CHAPTER 12

Skills, Tasks and Technologies: Implications for Employment and Earnings☆

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1. INTRODUCTION

2. AN OVERVIEW OF LABOR MARKET TRENDS

2.1. A brief overview of data sources

To summarize the basic changes in the US wage structure over the last five decades, we draw on four large and representative household data sources: the March Current Population Survey (March CPS), the combined Current Population Survey May and Outgoing Rotation Group samples (May/ORG CPS), the Census of Populations (Census), and the American Community Survey (ACS).[7] We describe these sources briefly here and provide additional details on the construction of samples in the Data Appendix. The March Annual Demographic Files of the Current Population Survey offer the longest high-frequency data series enumerating labor force participation and earnings in the US economy. These data provide reasonably comparable measures of the prior year's annual earnings, weeks worked, and hours worked per week for more than four decades. We use the March files from 1964 to 2009 (covering earnings from 1963 to 2008) to form a sample of real weekly earnings for workers aged 16 to 64 who participate in the labor force on a full-time, full-year (FTFY) basis, defined as working 35-plus hours per week and 40-plus weeks per year.

2.2. The college/high school wage premium

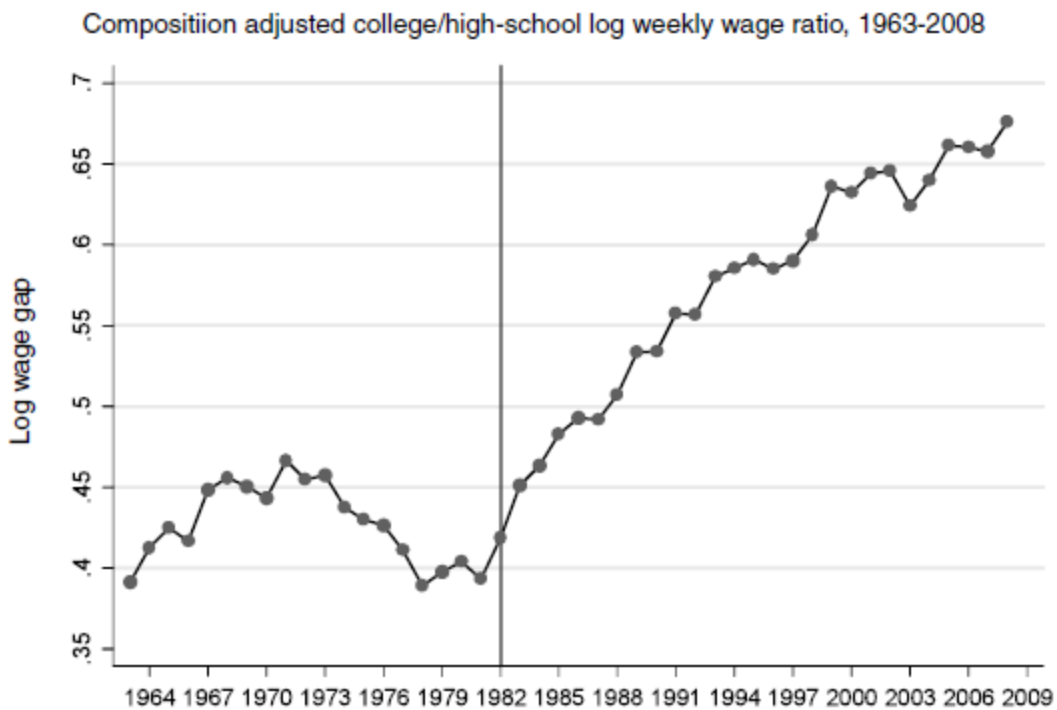

Figure 1 *Source: March CPS data for earnings years 1963-2008. Log weekly wages for full-time, full-year workers are regressed separately by sex in each year on four education dummies (high school dropout, some college, college graduate, greater than college), a quartic in experience, interactions of the education dummies and experience quartic, two race categories (black, non-white other), and a full set of interactions between education, experience, and sex. The composition-adjusted mean log wage is the predicted log wage evaluated for whites at the relevant experience level (5, 15, 25, 35, 45 years) and relevant education level (high school dropout, high school graduate, some college, college graduate, greater than college). The mean log wage for college and high school is the weighted average of the relevant composition adjusted cells using a fixed set of weights equal to the average employment share of each sex by potential experience group. The ratio of mean log wages for college and high school graduates for each year is plotted. See the Data Appendix for more details on the treatment of March CPS data.*

Figure 1 plots the *composition-adjusted* log college/high school weekly wage premium in the US labor market for years 1963 through 2008 for **full-time, full-year workers**. This composition adjustment holds constant the relative employment shares of demographic group, as defined by gender, education, and potential experience, across all years of the sample. In particular, we first compute mean (predicted) log real weekly wages in each year for 40 sex-education-experience groups. Mean wages for broader groups shown in the figures are then calculated as fixed-weighted averages of the relevant sub-group means (using the average share of total hours worked for each group over 1963 to 2008 as weights). This adjustment ensures that the estimated college premium is not mechanically affected by shifts in the experience, gender composition, or average level of completed schooling within the broader categories of college and high school graduates.[11]

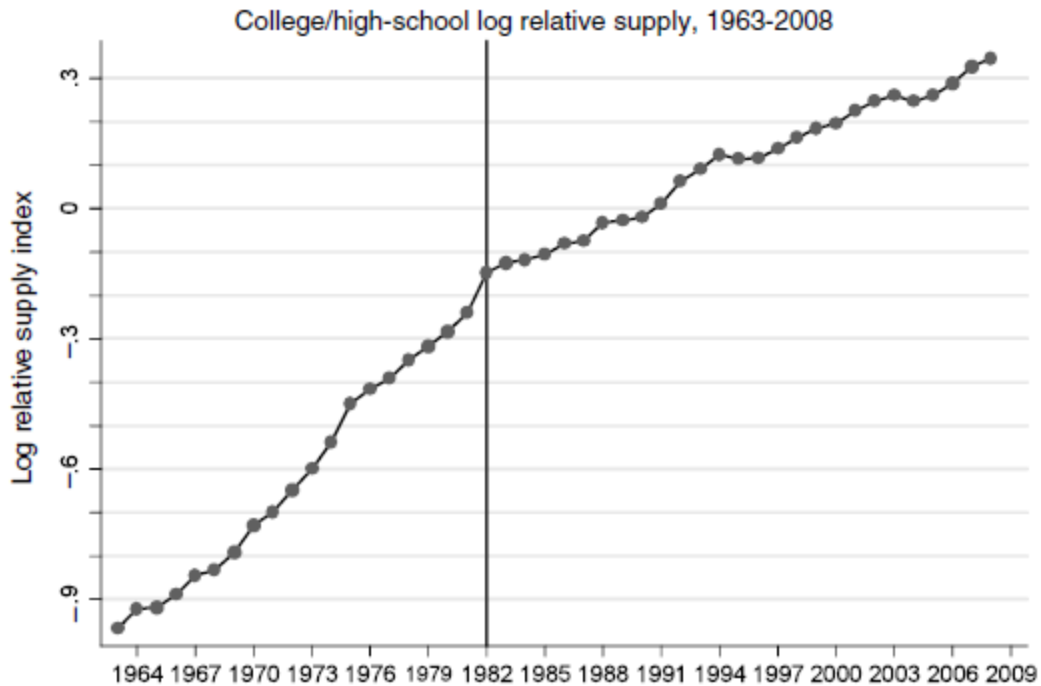

Figure 2 *Source: March CPS data for earnings years 1963-2008. Labor supply is calculated using all persons aged 16-64 who reported having worked at least one week in the earnings years, excluding those in the military. The data are sorted into sex-education-experience groups of two sexes (male/female), five education groups (high school dropout, high school graduate, some college, college graduate, and greater than college) and 49 experience groups (0-48 years of potential experience). The number of years of potential experience is calculated by subtracting the number six (the age at which one begins school) and the number of years of schooling from the age of the individual. This number is further adjusted using the assumption that an individual cannot begin work before age 16 and that experience is always non-negative. The labor supply for college/high school groups by experience level is calculated using efficiency units, equal to mean labor supply for broad college (including college graduates and greater than college) and high school (including high school dropouts and high school graduate) categories, weighted by fixed relative average wage weights for each cell. The labor supply of the "some college" category is allocated equally between the broad college and high school categories. The fixed set of wage weights for 1963-2008 are constructed using the average wage in each of the 490 cells (2 sexes, 5 education groups, 49 experience groups) over this time period.*

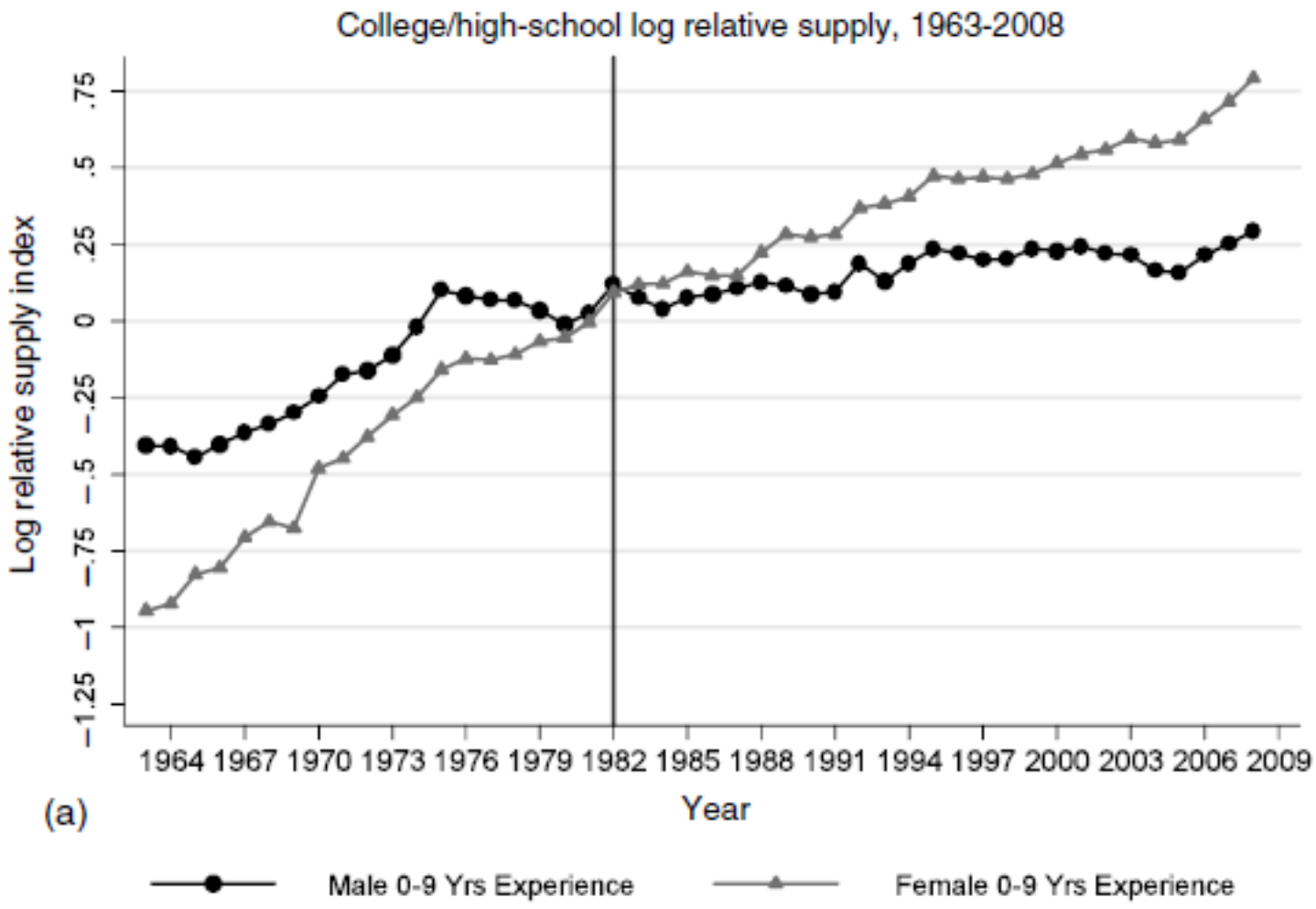
College/high-school log relative supply, 1963-2008
Log relative supply index
−1.25
−1
−.75
−.5
−.25
0
.25
.5
.75
1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009
(a)
Year
Male 0-9 Yrs Experience
Female 0-9 Yrs Experience

Figure 3

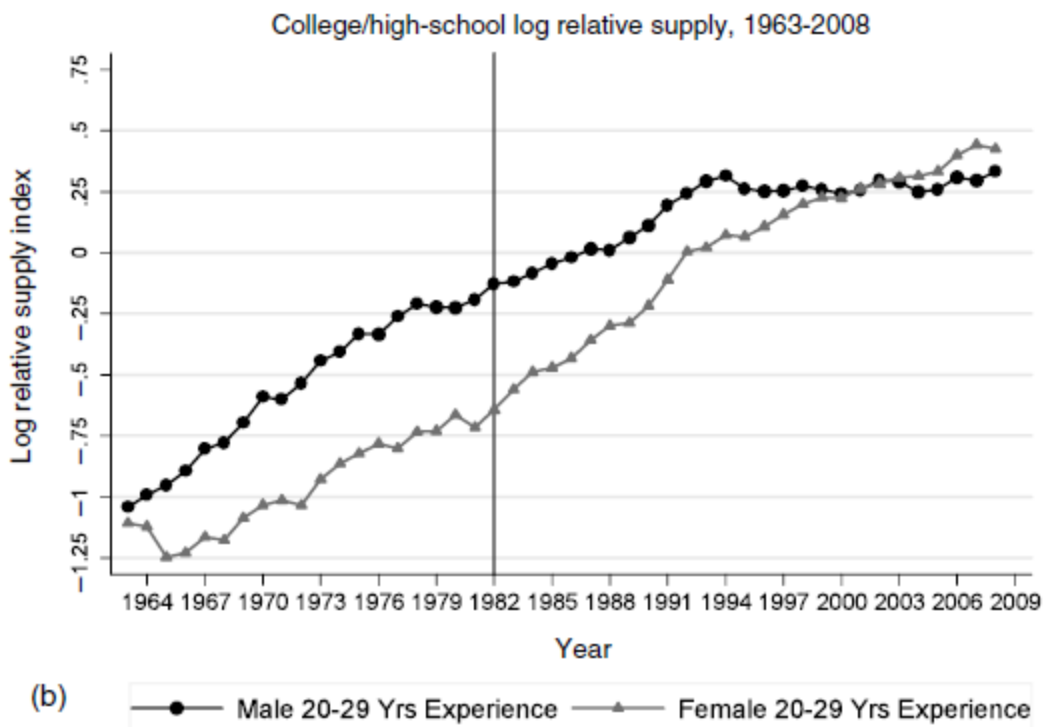

Figure 3 *Source: March CPS data for earnings years 1963-2008. See note to Fig. 2. Log relative supply for 0-9 and 20-29 years of potential experience is plotted for males and females.*

2.3. Real wage levels by skill group

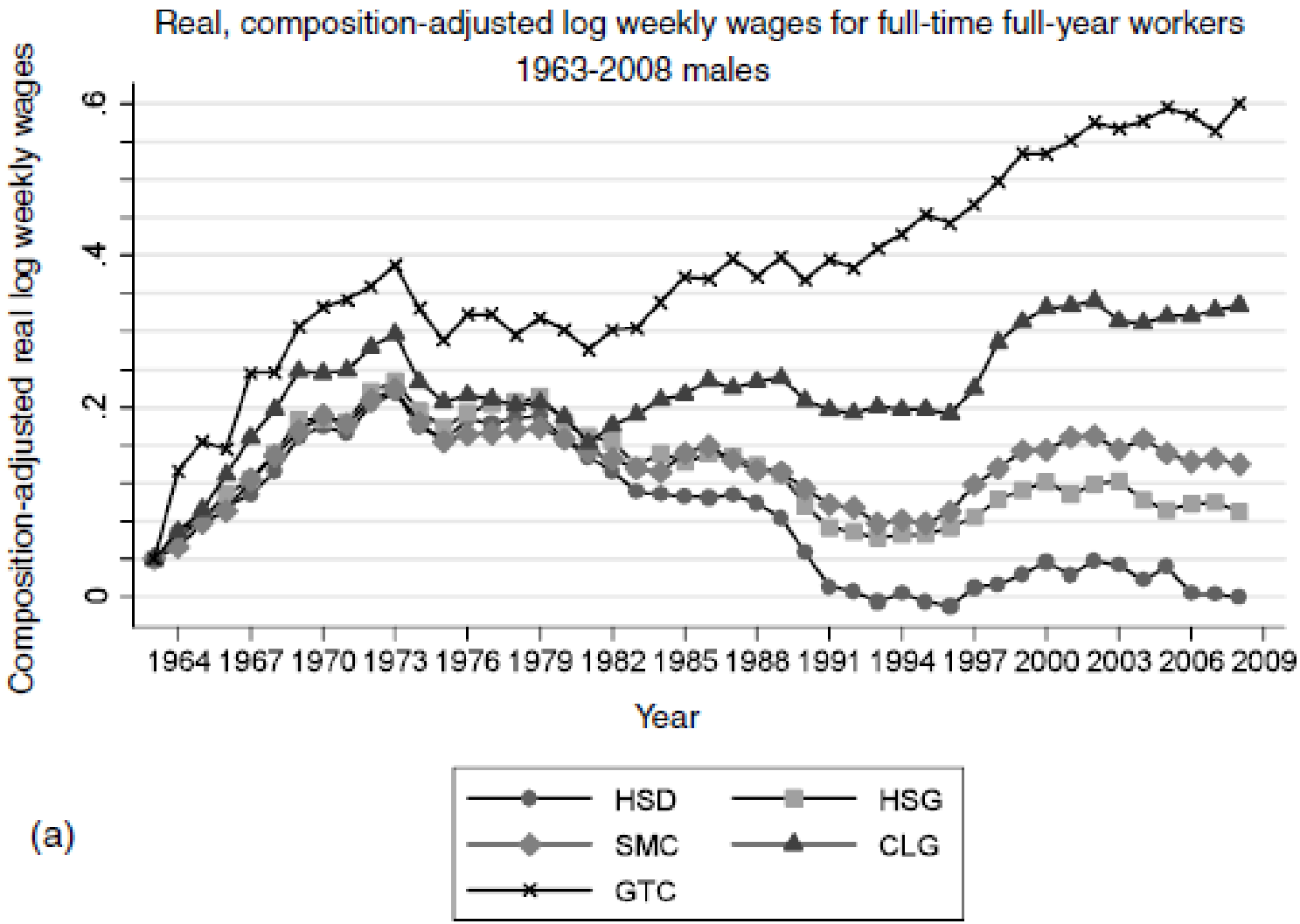
Real, composition-adjusted log weekly wages for full-time full-year workers
1963-2008 males
Composition-adjusted real log weekly wages
0
.2
.4
.6
1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009
Year
HSD
HSG
SMC
CLG
GTC
(a)

Figure 4

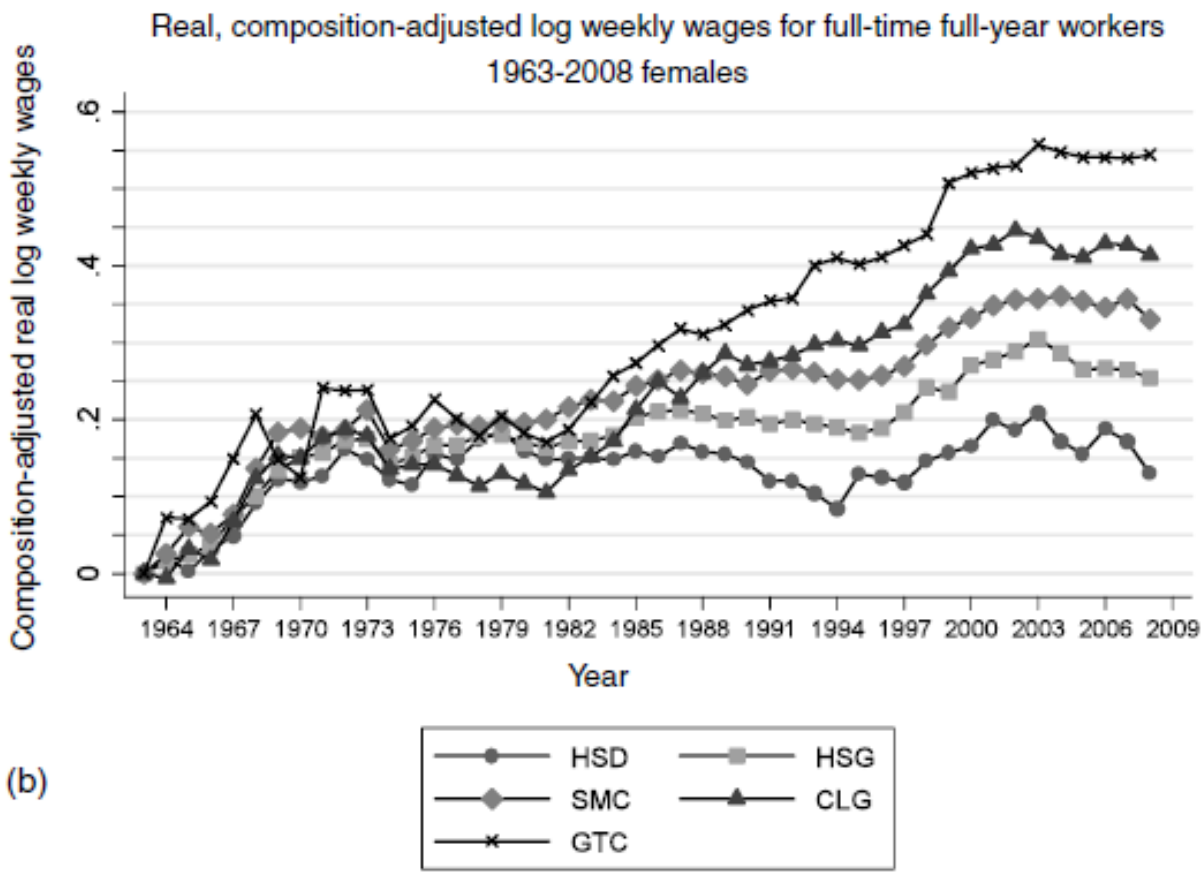

Figure 4 *Source: March CPS data for earnings years 1963-2008. See note to Fig. 1. The real log weekly wage for each education group is the weighted average of the relevant composition adjusted cells using a fixed set of weights equal to the average employment share of each group. Nominal wage values are deflated using the Personal Consumption Expenditure (PCE) deflator.*

Table 1a Changes in real, composition-adjusted log weekly wages for full-time, full-year workers, 1963-2008: by educational category and sex (100 × change in mean log real weekly wages).

	1963-1972	1972-1979	1979-1989	1989-1999	1999-2008	1963-2008
All	21.1	−1.7	−1.7	2.7	−0.3	20.1
Males	23.4	−2.8	−6.6	0.5	−1.2	13.3
Females	18.1	−0.2	4.9	5.8	1.0	29.6
Education (years)						
0-11						
Men	20.4	−1.5	−13.4	−7.4	−3.1	−5.1
Women	16.2	2.1	−2.7	0.2	−2.8	13.0
12						
Men	22.2	−0.7	−10.3	−2.1	−2.9	6.2
Women	17.3	0.7	1.9	3.7	1.8	25.4
13-15						
Men	20.9	−3.7	−5.8	2.8	−1.8	12.4
Women	18.7	1.0	5.8	6.4	1.0	33.0
16+						
Men	30.6	−6.3	4.9	9.5	3.6	42.2
Women	20.1	−5.0	14.6	12.8	2.5	44.9
16-17						
Men	28.0	−7.4	3.3	7.4	2.2	33.4
Women	18.7	−5.7	15.6	10.7	2.1	41.4
18+						
Men	36.0	−4.2	8.0	13.7	6.6	60.1
Women	23.7	−3.3	11.9	18.4	3.7	54.4

Source: March CPS data for earnings years 1963-2008. See note to Fig. 1.

Table 1b Changes in real, composition-adjusted log weekly wages for full-time, full-year workers, 1963-2008: by experience, educational category, and sex (100 × change in mean log real weekly wages).

	1963-1972	1972-1979	1979-1989	1989-1999	1999-2008	1963-2008
Experience						
5 years						
Men	20.8	−5.1	−10.0	4.7	−2.6	7.8
Women	18.9	−2.3	−0.6	5.6	−0.9	20.6
25-35 years						
Men	25.0	−0.9	−3.4	−2.1	−2.4	16.3
Women	17.2	2.1	8.5	5.4	1.7	34.8
Education and experience						
Education 12						
Experience 5						
Men	23.2	−3.1	−19.1	2.2	−4.4	−1.1
Women	17.3	−1.8	−6.3	3.2	0.5	12.8
Experience 25-35						
Men	20.5	1.6	−4.3	−4.2	−3.5	10.1
Women	16.9	2.7	6.4	5.2	1.8	33.0
Education 16+						
Experience 5						
Men	23.1	−11.6	8.6	10.4	0.6	31.2
Women	20.5	−5.6	14.7	9.3	−0.8	38.0
Experience 25-35						
Men	35.5	−0.1	4.4	6.8	2.9	49.6
Women	18.6	−2.3	12.7	14.5	4.2	47.6

Source: March CPS data for earnings years 1963-2008. See note to Fig. 1.

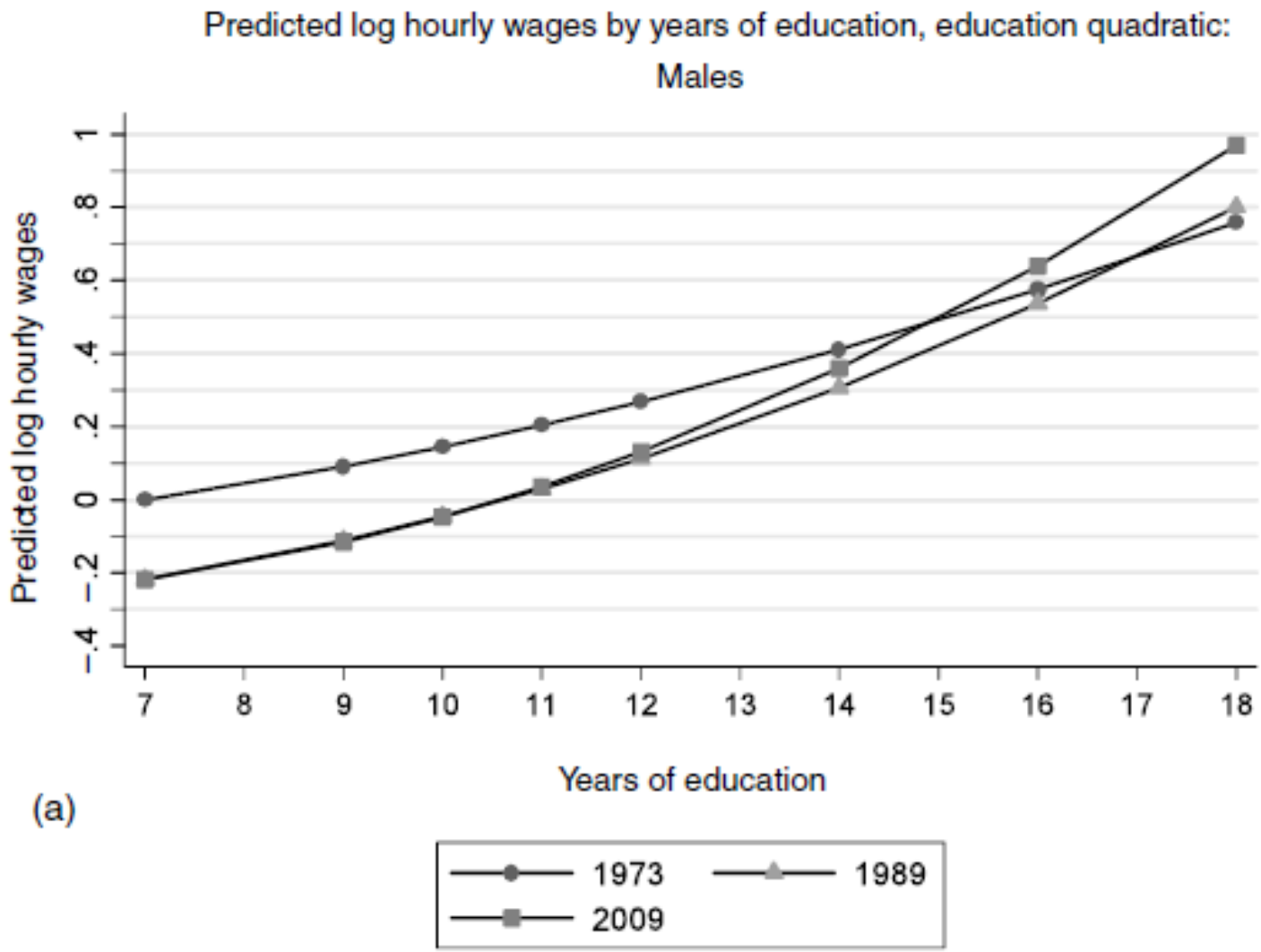
Predicted log hourly wages by years of education, education quadratic:
Males
Predicted log hourly wages
−.4
−.2
0
.2
.4
.6
.8
1
7
8
9
10
11
12
13
14
15
16
17
18
Years of education
(a)
1973
1989
2009

Figure 5

Convexification

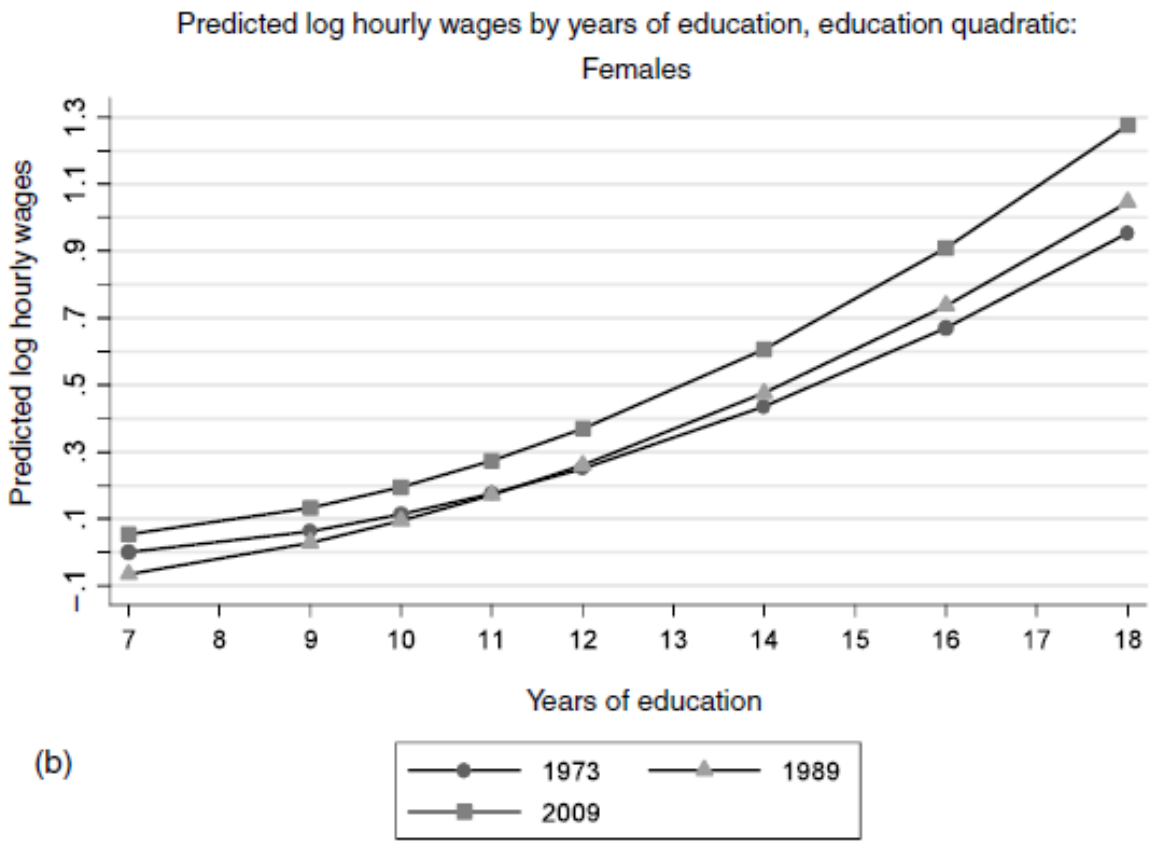

Figure 5 *Source: May/ORG CPS data for earnings years 1973-2009. For each year, log hourly wages for all workers, excluding the self-employed and those employed by the military, are regressed on a quadratic in education (eight categories), a quartic in experience, a female dummy, and interactions of the female dummy and the quartic in experience. Predicted real log hourly wages are computed in 1973, 1989 and 2009 for each of the years of schooling presented in the figure. See the Data Appendix for more details on the treatment of May/ORG CPS data.*

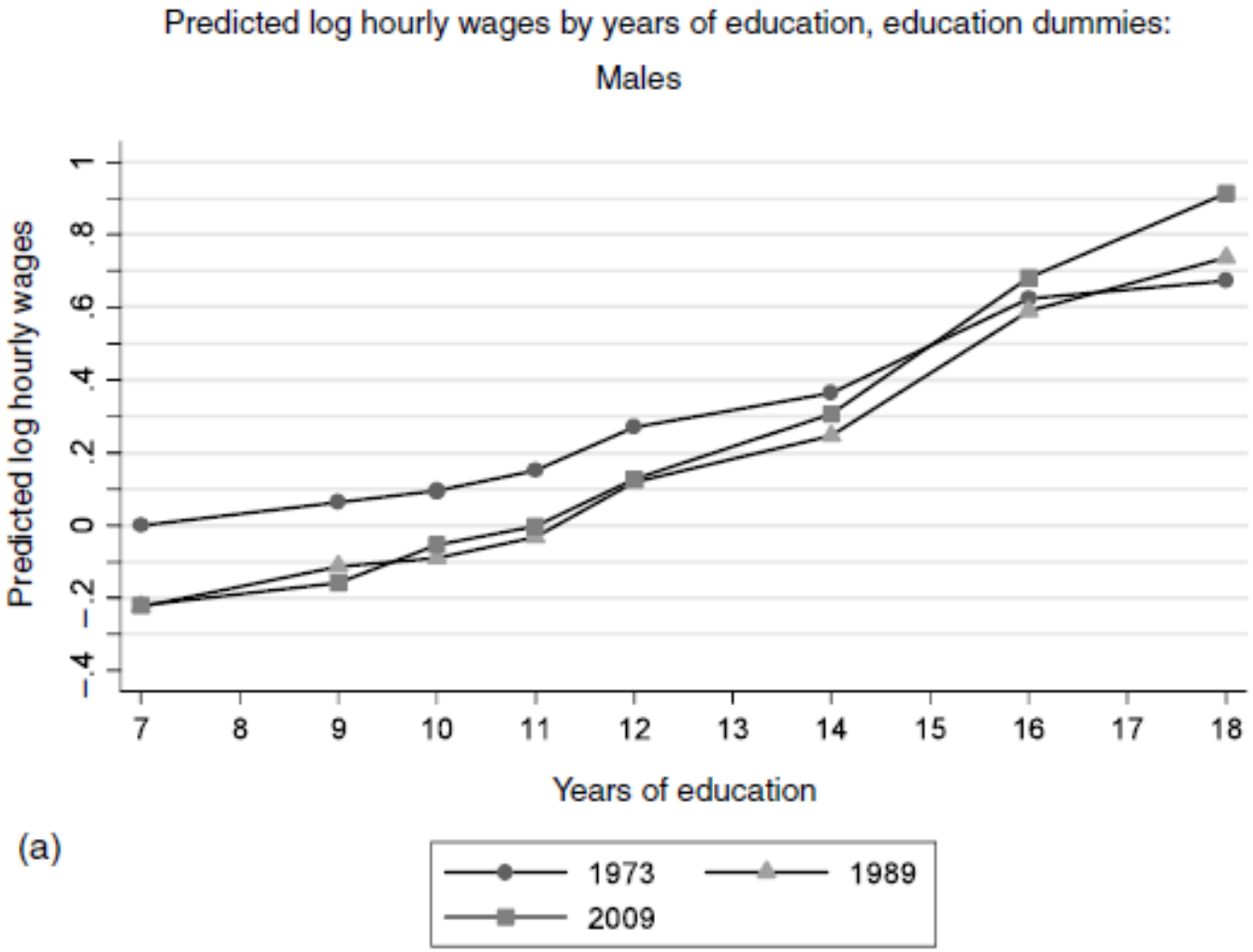
Predicted log hourly wages by years of education, education dummies:
Males
Predicted log hourly wages
−.4
−.2
0
.2
.4
.6
.8
1
7
8
9
10
11
12
13
14
15
16
17
18
Years of education
(a)
1973
1989
2009

Figure 6

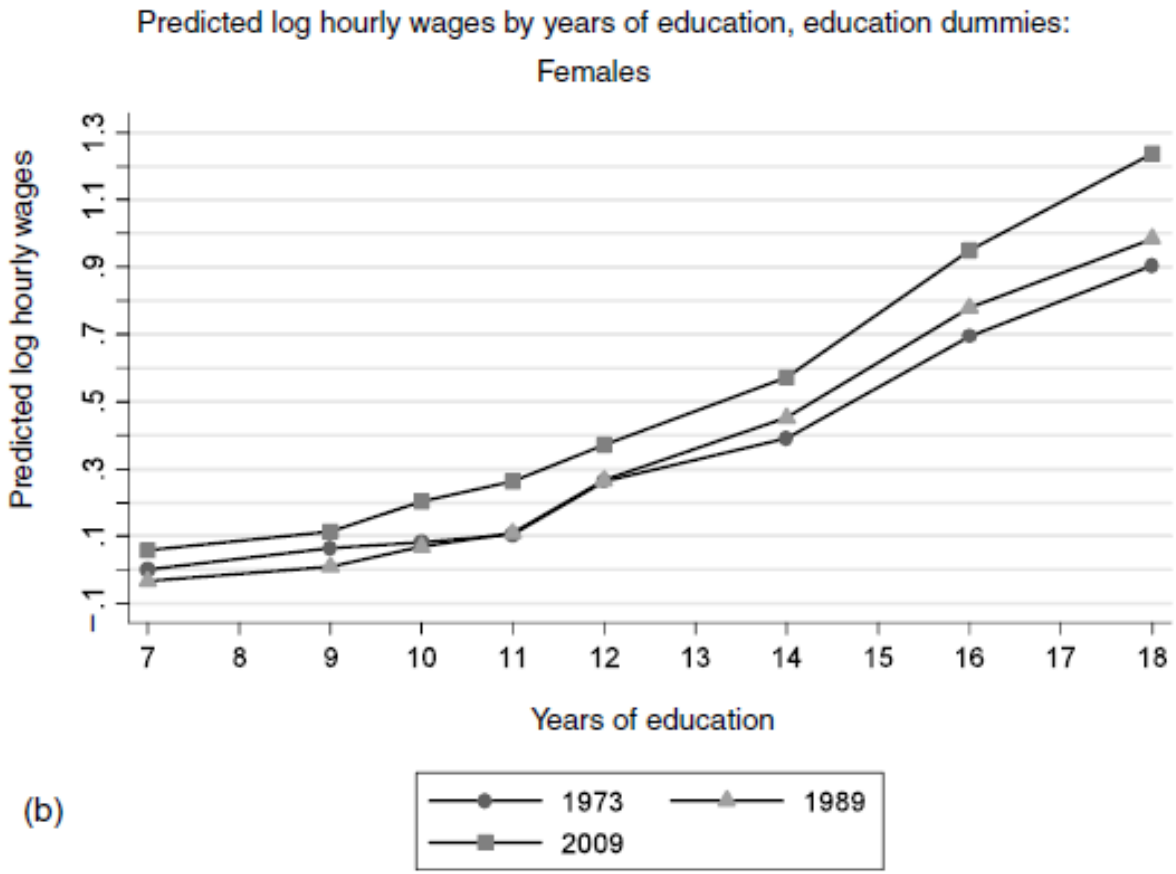

Figure 6 *Source: May/ORG CPS data for earnings years 1973-2009. For each year, log hourly wages for all workers, excluding the self-employed and those employed by the military, are regressed on eight education dummies, a quartic in experience, a female dummy, and interactions of the female dummy and the quartic in experience. Predicted real log hourly wages are computed in 1973, 1989 and 2009 for each of the years of schooling presented. See the Data Appendix for more details on the treatment of May/ORG CPS data.*

2.4. Overall wage inequality

Figure 7 plots the evolution of real log weekly wages of full-time, full-year workers at the 10th, 50th and 90th percentiles of the earnings distribution from 1963 through 2008.

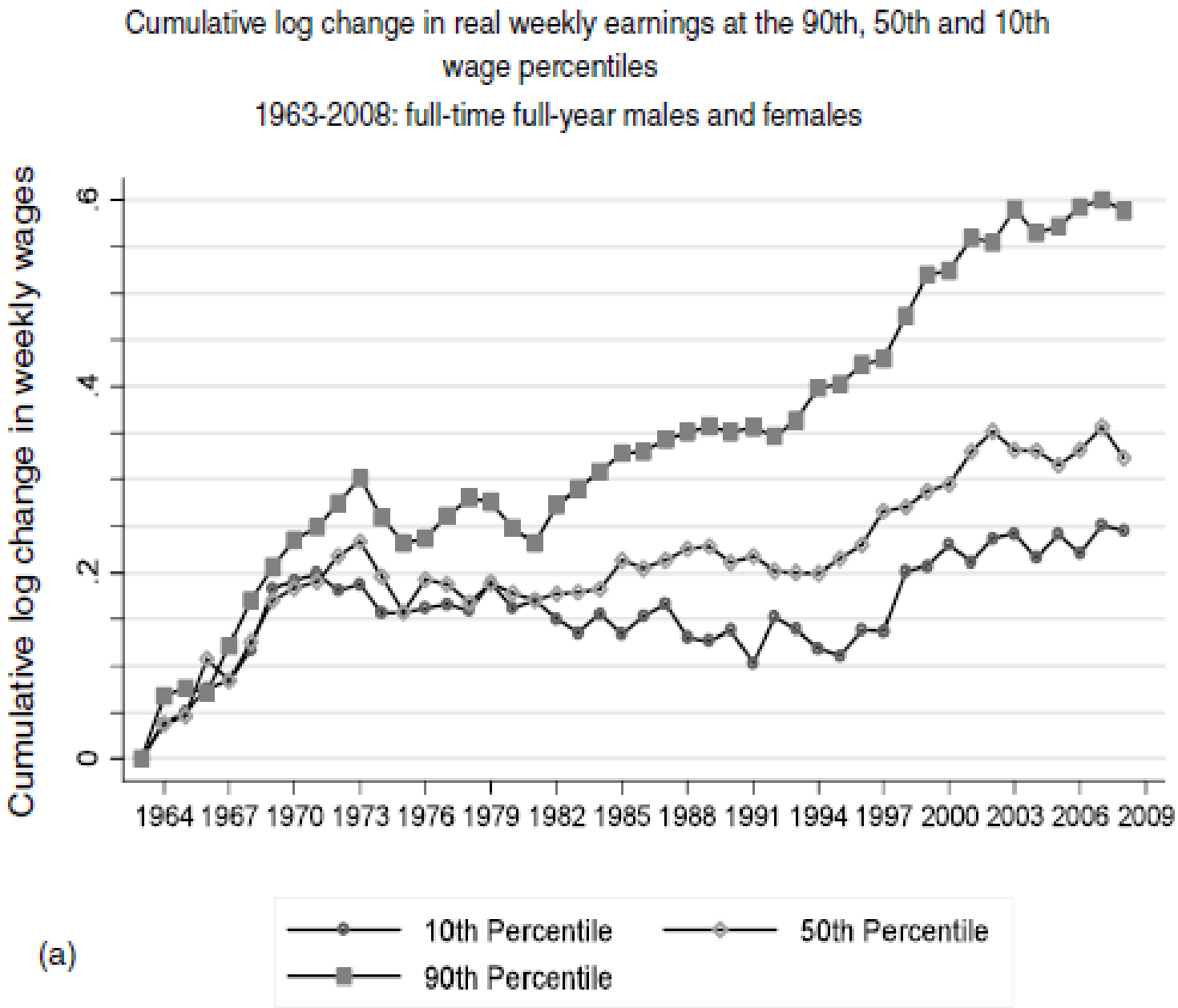
Cumulative log change in real weekly earnings at the 90th, 50th and 10th wage percentiles
1963-2008: full-time full-year males and females
Cumulative log change in weekly wages
0
.2
.4
.6
1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009
(a)
10th Percentile
50th Percentile
90th Percentile

Figure 7

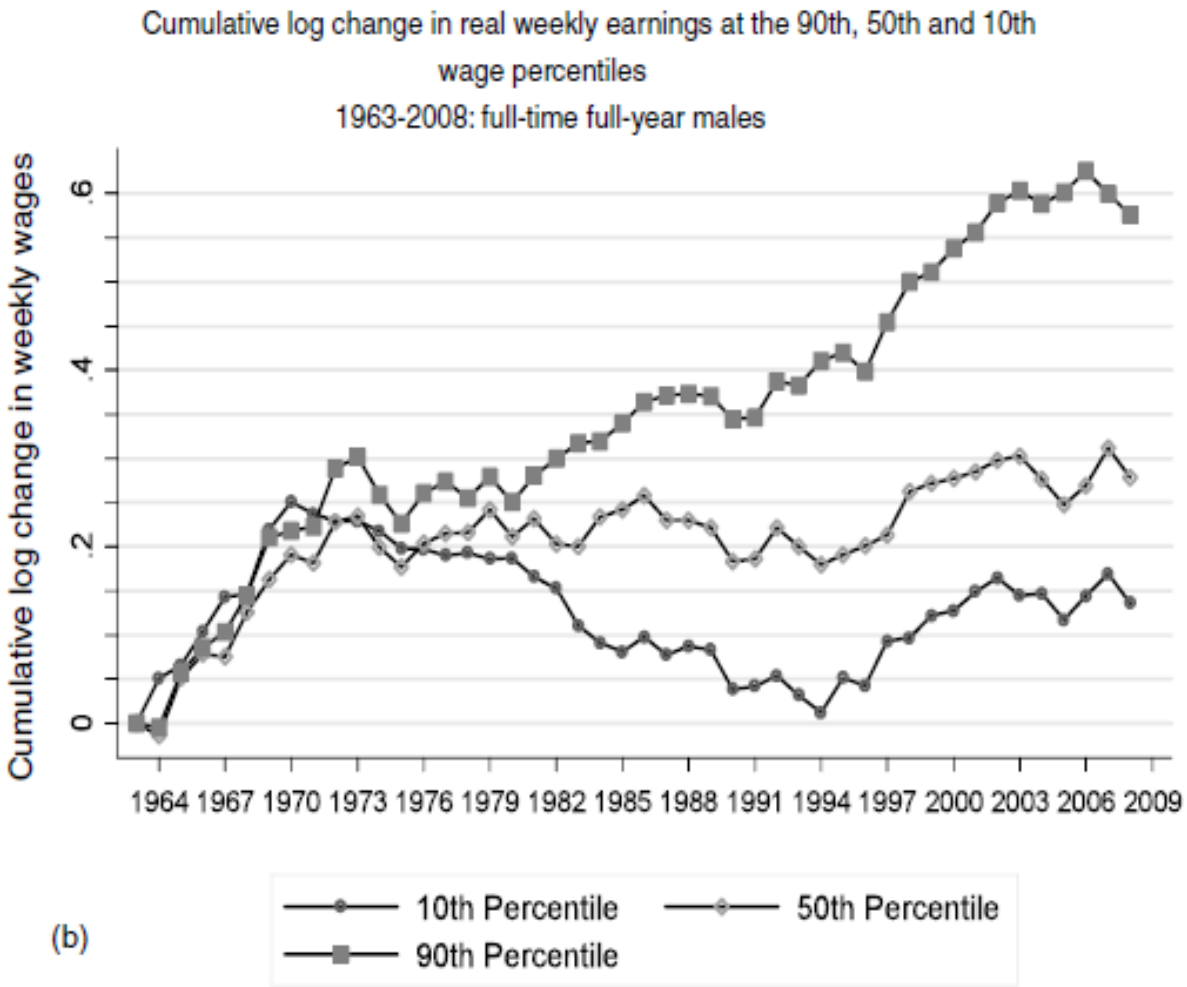

Figure 7 *Source: March CPS data for earnings years 1963-2008. For each year, the 10th, median and 90th percentiles of log weekly wages are calculated for full-time, full-year workers.*

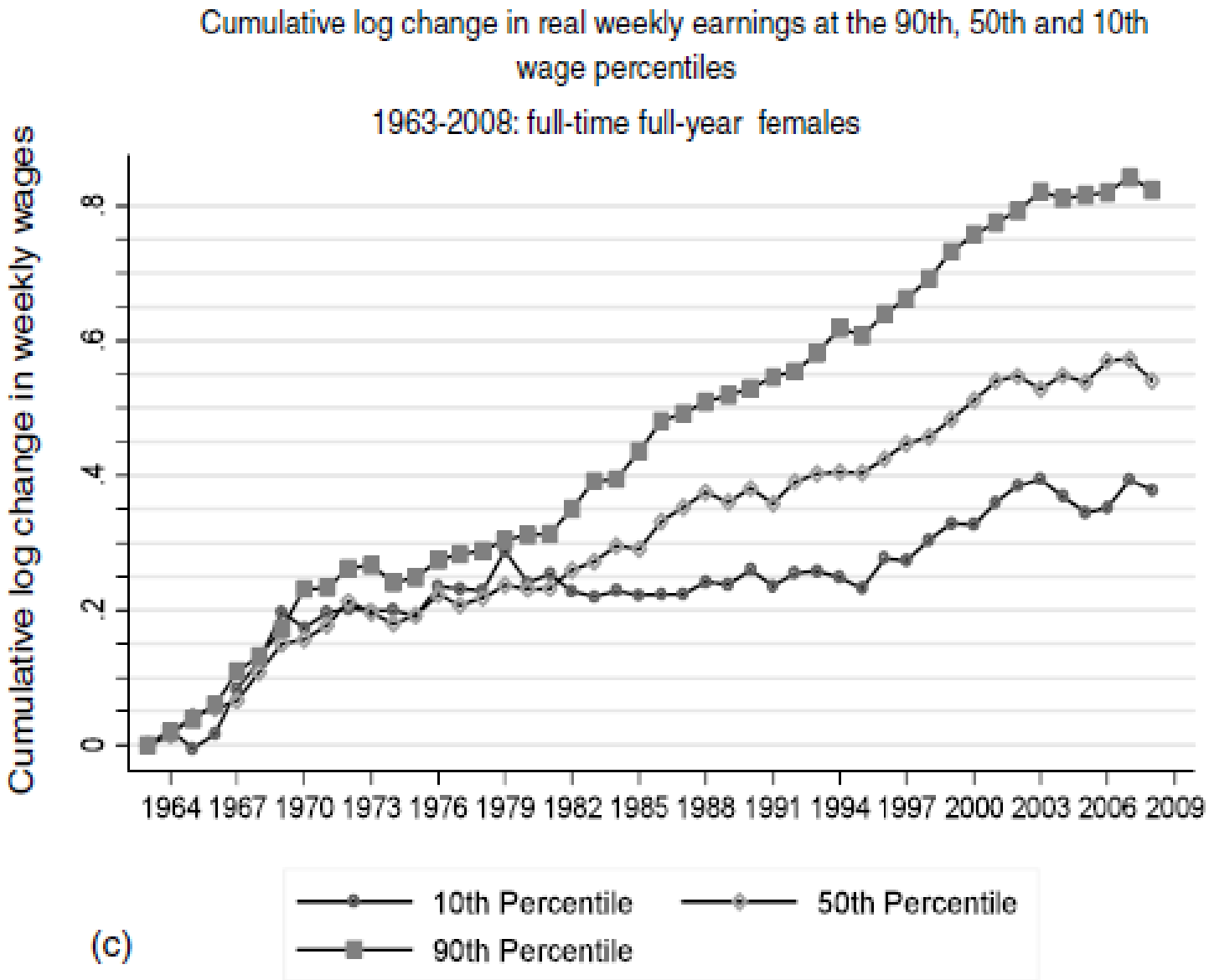

Figure 7 *(continued)*

Fig. 8 plots the corresponding trends in real indexed hourly wages of all employed workers at the 10th, 50th, and 90th percentiles.

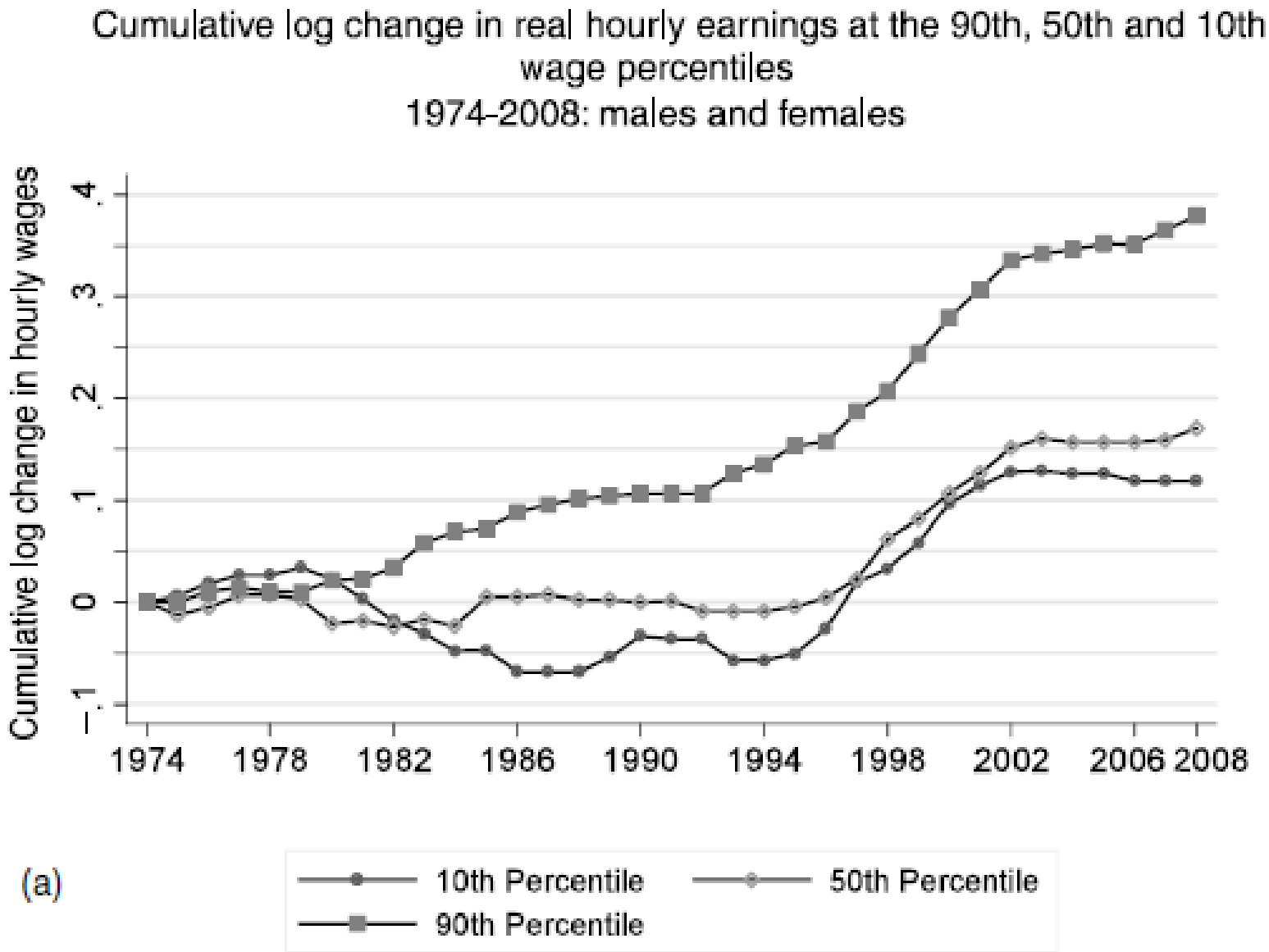
Cumulative log change in real hourly earnings at the 90th, 50th and 10th wage percentiles
1974-2008: males and females
Cumulative log change in hourly wages
-.1
0
.1
.2
.3
.4
1974
1978
1982
1986
1990
1994
1998
2002
2006
2008
(a)
10th Percentile
50th Percentile
90th Percentile

Figure 8

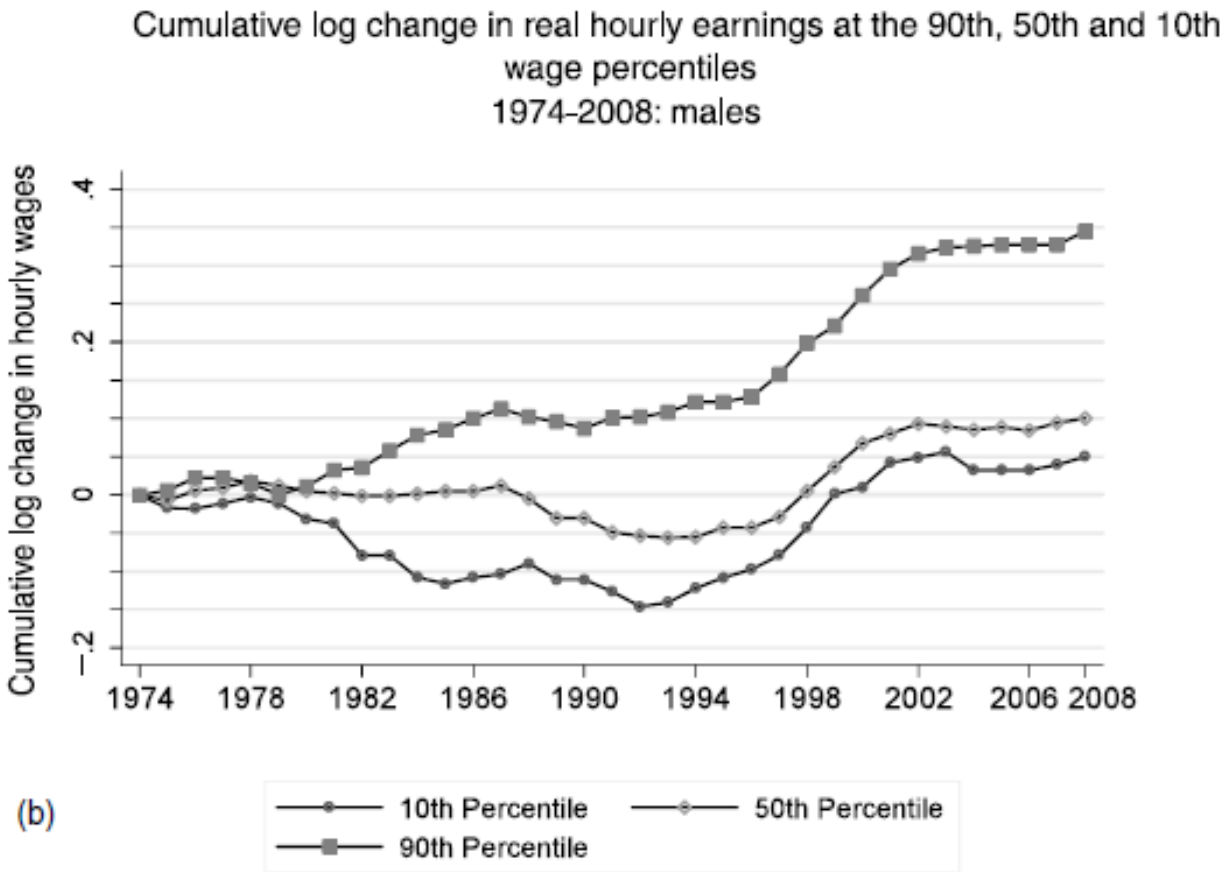

Figure 8 *Source: May/ORG CPS data for earnings years 1973-2009. The data are pooled using three-year moving averages (i.e. the year 1974 includes data from years 1973, 1974 and 1975). For each year, the 10th, median and 90th percentiles of log weekly wages are calculated for all workers, excluding the self-employed and those employed in military occupations.*

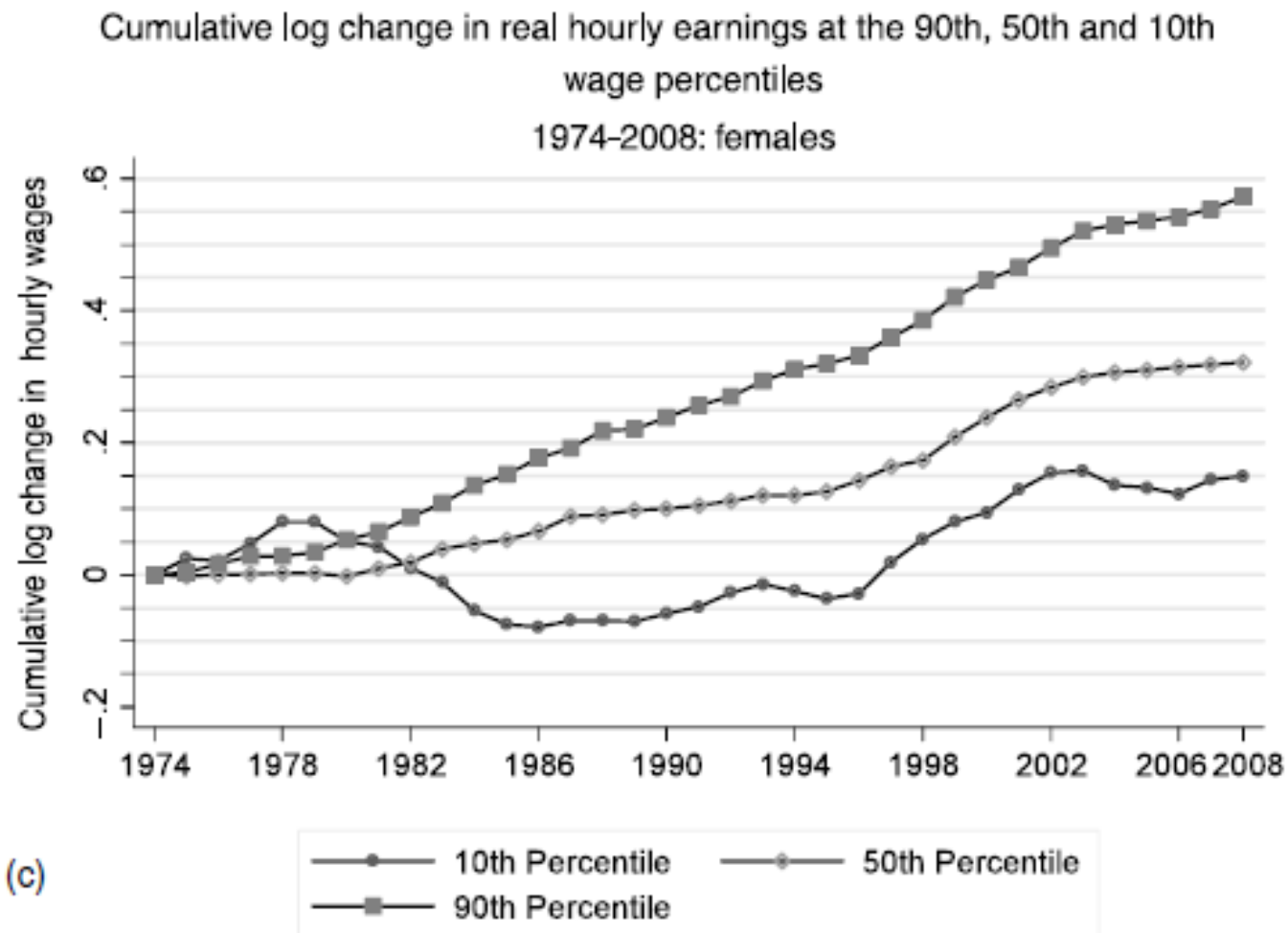

Figure 8 *(continued)*

Key Figure

Figure 9

Figure 9 *Source: May/ORG CPS data for earnings years 1973-2009. The data are pooled using three-year moving averages (i.e. the year 1974 includes data from years 1973, 1974 and 1975). For each year, the 5th through 95th percentiles of log hourly wages are calculated for all workers, excluding the self-employed and those employed in military occupations. The log wage change at the median is normalized to zero in each time interval.*

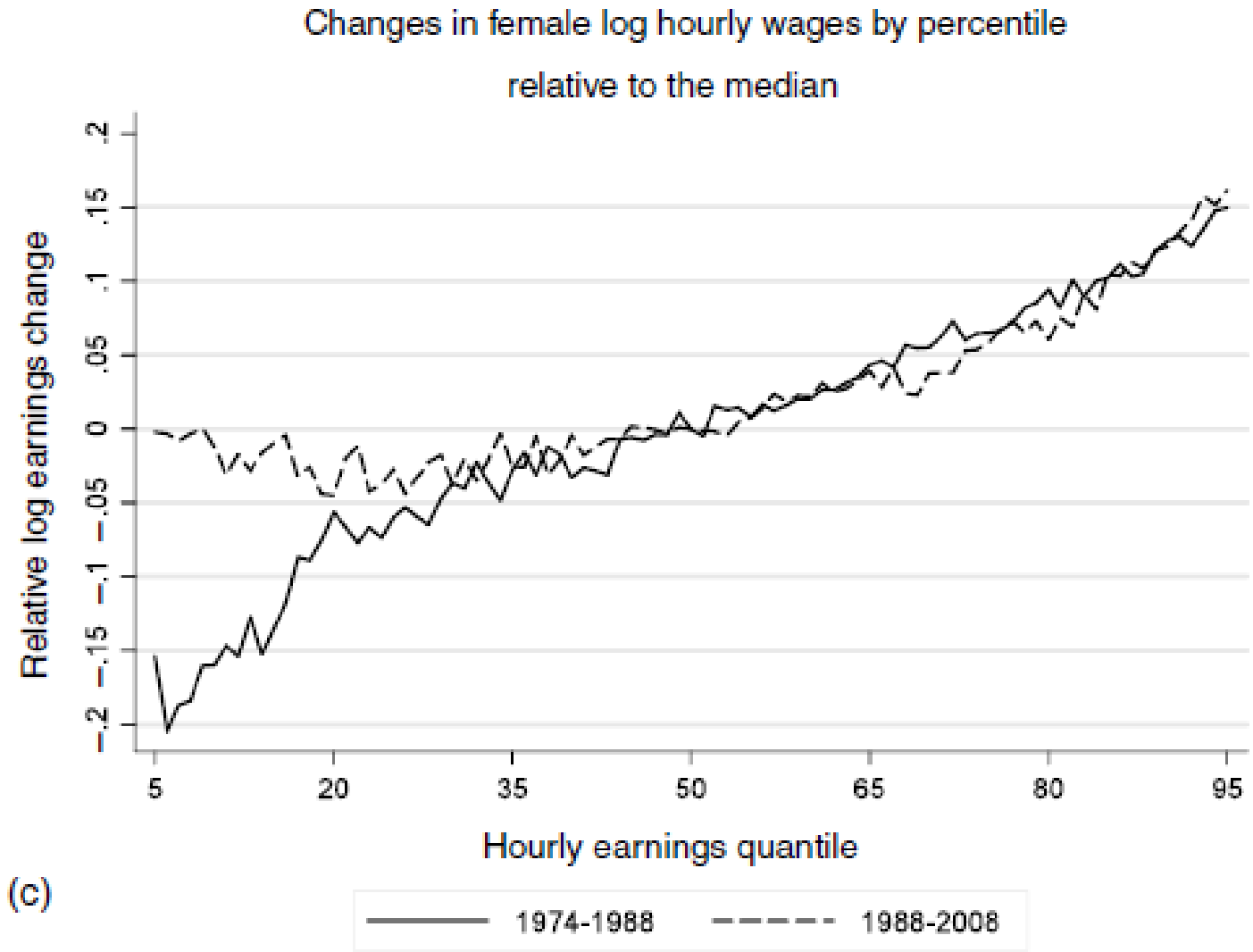

Figure 9 *(continued)*

2.5. Job polarization

Changes in occupational structure

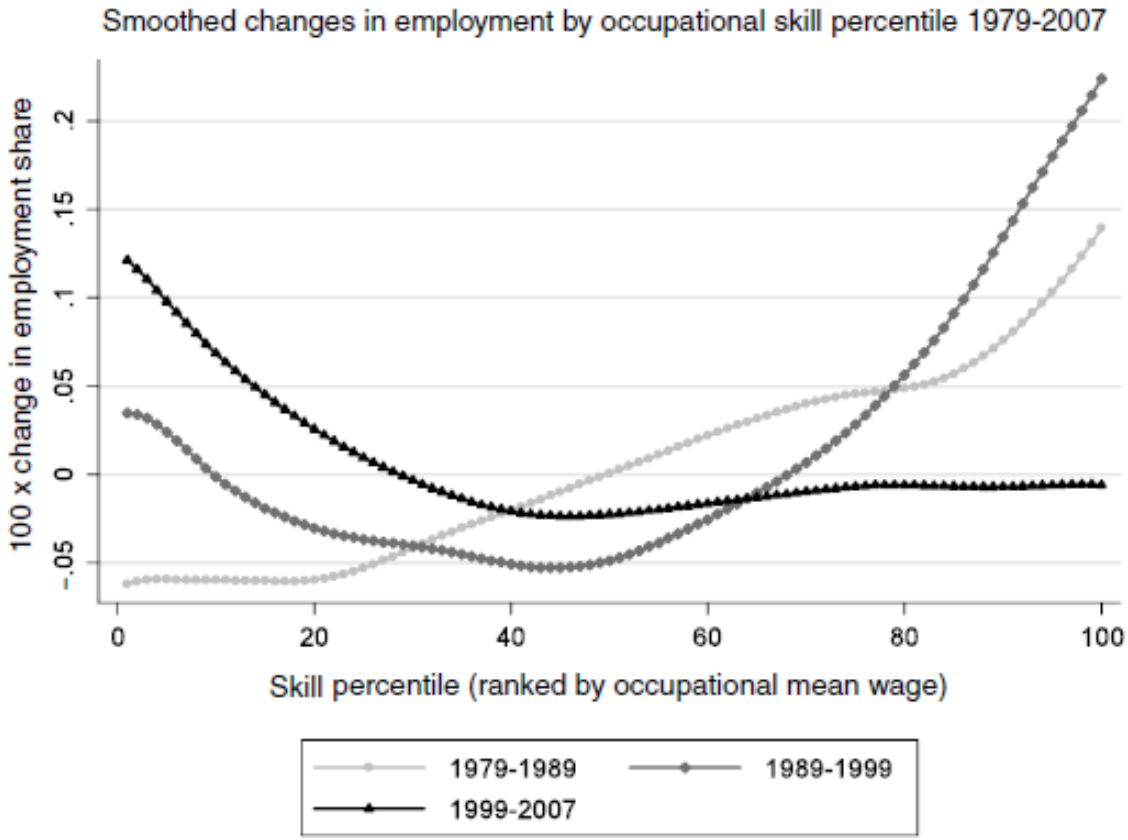

Figure 10 *Source: Census IPUMS 5 percent samples for years 1980, 1990, and 2000, and Census American Community Survey for 2008. All occupation and earnings measures in these samples refer to prior year's employment. The figure plots log changes in employment shares by 1980 occupational skill percentile rank using a locally weighted smoothing regression (bandwidth 0.8 with 100 observations), where skill percentiles are measured as the employment-weighted percentile rank of an occupation's mean log wage in the Census IPUMS 1980 5 percent extract. The mean log wage in each occupation is calculated using workers' hours of annual labor supply times the Census sampling weights.Consistent occupation codes for Census years 1980, 1990, and 2000, and 2008 are from Autor and Dorn (2009).*

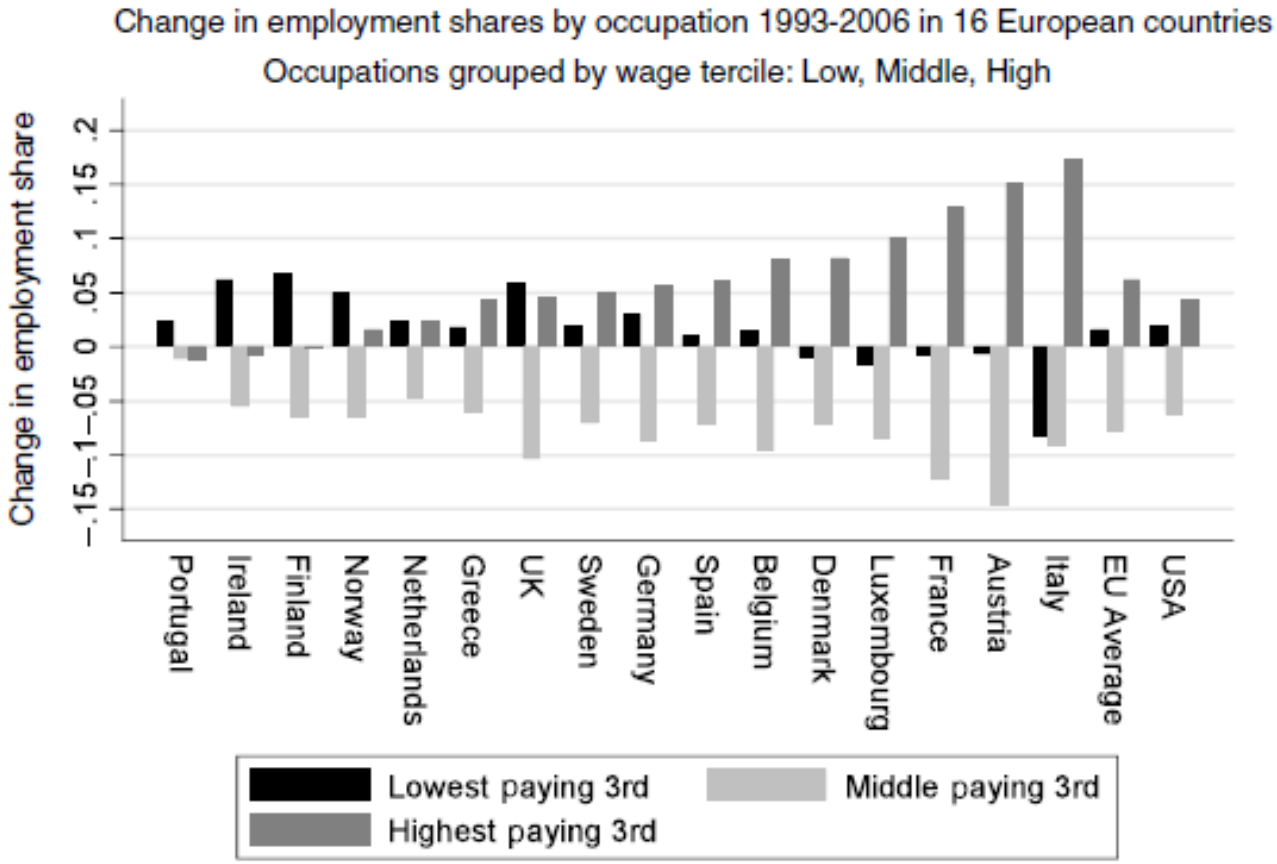

Figure 11 *Source: Data on EU employment are from Goos et al. (2009). US data are from the May/ORG CPS files for years 1993-2006. The data include all persons aged 16-64 who reported employment in the sample reference week, excluding those employed by the military and in agricultural occupations. Occupations are first assigned to 326 occupation groups that are consistent over the given time period. These occupations are then grouped into three broad categories by wage level.*

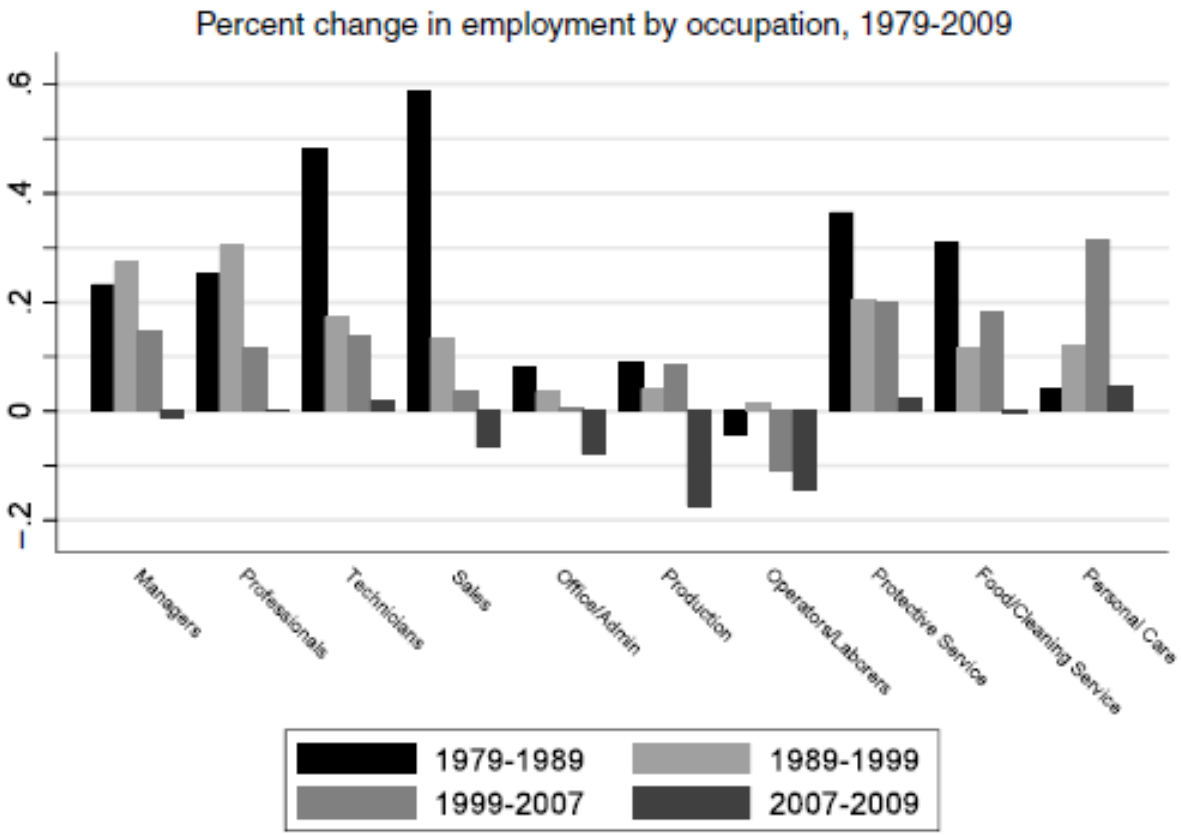

Figure 12 *Source: May/ORG CPS files for earnings years 1979-2009. The data include all persons aged 16-64 who reported employment in the sample reference week, excluding those employed by the military and in agricultural occupations. Occupations are assigned to 326 occupation groups that are consistent over the given time period. All non-military, non-agricultural occupations are assigned to one of ten broad occupations presented in the figure.*

Sources of job polarization: The "routinization" hypothesis

Autor et al. (2003) link job polarization to rapid improvements in the productivity—and declines in the real price—of information and communications technologies and, more broadly, symbolic processing devices.

Linking occupational changes to job tasks

Characterize the “task content” of jobs

ALM used the US Department of Labor’s *Dictionary of Occupational Titles* (DOT) to impute to workers the task measures associated with their occupations.

To keep categories manageable and self-explanatory, we use broad occupational groupings, either at the level of the ten categories as in Fig. 12—ranging from Managers to Personal Care workers—or even more broadly, at the level of the four clusters that are suggested by the figure: (1) managerial, professional and technical occupations; (2) sales, clerical and administrative support occupations; (3) production, craft, repair, and operative occupations; and (4) service occupations.

Table 5a shows that the intensity of use of non-routine cognitive (“abstract”) tasks is highest in professional, technical and managerial occupations, and lowest in service and laborer occupations.

Set of O★NET-based measures of abstract task input.

Our O★NET task measures also make a further distinction between non-routine cognitive analytic tasks (e.g., mathematics and formal reasoning) and non-routine cognitive interpersonal and managerial tasks.

The evolution of job tasks

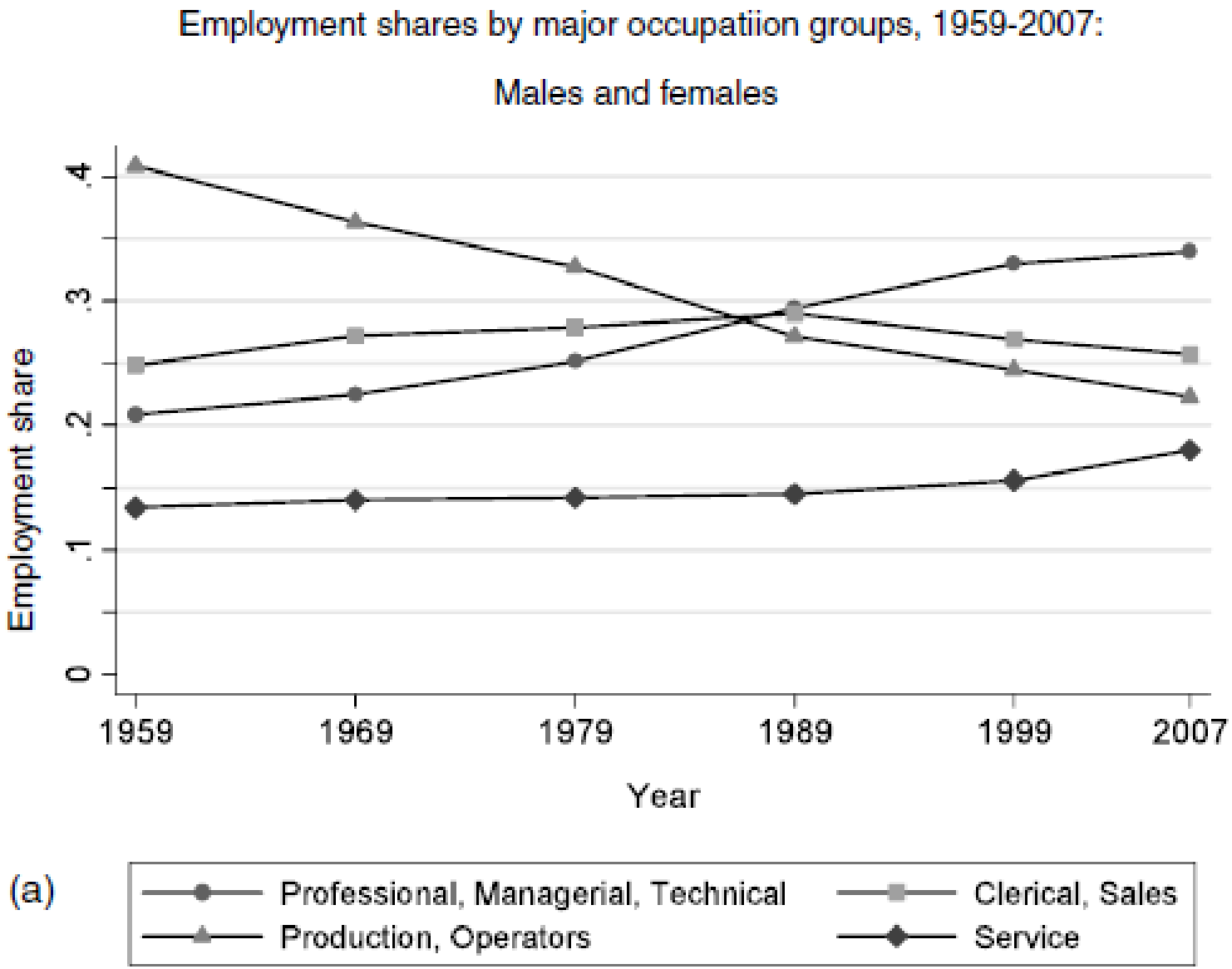
Employment shares by major occupatiion groups, 1959-2007:
Males and females
Employment share
0
.1
.2
.3
.4
1959
1969
1979
1989
1999
2007
Year
(a)
Professional, Managerial, Technical
Clerical, Sales
Production, Operators
Service

Figure 13

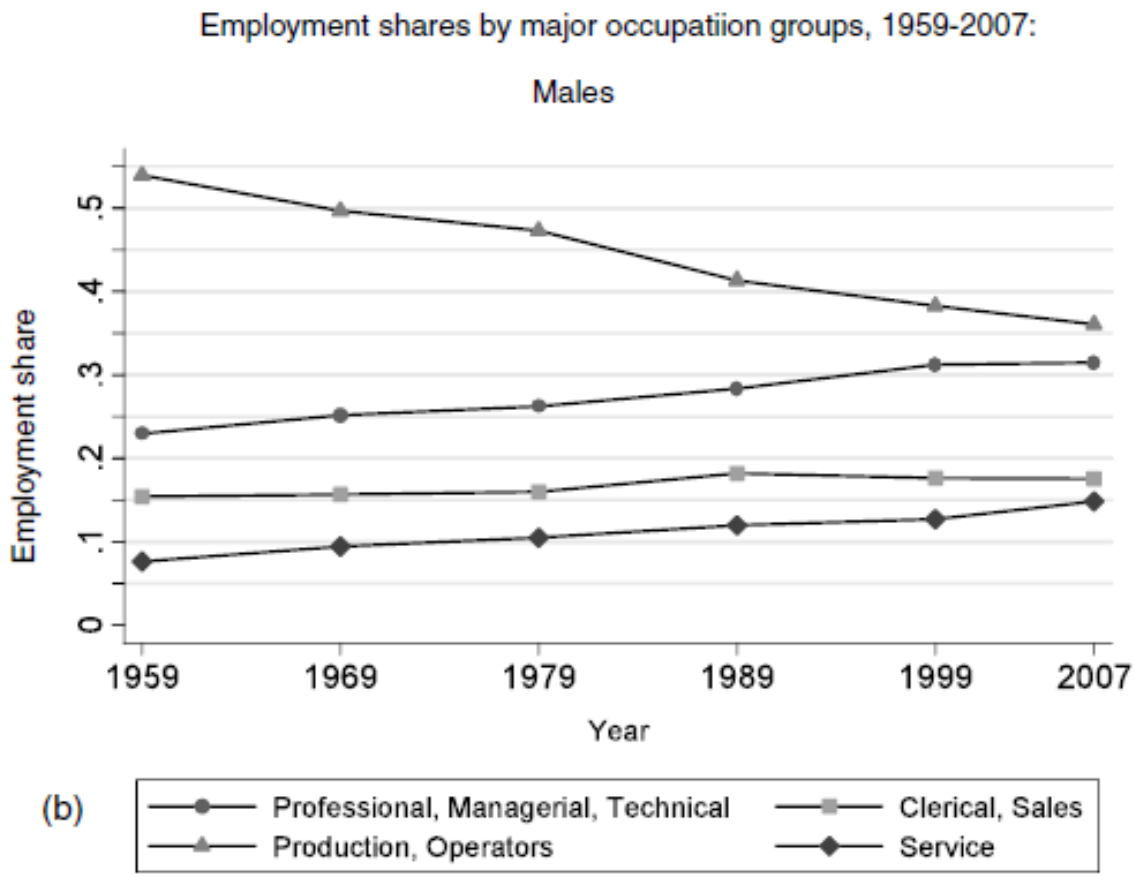

Figure 13 *Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. The data include all persons aged 16-64 who reported having worked last year, excluding those employed by the military and in agricultural occupations. Occupations are first assigned to 326 occupation groups that are consistent over the given time period. All non-military, non-agricultural occupations are assigned to one of four broad occupations.*

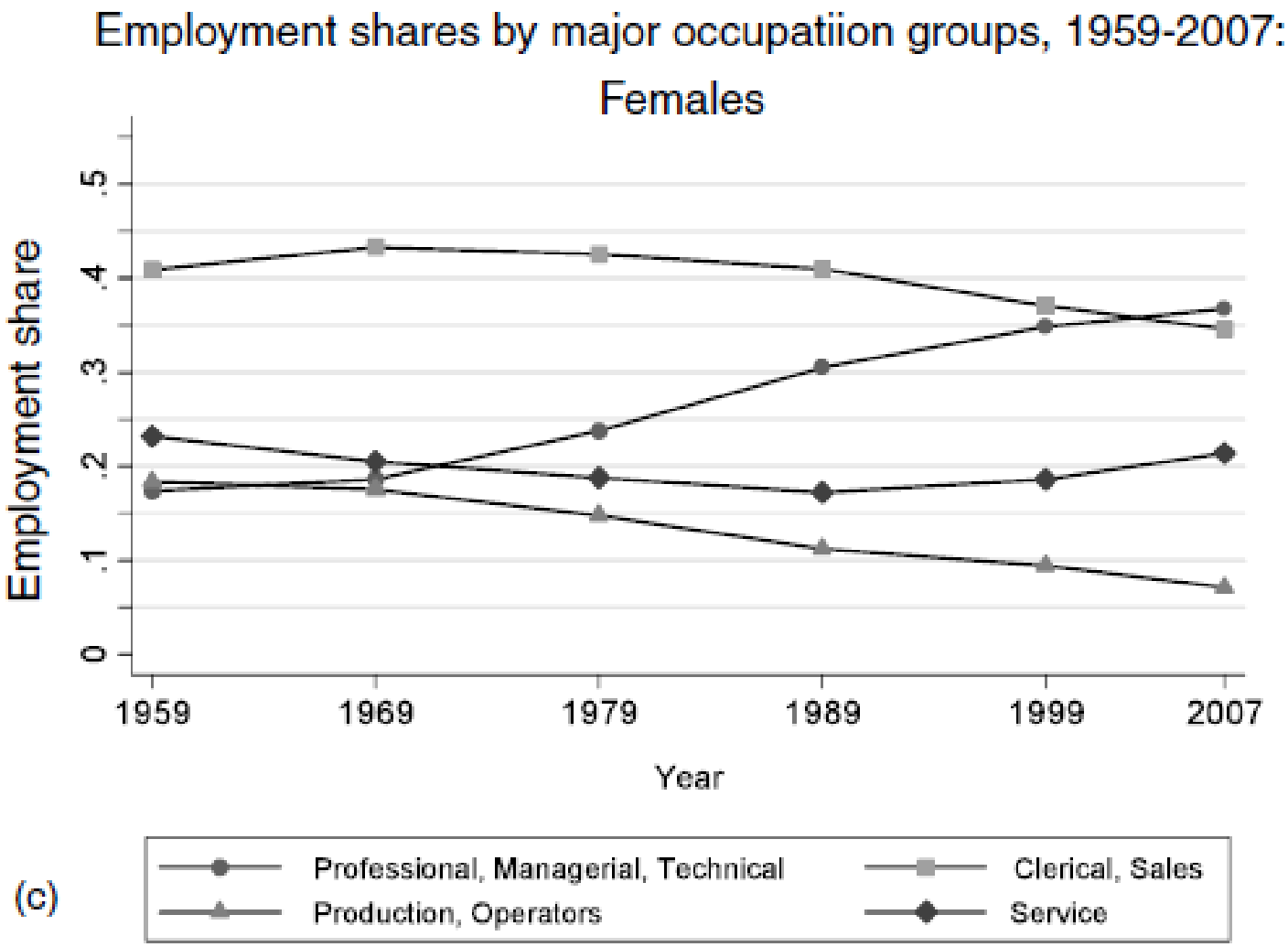

Figure 13 *(continued)*

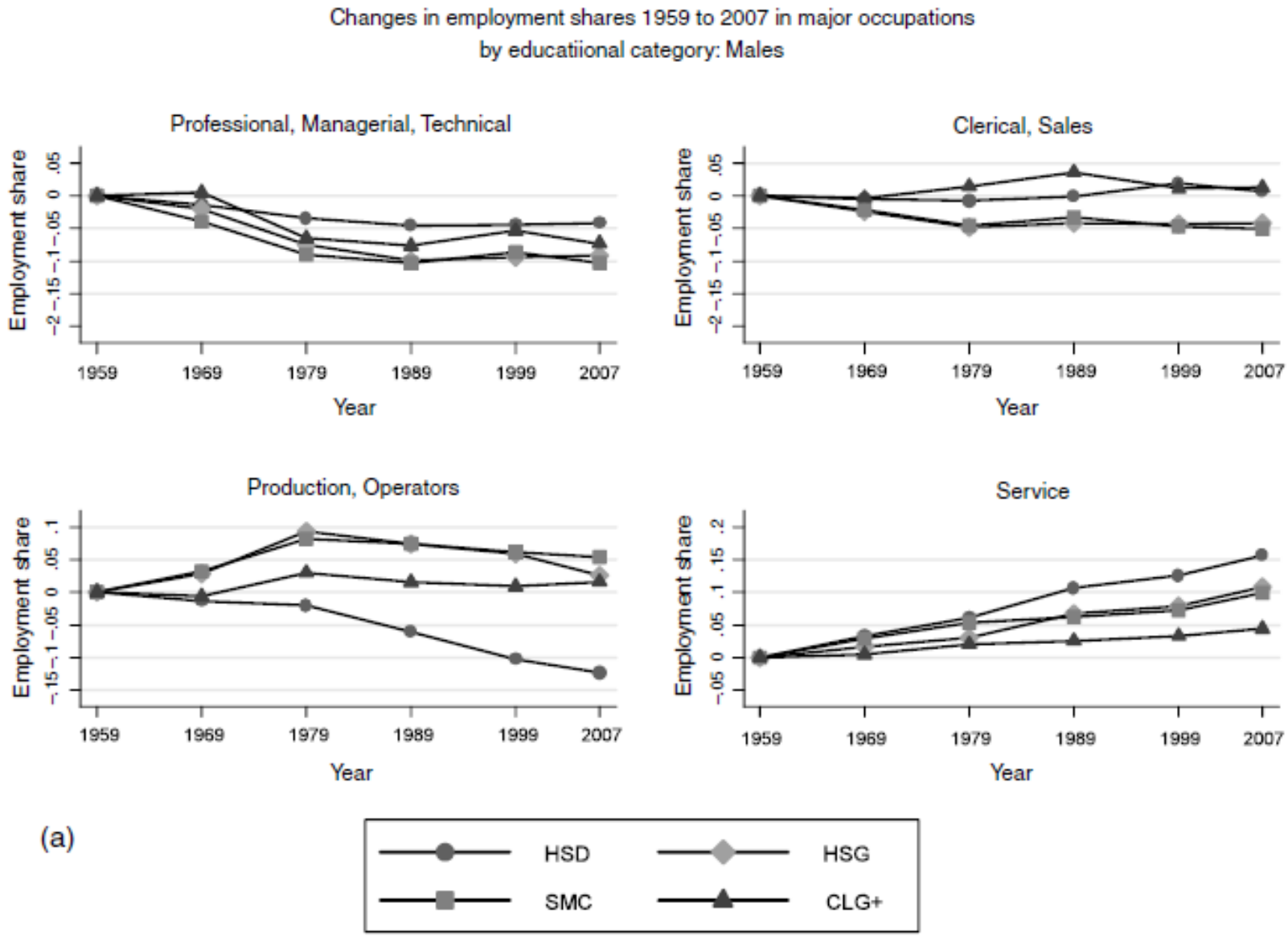

Figure 14 *Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. See note to Fig. 13.*

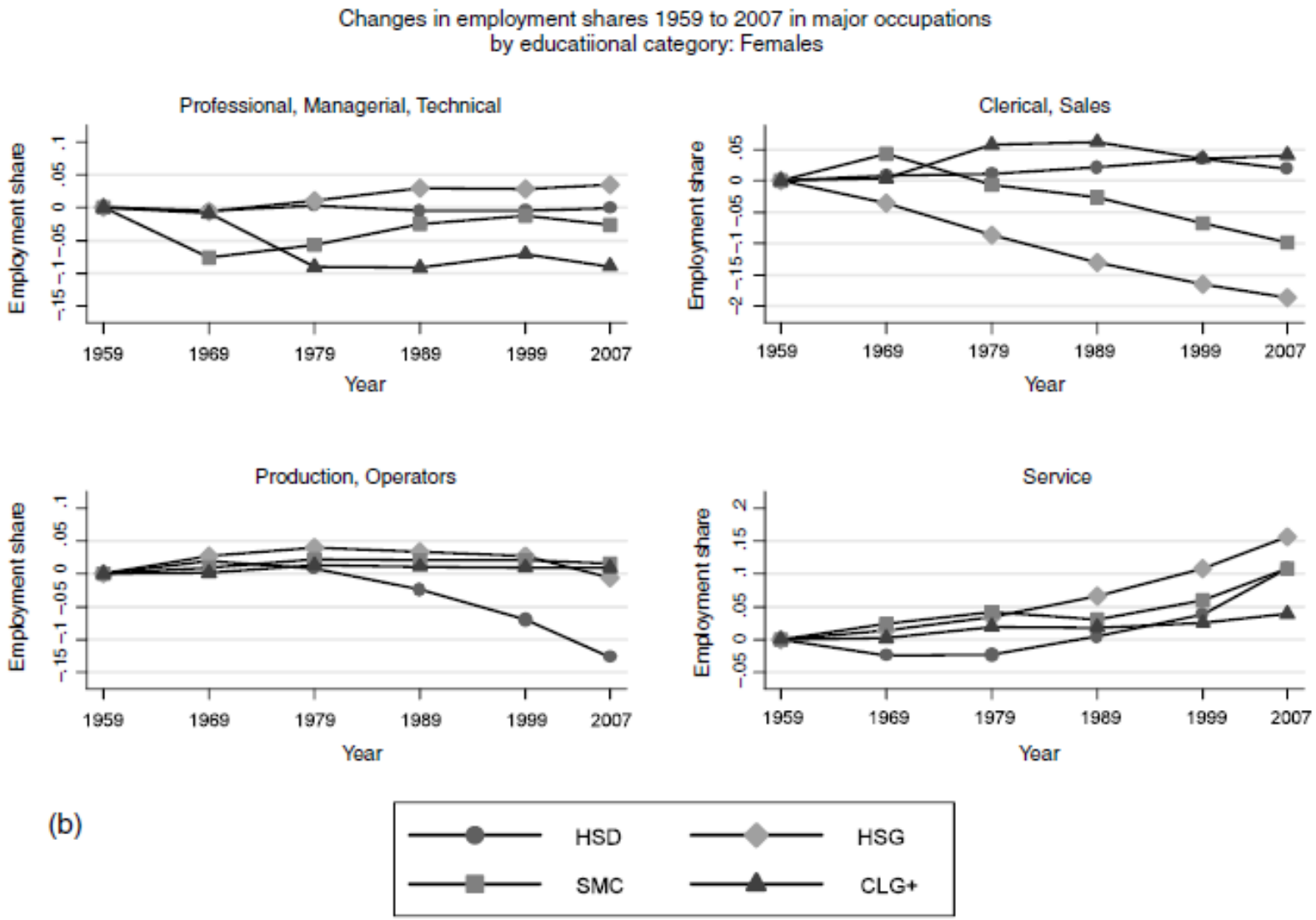

Figure 14 *(continued)*

Cross-national evidence on employment polarization

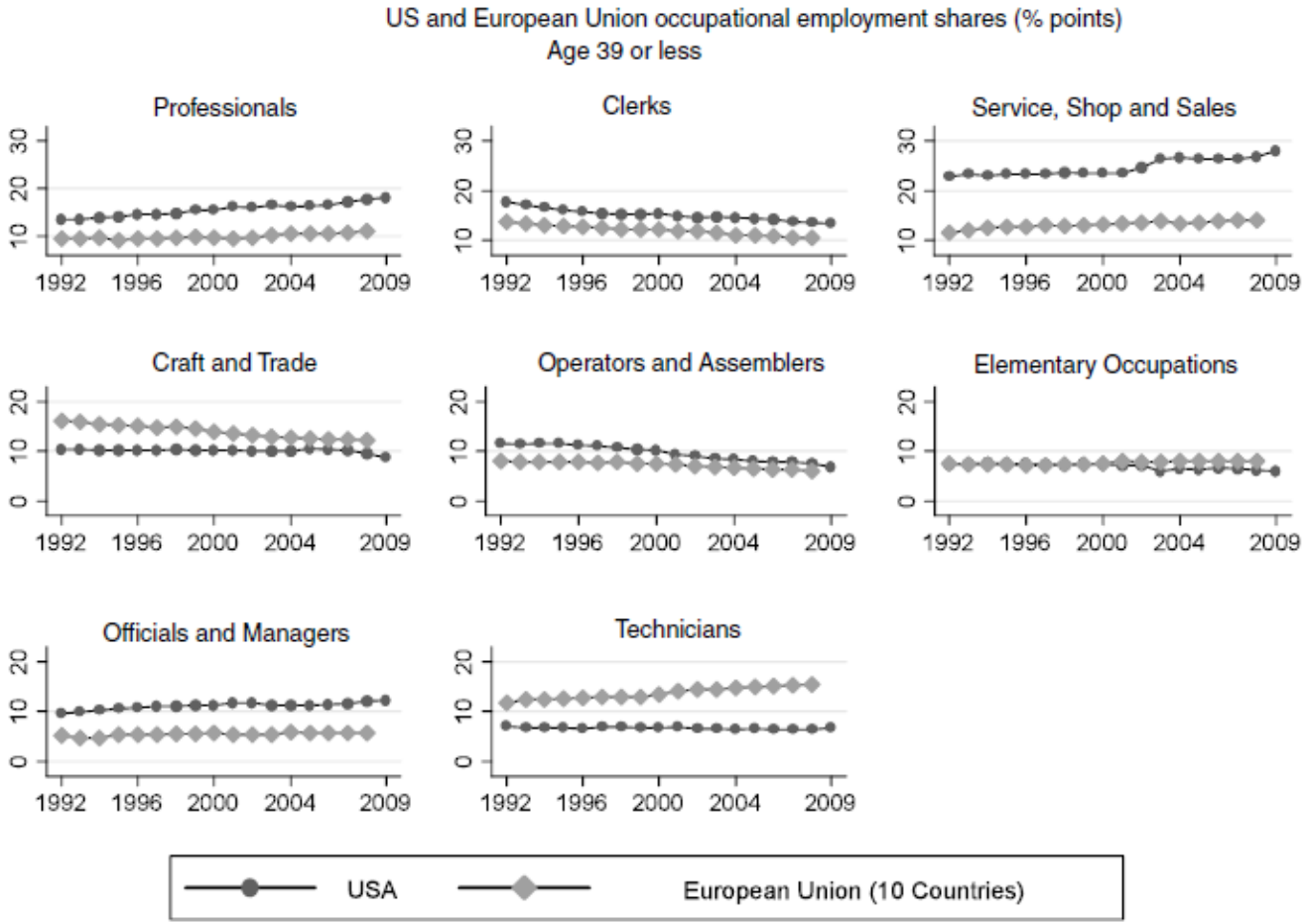

Figure 15 *Source: US data from May/ORG CPS data for earnings years 1992-2009. The data include all persons aged 16-64 who reported employment in the survey reference week, excluding those employed by the military and in agricultural occupations. Occupations are first assigned to 326 occupation groups that are consistent over the given time period. From these groups, occupations are then consolidated into the eight broad categories presented in the figure. The occupation share is the percentage of all workers employed in that occupation. European data are from Eurostat data 1992-2008. The data include all persons aged 15-59 who reported having worked in the last year, excluding family workers, those employed by the military and in agricultural occupations. Occupation shares are calculated using unweighted employment data for ten European countries: Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and the United Kingdom.*

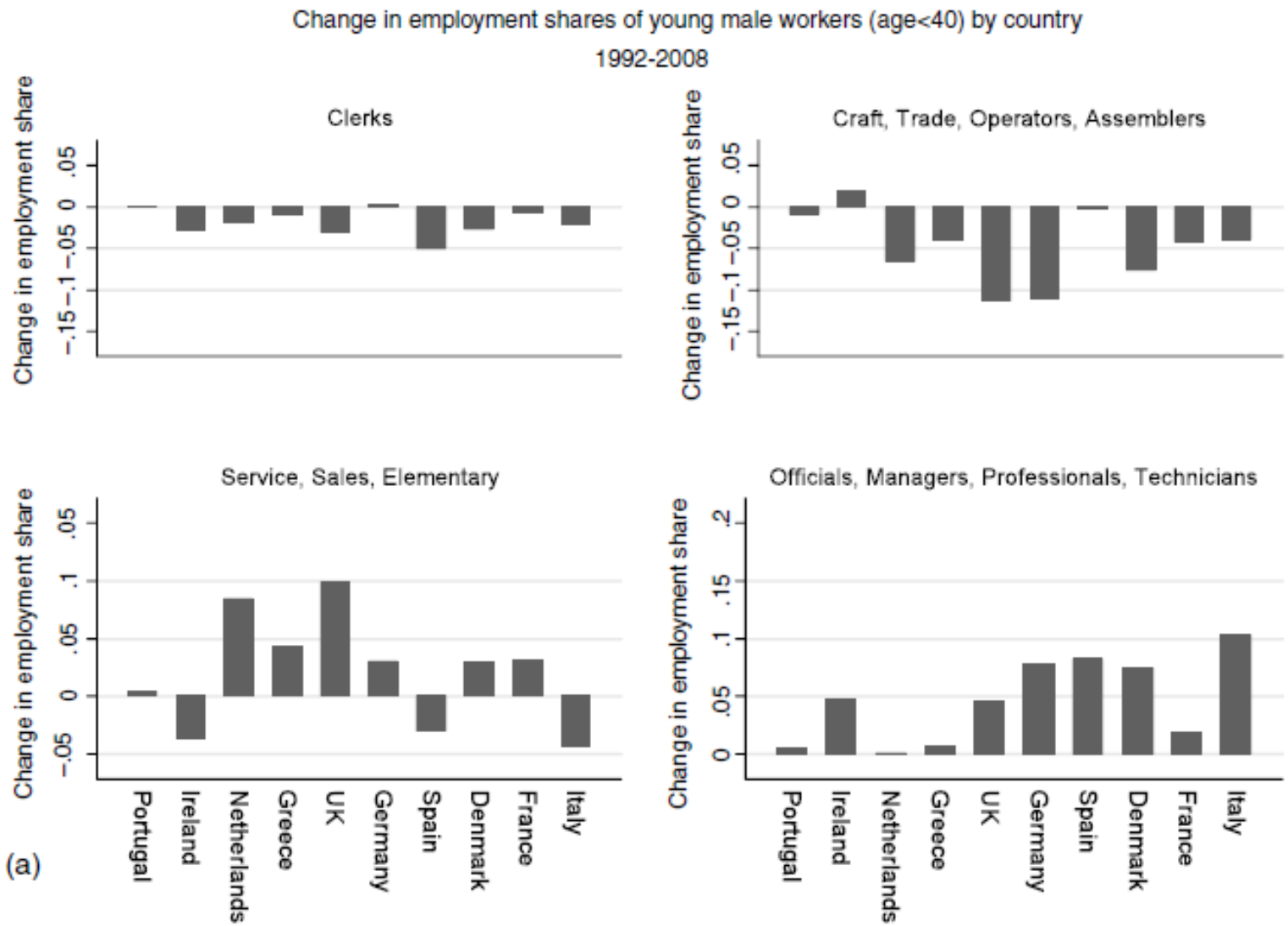

Figure 16 *Source: European data from Eurostat data 1992-2008. See note to Fig. 15. Employment shares are calculated for each of the ten European countries individually, for workers under 40 years of age.*

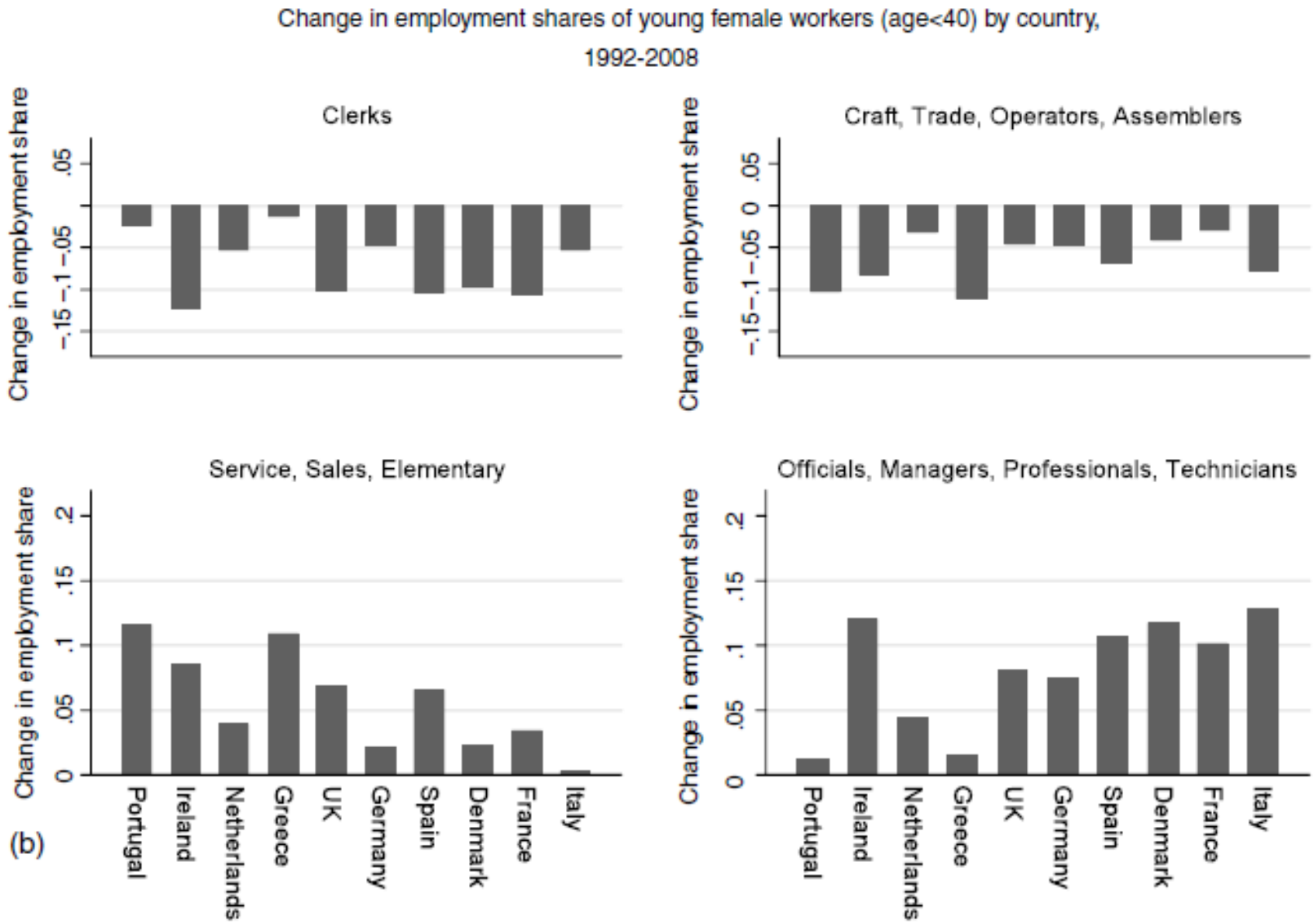

Figure 16 *(continued)*

Is job polarization explained by industrial composition?

$$\Delta E_{jt} = \sum_k \Delta E_{kt} \lambda_{jk} + \sum_j \Delta \lambda_{jkt} E_k$$
$$\equiv \Delta E_t^B + \Delta E_t^W. \quad (1)$$

Here, ΔE_{jt} is the change in the overall share of employment in occupation j over time interval t, ΔE_t^B is the change in occupation j's share of employment attributable to changes in industrial composition and, conversely, ΔE_t^W is the change in occupation j's employment share attributable to within-industry shifts.

Table 2 Employment and wages in ten broad occupations, 1959-2007.

	1959	1969	1979	1989	1999	2007
	A. Employment shares					
Managers	8.9	8.5	9.8	11.8	14.1	14.4
Professionals	8.6	10.7	11.7	13.4	14.9	15.7
Technicians	2.2	2.6	3.1	3.6	3.6	3.5
Sales	8.3	8.3	10.0	11.9	11.3	11.4
Office and admin	15.1	18.1	17.3	16.6	15.3	14.0
Production, craft and repair	13.8	12.7	12.7	11.1	11.2	10.1
Operators, fabricators and laborers	24.7	22.6	19.2	15.6	13.0	11.9
Protective service	1.1	1.1	1.5	1.8	2.0	2.2
Food prep, buildings and grounds, cleaning	4.8	6.0	7.4	7.6	7.5	8.8
Personal care and personal services	6.7	6.6	5.0	4.9	5.9	6.8
	B. 100*log weekly full-time, full-year wages relative to the 1959 mean					
Managers	47.9	67.3	60.9	67.5	80.8	88.5
Professionals	27.4	54.1	49.3	62.9	72.2	75.5
Technicians	16.5	33.5	34.3	45.6	64.3	68.5
Sales	−6.2	10.5	9.8	20.5	28.3	27.9
Office and admin	−6.5	7.6	7.1	13.8	19.3	17.5
Production, craft and repair	23.1	41.1	42.3	42.1	43.1	39.9
Operators, fabricators and laborers	−4.7	11.1	15.7	15.1	22.5	17.3
Protective service	15.3	41.4	34.3	40.6	49.1	50.3
Food prep, buildings and grounds, cleaning	−54.7	−31.5	−29.5	−23.1	−15.3	−22.0
Personal care and personal services	−76.9	−46.7	−29.2	−18.8	−5.8	−10.4

(continued on next page)

Table 2 (continued)

	C. 100*log hourly wages (May/ORG) relative to the 1973 mean					
	1973	1979	1989	1999	2007	2009
Managers	36.8	33.7	39.4	49.9	58.7	60.7
Professionals	33.0	31.8	38.4	49.7	54.1	56.4
Technicians	15.3	13.7	23.9	27.7	53.6	52.5
Sales	−18.9	−17.4	−18.5	−4.2	−0.3	−1.1
Office and admin	−8.8	−9.8	−10.8	−5.8	−1.1	1.6
Production, craft and repair	21.9	21.3	14.7	19.0	18.3	21.6
Operators, fabricators and laborers	−7.5	−5.7	−16.1	−11.7	−6.1	−2.0
Protective service	8.4	5.7	3.3	13.0	25.9	23.2
Food prep, buildings and grounds, cleaning	−49.0	−49.2	−55.2	−44.8	−39.6	−38.3
Personal care and personal services	−44.1	−39.3	−43.5	−31.4	−23.7	−22.7

Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. May/ORG CPS data for earnings years 1973-2009. Labor supply is calculated using all persons aged 16-64 who reported having worked at least one week in the earnings years, excluding those in the military and agriculture. Occupations are first assigned to 326 occupation groups that are consistent over the given time period.

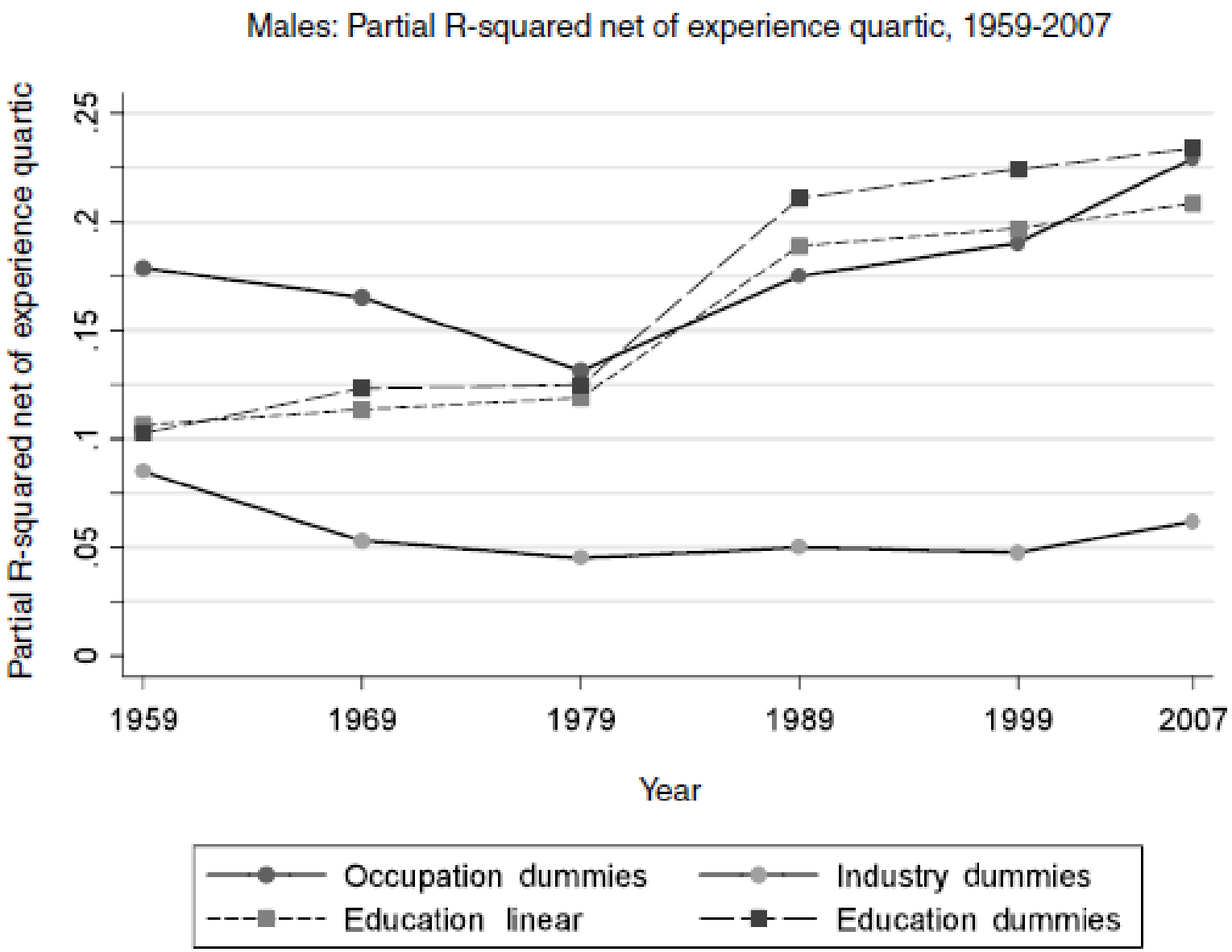
Males: Partial R-squared net of experience quartic, 1959-2007
Partial R-squared net of experience quartic
0
.05
.1
.15
.2
.25
1959
1969
1979
1989
1999
2007
Year
Occupation dummies
Industry dummies
Education linear
Education dummies

Figure 17

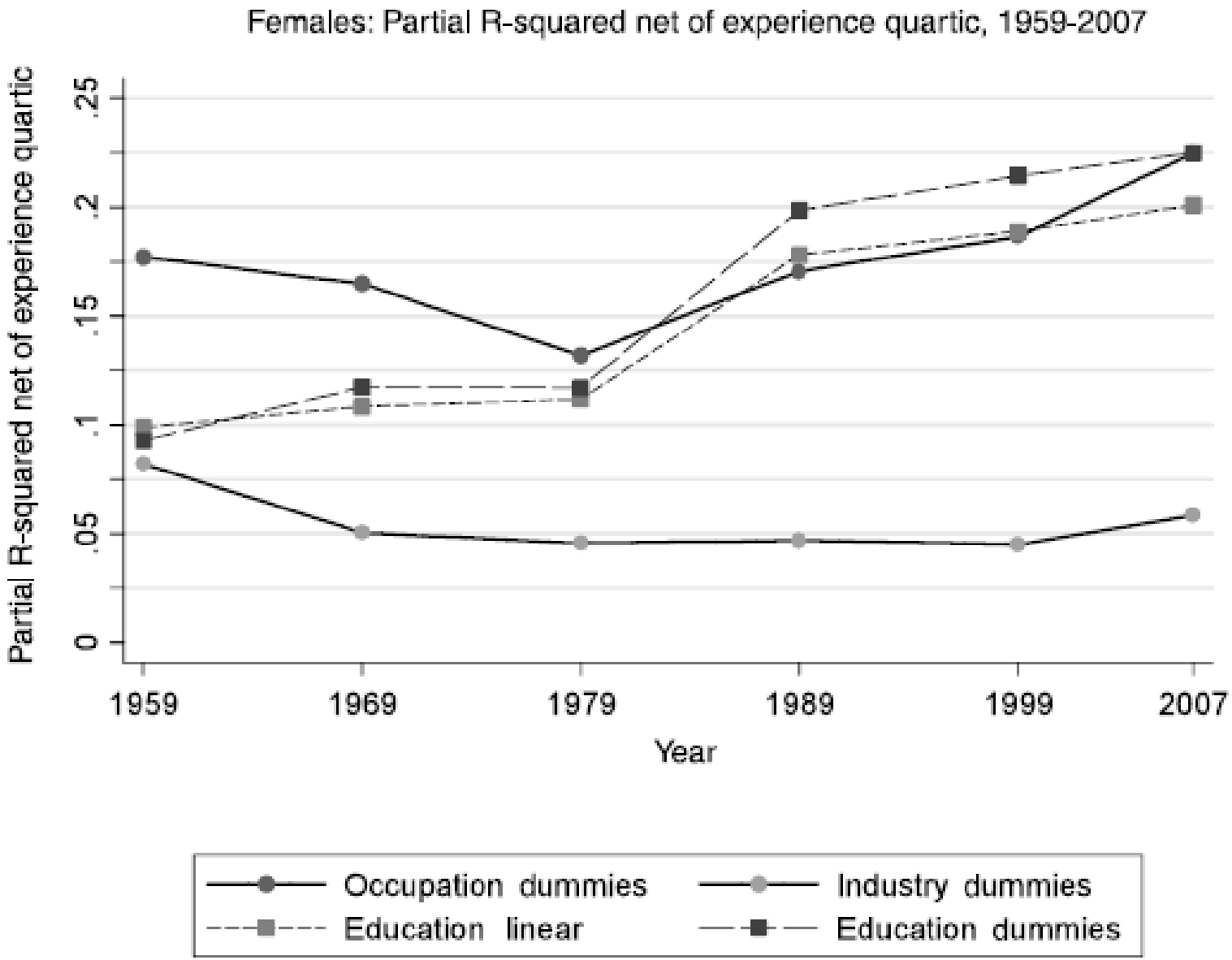

Figure 17 *(continued)*

Figure 17 *Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. The data include all full-time, full-year workers aged 16-64, excluding those employed by the military and in agricultural occupations. Linear education measure is equal to years of educational attainment. For those who have not completed second grade, their years of education are imputed based on gender and ethnicity. Education dummies consist of five broad categories: high school dropouts, high school graduates, some college education, college graduates, and post-college degree. Occupations are assigned to 326 occupation groups that are consistent over the given time period. From these groups, occupations are then consolidated into ten broad categories: Managers; Professionals; Technicians; Sales; Office and administrative; Production, craft and repair; Operators, fabricators and laborers; Protective service; Food prep, buildings and grounds, cleaning; and Personal care and personal services. Industries are similarly converted from their respective scheme to a consistent set of 149 industries, as used in Autor et al. (1998). From these 149 industries, ten broad industry categories are constructed and include: Construction; Manufacturing; Transport and utilities; Wholesale trade; Retail trade; Finance, Insurance and Real Estate; Business services; Personal services and entertainment; Professional services; and Public administration. The partial R-squared values presented above are calculated as follows: Log weekly wages and each variable group above are orthogonalized using a quartic in experience and two ethnicity dummies. Using the residuals from each of these regressions, residual log weekly wages are regressed separately on the residuals from the variable groups of interest, and the R-squared value from this regression is plotted above for each year. All regressions are weighted by Census person weights.*

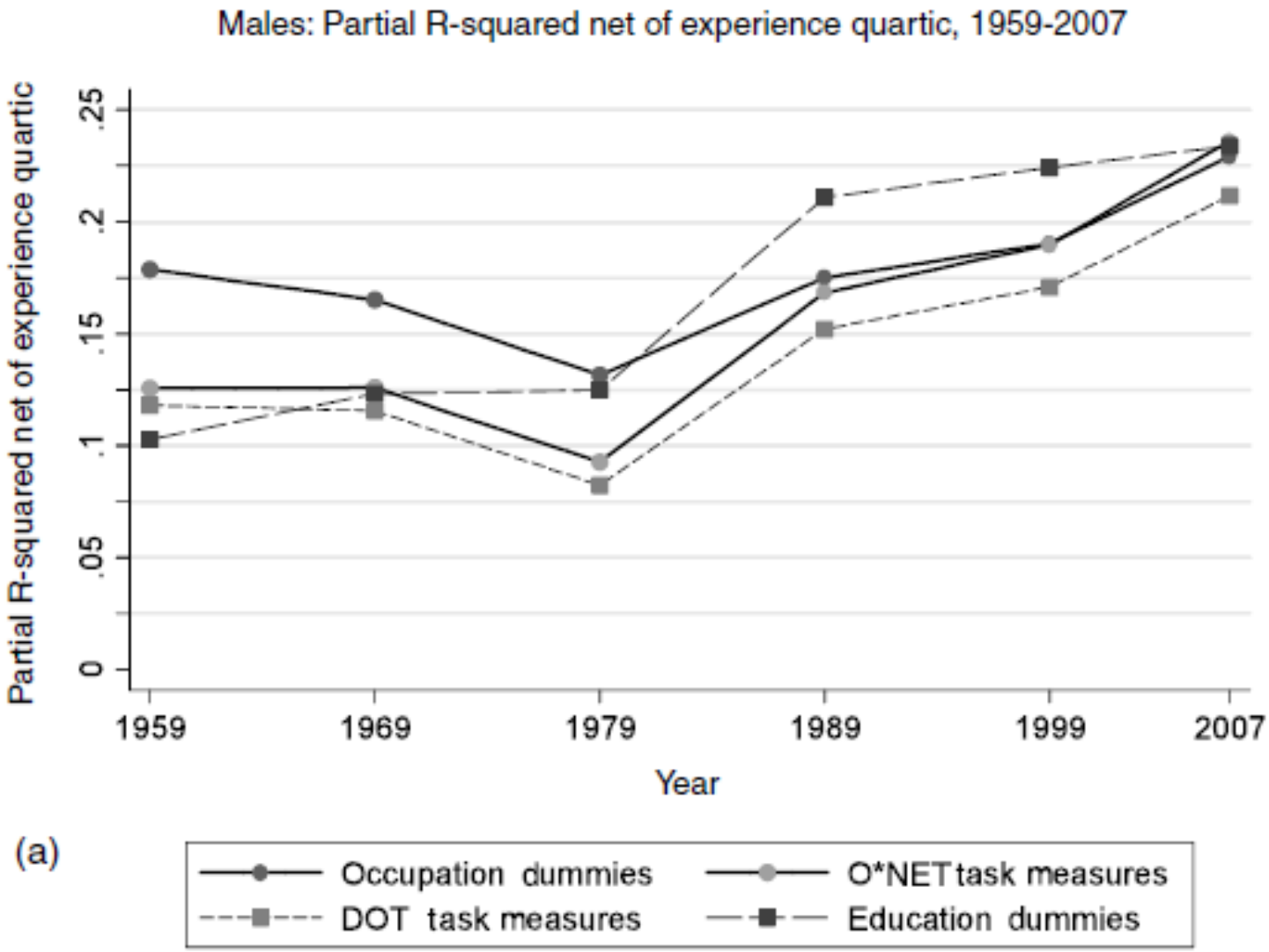
Males: Partial R-squared net of experience quartic, 1959-2007
Partial R-squared net of experience quartic
0
.05
.1
.15
.2
.25
1959
1969
1979
1989
1999
2007
Year
(a)
Occupation dummies
O*NET task measures
DOT task measures
Education dummies

Figure 18

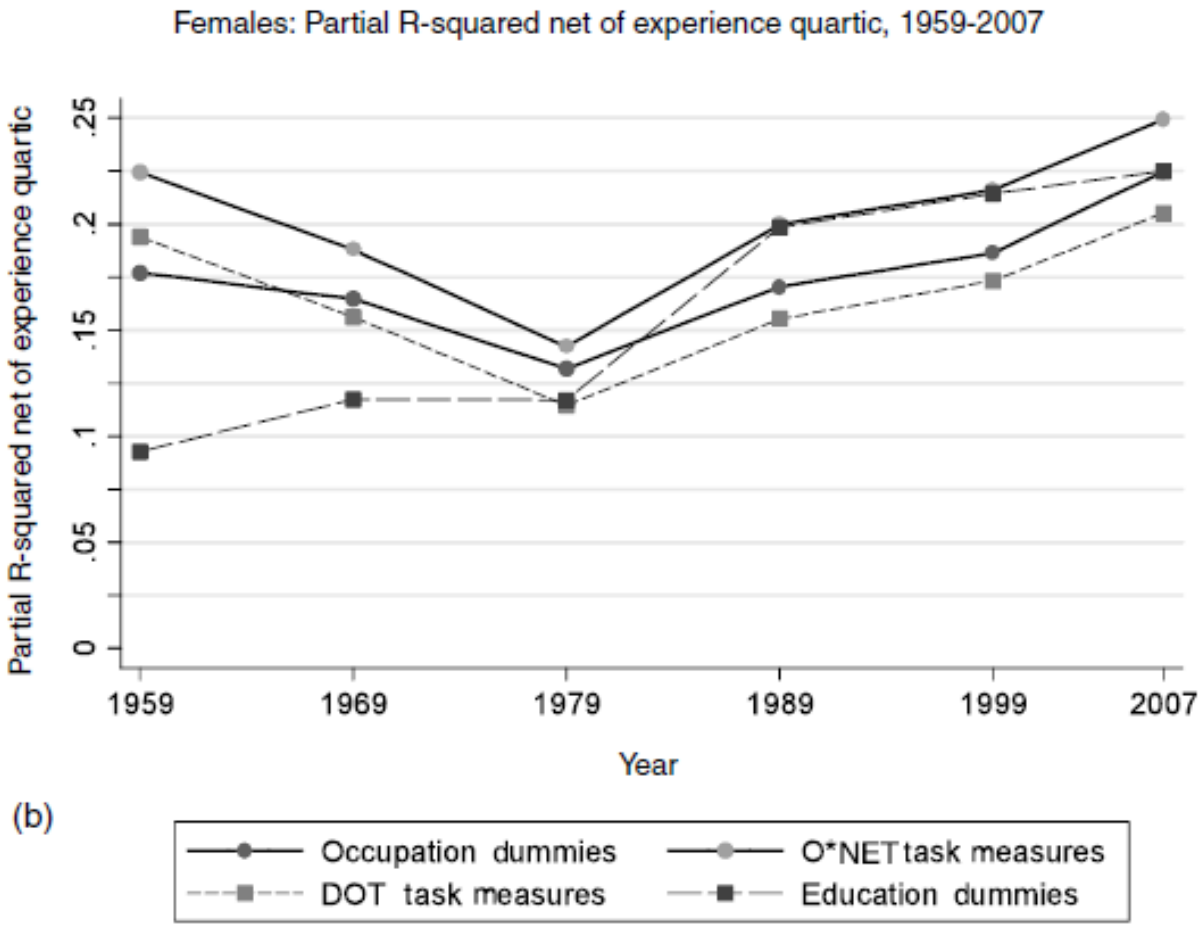

Figure 18 *Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. See note to Fig. 17 for the partial R-squared calculation procedure. Five O*NET constructed task measures, constructed from a combination of O*NET activities and context scores, are utilized: routine cognitive, routine manual, non-routine cognitive analytic, non-routine manual, and non-routine interpersonal. Three DOT task measures are utilized, as in Autor et al. (2003): abstract, routine, and manual. See the Data Appendix for more information on the construction of the O*NET task measures.*

Table 3a Employment shares in four broad occupational categories (%), 1959-2007.

	1959	1969	1979	1989	1999	2007
All						
Professional, Managerial, Technical	20.9	22.4	25.1	29.4	33.0	34.0
Clerical, Sales	24.9	27.2	27.9	29.0	26.9	25.7
Production, Operators	40.8	36.3	32.8	27.1	24.5	22.3
Service	13.4	14.0	14.2	14.5	15.6	18.0
Males						
Professional, Managerial, Technical	22.9	25.2	26.2	28.4	31.3	31.5
Clerical, Sales	15.4	15.7	16.0	18.2	17.7	17.6
Production, Operators	54.0	49.7	47.3	41.4	38.3	36.1
Service	7.7	9.4	10.5	12.0	12.8	14.9
Females						
Professional, Managerial, Technical	17.4	18.6	23.8	30.5	34.9	36.8
Clerical, Sales	41.0	43.3	42.6	41.0	37.1	34.6
Production, Operators	18.4	17.6	14.8	11.2	9.4	7.1
Service	23.2	20.5	18.8	17.2	18.6	21.4

Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. See note to Fig. 13.

Table 3b Mean log full-time, full-year weekly and all hourly earnings in four broad occupation categories, 1959-2007 (Census) and 1973-2009 (May/ORG).

	A. 100 × Log weekly full-time, full-year wages relative to 1959 mean					
	1959	**1969**	**1979**	**1989**	**1999**	**2007**
All						
Professional, Managerial, Technical	34.1	56.3	51.7	62.4	75.0	80.1
Clerical, Sales	−6.4	8.4	8.0	16.4	22.9	21.9
Production, Operators	5.4	22.3	25.7	25.6	31.6	27.2
Service	−58.7	−30.7	−22.2	−13.3	−3.0	−8.3
Males						
Professional, Managerial, Technical	31.4	53.4	53.1	62.8	73.4	78.1
Clerical, Sales	1.1	23.3	22.7	25.0	24.9	21.2
Production, Operators	−7.0	12.3	16.9	14.7	19.2	13.3
Service	−34.7	−13.7	−16.8	−15.0	−6.7	−13.6
Females						
Professional, Managerial, Technical	34.5	61.7	63.2	80.6	95.7	102.1
Clerical, Sales	10.8	25.9	30.5	40.4	49.3	49.0
Production, Operators	2.7	17.3	24.1	30.7	40.9	37.3
Service	−50.6	−20.2	−2.2	9.3	21.5	17.3

	B. 100*Log hourly wages relative to 1973 mean					
	1973	1979	1989	1999	2007	2009
All						
Professional, Managerial, Technical	32.8	30.6	37.0	47.4	56.0	57.8
Clerical, Sales	−11.6	−11.9	−13.8	−5.1	−0.8	0.5
Production, Operators	3.0	4.4	−3.8	0.7	5.4	8.9
Service	−40.5	−39.4	−43.7	−32.4	−24.9	−24.3
Males						
Professional, Managerial, Technical	16.0	12.1	12.3	17.2	26.4	28.7
Clerical, Sales	−6.8	−6.9	−12.4	−11.0	−8.6	−9.6
Production, Operators	−5.9	−0.8	−13.7	−7.9	−7.0	−8.8
Service	−28.6	−31.8	−36.3	−32.3	−22.7	−23.9
Females						
Professional, Managerial, Technical	30.2	28.4	32.7	41.4	50.9	51.5
Clerical, Sales	−3.0	2.9	3.9	13.2	17.0	16.2
Production, Operators	−4.4	2.4	−1.4	9.5	12.9	20.7
Service	−19.9	−11.4	−12.8	−6.0	7.9	6.4

Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. May/ORG CPS data for earnings years 1973–2009. See note to Fig. 13.

Table 3b

Table 4 Education distribution by occupation and gender in 1979 (Census data).

	< High school	High school	Some college	4-year college	Post-college
	A. Ten occupations				
All					
Managers	8.5	25.2	27.9	27.3	11.1
Professionals	3.1	8.5	20.7	36.6	31.1
Technicians	7.1	25.6	42.7	17.1	7.6
Sales	19.3	34.3	30.3	13.5	2.6
Office and admin	11.1	46.4	33.1	7.7	1.7
Production, craft and repair	31.2	43.5	20.1	4.2	1.0
Operators, fabricators and laborers	42.3	40.3	15.0	1.9	0.5
Protective service	17.6	34.0	37.0	9.1	2.3
Food prep, buildings and grounds, cleaning	45.0	30.5	21.2	2.5	0.7
Personal care and personal services	35.4	36.3	23.2	4.0	1.2

B. Four occupations

All					
Professional, Managerial, Technical	5.8	17.3	26.3	30.5	20.2
Clerical, Sales	14.1	42.0	32.1	9.8	2.0
Production, Operators	37.9	41.5	17.1	2.8	0.7
Service	38.6	33.0	23.6	3.8	1.1
Males					
Professional, Managerial, Technical	5.9	15.9	24.5	29.7	24.1
Clerical, Sales	14.9	30.6	33.2	17.2	4.1
Production, Operators	36.2	41.4	18.5	3.1	0.7
Service	37.8	28.2	27.3	5.0	1.7
Females					
Professional, Managerial, Technical	5.7	19.2	28.7	31.4	14.9
Clerical, Sales	13.7	47.3	31.5	6.4	1.1
Production, Operators	44.3	42.1	11.4	1.8	0.4
Service	39.1	36.3	21.1	2.9	0.6

Source: Census IPUMS 5 percent samples for years 1960, 1970, 1980, 1990, and 2000, and Census American Community Survey for 2008. See note to Tables 3a and 3b.

Table 4

3. THE CANONICAL MODEL

Tinbergen (1974, 1975)

Welch (1973)

Murphy (1992)

Table 5a Means and standard deviations of DOT and O*NET task measures for four broad occupational groups in 1980 Census.

	Professional, Managerial, Technical	Clerical, Sales	Production, Operators	Service
	Males and females combined			
Non-routine cognitive				
DOT abstract (non-routine cognitive)	1.12	−0.27	−0.53	−0.71
	(0.81)	(0.61)	(0.68)	(0.28)
O*NET non-routine cognitive analytic	1.19	−0.30	−0.38	−0.93
	(0.43)	(0.69)	(0.67)	(0.98)
O*NET non-routine cognitive interpersonal	1.03	−0.34	−0.38	−0.42
	(0.87)	(0.65)	(0.82)	(0.75)
Routine cognitive and manual				
DOT routine	−0.41	0.27	0.41	−0.65
	(0.91)	(1.10)	(0.84)	(0.58)
O*NET routine cognitive	−0.23	0.45	0.19	−0.52
	(0.81)	(1.09)	(0.69)	(0.91)
O*NET routine manual	−0.86	−0.48	0.98	0.05
	(0.57)	(0.64)	(0.66)	(0.69)
Non-routine manual				
DOT Non-routine manual	−0.28	−0.77	0.62	0.40
	(0.70)	(0.24)	(1.10)	(0.99)
O*NET Non-routine manual	−0.81	−0.59	0.95	0.14
	(0.55)	(0.51)	(0.76)	(0.47)
Offshorability				
O*NET offshorability	0.24	0.61	−0.58	−0.35
	(1.04)	(0.81)	(0.83)	(0.78)
# of Detailed occupations	106	51	127	34

Source: O*NET and DOT. Task measures are constructed according to the procedure in the Data Appendix.

Table 5b Means and standard deviations of DOT and O*NET task measures by education level in 1979 Census.

	All	< High school	High school	Some college	4-year college	Post-college
			A. Males			
Non-routine cognitive						
DOT abstract (non-routine cognitive)	0.08	−0.43	−0.18	0.15	0.84	1.01
	(1.05)	(0.79)	(0.91)	(1.02)	(1.02)	(0.93)
O*NET non-routine cognitive analytic	0.09	−0.44	−0.15	0.16	0.78	1.20
	(0.98)	(0.83)	(0.84)	(0.91)	(0.81)	(0.72)
O*NET non-routine cognitive interpersonal	0.07	−0.34	−0.13	0.13	0.63	0.86
	(1.03)	(0.89)	(0.96)	(1.01)	(1.00)	(0.91)
Routine cognitive and manual						
DOT routine	−0.06	0.09	0.09	−0.09	−0.36	−0.51
	(0.94)	(0.90)	(0.94)	(0.96)	(0.89)	(0.83)
O*NET routine cognitive	−0.06	0.02	0.04	−0.02	−0.22	−0.45
	(0.85)	(0.82)	(0.83)	(0.88)	(0.84)	(0.81)
O*NET routine manual	0.09	0.63	0.39	−0.06	−0.70	−0.91
	(1.03)	(0.87)	(0.95)	(0.96)	(0.77)	(0.68)
Non-routine manual						
DOT Non-routine manual	0.15	0.50	0.31	0.03	−0.32	−0.32
	(1.09)	(1.14)	(1.14)	(1.06)	(0.80)	(0.70)
O*NET Non-routine manual	0.21	0.72	0.52	0.09	−0.61	−0.77
	(1.06)	(0.92)	(0.99)	(0.99)	(0.77)	(0.69)
Offshorability						
O*NET Offshorability	−0.17	−0.40	−0.37	−0.12	0.37	0.20
	(0.99)	(0.79)	(0.94)	(1.05)	(1.00)	(0.96)

B. Females

Non-routine cognitive						
DOT abstract (non-routine cognitive)	−0.19	−0.57	−0.31	−0.10	0.36	0.67
	(0.84)	(0.68)	(0.75)	(0.81)	(0.91)	(0.94)
O*NET non-routine cognitive analytic	−0.12	−0.71	−0.31	0.01	0.78	1.12
	(1.02)	(0.98)	(0.87)	(0.91)	(0.86)	(0.72)
O*NET non-routine cognitive interpersonal	−0.06	−0.42	−0.29	0.00	0.75	1.02
	(0.95)	(0.79)	(0.79)	(0.92)	(1.01)	(0.87)
Routine cognitive and manual						
DOT routine	0.17	0.05	0.34	0.33	−0.30	−0.64
	(1.07)	(0.96)	(1.05)	(1.09)	(1.06)	(0.87)
O*NET routine cognitive	0.25	0.11	0.42	0.41	−0.13	−0.51
	(1.02)	(0.99)	(1.01)	(0.99)	(0.99)	(0.83)
O*NET routine manual	−0.20	0.38	−0.12	−0.36	−0.79	−1.01
	(0.92)	(1.00)	(0.88)	(0.73)	(0.71)	(0.60)
Non-routine manual						
DOT Non-routine manual	−0.31	−0.05	−0.44	−0.40	−0.16	−0.15
	(0.76)	(0.82)	(0.71)	(0.74)	(0.77)	(0.73)
O*NET non-routine manual	−0.44	−0.03	−0.40	−0.52	−0.84	−0.98
	(0.68)	(0.63)	(0.67)	(0.60)	(0.61)	(0.58)
Offshorability						
O*NET offshorability	0.25	0.20	0.37	0.20	0.12	0.09
	(1.00)	(0.87)	(0.95)	(1.13)	(1.04)	(0.84)

Source: O*NET and DOT. Task measures are constructed according to the procedure in the Data Appendix.

Table 5b

Table 6 Decomposition of changes in the share of employment in four occupational categories by decade (percentage points) due to changes in industry shares and changes in occupational shares within industries, 1959-2007.

	Changes by decade				Long changes (decadal means)		
	1959-1969	1969-1979	1979-1989	1989-1999	1999-2007	1959-1979	1979-2007
A. Males							
Professional, Managerial, and Technical Occs (non-routine cognitive)							
Total Δ	2.21	1.06	2.14	2.92	0.18	1.63	2.28
Industry Δ	1.81	0.90	0.49	0.80	0.13	1.35	0.61
Occupation Δ	0.40	0.16	1.65	2.12	0.05	0.28	1.68
Clerical, Administrative, and Sales Occs (routine cognitive)							
Total Δ	0.26	0.29	2.23	−0.56	−0.07	0.28	0.95
Industry Δ	0.23	0.05	0.72	−0.16	−0.03	0.14	0.31
Occupation Δ	0.03	0.25	1.51	−0.40	−0.05	0.14	0.63
Production, Craft, Repair and Operative Occs (routine manual)							
Total Δ	−4.21	−2.41	−5.92	−3.10	−2.22	−3.31	−5.10
Industry Δ	−2.59	−1.28	−1.89	−0.70	−0.81	−1.94	−1.56
Occupation Δ	−1.62	−1.13	−4.03	−2.39	−1.41	−1.37	−3.54
Service occupations (non-routine manual)							
Total Δ	1.74	1.06	1.55	0.74	2.11	1.40	1.88
Industry Δ	0.55	0.33	0.68	0.06	0.70	0.44	0.64
Occupation Δ	1.19	0.72	0.87	0.68	1.41	0.96	1.24

B. Females

Professional, Managerial, and Technical Occs (non-routine cognitive)							
Total Δ	1.23	5.19	6.70	4.34	1.90	3.21	5.86
Industry Δ	3.13	1.40	1.10	1.61	0.60	2.27	1.40
Occupation Δ	−1.91	3.79	5.60	2.73	1.30	0.94	4.46
Clerical, Administrative, and Sales Occs (routine cognitive)							
Total Δ	2.32	−0.73	−1.55	−3.95	−2.42	0.79	−3.18
Industry Δ	0.85	2.07	0.63	−0.55	−0.30	1.46	0.02
Occupation Δ	1.46	−2.80	−2.18	−3.40	−2.12	−0.67	−3.20
Production, Craft, Repair and Operative Occs (routine manual)							
Total Δ	−0.75	−2.79	−3.57	−1.81	−2.29	−1.77	−3.40
Industry Δ	−2.11	−1.95	−2.27	−1.36	−1.48	−2.03	−2.25
Occupation Δ	1.36	−0.83	−1.30	−0.44	−0.81	0.26	−1.15
Service occupations (non-routine manual)							
Total Δ	−2.79	−1.68	−1.59	1.41	2.81	−2.23	0.72
Industry Δ	−1.88	−1.51	0.54	0.30	1.18	−1.70	0.83
Occupation Δ	−0.91	−0.16	−2.12	1.11	1.63	−0.54	−0.11

Source: Census IPUMS 1960, 1970, 1980, 1990 and 2000, and American Community Survey 2008. Each set of three rows presents the change in the share of national employment (in percentage points) in the designated occupational category and time interval and decomposes this change into between and within-industry components. The decomposition uses 10 occupation and 11 industry groups that are harmonized for the full sample interval. See text for additional details.

Table 6

Table 7 Partial R-squared values of DOT and O*NET task and offshorability measures, net of quartic in potential experience.

	Offshorability (O*NET)	O*NET Tasks (5 Vars)	O*NET Tasks + Offshorability	DOT Tasks (3 Vars)	DOT Tasks + Offshorability
			A. Males		
1959	0.027	0.126	0.128	0.118	0.119
1969	0.035	0.126	0.129	0.116	0.116
1979	0.026	0.093	0.095	0.082	0.083
1989	0.055	0.168	0.172	0.152	0.152
1999	0.066	0.190	0.193	0.171	0.171
2007	0.079	0.236	0.239	0.212	0.212
			B. Females		
1959	0.025	0.224	0.225	0.194	0.198
1969	0.003	0.188	0.188	0.156	0.157
1979	0.000	0.142	0.142	0.115	0.115
1989	0.001	0.200	0.202	0.155	0.162
1999	0.001	0.216	0.217	0.173	0.180
2007	0.000	0.249	0.250	0.205	0.214

Source: O*NET, DOT and Census IPUMS 5 percent samples for years 1980, 1990, and 2000, and Census American Community Survey for 2008. See note to Fig. 17.