are only available for the previous week (HRSWORK). I regress hours worked on years of schooling and a quadratic in experience to impute hours worked. After 1975, I use usual hours worked per week (UHRSWRK).

Income variables: Labor earnings are defined as the sum of wage and salary incomes (INCWAGE). Wages are defined as labor earnings divided by hours worked. Wages are set to missing if weeks worked are below +++ or hours worked per week are below +++. Outliers with less than +++% or more than +++ times the median wage are dropped.

Income variables are top-coded. As discussed in Bowlus and Robinson (2012), the frequency of top-coding and the top-coded amounts vary substantially over time. In addition, top-coding flags contain obvious errors. In most years, fewer than 2% of labor earnings observations appear to be top-coded. Following Bowlus and Robinson (2012), I use median rather than mean log wages to avoid this problem. Dollar values are deflated using the Consumer Price Index (all items, U.S. city average, series Id: CUUR0000SA0; see bls.gov).

A.3 Aggregate Variables

Schooling: The fraction of persons in cohort τ that achieves school level s is calculated by averaging over ages 30 through 50 (not all ages are observed for all cohorts). Figure Figure 6 shows these fractions. Each point represents one cohort. Educational attainment grows until the 1950 cohort and then levels off (see Goldin and Katz 2008 for an extensive discussion of these trends).

Out of sample: assumed constant (for now +++).

Age wage profiles: Construct median earnings per week for each (s, a, c) cell. This drops outliers, but retains workers who report zero hours and thus zero earnings. This is the target.

Shows a very large decline after age 60. Hard to interpret because hours worked decline as well (retirement). For this reason, exclude observations past age 60 from the targets.

Figure +++

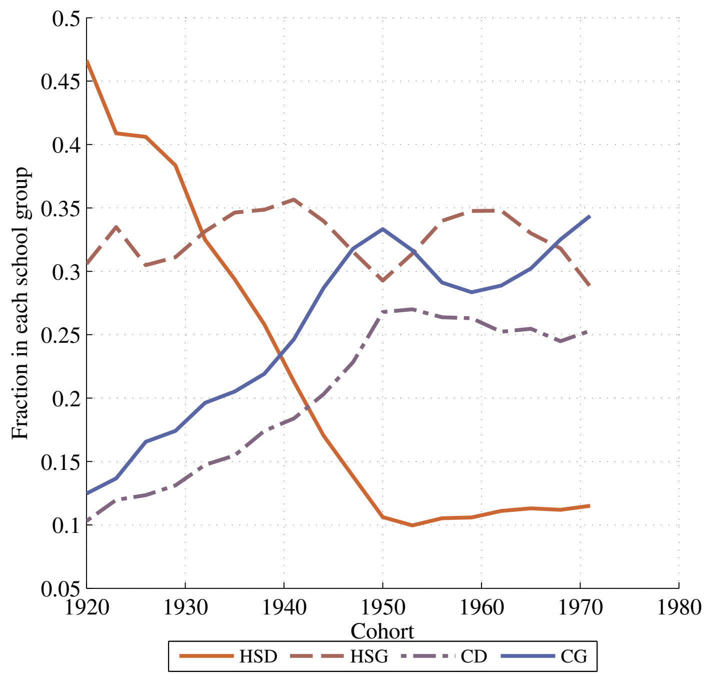

Figure 6: Educational Attainment By Birth Cohort

B Model Fit

Figures Figure 7 through Figure 10 compares observed and model predicted age-wage profiles for selected cohorts.

Figure 7: Model Fit: HSD

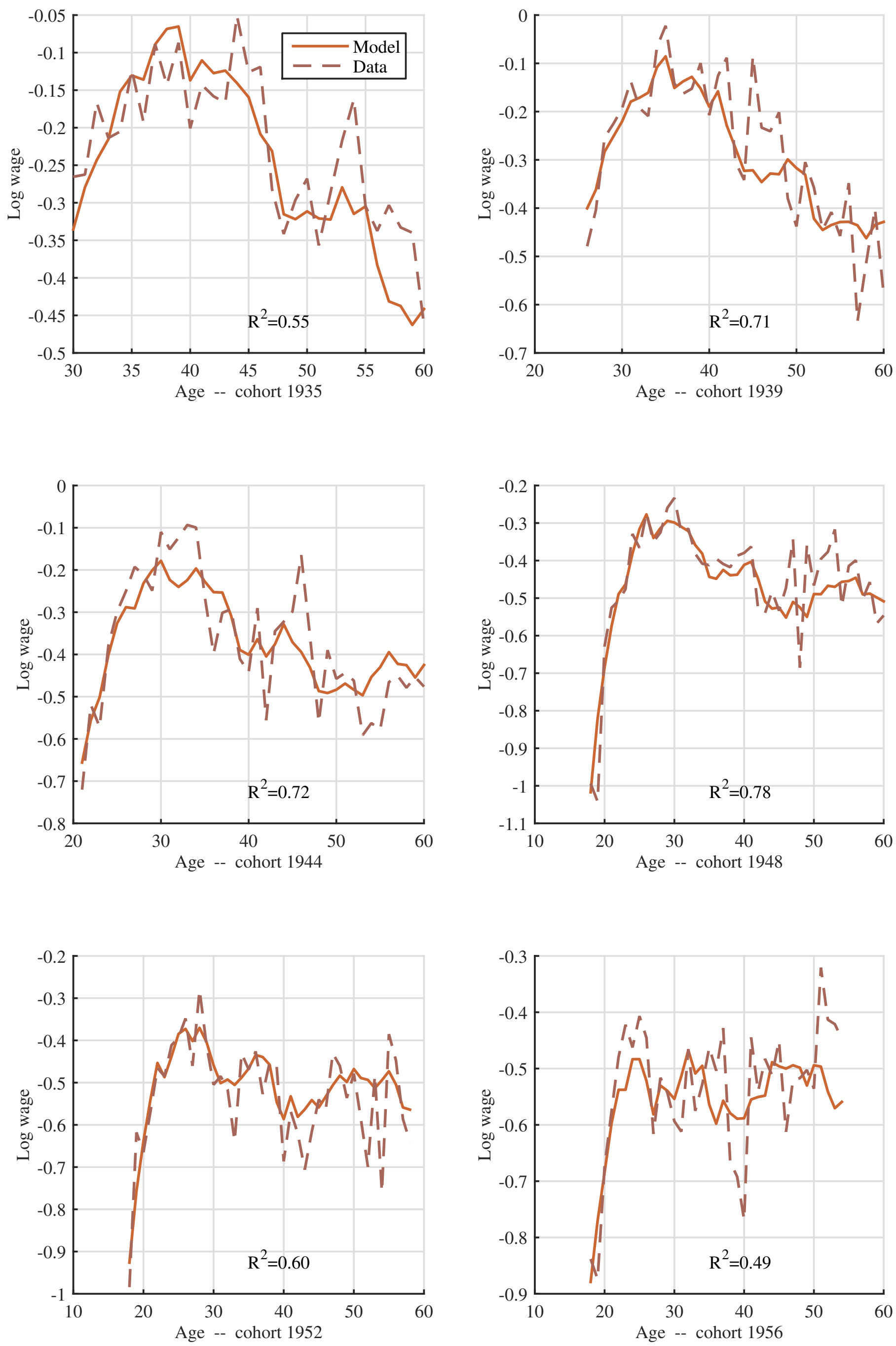

Figure 8: Model Fit: HSG

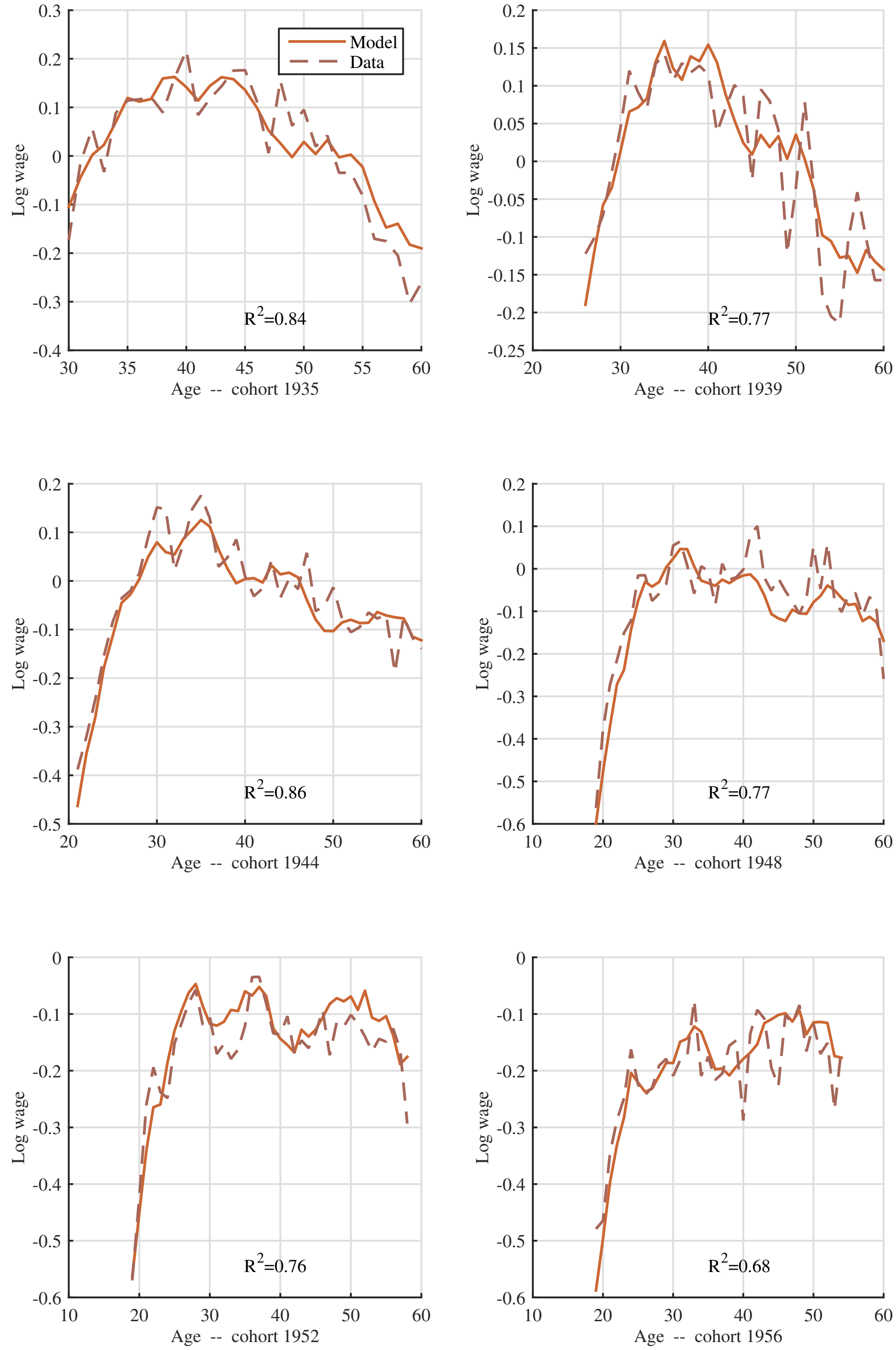

Figure 9: Model Fit: CD

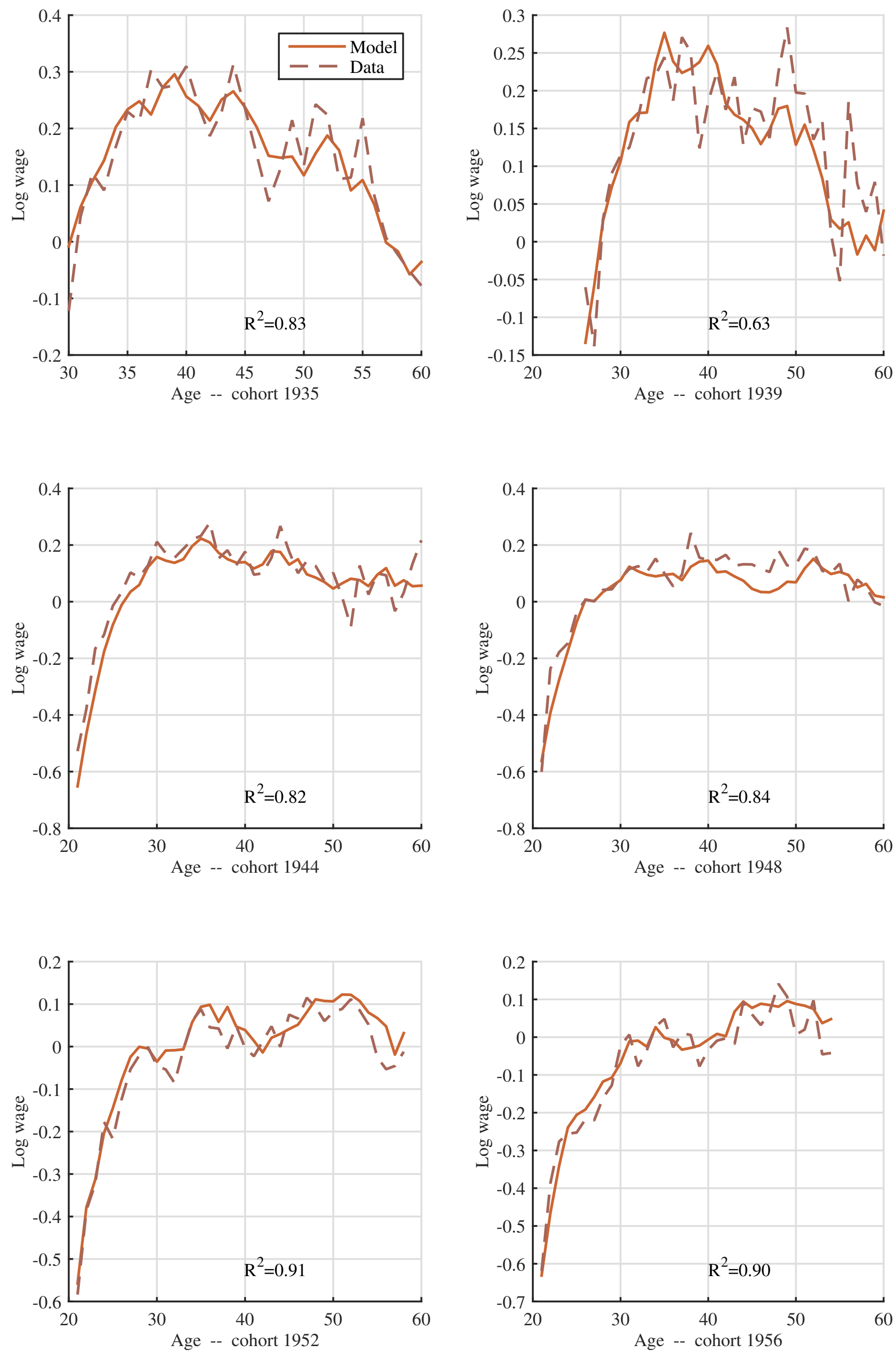

Figure 10: Model Fit: CG