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ABSTRACT

We examine employment effects of the COVID-19 crisis in Norway from March 2020 through June 2022: during the initial lockdown, through the subsequent recovery, and after the dust had settled. While we identify large and socially skewed effects of the crisis through its early phases, we find no long-term effects on employees exposed to early risk of job loss. For those employed at the onset of the pandemic, both the level and the socioeconomic composition of employment quickly returned to normal. In contrast, we find considerable negative long-term employment effects on people who were neither in employment nor in education when the crisis hit. We argue that these patterns can be explained by social insurance policies that gave priority to protecting existing jobs and to distribute benefits to those who were temporarily laid off. Given the extreme increase in the social insurance caseload, an almost unavoidable side-effect was reduced capacity for providing services to the already non-employed.

Keywords: Labor demand shock; COVID-19; Employment; Social Gradient

JEL: E24; J2; J4; J6; J11

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1 Introduction

The economic crisis triggered by the COVID-19 pandemic gave rise to major labor market disruptions and caused unemployment and underemployment to rise at unprecedented rates, especially for lower socio-economic groups. Researchers were quick to document these patterns during the crisis, see for instance, Alstadsæter et al. (2020) for Norway, Adams-Prassl et al. (2021) for the UK, US, and Germany, Crossley et al. (2021) for the UK, Zimpelmann et al. (2021) for the Netherlands, Angelov and Waldenström (2023) for Sweden, and Stantcheva (2022) for an overview. Studies of employment loss during the pandemic typically focus on inequalities during the lockdown phase. Evidence on longer-term consequences remains scarce. An exception is Chetty et al. (2023), who document persistent reduced employment rates in low-wage jobs in the US both during the immediate crisis and the subsequent recovery through 2021. In a recent study, Autor et al. (2023) show that the US employment-population ratio returned to its early-2000 level in the summer of 2022. We add to this literature by also considering longer term consequences of the COVID-19 induced economic crisis drawing on detailed time series of administrative micro data. Unlike previous studies, we explore how the pandemic differentially affected groups according to their labor market status at the onset of the crisis.

National support programs were established rapidly in many countries, partly motivated by the concern that the crisis could give rise to hysteresis, both through individual scarring effects and through disproportionate job loss for workers with poor re-employment prospects. In the present paper, we examine how the pandemic affected the "social gradient" in employment and pay, where we define the social gradient as the relationship between past earnings rank and the patterns of employment and pay through the crisis. This relationship is important from a policy perspective, as it helps identify short- and long-term distributional labor market consequences of the crisis. We utilize rich monthly administrative micro data on pay records covering all employers and all employees in Norway, linked to long time series of socio-economic characteristics covering the full population.

The existing literature has revealed that job loss during economic crises may have persistent negative earnings effects (Bertheau et al. 2023) and leave individuals more exposed to future unemployment (Blanchard and Summers 1986; Mousteri et al. 2018; Pieh et al. 2020). Hence, from a policy perspective, it is important to identify those that were left behind during and after the recovery. We examine the social gradient in employment through three phases: The shock

period (April-June 2020), the unstable recovery period during the next 12 months, and the post-crisis labor market boom from the summer of 2021 through June 2022.

The official unemployment rate based on Norwegian labor force surveys (LFS) rose by only 1.0 percentage point between the first and the second quarter of 2020 (Statistics Norway, 2022), illustrating that LFS statistics fail to capture the drop in labor input during economic shocks when workers are covered by extensive furloughs or job retention programs. In order to identify the scale of lost hours and employment, information on actual hours worked is preferable to data on contracted hours. We exploit administrative micro data with monthly pay records for the full population of employees. Comparing outcomes of the pandemic cohorts with data constructed the exact same way for recent pre-crisis cohorts, we can obtain a rough characterization of the scale of the crisis in terms of lost labor input. Our data indicate that the COVID crisis caused a decline in total labor input of 7.7% from February to April 2020.

The pandemic hit the whole economy, but effects were far from uniformly distributed across the labor market. In the present paper, we examine how the crisis affected individuals differently depending on their initial labor market position and their pre-crisis economic status. For persons aged 30 or older, we measure economic status in terms of gender-specific earnings rank within complete birth cohorts, using the three highest annual earnings obtained over the last 10 years. Our intention is to arrive at an earnings rank measure that not only captures access to economic resources per se, but also reflects socioeconomic position and long-term economic prospects more broadly. For young people below age 30, we instead measure status based on the earnings rank of their parents; i.e., we combine the three highest annual earnings obtained by the mother and the father over the last 10 years, and use the resultant average as the foundation for ranking economic status within the full population aged 20-29.

Equipped with these measures, we study how the crisis affected the social gradient in employment and pay, operationalized as the empirical association between own or parental earnings rank and employment and pay at different stages of the crisis and its subsequent recovery. We expect the consequences of the crisis to depend critically on initial labor market position and divide the population into groups defined by employment status and age in February 2020. For employees, the age split distinguishes young people (age 20-29), prime-age workers (age 30-61), and senior workers (age 62-67). Whereas young workers are likely to be particularly exposed to job loss due to their shorter tenure and work experience, senior workers may respond more strongly to temporary job loss due to the extensive margin playing

a more central role given the option of early retirement (Goda et al. 2021). For each group, we examine the month-by-month developments of employment and pay over a 42-month period: the 14 months leading up to the pandemic and the 28-month period following the initial pandemic lockdown (March 2020 through June 2022). For the non-employed in February 2020, we limit attention to the young and the prime aged, but split the former of these groups into those that were in education and those that were neither in education nor employment.

To isolate the effects of the COVID-19 crisis, we use a simple difference-in-differences strategy, where we study employment and pay during the pandemic for cohorts observed in February 2020 compared with data constructed in the exact same fashion for cohorts observed three years earlier, i.e., in February 2017. Such a comparison group is needed in our case because many people change labor market state also in "normal" times, and our interest lies in the excess changes caused by the crisis. By going back to 2017, we prevent the 28-month post-sampling outcome period of the comparison group from reaching into the pandemic. Our data cover a full cycle, including the initial and unprecedentedly large drop in economic activity, the feeble recovery period with some setbacks due to new rounds of lockdown, and the post-crisis economic boost caused by aggressive demand policies. The data thus offer a unique opportunity to examine the distributional aspects of the crisis from a dynamic perspective.

Encrypted identification numbers enable us to link complete payroll data to other administrative registers that include demographic characteristics, educational attainment, occupation, labor market status, and employer characteristics. This facilitates an examination of the sources behind observed changes in the social gradients, and also to distinguish mechanisms related to job or firm characteristics from those related to individual characteristics.

For employed men, we show that the crisis caused an immediate drop in employment, particularly among the young where the employment rate fell by almost 8 percentage points. A quick recovery followed, however, and after a short setback related to a second wave of pandemic-related restrictions during the winter months of 2020/2021, employment gradually returned to its pre-crisis trend. For employed women, the longer-term influence of the crisis was more age-dependent. In contrast to evidence from other countries such as the UK, the US, Sweden, and Spain, showing that women were harder hit than men (Adams-Prassl et al. 2020; Albanesi and Kim 2021; Alon et al. 2022; Angelov and Waldenström 2023; Martinez-Bravo and Sanz 2021), for Norwegian prime-aged women, the crisis evolved exactly as for men.

However, whereas the employment rate of senior women stabilized almost two percentage points below the pre-crisis trend, the employment rate for young women exceeded the pre-crisis trend by more than 2 percentage points already in October 2021. A possible explanation for these patterns is that some typical female occupations were exposed to considerable increases in work load during the crisis (nurses, social workers), as well as changes in work organization (teachers), potentially motivating older workers to leave the labor market while increasing the demand for younger workers.

For prime-aged individuals who were non-employed when the crisis hit, we identify both large and lasting negative impacts on subsequent employment, most likely due to a drop in vacancies and a mismatch in qualifications as documented by Barth et al. (2021). The immediate drop in the hiring rate of 6 percentage points among men turned out to be permanent. For non-employed prime-aged women the initial drop was similar as for men but employment converged toward more normal levels over time. For younger non-employed people, the crisis either left longer-term prospects unchanged (for those neither in employment nor in education) or represented an outright improvement (for those in education); the latter most likely following from the post-crisis economic boost and the fact that some senior workers had been motivated by the crisis to leave the labor market.

Prior evidence shows that, in times of economic crisis, low-skilled and immigrant workers are disproportionally affected (Dustman et al. 2010; Bratsberg et al. 2010, 2018; Hoynes et al. 2012), which was also the case for the COVID crisis, as documented for instance by Chetty et al. (2023) for the US. To assess the crisis' influence on social gradients in employment over time, we examine the three phases (shock, recovery, and post) of the crisis separately, and show how the relationship between own or parents' earnings rank and employment outcomes evolved when compared to the comparison group from 2017. For employees, our findings indicate that the social gradient steepened considerably during the shock period; i.e., workers with low earnings rank were much harder hit by the crisis than workers with high earnings rank. The steeper social gradient was partly explained by personal characteristics and the types of jobs held by persons with different ranks, but for prime-aged and senior workers it remained significantly steeper even within occupations, industries, and firms. During the recovery period, however, the social gradients returned toward their pre-crisis patterns. In the post-crisis period, the social gradients were almost indistinguishable from those observed in the control period.

For those who were non-employed at the start of the crisis, we document a different pattern. For the prime aged, we find that the social gradient became steeper for both genders during the shock period. Over time, it returned to pre-pandemic steepness for women whereas it flipped sign and turned *less* steep for men. Whereas non-employed men of low rank had largely the same or similar (low) employment prospects as in the pre-crisis comparison period, employment rates dropped for non-employed men with high prior earnings rank. Hence, for the non-employed, the crisis appears to have had a sort of indiscriminate component with respect to economic status, such that the normally quite steep social gradient in employment outcomes was slightly levelled. Similar patterns are found for young people who were in education at the time of the crisis. For young people who were neither in employment nor in education, we see only minor changes in the social gradients.

2 The course of the COVID-19 induced crisis in Norway – An overview

In Norway, the COVID-19 crisis hit the labor market with full force on March 12, 2020. Strict, and largely unexpected, regulations on social distancing led to an immediate and massive reduction in economic activity, and during the following few weeks 360,000 people (approximately 12% of the labor force) signed up for unemployment benefits (Alstadsæter et al. 2020). Approximately 90 percent of the layoffs during the initial stages of the crisis were temporary, however, and many of them were "partial," in the sense that employment continued with reduced work hours. This means that most workers directly affected by layoffs retained their employment relationship. A few days into the crisis (on March 16), the Norwegian parliament agreed to temporary changes in the unemployment insurance program with increased replacement rates, an extended maximum duration, and lighter eligibility requirements. As in other countries, the lockdown was later followed up by a wide range of stimulus packages, including generous cash support to firms with sufficiently large, documented reductions in sales (compared to the previous year).

The analysis in this paper is based on encrypted administrative registers providing monthly records of actual wage payments from all employers (including the public sector) to all employees, from January 2016 and currently up to and including June 2022. As the pay records are directly reported by firms and used for administrative tax purposes and for computation of social insurance entitlements, they are highly reliable. Given that hourly wages typically are adjusted only once a year, and then only moderately, the short-term fluctuations in individual earnings almost exclusively reflect fluctuations in labor input (with some caveats related to

bonuses and holiday pay). Hence, for the period covered in this paper, the data offer an extremely good insight into the individual labor market effects of the COVID-19 pandemic, including entry into and exit out of employment. The generous unemployment insurance implies that the earnings losses examined in this paper do not automatically translate into losses of individual income. The purpose of this study, however, is to describe the fluctuations in total labor input over time and across groups – and not to examine the individual consequences for economic welfare.

The data cover all residents in Norway. Based on encrypted identification numbers, we merge the payroll data with administrative registers containing information about demographic characteristics (sex, birth-year, family linkage, and, for immigrants, country of origin), own earnings history (annual earnings during the past 10 years), parents' earnings history, educational attainment, occupation, industry, firm identity, and labor market status.

To examine the overall labor market impacts of the crisis, Figure 1 shows how the number of employed workers and the total real wages for all employees aged 16-72 in Norway developed month-by-month from January 2016 through May 2022; with both series normalized to 100 in January 2016. Employment is defined as having positive contractual hours and a monthly pay above a time-varying threshold corresponding to approximately 17% of average fulltime monthly earnings.[1] The graphs illustrate the strong seasonal pattern in employment and wages, as well as the fact that Norway was on a steady path of economic growth when the crisis hit in March 2020. The growth paths are visualized by linear trend lines, estimated on the pre-crisis data (January 2016 - February 2020). The graphs also indicate the scale of the crisis, as reflected by the considerable drops in employment and total wages from February to April 2020. To illustrate, between February and April 2020 the total wage payments shown in the right-hand-side panel fell from 115.2 to 108.1, a decline of 6.2%. In all other years in the figure, total wages *increased* between February and April. Taking the increase of 1.5% in 2017 as representative, the implication is that the pandemic caused an immediate decline in total labor input of 7.7%. However, viewed with hindsight from a longer-term perspective, the Norwegian COVID-19 crisis stands out more as a story of delayed employment growth than a story of a serious recession, and in the wake of the second (and more moderate) lockdown during the

[1] The threshold is defined as G/12, where G is the Basic amount of the Norwegian national social insurance program, adjusted annually in line with average wage growth. As of June 2023, G is set to NOK 118,620 (approximately € 10,000).

winter of 2020/2021, employment and total wages rapidly approached the extrapolated pre-crisis trend lines.

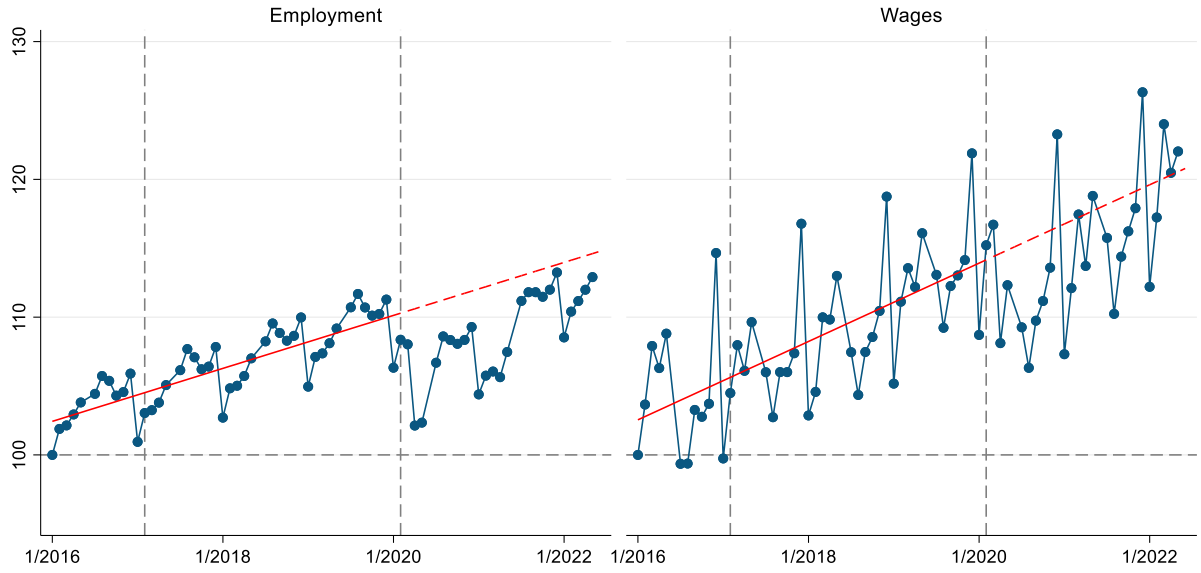

Figure 1. Total monthly employment and real wages, January 2016-May 2022

Note: Population consists of all wage earners aged 16-72 in monthly payroll data. Wages are inflated to June 2022 currency using the CPI. Employment counts the number of individuals with monthly pay exceeding G/12, where G is the base unit of the national social insurance program. Series are indexed to their January 2016 value (= 100). Employment in January 2016 was 2.2 million; total wage bill was 111.0 billion NOK (June 2022 currency). Vertical dashed lines mark February 2017 and February 2020. Figure omits month of June. Solid red line is the linear trend though February 2020 and dashed red line the extension of the pre-pandemic linear trend.

To zoom in on the consequences of the COVID crisis, we focus on employment fluctuations after February 2020, compared to corresponding developments from February 2017, and identify crisis effects based on a difference-in-differences strategy. The choice of February 2017 as the base of the control period is of course somewhat arbitrary. A practical reason for not using, e.g., the period after February 2018 as the counterfactual period is that the last months of our 28-month outcome period would fall after the onset of the pandemic.[2] With the counterfactual, we use the exogenous and unexpected adverse labor market shock of unusual magnitude triggered by the pandemic to learn more about the vulnerability of different groups distinguished by their initial labor market state and socioeconomic status.

We study the consequences of the COVID crisis for six different groups, distinguished by their labor market state and age in February 2020;

[2] We return to an assessment of the choice of comparison period below, based on a simple placebo analysis.

i) employed young workers (age 20-29),
ii) employed prime-age workers (age 30-61),
iii) employed senior workers (age 62-67),
iv) non-employed young persons in education (age 20-29),
v) non-employed, non-disabled young persons not in education (age 20-29),
vi) non-employed, non-disabled prime-age persons (age 30-61).

In the main part of the analysis, we focus on the dichotomous employment outcome (the left-hand panel of Figure 1) rather than on the continuous pay outcome. The motivation for this choice is that monthly pay exhibits large high-frequency movements due to seasonal fluctuations that are likely to vary from year to year, and that payments are not always fully aligned with hours worked at the monthly level. In particular, there are bonuses and holiday payments that relate to work performed in previous periods. Nonetheless, for the three employed-worker groups, we show the main descriptive patterns and estimation result based on pay in appendix. Table 1 provides descriptive statistics for the six subsamples used in our analysis, including average employment rates for each of the three periods.

For each of the three groups of initially employed, and separately by gender, the upper panels of Figure 2 show employment rates month-by-month from 14 months before to 28 months after the first lockdown as well as for the corresponding period using February 2017 as the base month. The lower panels then show the differences between the employment rates for the 2017 and 2020 cohorts, and these differences are what we interpret as effects of the COVID pandemic.

The dynamic pattern of the crisis as depicted in Figure 2 indicates three phases: The immediate *shock* (April-June 2020), ii) the unstable *recovery* period (July 2020-June 2021), and iii) the *post*-crisis labor market boost (July 2021-June 2022).

Table 1. Descriptive statistics, analysis samples.

	Employed youth (20-29)		**Employed prime age (30-61)**		**Employed seniors (62-67)**		**Non-employed youth (20-29), in education**		**Non-employed youth (20-29), not in education**		**Non-employed prime age (30-61)**	
	2017	2020	2017	2020	2017	2020	2017	2020	2017	2020	2017	2020
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employment (%)												
Shock (April-June)	91.2	85.2	97.1	93.5	94.6	91.1	19.4	18.8	25.9	21.5	26.6	22.5
Recovery (next 12 months)	84.7	83.8	94.8	93.5	82.6	81.0	34.7	33.6	37.1	34.2	38.6	33.5
Post (next 12 months)	83.4	84.7	93.1	92.9	68.0	67.4	47.2	49.3	45.5	45.1	47.3	43.3
Female (%)	47.4	46.9	49.2	48.5	48.4	47.3	53.7	54.4	44.7	44.6	47.2	47.3
Age	25.1	25.1	45.4	45.3	64.0	64.0	23.0	23.0	24.0	23.8	42.5	42.2
Earnings rank	50.4	50.3	59.5	59.1	63.7	63.7	56.2	56.0	44.3	44.4	40.4	35.5
Years of schooling	13.6	13.8	14.3	14.4	13.6	13.7	13.7	13.8	12.1	12.3	13.3	13.3
Immigrant group (%)												
Low-income country	3.9	4.5	6.8	8.5	2.2	3.0	5.1	5.9	7.8	8.8	20.4	24.3
Old EU	0.5	0.7	3.3	3.7	2.7	2.9	0.8	1.0	1.0	1.4	4.4	5.4
New EU	0.7	1.1	3.2	4.4	0.7	1.2	0.9	1.2	1.5	2.5	8.9	14.3
Observations	330,558	354,425	1,539,581	1,645,432	149,711	163,506	160,581	155,213	80,992	74,735	160,545	162,965

Note: Employed samples are drawn from February 2017 and 2020 payroll files and are restricted to individuals with pay of at least G/12 in the base month. Samples of non-employed consist of persons who did not have sufficient earnings in the base month to be defined as employed. Non-employed prime-age samples are further restricted to those either registered unemployed in the base month or with employment during past ten years; those with self-employment income in the prior calendar year are dropped from sample. Persons with disability benefits in the prior calendar year are excluded from non-employed, not in education youth samples and from non-employed prime-age samples. Earnings rank for youth are computed from earnings of parents, using the same algorithm as for the prime-age and senior samples but with rank computed within the full sample of youth. All samples are restricted to those with residency in Norway, and with valid data on earnings rank and educational attainment. Immigrants are defined as foreign-born with two foreign-born parents, all others are included with natives. The Old EU category adds immigrants from the US, Canada, Australia, and New Zealand; New EU consists of new member countries since 2004; and the low-income country category covers immigrants from all other countries. Main countries of birth in the employed samples are Sweden (25%), Germany (19%), and Denmark (11%) in the OldEU group, Poland (54%), Lithuania (19%), and Romania (7%) in the NewEU group, and the Philippines (7%), Thailand (6%), Russia (5%), Iraq (5%), Bosnia (5%), Iran (5%), Somalia (4%), Vietnam (4%), Pakistan (4%), and Eritrea (4%) in the low-income group.

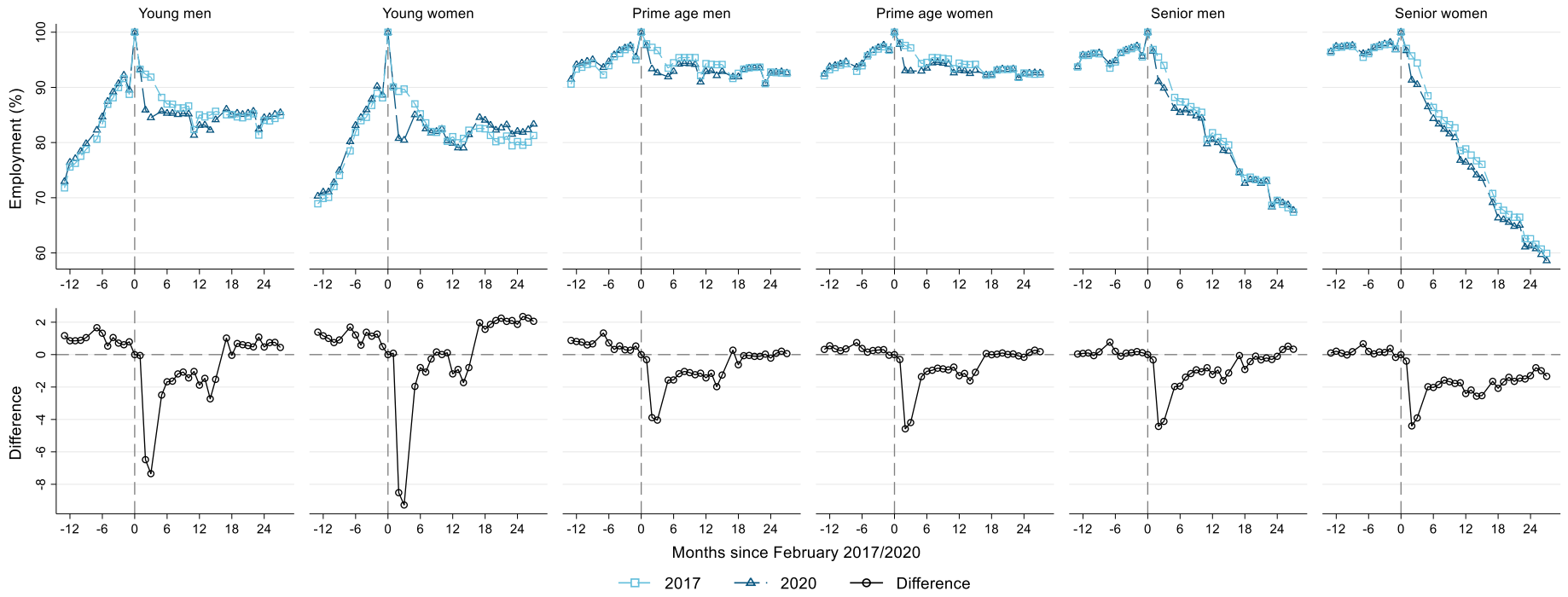

Figure 2. Trends in employment. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February 2017/2020

Note: Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in base month.

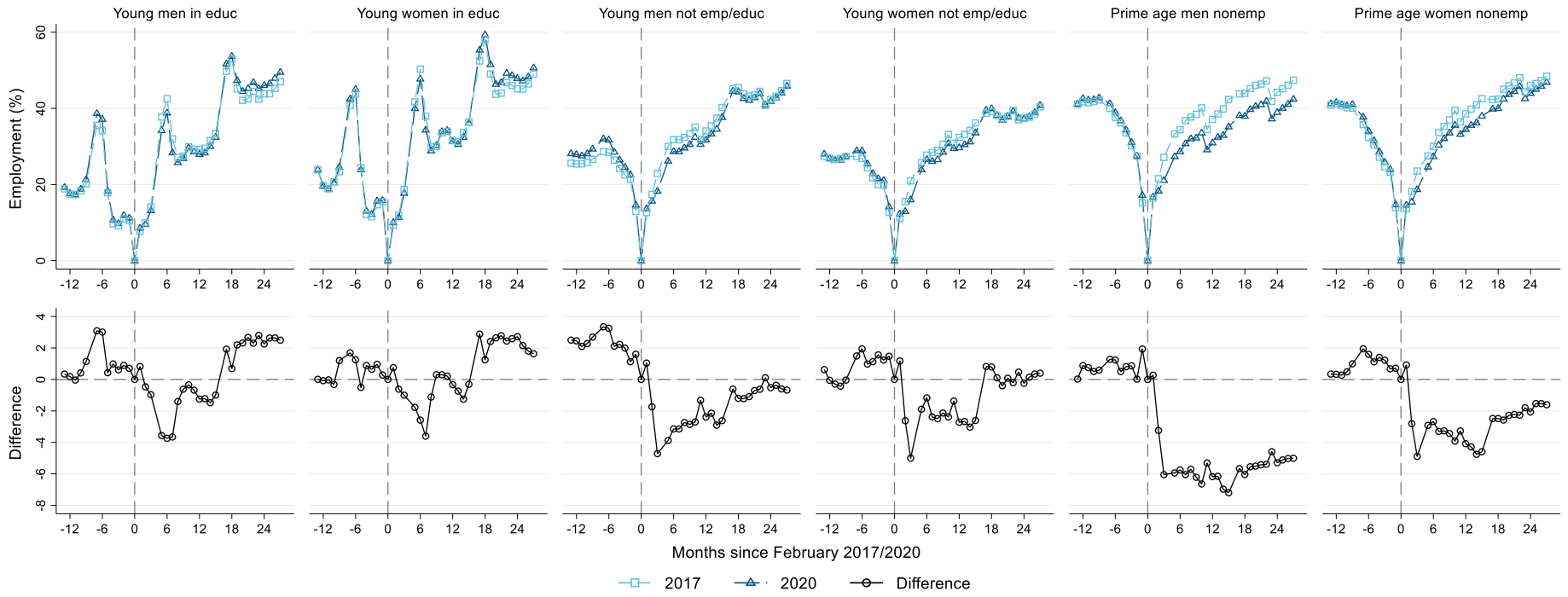

Figure 3. Trends in employment. Samples of young, non-employed persons in education (20-29), young, non-employed outside education (20-29), and non-employed prime-age persons (30-61) as of February 2017/2020

Note: Young, in education, samples consist of persons in education and not in employment in February 2017/2020. Young, not in employment nor in education, samples consist of those in neither of these two states nor on disability insurance. Prime-age non-employed samples consist of persons neither employed nor on disability insurance in the base month but with at least one year of employment during past ten years.

Since Figure 2 follows individuals from an initial condition of being employed, employment rates are bound to drop over time. From 2017 to 2019, employment rates among the young and the prime-aged employed gradually dropped by about 15-20 and 7-8 percentage points, respectively, over the 28-month post-sampling period. For senior employees, close to one in three was not employed. All senior workers aged 62 or more (with sufficient work experience) are entitled to an old age pension, and the major difference in transitions out of employment is explained by retirement.

As our identification strategy relies on the 2017 cohort as a reasonable counterfactual, it is reassuring that the 2020-2017 employment differentials during the 12 months leading up to the February baseline are relatively small (for the young) or close to zero. Despite these parallel pre-trends, one might be concerned about differential composition. Table 1 reveals that gender composition, age, earnings rank, years of schooling and immigrant background are similar in 2017 and 2020 for the three employee groups, but that there are some differences for the non-employment groups. In particular, it is notable that the group of non-employed prime age persons was composed of people with considerably lower past earnings rank in 2020 than in 2017.

While Figure 1 shows that employment patterns after February 2017 do not stand out as particularly different from the neighboring years, we also perform placebo tests where we replace employment patterns of the February 2020 cohort with those of 2016 and 2018 as "treatment" cohorts. As appendix Figure A1 shows, for those initially employed there are only minor differences in employment rates of the 2017 and the placebo cohorts from March onwards. For the prime-aged non-employed and for young people neither in employment nor in education (appendix Figure A2), there are indications that transitions to employment were somewhat larger for the 2017 cohort since the 2016/2018 treatment cohorts have slightly lower post-March employment rates. These placebo estimates suggest that, for employees, our estimates of COVID effects do not hinge critically on the choice of the 2017 cohort as a counterfactual, whereas estimated effects for some of the non-employment groups may be sensitive to the choice of comparison period.

Figure 2 shows that the adverse effects of the crisis peaked already in April-June 2020, with a total employment loss close to 8 percentage points for young and 4 percentage points for prime-aged and senior workers. As many workers continued in employment with reduced hours, the total earnings loss was bigger – 12-14% for the young, 7-8% for the prime-aged and 5-7% for

the seniors; see appendix Figure A3. The large employment (and earnings) losses were quickly reversed, however, and already in the summer of 2020, the negative employment effect had been cut to 1-2 percentage points for all groups. After a small setback during the winter months of 2021, the recovery gained speed, and by summer and fall of 2021, it is no longer possible to see any employment effects of the pandemic, with some notable exceptions, albeit in the opposite direction, for young and senior women. In contrast to evidence from other countries, for prime-aged workers the figure gives no indication of a "she-cession" whereby women were disproportionally affected by the crisis (Adams-Prassl et al. 2020; Albanesi and Kim 2021; Alon et al. 2022). However, for senior women, the negative employment shock persisted into the post-crisis period, likely operating through early retirement. In the beginning of the crisis, the Norwegian experience looks more like a "youth-cession" (Pastore, 2023); yet, when the dust had settled, employment rates were, if anything, higher than normal for young people that were employed when the crisis hit.

Figure 3 shows the corresponding employment patterns for those who were non-employed at the onset of the crisis. Based on previous evidence showing that the number of vacancies dropped in response to the pandemic and did not match the qualifications offered by the unemployed very well (Barth et al. 2021), we expect that the pandemic also hit the non-employed in the form of delayed transitions into employment. Figure 3 confirms this prediction, as the re-employment rates are systematically lower for the COVID-19 cohort compared to those non-employed three years earlier. When the crisis hit, the male employment propensity dropped almost immediately by approximately 4-5 pp for the young and by 6 pp for the prime-aged. For prime-aged men, the effect remained at about the same level for 28 months, whereas for prime-aged women the effect attenuated over time, such that the employment rate ended up around 2 pp below trend. For young people enrolled in education at the onset of the pandemic, our data indicate a positive crisis effect over the long haul, similar in magnitude to that uncovered for employed youth and most likely reflecting the post-pandemic economic boost.

3 Social gradients

Even if the lockdown and the countermeasures impacted employment throughout the economy, it disproportionally affected workers in low-skill occupations and industries, as typically observed during economic crises (e.g., Hoynes et al. 2012; Chetty et al. 2023). Immigrants were hit harder than natives (Alstadsæter et al., 2020), as expected from previous studies of

economic fluctuations and immigrant labor market outcomes (Dustmann et al. 2010; Bratsberg et al. 2010; 2018).

We use the term "social gradient" to describe the relationship between socioeconomic status and the employment losses during and after the crisis. Socioeconomic status is by no means uniquely defined, and can be measured in several ways, the most common being based on earnings, education, occupation, or family background. Our preferred metric is based on earnings over the preceding 10 years. More specifically, for prime-aged and senior people, we use the highest three out of the past ten years of annual earnings as the foundation for ranking and assign each person a rank (on a 1-100 scale) within the complete gender-specific annual birth cohort. By using the highest three out of 10 years, we aim at obtaining an earnings rank measure that comes close to characterizing human capital resources and permanent income potential, without being dominated by differences in the timing of labor market entry or breaks due to, e.g., parental leave; see Markussen and Røed (2023) for a more thorough discussion. For the young people – who have not yet had time to reveal their earnings potential in the data – we instead use parental earnings; i.e., we choose the highest three earnings observations for each of the parents during the past 10 years and use the average of parental earnings as a foundation for the ranking. Again, we make the ranking within the complete offspring birth cohort.

A distinguishing feature of the labor market shock created by COVID-19 is that it initially hit complete industries in a rather non-discriminatory fashion, with no obvious elements of (within-industry) skill-biasedness or social class structure. It may still have affected the social gradient, though, both due to the non-random sorting into the most exposed industries and firms, and because the same individual shock (say, in terms of job loss) may have very different consequences over time for different persons. It is thus important to distinguish the immediate impacts of the crisis from its longer-term consequences. Therefore, we examine how the social gradient in employment patterns evolved through the three phases of the crisis identified in the previous section, i.e., the initial shock period (first three months), the feeble recovery period (next 12 months) and the post-pandemic economic boost. The inclusion of the latter period represents an attempt to identify the lasting influences of a big, but strictly temporary, negative shock to aggregate employment.

To motivate our choice of empirical model, Figures 4 and 5 display binned scatter plots of the key relationship under study, with each sub-population split into ten equally sized bins defined

by own or parental earnings rank. The figure panels show average employment during the three phases of the crisis by individual earnings rank for those who were employed (Figure 4) or non-employed (Figure 5) at the start of the crisis, with the February 2017 cohort included for comparison. For prime-aged and senior employees, future employment rates are increasing in past earnings rank in "normal" times (as represented by the 2017 cohort) as well as in crisis times, but the differences across deciles are modest above median earnings rank. For the young, there is a weakly hump-shaped pattern, most likely reflecting higher rates of enrollment in education at the top of the parental earnings distribution. The decreasing marginal "returns" to rank means that the relationship between future employment and past earnings rank cannot be properly specified as being linear. The implication is that our measure of social gradient—the association between past earnings rank and future employment—varies across the rank distribution. In particular, during the first three months following the base month (i.e., the top panels of Figure 4), the social gradient is steeper for those with low than those with high rank. During the initial phase of the pandemic employment dropped for all earning ranks, but much more for those with lowest rank. Over the next 12 months, the employment rates of the COVID-19 cohort converged towards those experienced by the 2017 cohort (see recovery, second row). In the post-period (third row), the two cohorts were almost indistinguishable. With a notable exception for senior women, there are apparently no visible longer-term traces of the crisis for those who were employed at its onset, neither with respect to the overall employment level, nor with respect to its social gradient.

In Appendix Figure A3, we show a version of Figure 4 with percentage change in monthly pay relative to the average over the six-month period leading up to the base-month (February 2017/2020) as the outcome. The differences between the two cohorts display a pattern similar to that in Figure 4. However, the "normal-times" relationship between past earnings rank and future earnings *changes* displays a more u-shaped pattern, as there is a considerable element of regression-to-the-mean in monthly pay, particularly in the tails of the past earnings rank distribution.

Turning to the non-employed in February 2020 (2017), Figure 5 displays binned scatter plots of employment rates by earnings rank. As for the employed, there is a concave social gradient, and it is particularly steep for the prime-aged. Regardless of period, employment rates among the prime-aged with high prior earnings rank are about three times those of the lowest rank. During the shock period the social gradient appears somewhat steeper than in the same months of 2017. After that, it is hard to see any differential steepness of the employment profile during

and after the pandemic. As we have already seen in Figure 2, however, for those who were initially non-employed overall employment among the prime-aged seems to have settled at a lower level in the aftermath of the crisis. Viewed in light of the corresponding patters observed for the initially employed, a possible interpretation is that whereas the extensive furlough and unemployment insurance programs were successful in protecting employees from the longer-term consequences of the crisis, they did not protect the already non-employed to the same extent. However, as we also saw in Table 1, among the non-employed the initial distribution of earnings rank was not exactly the same for the COVID and the control cohorts. In Figure 5, this can be seen by the marked leftwards movement of the binned scatter points, particularly among prime-aged females.

For young people outside employment and education, we see a similar pattern as for the prime-aged, although with a less steep gradient. And for young people in education, both the level of employment and the social gradients remained almost unaffected by the crisis.

Figure 4: Own or parental earnings rank and employment. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February 2017/2020

Note: The scatter points report average employment rates in each of the three periods by previous earnings rank percentile, without control variables. Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in base month. Each scatter point captures ten percent of the underlying sample.

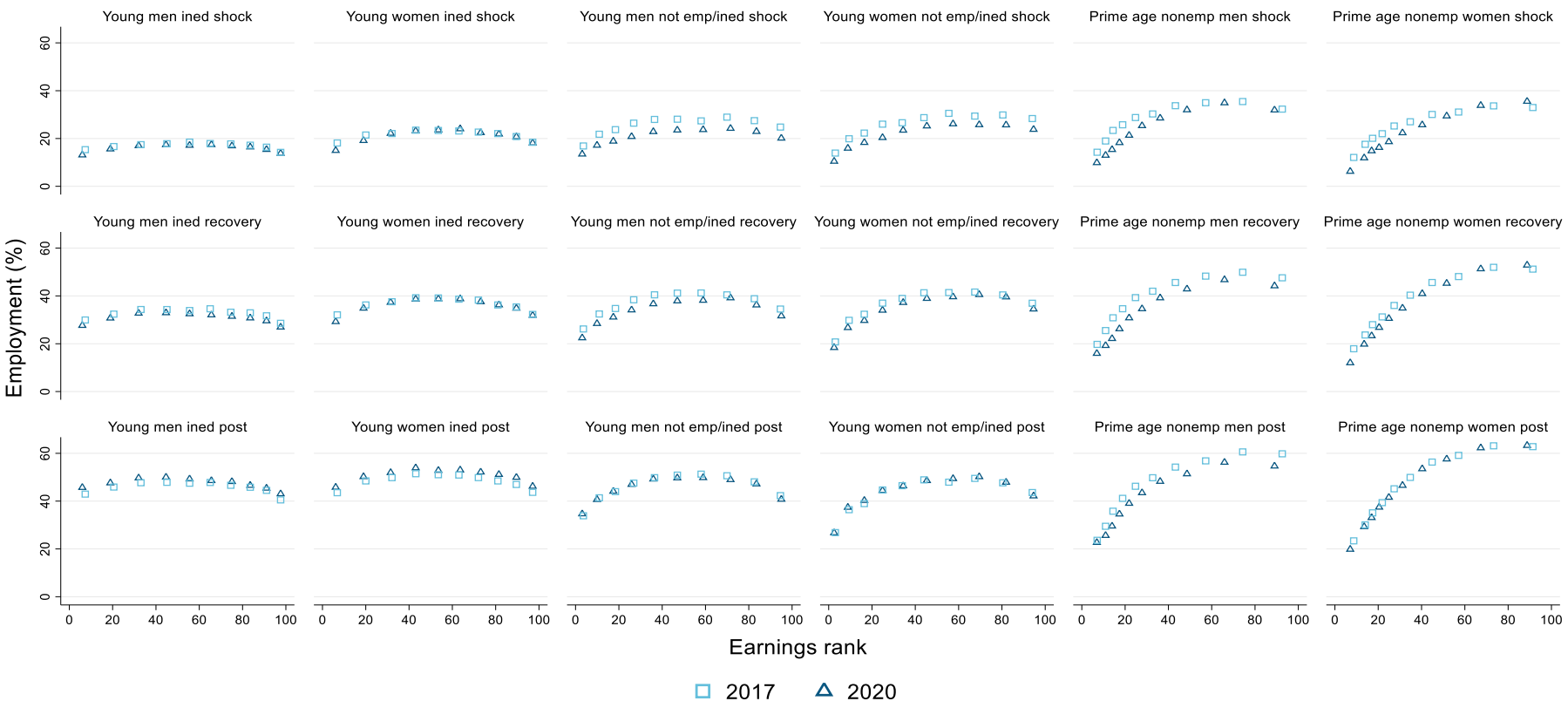

Figure 5: Own or parental earnings rank and employment. Samples of young, non-employed persons in education (20-29), young, non-employed outside education (20-29), and non-employed prime-age persons (30-61) as of February 2017/2020

Note: The scatter points report average employment rates in each of the three periods by previous earnings rank percentile, without control variables. Young, in education, samples consist of persons in education and not in employment in February 2017/2020. Young, not in employment nor in education, samples consist of those in neither of these two states nor on disability insurance. Prime-age non-employed samples consist of persons neither employed nor on disability insurance in the base month but with at least one year of employment during past ten years. Each scatter point captures ten percent of the underlying sample.

The empirical model

We now turn to a more formal statistical analysis of how the social gradient in employment was affected by the crisis during its different phases. We are then interested in both examining the extent to which the social gradient did become steeper, and investigating the mechanisms behind any such changes in terms of individual or job characteristics. To answer these questions, we use a simple difference-in-differences strategy, where we compare the future outcomes for the two cohorts. The employment profiles in Figures 4 and 5 suggest that our empirical model should allow for a non-linear association with earnings rank, such that any impact of the pandemic on the social gradient can be evaluated at different rank percentiles. The model is estimated by period and employment status, with all coefficients of interest allowed to vary by gender and age group. The estimated model for employed worker *i* belonging to initial employment/enrollment state, gender, and age group *a* in job *j* in period *p* and year *t* is specified as

$$Y_{iapjt} = \alpha_{apt} + \sum_{a=1}^{6} I_a \left(f_{ap}(Rank_{it}) + g_{ap}(Rank_{it})Covid_t + \delta_{ap}X_{it} + \theta_{ap}X_{it}Covid_t \right) + \zeta_{pjt} + \varepsilon_{ipt} \qquad (1)$$

where Y_{iapjt} is the employment outcome for a person *i* belonging to age-gender-group *a* with a baseline job of type *j* and with the outcome measured in period *p* (shock period, recovery period, and post period) for cohort *t* (i.e., COVID-19 or control cohort). I_a is an indicator for belonging to group *a*. The two functions *f* and *g* are formulated as second order polynomials in own/parental earnings rank, such that we allow for a concave social gradient. The *g*-function then captures the effect of the crisis on the social gradient. Individual characteristics (X_i) include educational attainment and immigrant status, and the inclusion of these variables may to some extent modify the interpretation of the socioeconomic rank variable as they no longer pick up effects that are mediated through them. A point to note from Equation (1) is that whereas all individual characteristics are allowed to have a group-specific influence (i.e., different effects for each initial state-age-gender group), we assume that job characteristics have the same effect regardless of group. The job-specific effects are included as occupation fixed effects (4-digit), industry fixed effects (4-digit), or as firm-fixed effects. The empirical model is estimated separately for each of the three periods (shock, recovery, post).

For the non-employed, we use a model with the same specification of individual covariates, but where we substitute municipality fixed effects for the (then missing) job characteristics.

For ease of access to our main results, we report the point estimates graphically. In Figures 6 and 7, each panel displays the differential (excess) coefficient for marginal effects of past earnings rank for six different sets of control variables. For each combination of age, initial employment/enrollment state, gender, and period, we report the excess marginal rank effect in the COVID-cohort across the rank distribution (25^{th}, 50^{th}, and 75^{th} percentiles) based on the estimated interaction term ($g_{ap}(Rank)$). In the figures, a positive estimate means that the social gradient became steeper during and after the COVID-19 pandemic, while any negative value implies a reduction of the social gradient in employment.

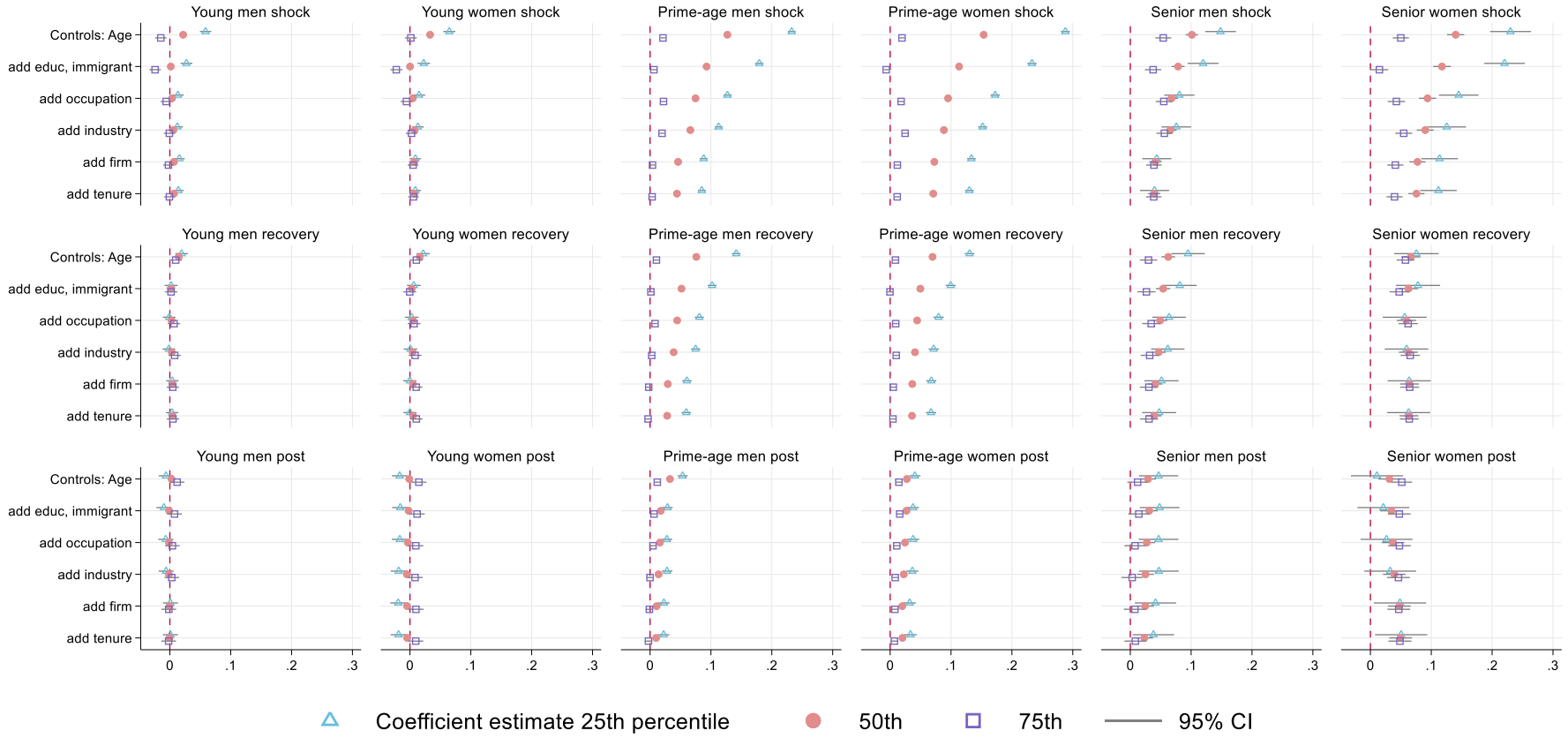

Figure 6. Estimate of excess social gradient in employment during the shock (April-June 2020), recovery (July 2020-June 2021), and post-crisis (July 2021-June 2022) periods. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February 2017/2020

Note: Estimates show the excess marginal rank effects during COVID, $g_{ap}(Rank)$, evaluated at the 25th, 50th, and 75th percentiles of the earnings rank distribution, with 95% confidence intervals.

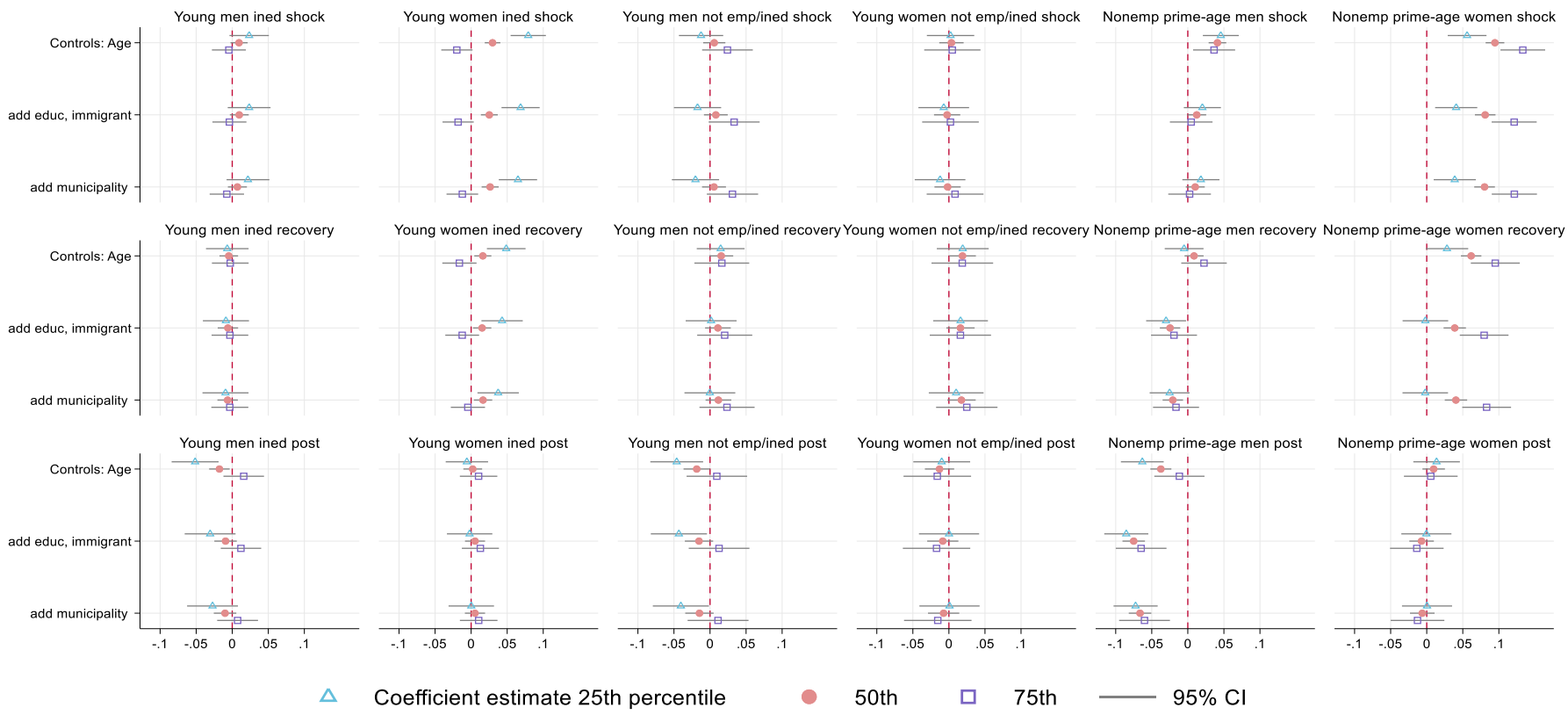

Figure 7. Estimate of excess social gradient in employment during the shock (April-June 2020), recovery (July 2020-June 2021), and post-crisis (July 2021-June 2022) periods. Samples of young, non-employed persons in education (20-29), young, non-employed outside education (20-29), and non-employed prime age (30-61) as of February 2017/2020

Note: Estimates show the excess marginal rank effects during COVID, $g_{ap}(Rank)$, evaluated at the 25th, 50th, and 75th percentiles of the earnings rank distribution, with 95% confidence interval.

The first row in each figure reports the results for the April-June 2020 period (with April-June 2017 used as control period). Looking, for example, at the estimated shock effect for prime-age employed men at the 25th rank percentile in the model without other controls than age (the estimate indicated by the triangle in the top row of the third column in Figure 6), the point estimate of 0.233 means that, when evaluated at the 25th percentile, the impact of a 1 percentile difference in the past earnings rank on employment was 0.233 percentage points (pp) larger during the COVID shock than in the control period. Moving down across model specifications in the same panel, we note that a considerable part of this effect was explained by occupation and industry/firm. When we control for both occupation and firm, the steepening of the gradient at the 25th percentile is cut by almost two-thirds to 0.088 pp.

Viewed as a whole, the pandemic had minimal implications for the social gradient in the upper part of the rank distribution, at least for young and prime-aged workers. For the median and low-rank employees, however, the steepness of the employment profile was significantly larger for the COVID-19 cohort, both during the shock and through the recovery period, particularly for prime-aged and senior workers. Most of this steepening was explained by job characteristics. It seems probable that variation across occupations in the possibility to work remotely played a role in this context. Yet, for prime-aged workers, the steeper gradient prevailed through the recovery period even within occupations and firms.

In the overview section, we showed that, for those employed at the onset of the crisis, employment was back to normal in the post-pandemic period (Figure 2). The same largely holds for the social gradient. Even without controls, Figure 6 shows that the rank gradient coefficient is just slightly larger for the COVID-19 cohort. The return to the normal gradient happened for both genders and all age groups, with one exception. Among senior women, there is some indication of an increased social gradient in the post-COVID period. Although not shown here, these changes are related to a slight increase in retirements observed for senior women.

For the non-employed (Figure 7), the gradient became steeper for prime-aged women as well as for women in education, both during the shock and the recovery periods. This also happened for prime-aged men, but this is fully explained by education and immigrant status. Notably, for prime-aged men the gradient is flatter (and not steeper as for the employed) in the post-COVID period when we control for differences in education and immigrant status.

Appendix Figure A5 shows results from analyses where percent change in pay replaces employment as the dependent variable for the samples of employees. For male wage earners, the pay-based results largely replicate those for the employment outcome: the social gradient became much steeper during the shock period, particularly in the lower half of the earnings distribution, but returned to normal over time. For female prime-age wage earners, the social gradient in pay steepened among low earners during the shock period, while the post-crisis period saw some reduction in the social gradient among low earners, largely accounted for by industry of employment.

4 Concluding remarks

Based on administrative register data containing monthly pay for all employees in Norway, we have evaluated the overall labor market impacts of the COVID-19 pandemic, from its start in March 2020 through June 2022. The impacts are identified with a difference-in-differences approach, using patterns for cohorts observed just before the COVID lockdown to establish counterfactual outcomes. To study the social gradient of the crisis, we have ranked all individuals based on their earnings over the past 10 years (for persons of age 30-67) or based on their parents' earnings (for persons of age 20-29). We study how the social gradient evolved during three phases of the crisis: the initial shock, the recovery period, and the post-pandemic economic boom. We emphasize three takeaways from our analysis.

The first is that although the lockdown led to a massive increase in unemployment and underemployment during the crisis, we find no adverse long-term effects on either the young or the prime-aged men or women or on senior men that were employed at the onset of the crisis. This finding squares well with recent US evidence on employment-population rates (Autor et al. 2023). For senior female employees, we identify a lasting effect of 2 percentage points increase in early retirement when compared to the control period. On the other hand, we identify a *positive* lasting employment effect of around 2 percentage point for young female employees.

The second takeaway is that the employment prospects appear to have deteriorated more permanently for prime-aged persons who were non-employed at the onset of the crisis. Not even a post-crisis labor market boom was sufficient for bringing this group up to more "normal" employment levels. We identify a lasting negative employment effect of around 5 percentage points for men and 2 percentage points for women. On the other hand, for young men and

women that were in education at the time of the crisis, we identify *positive* long-term effects around 2-3 percentage points.

Finally, we show that whereas the crisis initially had a socially skewed impact on employment propensities – in the sense that employees with low past earnings were much harder hit than those with high earnings – the social gradient quickly returned to normal once the crisis was over. In contrast to widespread concerns during the initial phases of the crisis, we do not identify any tendency that the crisis led to out-sorting of employees with particularly poor re-employment prospects.

These findings must be interpreted in light of the crisis policies that were pursued in Norway. The unemployment insurance system was immediately expanded in order to cover a larger fraction of employees and to give higher and more lasting benefit entitlements. The furlough scheme was extended, such that almost the entire increase in unemployment was accounted for by persons who actually maintained their employment contract. At the same time, the most hardly hit firms received additional cash support. As a result of these (and other) policies, the level of shutdowns and bankruptcies actually declined during the crisis, and most of the initially unemployed workers could return to their original job after the initial shock period.

For those that were unemployed when the crisis hit, the policy changes may have had a different impact. First, the mere fact that the social insurance administration suddenly had to deal with a caseload of unprecedented size implied that the capacity to provide help and support to long-term unemployed and people with health problems was severely limited. Activation strategies were largely put on hold, both due to capacity constraints and social distancing concerns. Whereas the prolongation of maximum benefit periods served to save existing jobs, it may simply have extended the (inactive) non-employment duration for those without a job, potentially adding to scarring and discouraged worker effects.

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Appendix

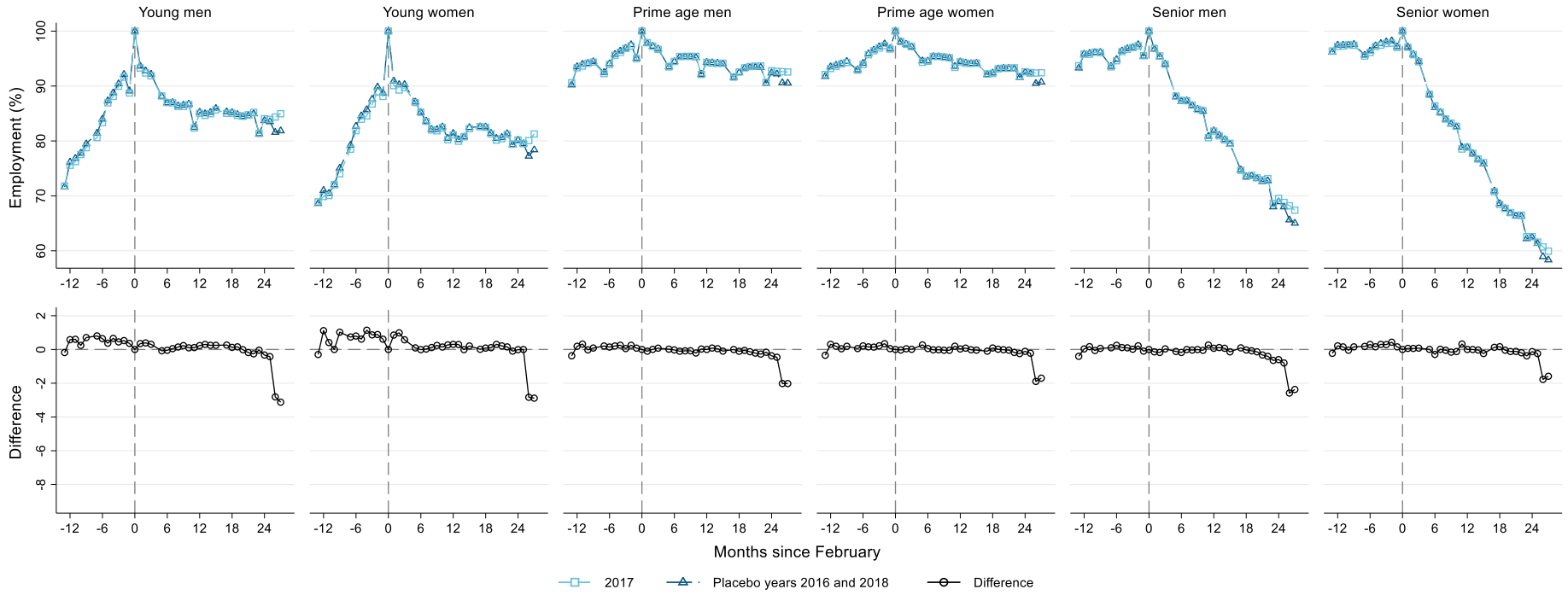

Figure A1. Placebo employment effects. February 2016/2018 vs 2017. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February each year

Note: Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in the base month. Note that the last months of the placebo years reach into the pandemic.

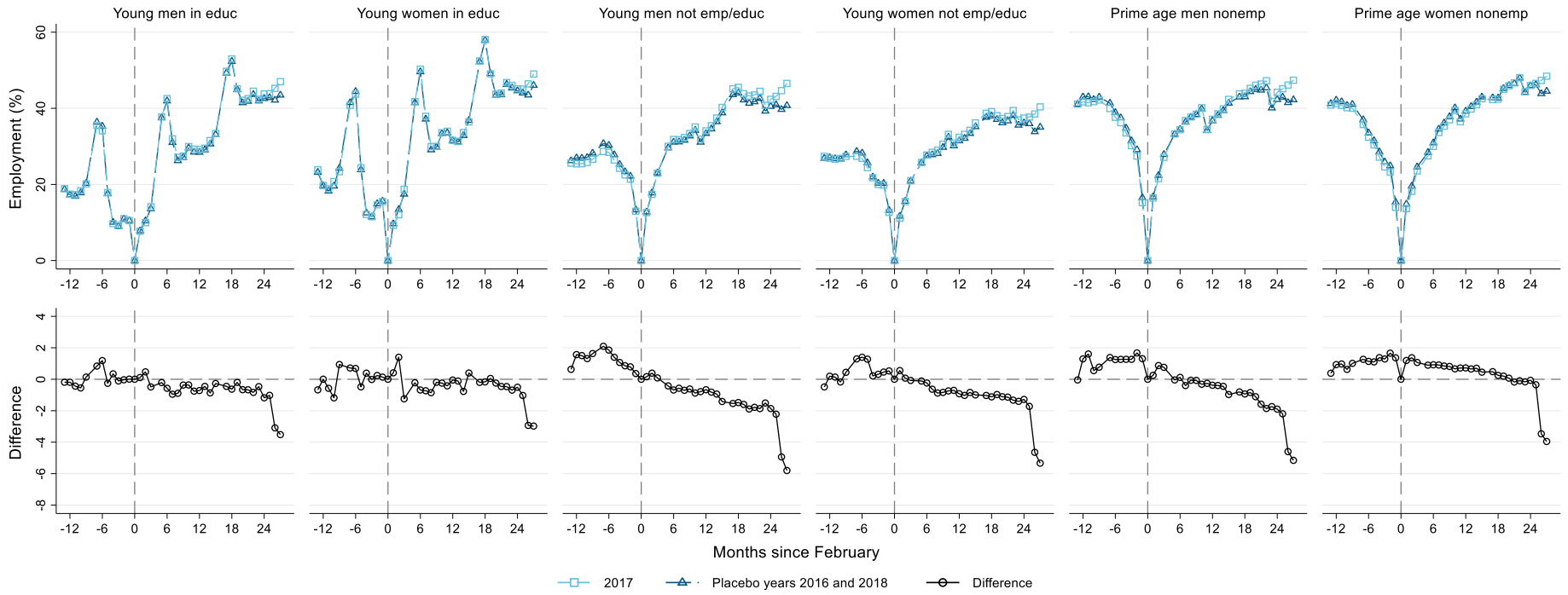

Figure A2. Placebo employment effects. February 2016/2018 vs 2017. Samples of young, non-employed persons in education (20-29), young, non-employed outside education (20-29), and non-employed prime age (30-61) as of February each year

Note: Young, in education, samples consist of persons in education and not in employment in February. Young, not in employment nor in education, samples consist of those in neither of these two states nor on disability insurance. Prime-age non-employed samples consist of persons neither employed nor on disability insurance in the base month but with at least one year of employment during past ten years. Note that the last months of the placebo years reach into the pandemic.

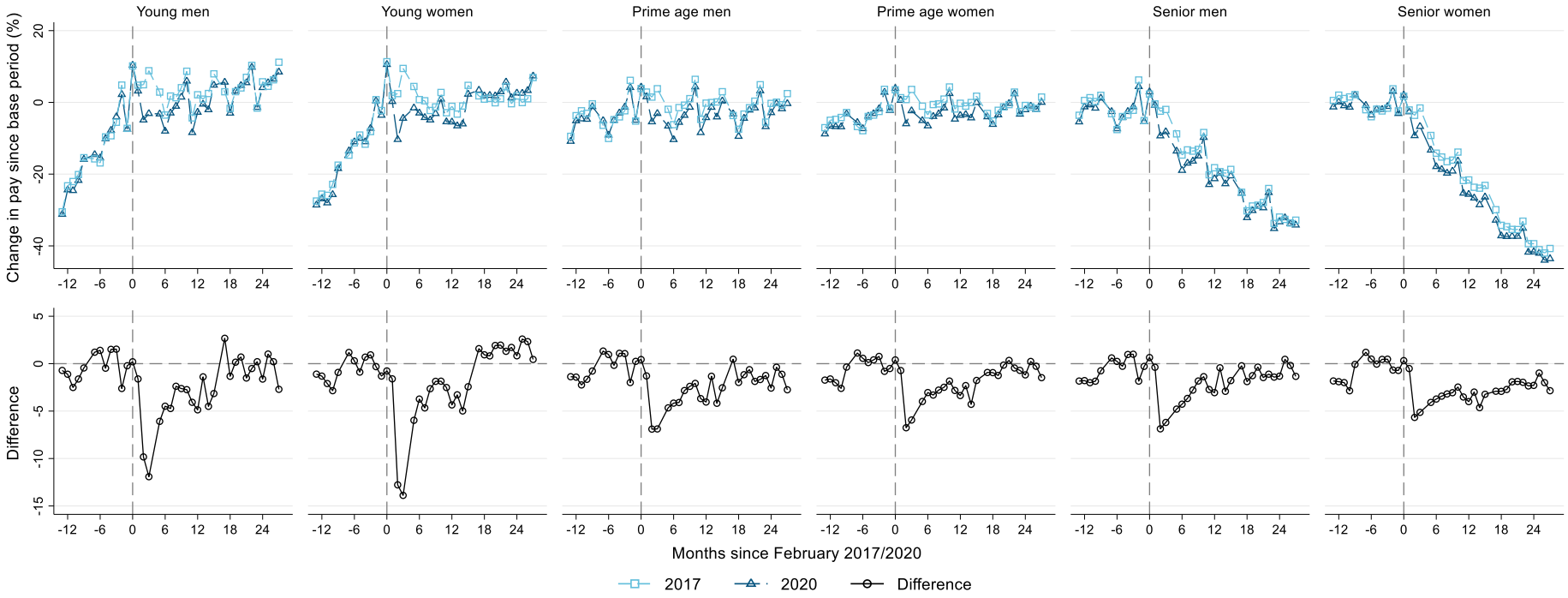

Figure A3. Trends in total monthly pay. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February each year

Note: Panels in top row show percent change in pay from six-month base period ending in February 2017/2020. Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in base month.

Figure A4. Earnings rank and percentage change in monthly pay relative to base period. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February each year

Note: Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in base month.

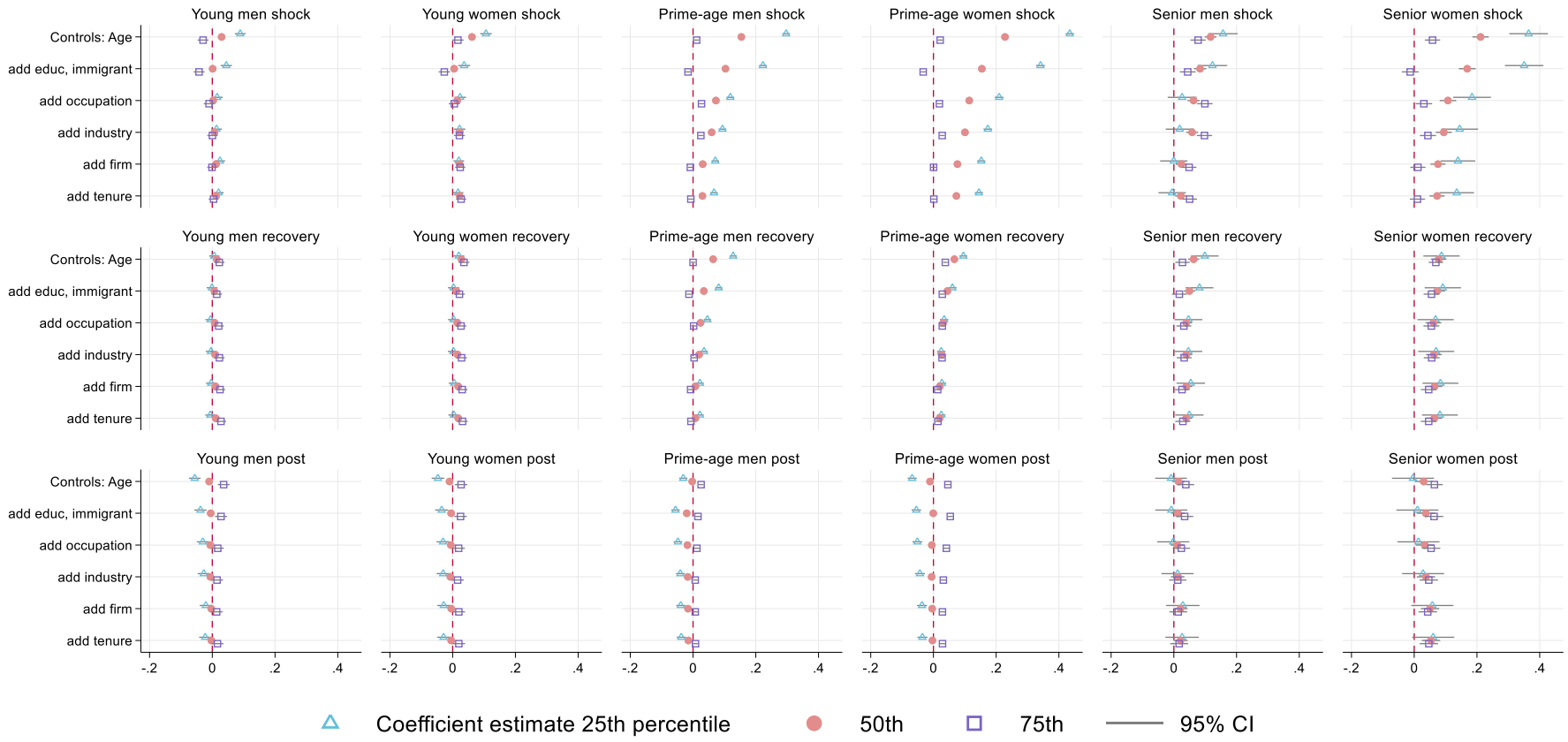

Figure A5. Estimate of excess social gradient during and after COVID based on percentage change in pay as outcome. Samples of young (20-29), prime-age (30-61), and senior (62-67) wage earners as of February each year

Note: Samples are restricted to individuals with non-zero hours worked and pay exceeding G/12 in base month. Estimates show the excess marginal rank effects during COVID, evaluated at the 25th, 50th, and 75th percentile of the earnings rank distribution, with 95% confidence intervals.