

Wage Scars and Human Capital Theory: Appendix

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Abstract

A large literature shows workers who are involuntarily separated experience wage scars: their hourly earnings fall initially by an average of 15.4% and remain much lower than their non-separated counterparts more than 20 years later. We find that this reduces average life-cycle wage growth by 14.7% and increases cross-sectional wage dispersion by 17.8%. We research variants of human capital theory capable of replicating scars, highlighting a tension in producing large, persistent wage scars alongside average life-cycle wage dynamics. An examination of labor market and demographic characteristics of workers who never recover suggests many theories of wage scars are operational, but on different groups of workers.

The full [manuscript](#) is available online and by clicking on the [manuscript](#) links.

1 Appendix

1.1 Data

We use the Panel Study of Income Dynamics (PSID) data through the 2015 wave of data. We restrict our sample to heads of households from the nationally-representative sample designed by the Survey Research Center. We use heads of household because the reason for job loss is only asked of heads for many years in the PSID sample and we need this question to isolate involuntary separations (the focus of this paper) from quits. We want to avoid issues of young workers exiting the workforce for more

education and we similarly want to avoid issues of older workers exiting the workforce to retire; therefore, we restrict our sample to 25 through 60 year old workers which is in line with sample restrictions for the literature as summarized in Table 1 of Couch and Placzek (2010)¹ We consider nominal wages above \$3.00, ignore top-coded wages and real wages above the top 0.034%(\$1,000 using the 2014 CPI-U as the base).² We require that any head in our sample meet these requirements at least three times.

1.2 Variable Construction Procedures

This section relates to the empirical analysis of PSID data explained in Sections 2 and 6 of the main text.

1.2.1 Hourly Earnings

The dependent variable for our equation is the natural log of real hourly earnings (w_t) in real 2014 dollars using the CPI-U. This variable comes from the question in the survey that asks heads of the household “What is your hourly wage rate for your regular work time?” (For example, this is variable V10466 or V10463 in the 1984 survey.) Starting in 1994, for those that give their response as an annual salary and do not have a value assigned for hourly earnings in the PSID, we adjust salary to an hourly rate using the same procedure as used in the PSID. For example, suppose the 1984 the correspondent responds to “How much is your salary?” The PSID³ then states, “The values for this variable represent dollars and cents per hour; if salary is given as an annual figure, it is divided by 2000 hours per year; if weekly, by 40 hours per week.” We ignore top-coded values for earnings in our estimation.

¹Our sample selection is similar to Stevens (1997). Couch and Placzek (2010) along with Jacobson, LaLonde, and Sullivan (1993) use bigger data sets with the requirement that workers have at least 6 years of tenure. We do not use this restriction.

²Our sample does not include workers who were separated before 1968.

³See the details of this question by clicking the [V10463](#) link.

1.2.2 Separation Dummy

A key independent variable is involuntary job loss at time $t - n$. To be involuntarily separated, the head of the household must meet specific criteria for having lost their previous job. The head of household is asked “Are you working now, unemployed, retired, or what?” We count the respondent as unemployed if they answer that they are “Looking for work, unemployed.” The head of the household is also asked “What happened to the job you had before—did the company fold, were you laid-off or what?” We count the head involuntarily separated if they answer that their last job loss occurred due to “Company folded, changed hands, moved out of town, employer died, went out of business” or due to being “Laid off, fired.”

We identify the year for separation in being the year the interview takes place for the unemployed head of household or in the previous year if the head of household is unemployed and its duration of unemployment went back to the previous year. If the head of the household is employed, we identify the year of separation as being that of the employment switch using the algorithm from Kambourov, G., & Manovskii, I. (2009). See the distribution of our separations in Table 1.

1.2.3 Duration of Unemployment

Duration of unemployment is constructed differently in the PSID for different waves of the data. From 1968 to 1975, the construction is done to create unemployed hours. Specifically, the PSID takes the days that the head of the household spent unemployed times eight. From 1976-1993, the construction for unemployed hours comes from the amount of weeks unemployed times forty. After 1993, the PSID provides measures of unemployment duration by day, week and month.

Our duration of unemployment variable considers days unemployed. As noted above, from 1968 to 1993 the PSID constructs hours of unemployment. We divide

this by eight to get days unemployed. The PSID’s calculation above puts a max of 260 days unemployed (52 weeks times 40 hours a week) until 1994. Therefore, we provide this same limit by normalizing unemployed time after 1993 to a 260 day work schedule by taking weeks unemployed by $260/52$ and months unemployed by $260/12$.

1.2.4 Education

The PSID reports years of education for the individual upon entering the sample with updates in 1975, 1985 and 2011. This can cause issues if an individual increases education between this time. One way to fix this, as done in Kambourov and Manovskii (2009), is to use the most recent reported education for all years. Instead, we decrease this by one for every year until reaching the original number. For example, if an agent reports of obtaining some graduate school in 1985, the education value is 17. If the individual only had a high school diploma in 1975, the education value in 1975 would be 12. We would then update education to be 16 in 1984, 15 in 1983, 14 in 1982 and 13 in 1981 before returning to the original PSID reported value of 12 in 1980.

1.2.5 Occupational and Industrial Codes

Our summary statistics for industry and occupation aggregate the three digit codes into broader categories similar to those provided by the PSID. The broad codes for industry by the PSID can be seen in figures 1 and 2. Our grouping for industrial codes are shown in Table 6. The broad codes for occupation by the PSID can be seen in figure 3. Our grouping for these codes follow that by the PSID closely and can be see in Table 7.⁴

⁴The mapping from the 1970 census occupational codes to the 2000 census occupation codes was less clear than that for industry. Therefore, our summary statistics only provide broad categories for occupation until 2001. These broad categories cover 196 of our 251 separated workers who recover and 104 of our separated workers who do not recover.

1.3 Computation

1.3.1 General Income Process (Section 3 of main text)

In this section we estimate the contribution of separation to moments of the wage distribution using a typical AR(1) wage process. Our goal is to replicate the PSID sample. As such we use the same sample size (7740) as the PSID, but work with a balanced panel as opposed to the unbalanced panel in the PSID. The time frequency is annual and all agents are simulated for 35 working years.

Targeted moments are listed in the main text. The weighting matrix used is similar to an identity matrix, but scales moments so they are all of a similar order of magnitude. The minimization routine implemented is Matlab’s genetic algorithm function. We use a constrained version limiting parameter values based on theory. For example, the persistence of the AR(1) process is restricted to be in (0,1) so that it is not a random walk. We stop the algorithm according to a function tolerance of $1e^{-4}$. Standard errors are calculated over 200 trials with new seeds.

1.3.2 Candidate Models (Sections 4 and 5 of main text)

In this section we estimate candidate models to replicate the wage scar. The first set of estimates target only moments related to the wage scar while the second set of estimates additionally targets moments related to cross-sectional and life-cycle wage outcomes for both stayers and those experiencing a separation.

Targeted moments are listed in the main text. The weighting matrix used is similar to an identity matrix, but scales moments so they are all of a similar order of magnitude. The minimization routine implemented is Matlab’s Nonlinear equation solver function “`fmincon`”. We use a constrained version limiting parameter values according to theory. For example, probabilities are limited to be in $[0.001, 0.99]$. We stop the algorithm according to a function tolerance of $1e^{-6}$.

1.4 Appendix Tables and Figures

Table 1: Separation Distribution

Separated	Never	One Time	Two Times	Three Times	Four Times	Five+ Times
Workers	3,394	1,124	518	233	130	106
Observations	26,111	9,597	4,874	2,453	1,416	1,119

Table 2: Industry Distribution

	Not Separated	Recover Before	Recover After	Do Not Recover Before	Recover After
Agriculture	1.2%	0.0%	1.2%	1.7%	2.4%
Mining	0.6%	1.4%	2.8%	0.8%	1.1%
Construction	7.9%	11.5%	12.0%	6.2%	4.7%
Manufacturing	25.3%	28.2%	26.5%	19.3%	19.9%
Transportation	9.6%	7.2%	7.2%	4.1%	3.5%
Trade	11.5%	10.1%	8.4%	24.3%	29.2%
Finance	3.9%	7.2%	8.5%	6.2%	3.0%
Low Service*	7.8%	10.5%	8.0%	19.4%	14.1%
High Service*	22.5%	18.2%	15.8%	16.1%	19.0%
Public Admin	9.7%	5.7%	9.6%	2.1%	3.2%

“Recover” (“Do Not Recover”) refers to workers in the top-quartile (bottom-quartile) of post separation residual wages.

*Low Service includes the industry for business, personal and recreational services.

*High Service includes the industry for professional services.

Table 3: Additional Results for the Coefficients from Equation 1

Union Participation	0.12590*** (0.006)
No HS Diploma	0.01072 (0.0121)
Some College	0.00860 (0.0099)
College Degree	0.09714*** (0.0127)
Graduate School	0.09550*** (0.0116)
Experience	0.01356*** (0.0008)
Exp^2	-0.00039*** (0.0000)
Separated 2x (at Least)	-0.10550*** (0.0099)
Separated 3x (at Least)	-0.05534*** (0.0131)
Separated 4x (at Least)	-0.10850*** (0.0172)
Separated 5x (at Least)	-0.09022*** (0.0244)
Observations	45,570
Workers	5,505
F	50.20
R-Squared Within	0.1310
R-Squared Between	0.1037
R-Squared Overall	0.1343

Standard errors in parentheses.

*Denotes statistical significance at the 10% level.

**Denotes statistical significance at the 5% level.

***Denotes statistical significance at the 1% level.

Table 4: Family Characteristics

	Not Separated	Separated Before	After	Recover Before	After	Do Not Before	Recover After
Married	74.0%	72.8%	71.2%	82.5%	84.7%	54.0%	47.0%
with Child*	55.6%	62.4%	54.0%	61.9%	53.3%	61.5%	49.8%
Youngest Age Child**	6.8	5.8	7.6	5.6	7.8	6.5	6.9
Number of Children**	1.9	2.0	2.0	2.0	2.0	1.9	2.0

“Recover” (“Do Not Recover”) refers to workers in the top-quartile (bottom-quartile) of post separation residual wages.

*This number can decrease due to a child’s age reaching 18.

**These averages are conditional on having one child.

Table 5: Moving Statistics

	Not Separated	Separated	Recover	Do Not Recover
Moved	48.1%	45.4%	42.7%	46.5%
Moved States	8.8%	10.4%	10.2%	5.5%
Moved Regions	8.6%	7.7%	7.6%	4.5%

“Recover” (“Do Not Recover”) refers to workers in the top-quartile (bottom-quartile) of post separation residual wages.

Table 6: Construction of Broad Industrial Codes

	3 Digit 1970 Census Code	3 Digit 2000 Census Code
Agriculture	17 - 28	17 - 29
Mining	47 - 57	37 - 49
Construction	67 - 77	77
Manufacturing	107 - 398	107 - 399
Transportation	407 - 479	607-639, 57-69
Trade	507 - 698	407-459, 467-579
Finance	707 - 718	687-719
Low Service	727 - 759, 769-798, 807-809	647-679, 757-779, 856-859, 866-869, 877-889, 897-907, 909
High Service	828 - 897	727-749, 786-847, 908, 916-929
Public Admin	907 - 937	937-987

Figure 1

ER21146 BC21 MAIN IND FOR JOB 1: 2000 CODE (HD)					
BC21. What kind of business or industry (is/was) that in?--CURRENT OR MOST RECENT MAIN JOB					
The 3-digit industry code from 2000 CENSUS OF POPULATION AND HOUSING: ALPHABETICAL INDEX OF INDUSTRIES AND OCCUPATIONS issued by the U.S. Department of Commerce and the Bureau of the Census was used for this variable. Please refer to www.census.gov/hhes/www/iaindex/iaindex.html for complete listings.					
N	Minimum	Maximum	Mean	Std Dev	Excluding Values
6359	17.00	987.00	577.88	291.88	0, 848, 999
Count	%	Value/Range Text			
168	2.15	17 - 29 Agriculture, Forestry, Fishing, and Hunting			
40	.51	37 - 49 Mining			
77	.98	57 - 69 Utilities			
558	7.13	77 Construction			
997	12.75	107 - 399 Manufacturing			
234	2.99	407 - 459 Wholesale Trade			
587	7.50	467 - 579 Retail Trade			
382	4.88	607 - 639 Transportation and Warehousing			
179	2.29	647 - 679 Information			
236	3.02	687 - 699 Finance and Insurance			
125	1.60	707 - 719 Real Estate and Rental and Leasing			
284	3.63	727 - 749 Professional, Scientific, and Technical Services			
269	3.44	757 - 779 Management, Administrative and Support, and Waste Management Services			
400	5.11	786 - 789 Educational Services			
586	7.49	797 - 847 Health Care and Social Assistance			
109	1.39	856 - 859 Arts, Entertainment, and Recreation			
343	4.39	866 - 869 Accommodations and Food Services			
315	4.03	877 - 929 Other Services (Except Public Administration)			
470	6.01	937 - 987 Public Administration and Active Duty Military			
83	1.06	999 NA; DK			
1,379	17.63	0 Inap.: did not work for money in 2002 or has not worked for money since January 1, 2001 (ER21127=5, 8, or 9)			
1	.01	848 Wild code			
Years Available: [03]ER21146 [05]ER25128 [07]ER36133 [09]ER42168 [11]ER47480					
Index Summary: Family Public Data Index 01>WORK 02>Industry 03>present or last main job 04>3-digit 2000 census code 05>head:					

Table 7: Construction of Broad Occupational Codes

3 Digit 1970 Census Code	
Technical	1 - 195
Management	201 - 245
Sales	260 - 285
Clerical	301 - 395
Craftsman	401 - 600
Operatives	601 - 695
Transport	701 - 715
Laborers	740 - 785
Farm Work	801 - 824
Service	901 - 965
Housework	980 - 984

Figure 2

ER17227 B10 MAIN INDUSTRY: 3 DIGIT (HD-E)						
B10. What kind of business or industry is that in?						
The 3-digit industry code from 1970 Census of Population; Alphabetical Index of Industries and Occupations issued June 1971 by the U.S. Department of Commerce and the Bureau of Census was used for this variable. Please refer to Appendix V2, Wave XIV (1981) documentation, for complete listings.						
N	Minimum	Maximum	Mean	Std Dev	Excluding Values	
5596	17.00	937.00	549.49	297.38	0, 999	
Count	%	Value/Range Text				
185	2.50	17 - 28 Agriculture, Forestry, and Fisheries				
29	.39	47 - 57 Mining				
512	6.91	67 - 77 Construction				
1,046	14.12	107 - 398 Manufacturing				
510	6.89	407 - 479 Transportation, Communications, and Other Public Utilities				
863	11.65	507 - 698 Wholesale and Retail Trade				
284	3.83	707 - 718 Finance, Insurance, and Real Estate				
444	6.00	727 - 759 Business and Repair Services				
172	2.32	769 - 798 Personal Services				
72	.97	807 - 809 Entertainment and Recreation Services				
1,023	13.81	828 - 897 Professional and Related Services				
456	6.16	907 - 937 Public Administration				
47	.63	999 NA; DK				
1,763	23.81	0 Inap.: not working for money now				
Years Available:	[81]V7713 [82]V8381 [83]V9012 [84]V10461 [85]V11652 [86]V13055 [87]V14155 [88]V15163 [89]V16664 [90]V18102 [91]V19402 [92]V20702 [93]V22457 [94]ER4018 [95]ER6858 [96]ER9109 [97]ER12086 [99]ER13216 [01]ER17227					
Index Summary:	Family Public Data Index 01>WORK 02>Industry 03>present main job 04>3-digit 1970 census code 05>head:					

Figure 3

ER17227 B10 MAIN INDUSTRY: 3 DIGIT (HD-E)						
B10. What kind of business or industry is that in?						
The 3-digit industry code from 1970 Census of Population; Alphabetical Index of Industries and Occupations issued June 1971 by the U.S. Department of Commerce and the Bureau of Census was used for this variable. Please refer to Appendix V2, Wave XIV (1981) documentation, for complete listings.						
N	Minimum	Maximum	Mean	Std Dev	Excluding Values	
5596	17.00	937.00	549.49	297.38	0, 999	
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29	.39	47 - 57 Mining				
512	6.91	67 - 77 Construction				
1,046	14.12	107 - 398 Manufacturing				
510	6.89	407 - 479 Transportation, Communications, and Other Public Utilities				
863	11.65	507 - 698 Wholesale and Retail Trade				
284	3.83	707 - 718 Finance, Insurance, and Real Estate				
444	6.00	727 - 759 Business and Repair Services				
172	2.32	769 - 798 Personal Services				
72	.97	807 - 809 Entertainment and Recreation Services				
1,023	13.81	828 - 897 Professional and Related Services				
456	6.16	907 - 937 Public Administration				
47	.63	999 NA; DK				
1,763	23.81	0 Inap.: not working for money now				
Years Available:	[81]V7713 [82]V8381 [83]V9012 [84]V10461 [85]V11652 [86]V13055 [87]V14155 [88]V15163 [89]V16664 [90]V18102 [91]V19402 [92]V20702 [93]V22457 [94]ER4018 [95]ER6858 [96]ER9109 [97]ER12086 [99]ER13216 [01]ER17227					
Index Summary:	Family Public Data Index 01>WORK 02>Industry 03>present main job 04>3-digit 1970 census code 05>head:					