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ABSTRACT

Recessions and Occupational Match Quality: The Role of Age, Gender, and Education

Although the adverse labor market effects of economic recessions have been well documented, a notable omission in the literature is how recessions impact workers' job match quality. This paper considers the short and longer-term losses in productivity associated with the job changing brought in train by the two most recent recessions. Changes in match quality are the mechanism, with dislocated workers being reemployed in jobs for which they are more mismatched. Using monthly data from the 1979 and 1997 cohorts of the National Longitudinal Survey of Youth and the Current Population Survey (CPS), we document direct changes in occupational match quality and the associated changes in wages. We first investigate how workers' match qualities change over the lifecycle and report that the total amount of mismatch averaged over all workers of the younger cohort actually decreased through time. For the older cohort, we then explore the role of age, education, gender, and occupational task groups. Economic recessions are shown to disproportionately harm the match quality of mid-aged workers versus that of young workers; to have more serious consequences for the match quality of men than women, especially highly educated men; and lead to occupational polarization, thereby amplifying the skill mismatch of mid-aged workers.

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1 Introduction

The adverse effects of economic recessions on the labor market have been well documented in the literature in studies mostly focusing on the quantity of employment, such as labor force participation rates, employment and unemployment rates, unemployment duration, and earnings losses. However, some crucial issues have been missing from the big picture. One omission has been the manner in which economic recessions impact workers' job match quality. Although some research has sought to measure the contribution of mismatch to output loss and to the rise in U.S. unemployment, there is a dearth of knowledge on job mismatch as a consequence of cyclical conditions. For instance, Sahin et al. (2014) examine how the mismatch between vacancies and job seekers translates into higher unemployment by lowering the aggregate job finding rate.[1] The authors argue that sectoral mismatch (across industries and three-digit occupations) explains approximately one-third of the rise in the U.S. unemployment rate around the Great Recession, namely between 2006 and end-2009. Further, Sahin et al. argue that the problem of mismatch – construed as searching for jobs in the wrong sectors – is nontrivial for higher-skill workers. To complicate matters, however, Hotchkiss et al. (2014) report that the increased schooling share among 25- to 54-year-old labor force leavers in the aftermath of the Great Recession is not to be viewed as a need to realign skills as it did not characterize those most adversely impacted by that recession. Rather, that development is attributed to a cyclical decline in labor market opportunity costs. One might thus characterize the evidence of the effects of last economic recession on mismatch as not only indirect and sparse but also mixed.

For their part, studies of recession effects have often tended to focus on the situation confronting labor market entrants. The adverse longer-term consequences for the earnings of graduates of interruptions in the initial process of career progression have received much attention (e.g., Kahn, 2010) at the same time as other research has suggested that poorly educated workers may be even more seriously at risk from recessions (Hoynes et al., 2012). A recent study by Schwandt and von Wachter (2018), in examining the persistence of these effects among all young workers who entered the U.S. labor market over 1976-2015, reports finds evidence of a continuing reduction in earnings, employment, and wages from labor market entry during recessions that lasts for at least 10 years. These losses are shown to be larger for the least advantaged labor market

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[1] See also Garibaldi et al. (2020).

entrants – high school dropouts and nonwhites – plus high school graduates. Yet, as the authors admit, the sources remain opaque. They do make mention of a reduction in employer quality in the case of college graduates, noting that employment fluctuations are more pronounced at higher-paying employers leading to cyclical downgrading. However, not only the sources but also the periodicity of the disadvantage of these 'unlucky cohorts' are at issue.

In contrast with the now extensive studies on young and less educated workers, much less attention has been accorded mid-aged and highly educated workers. Is their job match quality less adversely impacted by recessions? Or do these workers suffer some less obvious costs from recessions? Again, there is surprisingly little analysis of the labor market performance of mid-aged workers over the course of economic recessions.

Job mismatch has also figured lightly in gender analyses of the impact of the recession. Most research has focused on the emerging absence of a gender gap in unemployment since the early 1980s.[2] What we see is an unequal effect on male unemployment over the cycle: the "mancession" phenomenon. At issue is whether this process advantages women (the segmentation argument) or disadvantages them (the buffer argument). One predominant strand of research suggests that, on net, the buffer effect seems to dominate, such that periods of economic decline actually interrupt a trend toward decreasing occupational segregation (e.g. Banzak et al., 2012). On this view, recessions have no gender silver lining; that is, they impede rather than facilitate the gender integration of occupations.[3]

Direct examination of match quality is confined to the most recent additions to the literature on job matching and wage growth. The two formative studies chart occupational mismatch based on the discrepancy between the portfolio of skills required by an occupation and the array of abilities possessed by the worker for learning those skills, but confine their attention to male workers (see Guvenen et al., 2018; Lise and Postel-Vinay, 2016). However, in the tradition of these studies, Addison et al. (2020) have subsequently reported distinct gender differences in match quality and changes in match quality over the course of a career. They also report that a substantial portion of the gender wage gap stems from match quality differences among the college

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[2] Differences between men and women in respect of the flows between unemployment and inactivity also appear to have disappeared; but see Tüzemen and Tran (2019).

[3] For research on the responsiveness of gender wage differences to the cycle, see Elsby et al. (2016).

educated. That being said, we are unaware of any evidence on gender differences in occupational match qualities over economic recessions.

The present study attempts fill in some of the missing gaps in the literature by presenting new evidence integrating occupational match quality, the role of cycle, age, gender, education, and occupation. Mainly using monthly data from the 1979 cohort of the National Longitudinal Survey of Youths (NLSY79) and the Current Population Survey (CPS), we document direct changes in occupational match quality.[4] Our particular focus is upon the 2001 recession (from March 2001 to November 2001). We frame our analysis within this time period principally to examine whether the longer and more severe recession also had stronger negative effects on workers' match quality and how these effects varied across age, gender, education, and occupational groups.

The main implication of this study is that workers' occupational match quality is adversely affected by economic downturns in a manner that is not captured by traditional indicators such as unemployment rate. As the worst-matched workers are among the first to lose their jobs, the average amount of mismatch actually declines when the unemployment rate rises. The amount of mismatch then increases during the recovery period as workers are reemployed but most of whom are unable to find well-matched occupations. We also find that match quality deterioration is associated with wage loss. Specifically, a rise in the amount of mismatch is generally accompanied by a fall in the wage residuals, suggesting that the wage loss after economic recessions is attributable to the rise in skill mismatch.

The specifics of how changes in match quality throughout recession are related to an individual's age, gender, education, and occupational task groups are as follows. First, we document that economic recessions have disparate effects on the match quality of mid-aged workers versus that of young workers. Young workers' match qualities do not appear to be severely impacted by recessions. Although they are more likely to lose jobs when labor market is in retreat, they also have an opportunity to time their participation and the option to acquire new skills. In contrast, we report that the match quality of mid-aged workers substantially deteriorates in the wake of recession, and especially after the recession of 2001. Even though they are more likely to stay employed than young workers, this is achieved at the cost of occupational match quality as

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[4] Data from the NLSY97 are also used to establish whether the impact of the two recessions and their aftermath on match quality differed for a younger cohort of workers.

reflected in more frequent job changes during and shortly after recessions with both short and longer-term consequences.

Second, with respect to gender and educational differences, we find that economic recessions have more serious consequences for the match quality of men than women, and especially for highly educated men. The implication is that economic recessions are "mancessions" and that a loss of match quality is a hidden toll of that phenomenon. Moreover, among the mid-aged population, we find that irrespective of gender college-educated individuals suffer a greater loss in match quality in the wake of economic downturns than their less-educated counterparts, even though their employment status is less affected by recessions.

Finally, our analysis reveals that most of the mismatch for mid-aged workers can be attributed to *downskilling*. That is, the cycle amplifies occupational polarization or the hollowing out of job quality. With polarization has come a greater sliding down the job ladder on the part of mid-aged workers, with growing mismatch in the middle and low-skill occupations. Specifically, we observe a distinct flow of workers from non-routine cognitive occupations before the recession to non-routine manual occupations after the recession.

2 Data and Methodology

2.1 *Data Sources and Sample Construction*

Our primary data set is the 1979 cohort of the National Longitudinal Survey of Youth (NLSY), namely the NLSY79 which provides a nationally representative panel of data for the cohort of individuals aged 14 to 22 years in 1979. For part of our analysis, we also incorporate data from the younger NLSY cohort, the NLSY97, which comprises a panel of individuals who were aged 12 to 17 years in 1997. Both cohorts were initially interviewed annually – the NLSY79 until 1994 and the NLSY97 until 2011 – but are now followed biennially. We restrict our sample to the core samples of both surveys, thereby excluding the military as well as the oversample of Hispanic, black, and low-income youth. We exploit the long panel nature of the NLSY set to study the life cycle effects of recessions. Furthermore, both data sets also allow us to track workers' actual labor market experience and control for their multi-dimensional skill endowments, information on which is simply unavailable in other comparable panel data sets.

We concentrate on two recessions experienced by the NLSY cohorts. Our observation period begins one year before the start of the 2001 recession and extends several years beyond the

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end of the Great Recession. The first recession lasted from March 2001 through November 2001, during which period members from the NLSY79 cohort were around 37-44 years old (and those from the NLSY97 cohort were aged 17-21 years). For its part, the Great Recession lasted from December 2007 through June 2009. During this interval, the NLSY79 cohort comprised 43 to 52-year-olds (and the NLSY97 cohort were around 23 to 29 years old). A comparison of these two recessions enables us to incorporate age and career stage into our analysis. Moreover, it also highlights the importance of considering job match-quality dynamics, in addition to statistics on employment and wages, in assessing the *toll of recessions*.

Given that the NLSY cohorts are aging and are not necessarily nationally representative of the labor force in any given year,[5] we use data from the monthly Current Population Survey (CPS) to introduce 'snapshots' of nationally representative employment statistics. Their inclusion helps verify that the employment patterns we observe in the NLSY data for each age cohort are comparable to those of their national-level counterparts, demonstrating that our analysis is generalizable.

We also utilize the data from the Annual Social and Economic Supplement (ASEC) of the CPS to trace workers' job mobilities around the same period. The ASEC supplement contains a question (since 1976) asking how many employers an individual had during the previous year, not counting jobs held simultaneously.[6] The response is coded as alternately zero, one, two, and three-or-more jobs. Based on this question, we construct a lower-bound measure[7] of the fraction of individuals who changed jobs each year; this estimate is calculated as the number of individuals reporting more than one job divided by the number of employed individuals.

2.2 *The Measurement of Mismatch*

We define workers' skill mismatch as the discrepancy between their premarket skill levels and the requirements of the occupations in which they are currently employed. We consider four skill

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[5] Even if they are nationally representative of the age cohorts sampled at the beginning year of each survey.

[6] In other words, dual jobholders are not counted as having multiple jobs. The guiding principal is to derive a measure of the number of primary jobs held.

[7] This is a lower bound estimate because some individuals may have lost a job they had held all year shortly before the year in question ended and did not find a job until early in the following year. These individuals would be counted as non-changers, although the jobs they held did end (Farber 1999).

dimensions in our analysis: mathematical, verbal, science/technological/ mechanical (STM), and social. To link the skill supply side (workers' endowments) with the demand side (occupational requirements), we exploit the tools developed by the ASVAB Career Exploration Program.[8]

Workers' skill endowment measures are derived from the NLSY data sets. Following the strategies of Deming (2017a and 2017b) and Guvenen et al. (2018), we converted standard scores for each skill dimension in to percentile ranks. These range between 0 and 1; that is, from 0 to 100 percentile, where, for example, 0.75 refers to the 75th percentile. Occupational requirements are derived from the O*NET database. In our analysis, every occupation is defined by the combination of knowledge, skills and abilities (KSAs) it requires. We create percentile ranks for skill requirements among all occupations after mapping ONET characteristics to skill categories using DOD guidelines.[9]

The extent of skill-mismatch is measured as the absolute value of the differences between the percentile-rank scores of an individual's skill endowments and the percentile-rank scores of skills required in that individual's occupation. Specifically, let A_{ij} represent individual i's percentile-rank-scores in the ASVAB test for skill j (where j denotes mathematical, verbal, STM skills and social skills). Recall that A_{ij} does not vary by year or an individual's occupation. Let R_{ijc} denote individual i's O*NET occupational requirements for skill j in occupation c. In any occupation, for any particular skill, the amount of mismatch (the degree of skill mismatch for individual i for skill j in occupation c) is:

$$q_{ijc} = |A_{ij} - R_{ijc}|.$$

The total mismatch measure is then calculated as:

$$q_i = \sum q_{ijc} = \sum |A_{ij} - R_{ijc}|,$$

such that the lower the value of q's across all four dimensions, the better the skills are matched. This aggregate mismatch measure is our primary outcome variable in the empirical application. In generating this measure, we used equal weights for all skills. (Note, however, that our results were not sensitive to alternative weighting schemes.) For ease of interpretation, we rescaled this measure to have a standard deviation of one.

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[8]This program is administered by the Department of Defense (DoD) with a view to helping ASVAB participants identify and explore suitable career possibilities in the private, public, or military sectors.

[9] For details of the mapping strategy, see Addison et al. (2020).

2.3 *Econometric Specification*

Empirically, we first explore the evolution of mismatch and wages around the two recession periods. We document trends in mismatch and in other measures of labor market performance using a set of descriptive figures. In addition, we provide results from several econometric models in which we zero in on mismatch and its impact on wages controlling for other factors.

The main econometric specifications are as follows:

$$q_{it} = \beta_0 + \sum \beta_\tau d\tau_t + X'_{it}\gamma + u_{it} ,$$

$$LnW_{it} = \beta_0 + \sum \beta_\tau d\tau_t + Y'_{it}\gamma + u_{it}.$$

In the above specifications, q_{it} and LnW_{it} are outcome variables, namely the total amount of mismatch and log monthly wages for individual i at time t, respectively. $d\tau_t$ are the time dummy variables set equal to one if $t = \tau$, 0 otherwise. We divide the time around the recessions into five intervals: "1-6 months before the recession," "during the recession," "1-6 months after the recession," "7-12 months after the recession," and "13-18 months after the recessions". β_τ is the effect at time τ. We also account for observed differences between treatment and control periods by including observed controls X'_{it} and Y'_{it}. Specifically, the X'_{it} include an individual's characteristics (gender, race, years of schooling, marital status, average percentile ranks of skill endowments, the interaction term between the average percentile ranks of skill endowments and occupational tenure and occupational tenure squared), occupational characteristics (average percentile ranks of occupational skill requirements, tenure with current employer, weekly working hours, occupational task intensities), as well as the unemployment rate at the particular month. For their part, the Y'_{it} include all variables in X'_{it}, plus the one-digit occupation and industry groups. Based on this estimation, we then trace changes in mismatch and wages over the same periods conditional on unemployment, industry, occupation, and measures of human capital.

3 Results

3.1 *Recessions, Mismatch, and Earnings over the Life Cycle*

We begin by analyzing the impact of economic recessions on worker match quality over the life cycle for both NLSY cohorts. Figure 1 charts the course of workers' total amount of mismatch (mean) throughout the 2001 recession and the Great Recession, respectively. The findings are twofold. For the NLSY79 cohort, mismatch rose in the wake of the 2001-Recession, after which the average amount of mismatch plateaued through the Great Recession. In sharp contrast, the total

amount of mismatch averaged over all workers for the NLSY97 cohort decreased through time as its workers' careers developed.

Figure 1: Mismatch around the Recessions, NLSY79 and NLSY97

Notes: We plot the total amount of mismatch during and after the recessions for NLSY79 and 97 workers, respectively. The definition of the total amount of mismatch is provided in the Data and Methodology section of the paper.

Recall that NLSY97 respondents were young and at early career stages at the time of both recessions. Their occupational match quality was not significantly altered, implying that younger persons' match quality trajectories were not significantly affected by the economic recession. However, at the time of 2001-Recession, members of the NLSY79 cohort were aged between 37 and 44 and as such were in mid-career. Figure 1 illustrates that economic recessions had more adverse effects on match quality for mid-career workers than their younger counterparts. In what follows, therefore, we shall mainly focus on the NLSY79 cohort and examine how economic recessions impact its members' occupational match qualities.

Why might economic recessions more seriously impact mid-aged workers' match quality? One possible explanation is that mid-aged/mid-career workers have fewer options outside the labor market than young workers and/or constraints that prevent them from leaving the labor force. With the depreciation of family assets in economic recessions, job loss could be especially damaging for workers with family obligations, and this is likely to be the case for mid-aged workers. On the other hand, with elevated unemployment rates during an economic recession, many young workers may postpone search until a more propitious time and in the interstices opt for education. But the

struggle to stay employed on the part of mid-aged workers occurs at the cost of their employment stability and match quality. We will next argue that the CPS data contained in Figure 2 lends support to this argument.

Figure 2: Employment-to-Population Ratios and the Share of Job Movers among the Employed (Indexed to Pre-Recession Levels), by Age Groups, CPS Monthly Data


Notes: This graph is plotted based on the data from ASEC of the CPS. The employment-to-population ratio is defined as the number of employed workers divided by the number of the adult population in a particular year. This value is indexed to the year 2000, that is, the employment-to-population ratio in 2000 is set as 100. It follows that an index value of 110 then indicates an increase in employment to population ratio by 10% compared to the value in 2000 (the reference period). The Share of Job Movers is defined as the share of workers who had ever changed job once among the employed in a particular year. This value is also indexed to the year 2000.

Specifically, the first panel in Figure 2 shows the employment-to-population ratio (indexed to the pre-2001 recession levels) through the 2001 and 2008 recessions by broad age group; while the second panel captures the job mobility (or stability) of each age group again relative to pre-2001 recession levels. Compared with young workers (aged 25-34), mid-aged workers (workers aged 35 and above) were more likely to stay employed during and after both recessions. Observe that the recovery of employment after the 2001 recession started in 2002 for mid-aged workers (i.e. about a year after the recession) but not until 2003 for young workers. Compared with the recession of 2001, the recovery was much slower for both young and mid-aged workers after the Great Recession. These patterns reveal that compared with their younger counterparts mid-aged workers were more likely to remain employed and were more likely to become re-employed during economic downturns, even if neither group was as mobile as heretofore. Taken in conjunction with the material in Figure 1, we can reasonably infer that mid-aged workers stayed employed by moving jobs at the expense of their job match quality.

We would conclude that the number of job losses only tells a partial story of the cost of economic recessions. Workers' occupational match quality will also be adversely affected by economic downturns, and will not be captured by traditional labor market indicators (e.g. the labor force participation rate, the unemployment rate, and the employment-to-population ratio). Moreover, although the adverse effect of economic recession on match quality may be expected, it may not be immediately apparent how persistent the effects of mismatch can be. Furthermore, economic recessions have disparate impacts on mid-aged workers and young workers. On the one hand, young workers are more adversely affected by the poor labor market conditions in terms of their employment potential than mid-aged workers. However, recessions do not have a strong negative impact on match quality over the early career stages. On the other hand, recessions have the most considerable negative correlation with match quality during the mid-career years. Compared with young workers, mid-career workers do not have the option of withdrawing from the labor force during economic recessions. They stay employed at the costs of occupational match quality, as reflected in more frequent job changes during and shortly after recessions with long-term consequences. Once displaced, fewer outside options also inhibit mid-aged workers from finding well-matched occupations.

Figure 3: Mismatch and Residual Wages over Time (NLSY79)
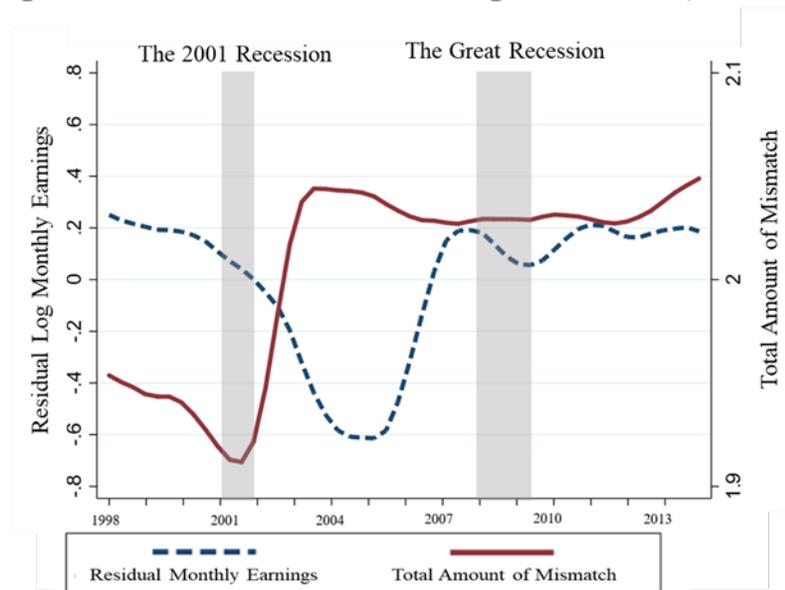
Notes: We obtained the residuals by regressing individual workers' log monthly nominal earnings on a series of variables excluding the mismatch measure, but including individuals' characteristics (gender, race, years of schooling, marital status, average percentile ranks of skill endowments, tenure with current employer, occupational tenure), occupational-specific characteristics (average percentile ranks of occupational skill requirements, weekly working hours, occupational-specific task intensities), as well as the unemployment rate at the particular month.

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Deteriorated match quality is associated with productivity loss. Figure 3 shows how mismatch is manifested in earnings. It plots the course of average mismatch and residual wages for the NLSY79 cohort from 1998 to 2013. Residual wages are that part of wages that cannot be explained by observed characteristics. Changes in residual wages over time reflect changes in unobserved productivity. As shown in the figure, a rise in the amount of mismatch is generally accompanied by a fall in the wage residuals, implying that the wage loss after economic recessions could be attributable to the rise in skill mismatch. The productivity loss associated with a deterioration in match quality persists for a long time after the 2001 recession. Indeed, the NLSY79 cohort was unable to fully regain its pre-recession level of match quality after the 2001 recession. Arguably, the Great Recession had permanently sidelined any such improvement for many in this cohort.

Table 1: Mismatch and Wage Earnings over the Recession Timeline
(Panel Data FE Estimates, NLSY79)

	Total Amount of Mismatch		Log of Monthly Wages	
	2001 Recession	2008 Recession	2001 Recession	2008 Recession
1-6 months before the recession	-0.009+	-0.002	-0.003	-0.028**
	[0.005]	[0.006]	[0.005]	[0.007]
1-6 months after the recession	0.020**	0.004	0.000	-0.002
	[0.006]	[0.004]	[0.006]	[0.004]
7-12 months after the recession	0.040**	0.014+	-0.079**	0.035**
	[0.011]	[0.008]	[0.015]	[0.007]
13-18 months after the recession	0.056**	0.006	-0.110**	0.051**
	[0.015]	[0.011]	[0.020]	[0.009]
Observations	110,088	130,798	113,974	135,182
Number of Individuals	4,217	3,892	4,377	4,043

Notes: In all specifications, the control variables include individual characteristics (gender, race, years of schooling, marital status, average percentile ranks of skill endowments, tenure with current employer, occupational tenure, the interaction term between average percentile ranks of skill endowments and occupational tenure); occupation-specific characteristics (average percentile ranks of occupational skill requirements, weekly working hours, occupational task intensity); and the unemployment rate in the month of observation. The coefficients are estimated based on an individual-fixed effects model. The baseline group is the period during the relevant recession. Standard errors in brackets are clustered at the individual level. ** $p<0.01$, * $p<0.05$, + $p<0.1$. Full results are available from the authors upon request

Using the monthly panel data in the NLSY79, we also estimate models of mismatch and earnings in which we seek to unravel the timeline of mismatch and wage effects. Table 1 reports the mismatch estimates and provides regression results for nominal monthly log earnings. In

estimating the mismatch effects, the vector of control variables include individual characteristics (gender, race, years of schooling, marital status, average percentile ranks of skill endowments, the interaction term between average percentile ranks of skill endowments and occupational tenure), occupational-specific characteristics (occupational tenure, average percentile ranks of occupational skill requirements, tenure with the current employer, weekly working hours, occupational-specific task intensities), and the unemployment rate. In estimating the wage effects, in addition to the above-mentioned variables, we also control for one-digit occupation and industry groups.

Table 1 reveals that both mismatch and the wage penalty associated with the 2001 recession significantly increase throughout the post-recession period, even after controlling for worker and occupation characteristics. The Great Recession seems to have arrived while the NLSY79 cohort was still recovering from the mid-career recession they had earlier experienced.

3.2 *Mismatch and Conventional Cyclical Indicators*

The labor force participation rate and the unemployment rate are the most widely recognized indicators of the severity of economic recessions. In this sub-section, we explore the association between mismatch and these conventional cyclical indicators. Now using monthly CPS data,


Figure 4: The Labor Force Participation Rate and Unemployment Rate around the Recessions, CPS Monthly Data
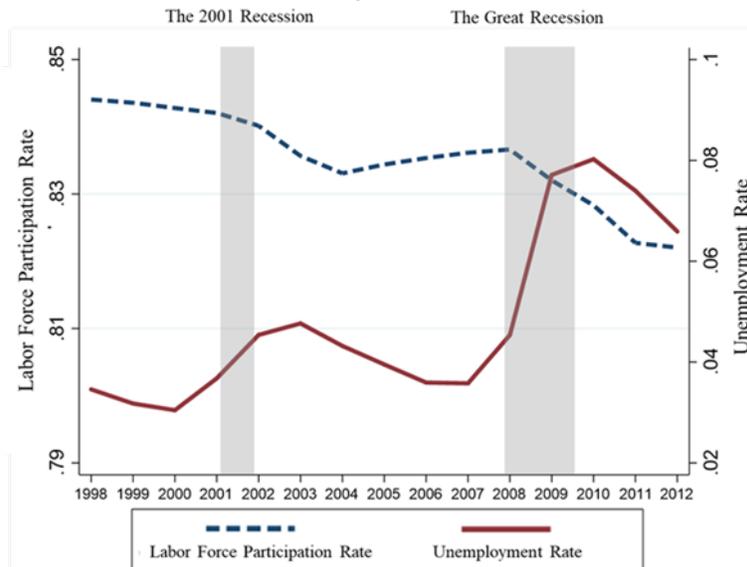
Notes: Based on CPS monthly data, we plot the labor force participation rate and unemployment rate around the recessions for CPS workers. The labor force participation rate is calculated as the number of workers in the labor force divided by the total amount of adult population for a particular month. The unemployment rate is calculated as the number of workers reported as unemployed divided by the total number of workers in the labor force for a particular month.

Figure 4 presents the course of the labor force participation rate and the unemployment rate of prime-aged individuals (25-55 years) over an extended interval including the 2001 recession and the Great Recession. While the labor force participation rate decreased somewhat after the Great Recession, the unemployment rate was much higher in the wake of the Great Recession than the 2001 Recession. That is, the Great Recession had a more adverse impact than the 2001 recession from the perspective of the traditional labor market indicators.

Figure 5: The Unemployment Rate and Mismatch around the Recessions, NLSY79
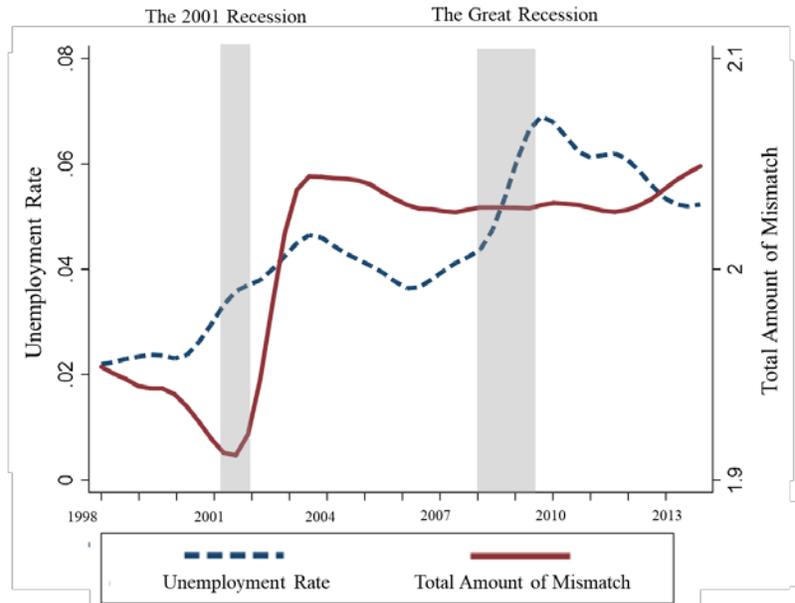

Notes: In this graph, we plot NLSY79 workers' unemployment rate and total amount of mismatch during and after the recessions. The unemployment rate is calculated as the number of workers reported as unemployed divided by the total number of workers in the labor force for a particular month. The definition of the total amount of mismatch is provided in the Data and Methodology section of this paper.

However, changes in worker match qualities tell a different story: mismatch fell during recessions and it rose at the start of the recovery period when unemployment began to fall. Figure 5 charts the extent of mismatch and the unemployment rate for NLSY79 workers across the two economic recessions. We observe a decrease in the amount of mismatch at the beginning of economic recessions when the unemployment rate started to rise. As the Great Recession had a more significant impact on the labor market than the 2001 recession, it took longer for the labor market to recover, and as a result we do not see an increase in the amount of mismatch until the year 2013.

Why do we observe a rise in the mismatch at the beginning of economic recovery? This is because the poorer-matched workers were displaced during the recession, while their better-matched counterparts were retained. With the onset of recovery, displaced workers were rehired.

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Figure 6: Employment-to-Population Ratios for the Best and Worst-Matched Workers, NLSY79
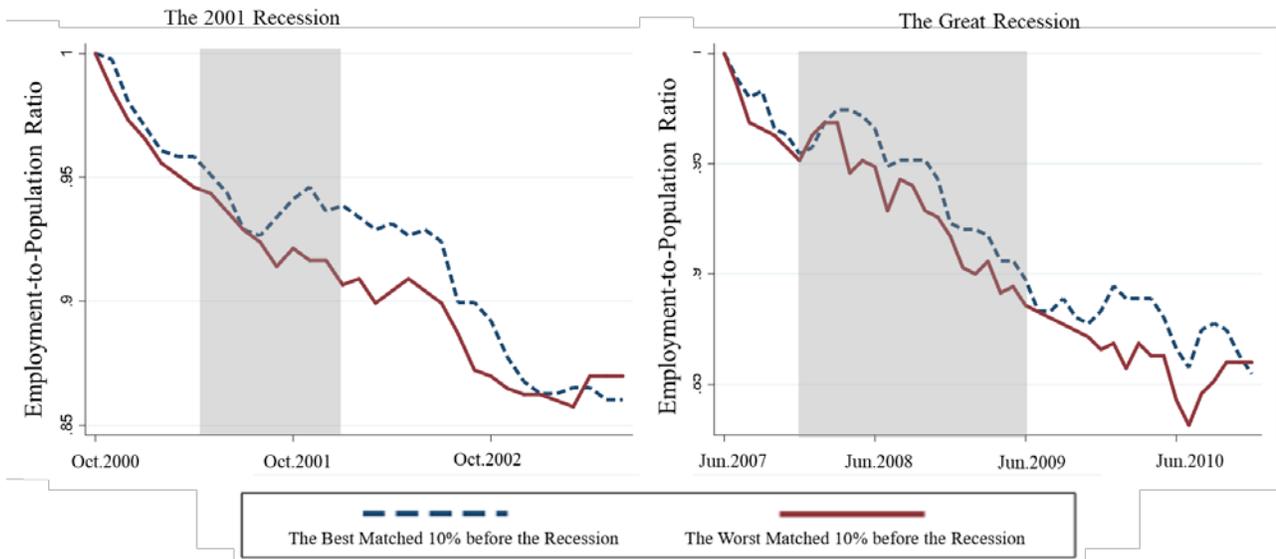
Notes: We divide NLSY79 workers into 10 groups based on their total amount of mismatch at 6 months before each recession, from the best matched 10% to the worst matched 10%. We plot the employment-to-population ratio during and after the recession indexed to pre-recession levels for these two groups for each recession.

Mismatch increased and then plateaued as it proved difficult for rehired workers to find jobs for which they were well-matched. By way of illustration, we divided NLSY79 workers into ten groups based on their total amount of mismatch (from the best-matched 10 percent to the worst-matched 10 percent) six months before the recessions. We then traced movements in the employment-to-population ratios of the two groups during and after each recession. As shown in Figure 6, the employment ratios of the two groups do not differ significantly before the recessions. However, the best-matched workers are more likely to stay employed during and after the recessions than the worst-matched workers, leading to the dive in mismatch during the economic downturns.

3.3 *Are Recessions Mancessions?*

We next explore in Figure 7 gender differences in the effects of the 2001 and 2008 recessions over and above the contributions of cohort and career stage differences noted earlier. The figure charts the path of mismatch over the two recessions by gender and education levels. Among the college-educated, both genders experienced a sharp increase in mismatch following the 2001 recession. For both men and women, the best-matched workers remained employed during this recession (again note the dip in average mismatch) with increasingly worse matches occurring in its aftermath. Among the non-college educated, males were much worse off than their female

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counterparts. This gender difference might suggest that, at the low end of the market, male occupations (in, say, construction) are much more cyclical.

Figure 7: Mismatch around the Recessions by Gender and Education, NLSY79
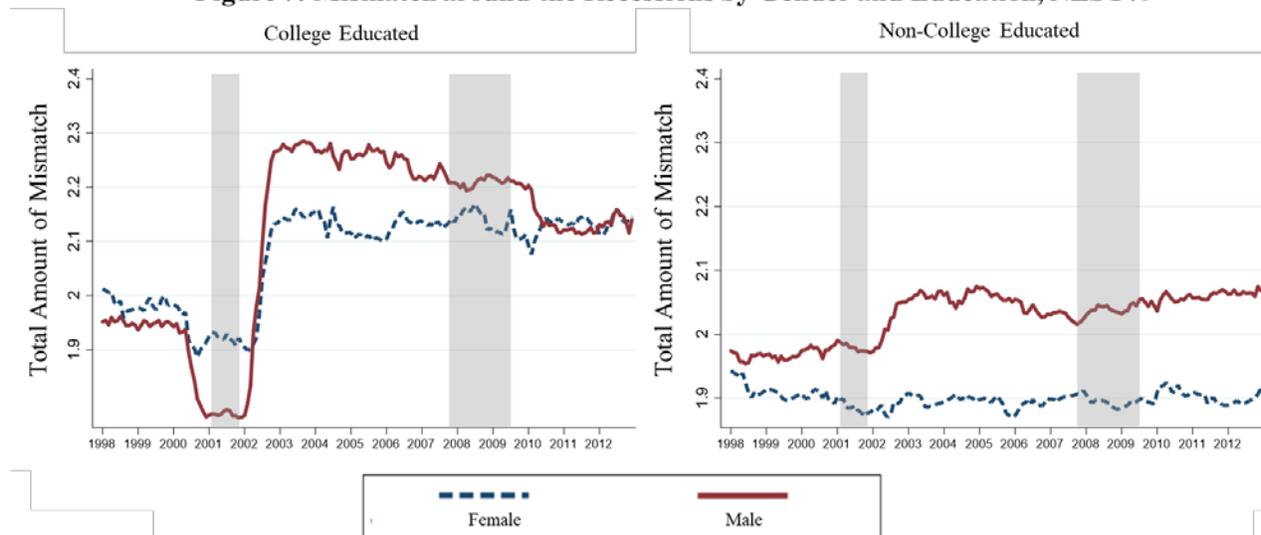
Notes: We divide NLSY79 workers in our sample into two groups: workers who had attained a bachelor's or higher degree, and workers who had not. We plot the total amount of mismatch during and after the recession for these two groups by gender.

We next estimate the changes in mismatch over the 2001 and 2008 recession timelines for non-college graduates and college graduates, respectively. The results are presented in Table 2. All specifications include the same control variables as were employed in the first two columns of Table 1. Table 2 shows that non-college educated females' match quality was scarcely affected by

Table 2: Mismatch over the Recession Timeline by Gender and Education
(Panel Data FE Estimates, NLSY79)

	Female				Male			
	Non College		College		Non College		College	
	2001	2008	2001	2008	2001	2008	2001	2008
1-6 months before the recession	0.004	0.011	0.007	-0.005	-0.008	-0.011	-0.021*	0.003
	[0.008]	[0.011]	[0.011]	[0.011]	[0.008]	[0.008]	[0.010]	[0.011]
1-6 months after the recession	-0.001	0.005	-0.005	0.008	0.015	0.009	0.033*	-0.011+
	[0.008]	[0.005]	[0.016]	[0.011]	[0.010]	[0.006]	[0.013]	[0.007]
7-12 months after the recession	-0.005	0.022	0.000	0.022	0.037*	0.022+	0.039+	-0.020
	[0.017]	[0.015]	[0.027]	[0.019]	[0.018]	[0.012]	[0.022]	[0.016]
13-18 months after the recession	-0.009	0.005	0.011	0.033	0.054*	0.019	0.061*	-0.023
	[0.022]	[0.019]	[0.036]	[0.023]	[0.025]	[0.016]	[0.029]	[0.025]
Observations	39,335	44,912	14,843	20,550	40,466	45,912	15,444	19,424
Number of Individuals	1,584	1,409	567	604	1,552	1,381	551	539

Notes: In all specifications the dependent variable is the total amount of mismatch. We control for individual characteristics (gender, race, years of schooling, marital status, average percentile ranks of skill endowments, tenure with current employer, occupational tenure, the interaction term between average percentile ranks of skill endowments and occupational tenure); occupation-specific characteristics (average percentile ranks of occupational skill requirements, weekly working hours, occupational-specific task intensities); and the unemployment rate in the month of observation. The coefficients are estimated based on an individual-fixed effects model. The baseline group is the period during the relevant recession. Standard errors in brackets are clustered at the individual level. ** $p<0.01$, * $p<0.05$, + $p<0.1$. Full results are available from the authors upon request.

either economic recession. However, non-college males experienced a significant drop in match quality after the 2001-Recession. Among college-educated individuals, female workers' mismatch increased after both recessions, albeit not significantly so. In the case of their male counterparts, however, the amount of mismatch increased dramatically after the 2001-recession. Moreover, the recovery in their match quality was much slower after the 2001-recession compared to all other groups.

Taken together, Figure 7 and Table 2 provide evidence indicating that economic recessions have a greater negative impact on men's labor market outcomes than those of women. Mid-career men experience a dramatic drop in occupational match quality after a recession, from which it takes a longer time to recover. Highly educated men are no exception. These results suggest that men suffer greater losses from economic downturns than women not only in terms of employment opportunities but also in terms of match quality, which may be referred to as the hidden toll of *mancession*.

3.4 *Hollowing-out and Mismatch*
The U.S. labor market has experienced a trend of occupational polarization since the 1980s. The employment shares and earnings of middle-skill occupations (mostly routine occupations) have decreased relative to low-skill (non-routine manual occupations) and high-skill occupations (non-routine cognitive occupations). Compared with non-routine occupations, routine occupations are more pro-cyclical and volatile. As the market begins to recover, high-skill workers slide down the job ladder in the sense that they are systematically hired over mid- and low-skill workers in the middle- and low-skill occupations. Empirically, we expect to observe greater mismatch in the middle- and low-skill occupations in the wake of economic recessions.

We investigate this question in Figure 8 by tracing the course of mismatch and employment share for NLSY79 workers by their occupational task groups through recessions. Two patterns are evident in the figure. First, the total amount of mismatch in non-routine manual occupations (food preparation, child/senior care, retail, etc.) and routine manual occupations (construction, manufacturing, production, etc.) experienced a substantial increase in the wake of the 2001-Recession. Second, the proportion of NLSY79 (read 'mid-career') workers in non-routine cognitive occupations (public relations, analytical, and medical/technical positions) drastically decreased after the 2001 Recession, but the share of workers in non-routine manual occupations,

Figure 8: Mismatch and Employment Share around the Recessions by Occupational Task Groups, NLSY79
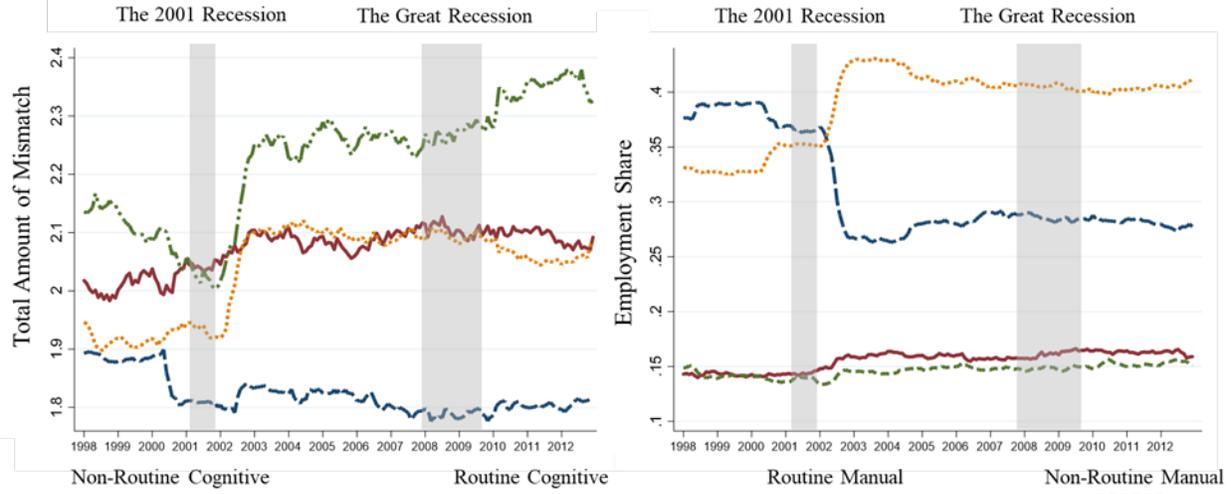
Notes: We group NLSY occupations into four groups based on the prime task: non-routine cognitive, routine cognitive, routine manual, and non-routine manual. For instance, professional, managerial and technical occupations are specialized in non-routine cognitive tasks; clerical and sales occupations are specialized in routine cognitive tasks; production and operative occupations are specialized in routine manual tasks; and service occupations are specialized in non-routine manual tasks. In this graph, we plot the total amount of mismatch and employment share during and after the recession for the four task groups, respectively. The employment share is calculated as the number of individuals employed in a particular occupational task group divided by the total number of employed.

increased after the recession. The patterns suggest a flow of mid-aged workers from non-routine cognitive occupations before the recession to non-routine manual occupations after the recession, implying that the deterioration in mid-aged workers' match quality was mainly due to the movement down the job ladder on the part of higher-skilled workers.

Panel A of Table 3 presents the distribution of post-recession occupational task groups, conditioning on workers' pre-2001 recession groups. Panel B illustrates the distribution of pre-

Table 3: Relocation Across Task Groups, The 2001 Recession, NLSY 79

Panel A: Distribution of post-recession task groups, conditioning on the pre-recession task groups				
Task groups 6 months before the 2001 recession	Task groups 12-18 months after the 2001 recession			
	Non-routine cognitive	Routine cognitive	Routine manual	Non-routine manual
Non-routine cognitive	**0.62**	0.07	0.07	**0.25**
Routine cognitive	0.06	**0.75**	0.04	0.15
Routine manual	0.05	0.05	**0.77**	0.13
Non-routine manual	0.07	0.05	0.04	**0.84**

Panel B: Distribution of pre-recession task groups, conditioning on the post-recession task groups				
Task groups 12 months after the 2001 recession	Task groups 6 months before the 2001 recession			
	Non-routine cognitive	Routine cognitive	Routine manual	Non-routine manual
Non-routine cognitive	**0.87**	0.03	0.02	0.08
Routine cognitive	0.15	**0.73**	0.04	0.09
Routine manual	0.17	0.04	**0.72**	0.07
Non-routine manual	**0.21**	0.04	0.04	**0.72**

2001-Recession occupational task groups, this time conditioning on the post-recession task groups. As is evident, most workers remained in their pre-recession occupational task groups. However, among workers employed in non-routine cognitive occupations before the 2001-recession, only 61.9 percent of them remain in the same task group and no less than 24.7 percent of them were employed in non-routine manual occupations. Further, of those workers employed in non-routine manual occupations one year after the 2001 recession, 20.5 percent were employed in non-routine cognitive occupations before the recession. Table 3 thus suggests that a disproportionate share of mid-aged workers employed in non-routine cognitive occupations before the 2001 recession were re-employed in non-routine manual occupations after the recession.

4 Conclusions

The toll of economic recessions is typically captured by indexes such as the unemployment rate and the labor force participation rate that only reflect a head count of the impact of recessions. There exists scant direct evidence on how worker-job match quality changes along economic cycles and their aftermath. In this paper, we attempt to fill this gap in the literature by comparing the changes in match quality of the NLSY79 cohort across two economic recessions (i.e. the recession of 2001 and the Great Recession) as well as vis-à-vis those of the younger NLSY97 cohort.

The main finding of this study is that a worker's occupational match quality is adversely affected by economic downturns, the consequences of which carry over into economic expansions. This result implies that the traditional cyclical measures in the form of unemployment and labor force participation rates tell only part of the story. Indeed, compared with the lingering impact of a recession on match quality, changes in employment status may be overshadowed by the longer-term effects of mismatch in the form of wage and productivity losses.

Mismatch not only leads to wage loss but also influences workers' long-term employment prospects. Compared with well-matched workers, those with poor match qualities are less likely to hold on to their jobs during economic downturns. As the worst-matched workers are among the first to lose jobs, the average amount of mismatch initially decreases during economic downturns. It subsequently increases during the recovery period as workers become re-employed, most of whom do not find well-matched occupations.

We also link occupational match quality with age, education, gender, and task groups. First,

we report that economic recessions impact the young and mid-aged workers in different ways. On the one hand, young workers are more adversely affected in terms of their employment by the onset of deteriorating labor market conditions. As has been well documented in the literature (Urquhart and Hewson, 1983; Langdon, McMenamin, and Krolik, 2002; Borbely, 2009), their mid-career counterparts seemingly fare better. On the other hand, the situation is clearly reversed in the wake of recessions when occupational mismatch is mostly a problem confronted by mid-aged workers. Compared with young workers, mid-career workers do not have the option of withdrawing from the labor force during economic recessions. Most of them stay in the labor market at the cost of occupational match quality, as reflected in more frequent job changes during and shortly after recessions. Second, we show that cyclical gender differences are not only manifested in employment opportunities but also in match quality. Mid-aged men experience a material drop in occupational match quality after a recession. Third, college-educated men are no exception in this regard. Last but not least, we show that higher skilled workers move down the job ladder and are re-employed in middle and low-skill jobs contributing to higher mismatch in those occupations. *Vulgo*: economic cycles seemingly amplify occupational polarization.

References

Addison, John T., Liwen Chen, and Orgul D. Ozturk. 2020. "Occupational Skill Mismatch: Differences by Gender and Cohort." *Industrial and Labor Relations Review* 73(3): 730-767.

Banzak, Cynthia, Mary E. Graham, and Allan N. Zebedee. 2012. "Business Cycles and Gender Diversification: An Analysis of Establishment-Level Gender Dissimilarity." *American Economic Review*, Papers and Proceedings 102(3): 561-565.

Borbely, James Marschall. 2009. "U.S. Labor Market in 2008: Economy in Recession." *Monthly Labor Review* 132(3): 3-19.

Elsby, Michael W. L., Donggyun Shin, and Gary Solon. 2016. "Wage Adjustment in the Great Recession and Other Downturns: Evidence from the United States and Great Britain." *Journal of Labor Economics* 34(S1): S249-S291.

Deming, David. J. 2017a. "The Growing Importance of Social Skills in the Labor Market." *Quarterly Journal of Economics* 132(4): 1593-1640.

Deming, David, J. 2017b. Replication data for: The Growing Importance of Social Skills in the Labor Market, https://doi.org/10.7910/DVN/CYPKZH, Harvard Dataverse, V1.

Farber, Henry S. 1999. "Mobility and Stability: The Dynamics of Job Change in Labor Markets." In Orley C. Ashenfelter and David Card (eds.), *Handbook of Labor Economics*, Vol 3B. Elsevier: North Holland, pp. 2439-2483.

Garibaldi, Pietro, Pedro Gomes, Thepthida Sopraseuth. 2020. "Output Costs of Education and Skill Mismatch." IZA DP No. 12974. Bonn: Institute of Labor Economics/IZA.

Guvenen, Fatih, Burhan Kuruscu, Satoshi Tanaka, and David Wiczer. 2018. "Multidimensional Skill Mismatch." NBER Working Paper No. 21376. Cambridge, MA: National Bureau of Economic Research.

Hotchkiss, Julie L., Melinda M. Pitts, and Fernando Rios-Avila. 2014. "A Search for Evidence of Skill Mismatch in the Aftermath of the Great Recession." *Applied Economics Letters* 21(9): 587-592.

Hoynes, Hilary, Douglas L. Miller, and Jessamyn Schaller. 2012. "Who Suffers During Recessions? *Journal of Economic Perspectives* 26(3): 27-48.

Kahn, Lisa B. 2010. "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy." *Labour Economics* 17(2): 303-316.

Langdon, David S., Terence M. Mcmenamin, and Thomas J. Krolik. 2002. "U.S. Labor Market in 2001: Economy Enters a Recession." *Monthly Labor Review* 125(2): 3-33.

Lise, Jeremy, and Fabien Postel-Vinay. 2016. "Multidimensional Skills, Sorting, and Human Capital Accumulation." Unpublished Paper, University College London. Available at: https://econ.ucalgary.ca/ sites/econ.ucalgary.ca/files/lise_postel-vinay.pdf.

Şahin, Ayşegül, Joseph Song, Giorgio Topa, and Giovanni L. Violante. 2014. "Mismatch Unemployment." *American Economic Review* 104(11): 3529-3564.

Schwandt, Hannes, and Till von Wachter, 2019. "Unlucky Cohorts: Estimating the Long-Term Effects of Entering the Labor Market in a Recession in Large Cross-Sectional Data Sets." *Journal of Labor Economics* 37(S1): S161-S198.

Tüzemen, Didem, and Thao Tran. 2019. "The Uneven Recovery in Prime-Age Labor Force Participation," *Economic Review*, Federal Reserve Bank of Kansas City, Issue QIII, pp. 21-41.

Urquhart, Michael A., and Marilyn A. Hewson. 1983 "Unemployment Continued to Rise in 1982 as Recession Deepened." *Monthly Labor Review* 106: 3-12.