Why Was US Labour Productivity Growth So High During the COVID-19 Pandemic? The Role of Labour Composition

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Abstract

In the first few weeks of the COVID-19 recession, around 20 million US workers lost their jobs, with half of those losses occurring in the last two weeks of March 2020. On the tail of these unprecedented job losses, labour productivity grew at an annualized rate of 10.3 per cent in 2020Q2 and the average hourly wage increased sharply. This study examines how these phenomena are related. Because most of the job losses were in low-wage industries or among low-wage workers in high wage industries, the average skill level of the labour force increased substantially. This study finds that this increase in average skill level accounted for 71 per cent (7.3 percentage points) of labour productivity growth in 2020Q2, and that about one-third of the increase in average skill level was due to the change in the distribution of workers across major industries, mainly because of the massive job losses in leisure and hospitality and other low-wage industries. Altogether, changes in the distribution of workers across major industries accounted for 24 per cent (2.5 percentage points) of the 10.3 per cent increase in labour productivity

Much has been written about the impact of the COVID-19 pandemic on the US labour market.[2] The job losses that occurred in late March and early April 2020 were unprecedented. Between mid-March and mid-April of 2020, private sector payroll employment, as measured by the Bureau of Labor Statistics' (BLS) Current Employment Statistics (CES) survey, declined by about 20 million jobs. But certain industries and demographic groups were hit harder than others.[3]

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2 See, for example, Bartik *et al.* (2020) and Groshen (2020). Handwerker *et al.* (2020) summarizes a number of these early papers.

3 The next two paragraphs summarize data from BLS Employment Situation News Releases.

The vast majority of these job losses — about 17.4 million of the nearly 20 million jobs lost — were in service-providing industries. This amounted to about a 16.2 per cent decline in employment in just a few weeks. In contrast, goods-producing industries lost 2.4 million jobs, amounting to a smaller, but still large, decline of 11.4 per cent. Within services, employment in the leisure and hospitality industry declined from 16.1 million in March to 8.5 million in April — a decline of 47.1 per cent. Other major industries that saw large decreases in employment between March and April are retail trade (2.3 million), professional and business services (2.2 million), health and education (2.6 million), and other services (1.3 million). Because the declines in employment were concentrated among low-wage workers, there was a sharp increase in the average hourly wage of $1.36, from $28.67 in March 2020 to $30.03 in April. This one-month increase of 4.7 per cent is more than 50 per cent larger than the increase of $0.86 for the one-year period between March 2019 and March 2020.

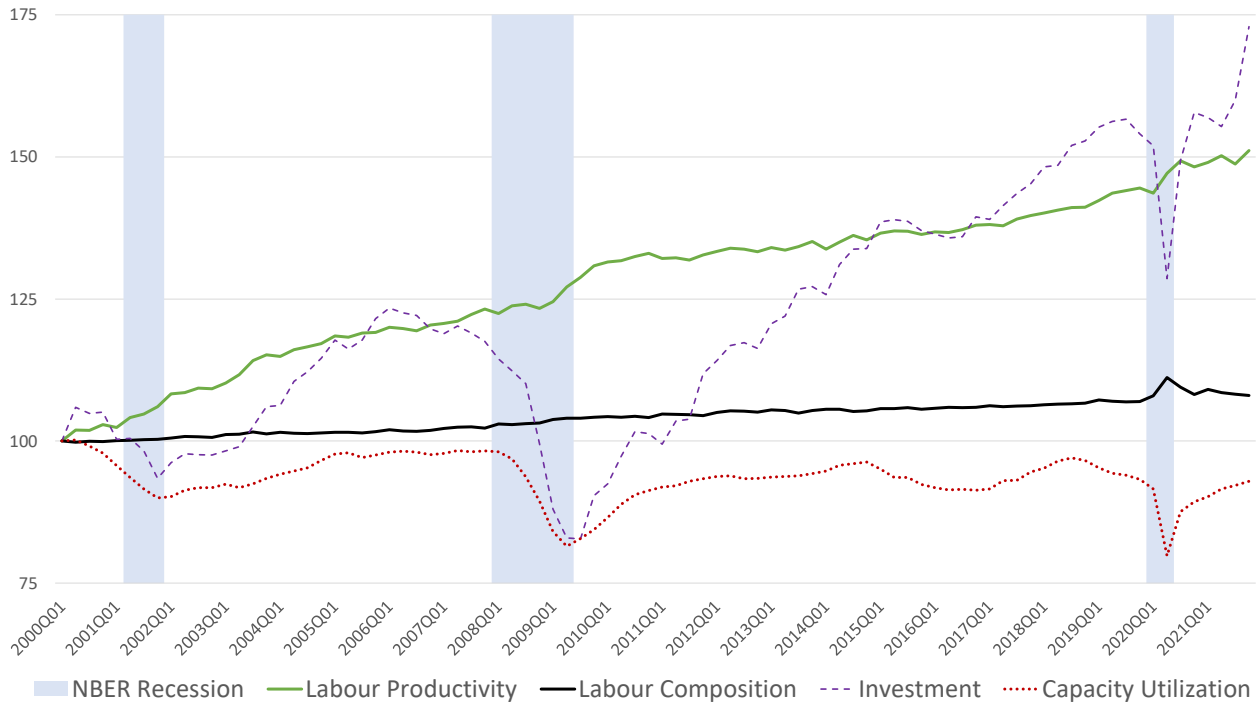
Data from BLS' household survey, the Current Population Survey (CPS), show the impact of the pandemic on different demographic groups and tell a story that is consistent with the establishment-based Current Employment Statistics (CES) data. The CPS data show that between February and April,[4] employment among high school dropouts and high school graduates fell by 26 per cent and 21 per cent, respectively. In contrast, employment of college graduates fell by just 6 per cent. Women lost jobs at a higher rate than men. And younger workers, both men and women, lost jobs at a higher rate than older workers. Around 30 per cent of 20-24-year-olds lost their jobs between February and April, compared with 13 per cent of 45-54-year-olds. Job losses were about the same for 20-24-year-old men and women. But among older workers, job losses were much higher for women than for men.

In 2020Q1, the onset of the pandemic, non-farm business sector labour productivity declined by an annualized rate of 2.5 per cent.[5] But in Q2, when both output and total hours worked labour fell sharply, labour productivity grew by 10.3 per cent. This high growth rate was caused by hours declining at a much faster pace

4 April is compared to February because pandemic-related job losses started showing up in the CPS data for March, whereas the CES data showed a much smaller decline between February and March. The difference is due to the difference in reference periods and how the reference periods interact with the definition of employment. The reference period for the CPS is the week that includes the 12th of the month, which was March 8-14. A person was classified as "employed" if he or she worked at least one hour during the reference week. Therefore, people who lost their jobs in the first week of March would show up as not employed during the CPS reference week (unless they immediately found another job). In contrast, the reference period for the CES is the pay period that includes the 12th of the month. Pay periods can be weekly, bi-weekly, semi-monthly, or monthly, and a worker was included in the payroll employment total if he or she was paid for at least one hour during the pay period. About 2/3 of CES respondents have pay periods longer than one week. Therefore, in cases where the pay period includes the first week of March, any workers who lost their jobs in the first week of March would be included in payroll employment. They would also be included in CES employment total if they did not work during the pay period but were paid.

5 Based on on estimates as of May 5, 2022. The BLS defines the non-farm business sector to include private wage and salary workers (except employees of non-profit organizations), workers in government enterprises (mainly the post office), and self-employed workers (both incorporated and unincorporated). All growth rates are annualized unless otherwise noted.

Chart 1: Indexes of Labour Productivity, Labour Composition, Industrial Capacity Utilization, and Gross Private Domestic Investment, 2000Q1=100



Source: Labour composition index: author's calculations from CPS data. Labour productivity and labour hours: BLS Labor Productivity and Costs program. Investment: Bureau of Economic Analysis. Capacity utilization: Federal Reserve Board of Governors via FRED.

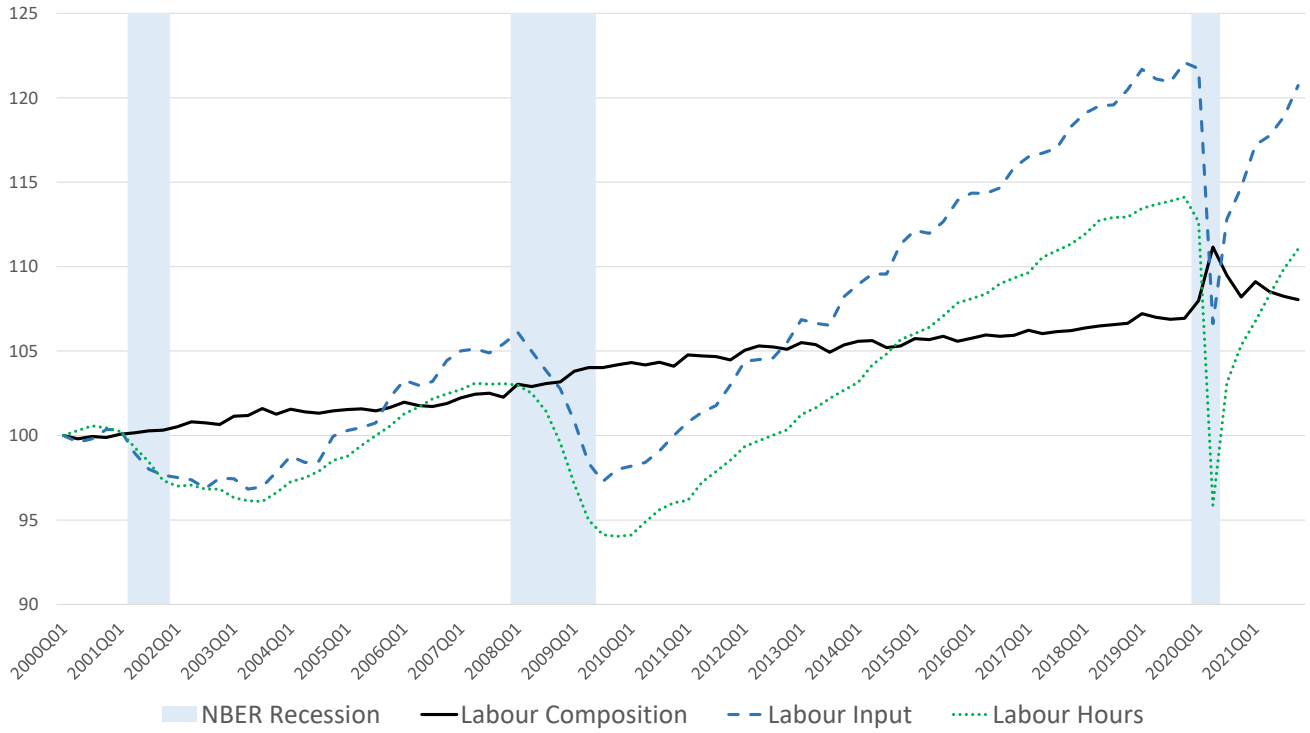
than output. Productivity continued to increase in Q3 by 6.2 per cent, however these gains were a result of a sharp rebound in both output and hours, where gains in output were faster than gains in hours. It may seem puzzling to non-economists that labour productivity growth was so strong in the middle of a pandemic. But we can shed light on these numbers by looking at the three components of labour productivity growth: the growth of total factor productivity (TFP); the change in capital services per hour worked (weighted by capital's cost share); and the change in labour composition (weighted by labour's cost share). Thus, labour productivity can be written as:

$$\dot{LP}_q = \dot{TFP}_q + s_{K,q}(\dot{K}_q - \dot{H}_q) + s_{L,q}\dot{LC}_q \quad (1)$$

where K is capital input, H is total hours worked, LC is labour composition ("quality"), and $s_{K,q}$ and $s_{L,q}$ are the average of q and $q-1$ cost shares of capital and labour. The "dots" indicate percentage growth from the previous quarter.

The main focus of this article is on the contribution of labour composition to labour productivity growth. BLS publishes estimates of labour composition at the aggregate level and by industry in its annual TFP statistics. These annual estimates are usually sufficient because growth of the labour composition index is due to increases in the education and experience of the labour force. Even during periods of rapid changes, labour composition changes slowly and is usually not a significant driver of labour productivity growth. However, the rapid changes experienced in the US economy in 2020 created a need to assess

Chart 2: Indexes of Labour Input, Labour Hours, and Labour Composition, 2000Q1 = 100



Source: Author's calculations from CPS data.

these trends at a higher frequency.

Chart 1 provides some insight as to possible drivers of 2020Q2 labour productivity growth. Ideally, the graph would include each term in equation (1). Unfortunately, there are no quarterly data on capital services. Instead, Chart 1 graphs gross private domestic investment and industrial capacity utilization. Both series exhibited sharp declines, which suggest a decline in capital services, although the sharp decrease in hours worked (Chart 2) suggests that capital intensity may have increased. The sharp increase in the labour composition index suggests that labour composition played a major role in labour productivity growth, which contrasts with previous recessions.

Of the three recessions since 2000, the 2001 recession was the least severe in terms of job losses, although some industries were hit very hard (e.g. travel-related industries). Although it is difficult to see in the indexes, there were several quarters in 2001-2002 with annualized quarterly labour productivity growth rates that exceeded 5 per cent (7.1 per cent in 2001Q2, 5.1 per cent in 2001Q4, and 8.6 per cent in 2002Q1). In those high-productivity-growth quarters, the labour composition index grew only slightly faster than long run trends. In addition, compared to the other two 21st century recessions, there was only a modest decline in investment and industrial capacity utilization.

During the Great Recession, there were several quarters of strong labour productivity growth — in the last three quarters of 2009, labour productivity grew at annualized rates of 8.7 per cent, 5.4 per cent, and 6.3 per cent. At the same time there were significant declines in both capacity

utilization and investment, but only slight increases in the labour composition index.

The COVID-19 recession was quite different from the previous recessions. As with the Great Recession, there were sharp declines in investment and capacity utilization; but unlike the Great Recession, both recovered quickly. Investment returned to pre-pandemic levels by 2020Q4 and exceeded pre-pandemic levels in the last two quarters of 2021. The labour composition index also behaved quite differently in the COVID-19 recession, increasing at an unprecedented rate of 2.9 per cent (12.3 per cent annualized) in 2020Q2. Labour composition's contribution to labour productivity growth was 7.3 percentage points (12.3 per cent $\times$ labour share of 0.596) and accounted for 71 per cent of the 2020Q2 growth in labour productivity.

It is worth noting that the large increase in the labour composition index for 2020Q2 was preceded by a larger-than-average increase of 1 per cent (4 per cent annualized) in 2020Q1. Although most of the 2020Q1 job losses occurred in the last two weeks and were not reflected in the establishment survey's employment estimates, employment estimated from the CPS showed a decline of about 2.8 million people between March and April (see footnote 4). As with Q2, the increase indicates that it was primarily low-wage/low-skill workers who lost their jobs in Q1.

In 2020Q3, the story was somewhat different. Labour productivity grew at an annualized rate of 6.2 per cent, while the labour composition index fell by an annualized 5.9 per cent (contributing -3.5 percentage points) to labour productivity growth. This large difference is likely due to greater capital utilization and, to a lesser extent, the rebound in investment. It is also likely that businesses made changes to their production processes to mitigate the impact of social distancing recommendations. About 65 per cent of the decline in the labour composition index was due to within-industry changes in labour composition and about 35 per cent can be attributed to hiring in low-wage industries. It is worth noting that the labour composition index remained above the pre-pandemic level (and above the pre-pandemic trend line) through the end of 2021Q4. Average private-sector employment increased by around 2.4 million jobs in the third quarter, with 95 per cent of the increase due to hiring in services industries with two major industries, retail trade and leisure and hospitality, accounting for 55 per cent of the increase in services.

Additional insights about the COVID-19 recession can be found in the quarterly utilization-adjusted TFP data that are posted on the Federal Reserve Bank of San Francisco (SF Fed) website as a research series.[6] Although those data indicate that 2020Q2 labour productivity growth was "only" 7.5 per cent, which is lower than the official estimate of 10.3 per cent, it is possible to identify the contributions of the three components in equation (1). The SF Fed data show that TFP growth was 17.9 per cent, the contribution of capital deepening (increased cap-

6 These data are based on the methodology outlined in Fernald (2014).

ital per hour worked) was 21.5 per cent and the contribution of the increase in the average skill level of the labour force was 4.0 per cent (a 6.3 per cent growth rate × labour share of 0.62). The large decline in TFP was due mainly to a decrease in capital and labour utilization. After adjusting for utilization, TFP growth was essentially unchanged at 0.1 per cent. The combination of these factors (including the adjustment for utilization) implies that the contribution of capital deepening to labour productivity growth was 3.4 percentage points. The increase in average skill level accounted for 62 per cent of the 2020Q2 increase in labour productivity, which is a much larger portion than in any previous quarter, although somewhat smaller than what was found in this study.

This rest of this article examines the role of labour composition in the sharp increase in labour productivity in 2020Q2. The next section describes this study's data and methodology, which are similar to BLS' official labour composition measure, and compares this study's estimates with the SF Fed labour quality measure and the official BLS measure. The following section shows how labour composition differs across major industries and examines the role of industry composition (the distribution of total hours across industries) on labour productivity growth. The final section summarizes and concludes.

Methods and Data

The quarterly labour composition index presented here is conceptually the same as the official BLS labour composition measure. It is calculated as the growth of "labour input" minus the growth of aggregate labour hours. The growth in labour input is equal to the weighted sum of hours growth across demographic cells, where the weights for each age × education × sex cell are each cell's share of total labour costs. Labour composition growth is given by:

$$\textit{Labour Comp Growth}_q = \sum_{c \in C} \bar{s}_{c,q} \cdot \ln\left(\frac{H_{c,q}}{H_{c,q-1}}\right) - \ln\left(\frac{\sum_{c \in C} H_{c,q}}{\sum_{c \in C} H_{c,q-1}}\right)$$

where $H_{c,q}$ is total hours worked by workers in demographic cell c in quarter q, C is the set of all demographic cells, and $\bar{s}_{c,q}$ is the average labour cost share weight, which is defined as:

$$\bar{s}_{c,q} = \frac{1}{2}\left(s_{c,q} + s_{c,q-1}\right)$$

where

$$s_{c,q} = \frac{\sum_{i \in c} \hat{w}_{i,c,q} \cdot H_{i,c,q}}{\sum_{c \in C} \sum_{i \in c} \hat{w}_{i,c,q} \cdot H_{i,c,q}}$$

and the $\hat{w}_{i,c,q}$ are predicted values from a wage equation.[7] Thus, the labour composition index increases when the hours worked by high-wage workers grow faster (or decline more slowly) than hours worked by low-wage workers.

7 This study uses a modified version of the methodology used in BLS' annual TFP growth statistics. The main differences are: (1) wages are estimated using a wage regression rather than using the median wage for each cell; this was necessary because of the small sample size. (2) Coarser demographic definitions were used; in addition, it was necessary to combine a number of cells in small industries to accommodate the smaller sample sizes encountered when generating quarterly statistics. (3) The measure is for the non-farm business sector so that it is consistent with quarterly labour productivity estimates, whereas the official measure used in the TFP statistics is for the private non-farm business sector. A discussion of some of the issues with estimating labour composition can be found in Zoghi (2010).

Data

This study uses data from the monthly Current Population Survey (CPS), which is the only data source that can be used to construct a high-frequency measure of labour composition. This section describes the data and discusses how various issues with the data were addressed.

The CPS collects information on employment, hours worked, usual weekly hours and earnings, industry, and occupation for the week that includes the 12th of the month.[8] It also collects demographic characteristics (age, education, and gender). The data were divided into 50 demographic cells: 5 age categories, 5 education categories, and 2 gender classifications.[9] Although it would have been desirable to use more finely defined demographic cells, the relatively small size of the quarterly CPS samples limit the number of cells that are feasible.[10] Even within this structure, it was necessary to combine very small cells with larger cells.[11]

Information on earnings is collected only in 2 of the 8 CPS rotation groups, known as the Outgoing Rotation Groups (ORGs, which are months in sample 4 and 8).[12] To generate wage rates for the other months in sample, a wage regression was estimated for each reference quarter using the ORG data from that quarter and the previous quarter,[13] and the coefficients were used to generate predicted values. These predicted values were used for all observations, even those with actual data.

The CPS collects hours worked on second jobs every month. But industry on the second job is collected only in the ORGs, and the CPS does not collect wages for second jobs. For analytical purposes, second jobs are treated as separate observations so that each observation represents a job rather than a person. Because industry on second jobs is available only in the ORG data, the ORG weights, which are approximately 4 times as large as the Basic CPS final weights, are used for second jobs.[14]

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8 The detailed CPS industries are aggregated into 14 major industries that are the same as the CES "supersectors." Throughout this article, the terms "industry" and "major industry" are used interchangeably.

9 The age categories are: 16-24, 25-34, 35-44, 45-54, and 55+. The education categories are: less than high school, high school, some college, bachelor's degree, advanced degree. The TFP program also stratifies by class of worker (self-employed vs. wage and salary). Self-employed workers were included in the present sample, but class of worker was not used to stratify the sample because the resulting sample sizes of self-employed cells would be too small. In addition, the CPS does not collect wage information for self-employed workers, which means that it must be assumed that self-employed workers earn the same hourly wage as wage and salary workers.

10 Each quarterly sample is composed of three monthly samples

11 For example, the small number of young workers with college degrees were combined with workers in the next age category. And because some of the major industries are small, it was necessary to further combine at least some additional cells in those industries. To make the major industry measures comparable to the aggregate measure, the industry-specific combining of cells was maintained in all calculations.

12 Sampled households are in the CPS for 4 consecutive months, out of the sample for 8 months, and back in the sample for another 4 months. The questions on earnings and the additional questions on second jobs are asked in these "outgoing" rotations because they are more burdensome.

13 Independent variables include age, age squared, education, gender (also interacted with age and age-squared), major industry, and occupation.

14 The Basic CPS final weights were used for the main job of respondents in the ORGs.

This study's sample covers the nonfarm business sector. The CPS sample weights were rescaled using data on total hours worked by major industry so that totals match the official estimates used by the BLS Labor Productivity and Costs (LPC) program.[15] It is important to control to major industry totals because the CPS weights account for the distribution of workers by demographic characteristics but not by industry. Finally, the labour composition index was seasonally adjusted and the indexes were rebased such that 2000Q1 = 100.[16]

Chart 2 shows the labour composition index and indexes of labour input and labour hours for the 2000-2021 period. Typically, rapid increases in labour composition are not expected, because shifts in worker experience, skills, and education tend to occur gradually over time. The exceptions occur during periods of rapid change, such as recessions, because job losses tend to be concentrated in lower-wage workers. In the three recessions that occurred during this period, there were large declines in both labour input and labour hours, with labour hours falling by more than labour input. In the 2001 recession, the decline in labour hours was only slightly larger than the decline in labour input, resulting in a slight increase in the labour composition index.

The Great Recession saw a somewhat larger increase in the labour composition index. In contrast, in 2020Q2, hours worked dropped by significantly more than labour input, which caused the sharp increase in the labour composition index. The index declined after 2020Q2 but remained above the pre-pandemic level (and above trend) through the end of 2021.

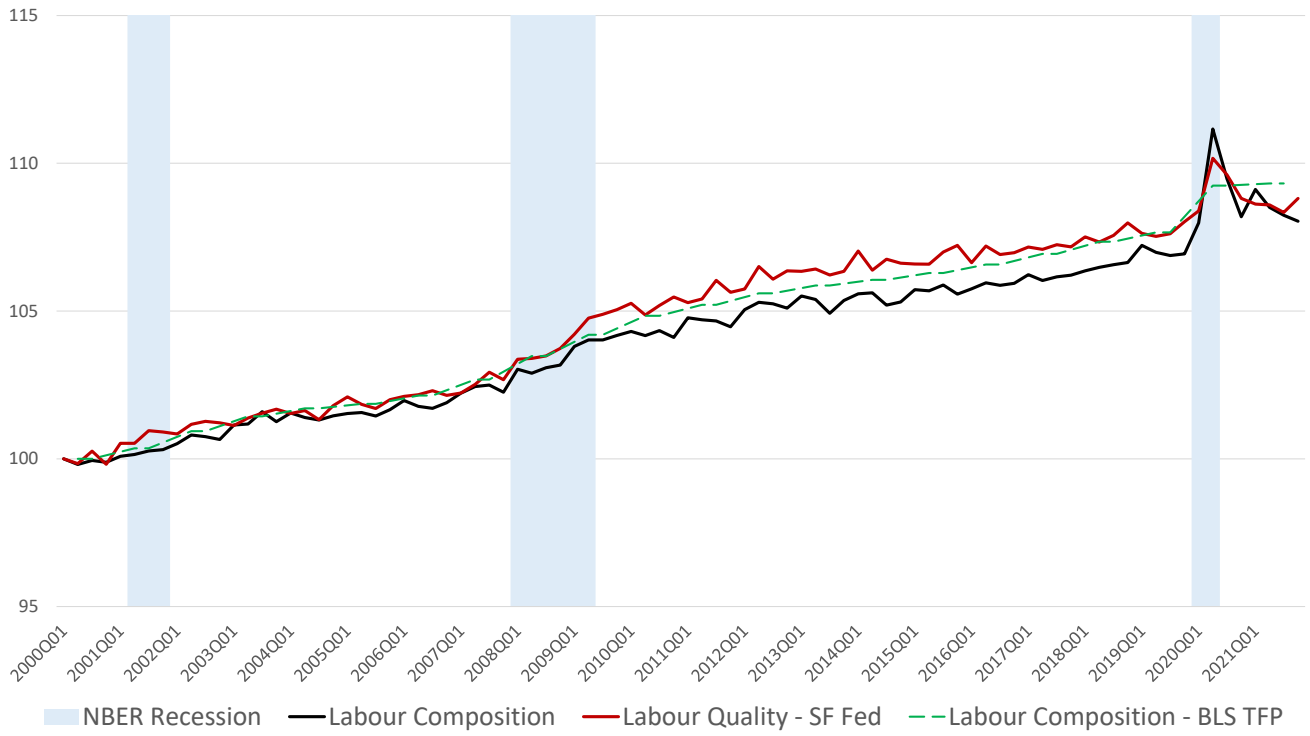
Comparison to other measures of labour composition

As previously noted, the SF Fed posts estimates of quarterly utilization adjusted TFP (and its components) on its website as a research series. The methodology for their labour composition measure, which is referred to as "labour quality," is based on Aaronson and Sullivan (2001), which differs from this study's methodology and the methodology used by the BLS TFP program. The SF Fed estimates of labour quality growth are calculated as the growth in average wages holding the return to demographic characteristics constant. Thus, the Aaronson and Sullivan measure is a quantity-weighted price (predicted wage) index, whereas the BLS measure is a cost-share weighted quantity index, which is consistent with how capital services and labour hours enter into the TFP equation. Because the measures are fundamentally different, the Aaronson and Sullivan measure will be referred to as labour quality and the BLS measure as labour composi-

15 Self-employed workers were included in the rescaling process to ensure that their weights were consistent with those of wage and salary workers.

16 By experimenting with seasonally adjusting the growth rates rather than the indexes, it was found that seasonally adjusting the indexes resulted in a smoother series. More importantly, the LPC program seasonally adjusts levels rather than growth rates.

Chart 3: Comparison of Alternative Measures of Labour Productivity and Labour Composition, 2000Q1=100



Source: Labour composition index: author's calculations from CPS data. Labour Quality – SF Fed: San Francisco Fed. Labour Composition – BLS TFP: BLS Total Factor Productivity program.

tion.[17]

Chart 3 compares the two quarterly labour composition indexes, along with the BLS TFP Program's index.[18] Note that the TFP index, which is annual, was assigned to Q2 to make it easier to see the differences in 2020. All three indexes exhibit similar long-run growth. The average compound growth rates from 2000Q1 through 2019Q4 are 0.34 per cent per year for this study's measure, 0.39 per cent for the SF Fed measure, and 0.37 for the BLS TFP measure. The main differences appear in 2020. Both quarterly measures exhibit a sharp spike in 2020Q2, with this study's modified BLS labour composition measure exhibiting a larger spike (growth of 2.9 per cent vs. 1.6 per cent, which translates to annualized growth rates of 12.3 and 6.3 per cent). Comparing the average values of the indexes for 2019 and 2020, the growth in the labour composition indexes are 2.1 per cent for this study's modified BLS measure, 1.4 per cent for the SF Fed measure, and 1.5 per cent for the BLS TFP measure. However, the higher growth rate for

17 Aaronson and Sullivan calculate the average wage as an hours-weighted mean, where the wage for each observation is the predicted value from a wage regression. Because there is no reason to prefer the coefficients from one quarter over the other, they estimate wage regressions for both the current and prior quarter, calculate growth rates using each set of coefficients, and then take the geometric mean of the two growth rates.

18 Indexes rather than growth rates are compared because growth rates tend to be noisy. The Pearson correlation coefficient between growth rates of this study's labour composition measure and the SF Fed's labour quality measure was only 0.24 between 2000Q1 and 2019Q4. However, when the series was extended through 2021Q4, the correlation coefficient more than doubled to 0.58, mainly due to the spike in 2020Q2.

this study's labour composition measure is entirely due to lower index values in 2019 rather than higher values in 2020.

Taking a closer look at the SF Fed data reveals a few inconsistencies with other data, which suggests that capital deepening played a smaller role in Q2 labour productivity growth and that labour quality/composition played a larger role. The SF Fed data show only a slight decline in the growth rate of capital services in 2020Q2 followed by a sharp slowing of capital growth in Q3, which is inconsistent with the changes in investment for Q2 and Q3 observed in the BEA data.[19] And the SF Fed estimate of labour quality growth, which is an hours-weighted average wage index (holding the returns to demographic characteristics constant), is not consistent with the observed wage changes. The 6.3 per cent annualized growth in labour quality, which translates into a one-quarter increase of 1.6 per cent, is considerably smaller than the observed increase in the average hourly wage of 4.2 per cent between the first and second quarters of 2020.[20] The BLS Employment Situation news release for April 2020 noted that "...the increases in average hourly earnings largely reflect the substantial job losses among lower-paid workers; this change, along with earnings increases, put upward pressure on the average hourly earnings estimates." Given that the CES average hourly wage also is an hours-weighted measure, one would expect the two wage growth measures to be similar.

One possible explanation is that the lower growth in the SF Fed labour quality measure in 2020Q2 is due to the dampening effect of using predicted wages to measure the growth in the wages. The predicted wage for an observation will be closer to the conditional mean than the actual wage. This occurs at both ends of the wage distribution. However, one would expect the impact to be smaller at the lower end of the wage distribution because, given that the wage distribution is right skewed, those values are closer to the conditional mean than wages at the upper end of the distribution. One might wonder why the use of predicted wages does not have the same impact on this study's measure. As noted earlier, the SF Fed labour quality measure is an hours weighted wage index, whereas this study's measure (and the official BLS measure) is a cost-share weighted hours index. For cost-share weights, only the average wages for the demographic cells matter. There is no benefit to having actual wages as long as average predicted wages are close to average actual wages.

-2.9cm

Labour Composition by Major Industry and the Role of Industry Composition

Chart 4 shows the labour composition indexes for 14 major industries. This section will note some general trends and discuss how the labour composition index be-

19 It is worth keeping in mind that short-term declines in investment can have only a limited effect on labour productivity, because investment is a relatively small portion of the capital stock.

20 Based on the average hourly wages for January — March and April — June 2020.

Chart 4: Indexes of Labour Composition by Major Industry

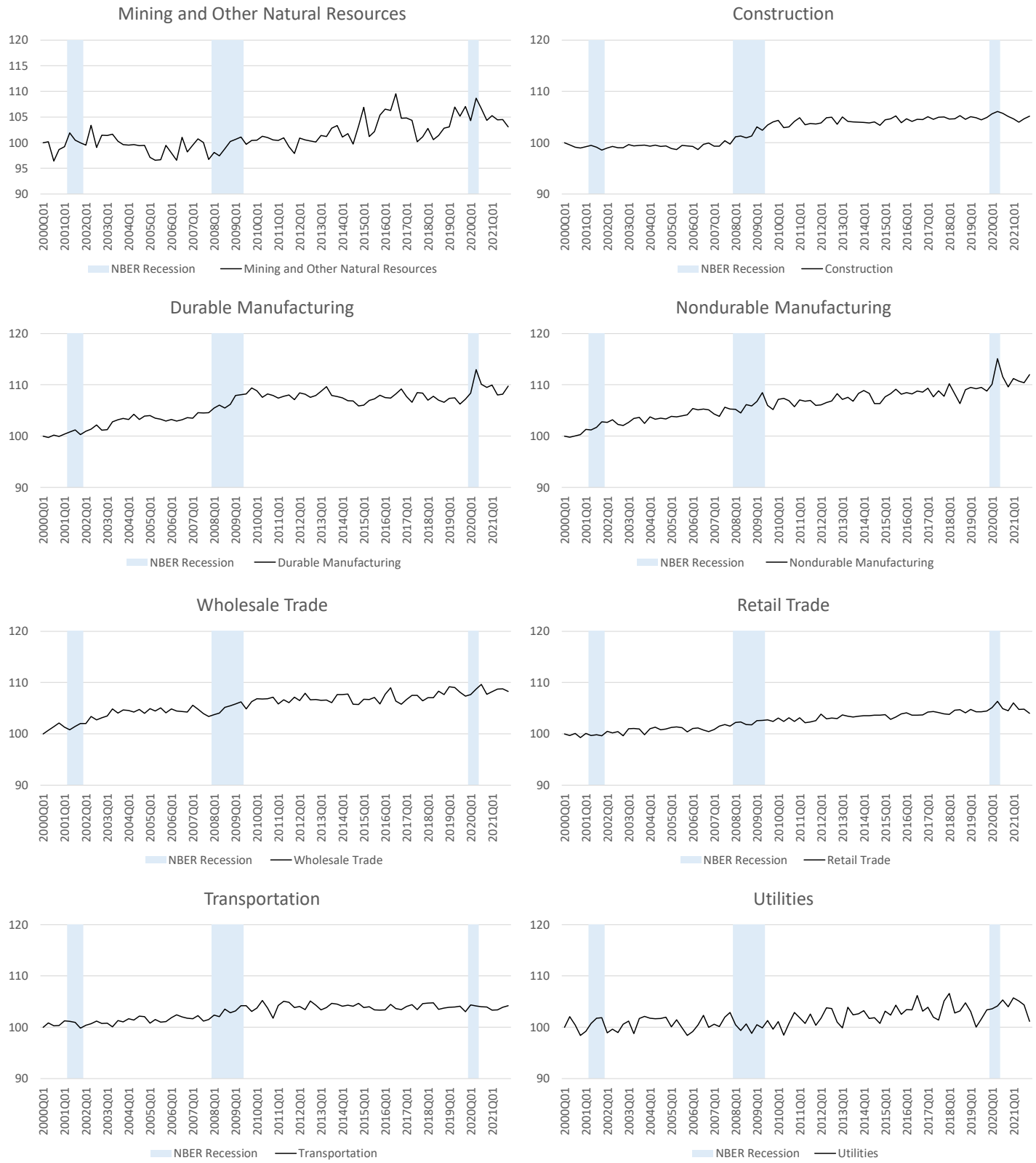
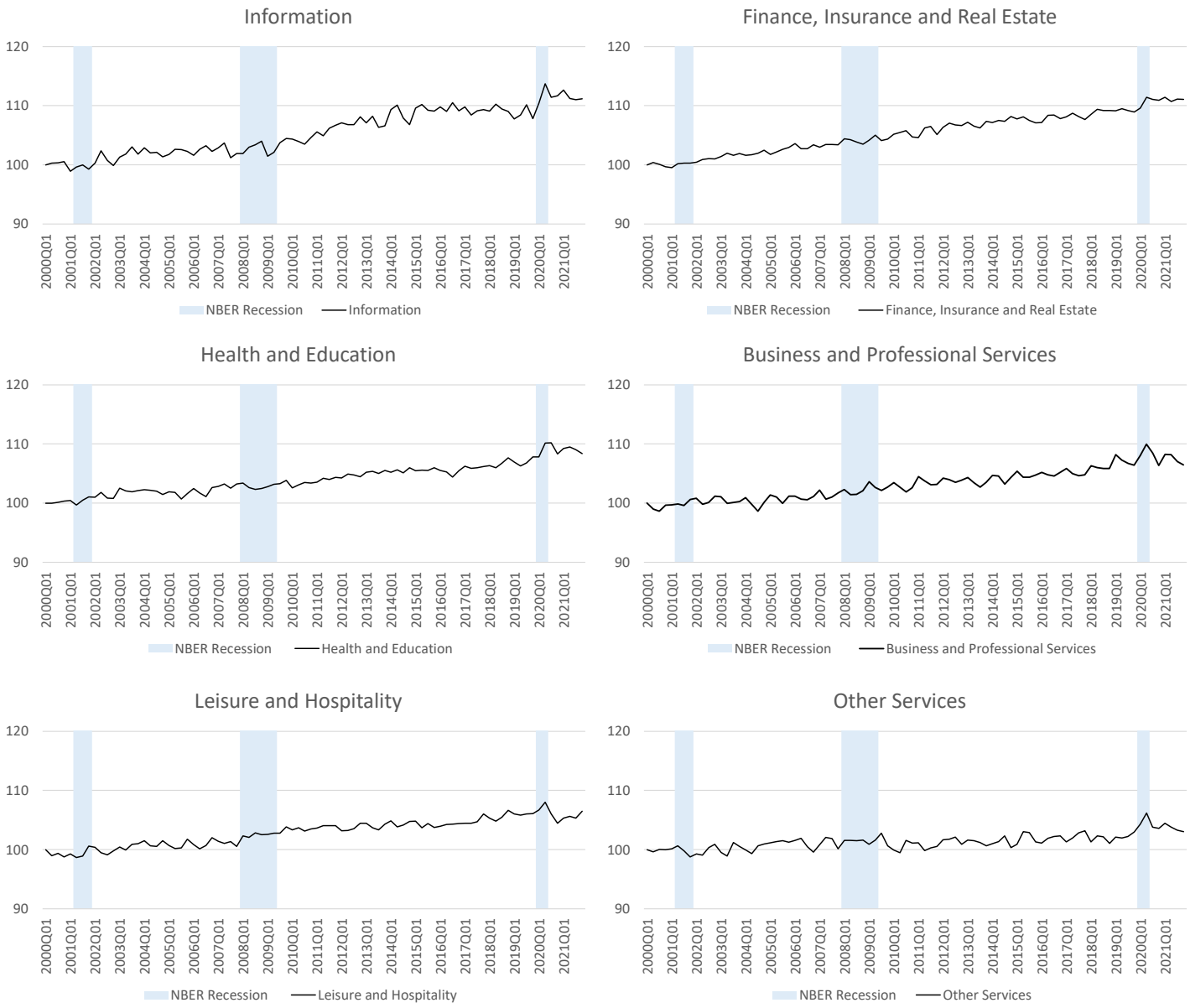


Chart 4 (continued): Indexes of Labour Composition by Major Industry



Source: Author's calculations from CPS data.

haved during the Great Recession. It will then examine how the change in industry composition (the change in the distribution of total hours across major industries) contributed to labour productivity growth in the early months of the COVID-19 pandemic.

The first point to note about Chart 4 is that the trends in labour composition over the 2000-2019 period vary quite a bit by major industry. The labour composition index increased in all major industries, but the utilities, transportation, and other services industries exhibited noticeably slower growth. The largest increases were in nondurable manufacturing, and finance, insurance and real estate (FIRE). Both construction and durable manufacturing exhibited a ratcheting up of the labour composition index around the time of the Great Recession. In construction, the index increased from around 100 to 105 between 2007Q4 and 2010Q1. Looking at occupation data from the Occupational Employ-

ment and Wage Statistics (OEWS) survey for approximately the same period, total employment in construction declined by 26 per cent. Employment in high-wage occupations declined by less than the overall decline (14-20 per cent depending on the occupation), while employment in low-wage occupations fell by more (34-50 per cent depending on the occupation).[21]

A similar pattern is seen in durable manufacturing, where the labour composition index increased from around 105 in 2007Q1 to around 110 in 2009Q1. The published OEWS data do not breakdown manufacturing into durable and non-durable, but looking at manufacturing as a whole reveals a similar — though less dramatic — pattern. Between 2007 and 2009, employment in manufacturing declined by about 11 per cent. Employment in high-wage occupations fell by less (1-6 per cent depending on the occupation), while low-wage occupations declined by more (10-18 per cent depending on the occupation).

These patterns are consistent with firms shedding employees during the recession by outsourcing low-wage jobs. But other than these two major industries, there were no sharp changes in labour composition during the Great Recession. Most other major industries exhibited a steadier increase in the labour composition index, which matched the increase in the overall labour composition index.

The behaviour of the labour composition index during the COVID-19 recession of 2020 was quite different in that there are noticeable spikes in some industries in 2020Q2. Some of these spikes (in durable and non-durable manufacturing, retail trade, information, health and education, and other services) are obvious from the graphs in Chart 4. In other major industries, the spikes are less obvious because they do not look that different from the usual quarter-to-quarter variation (construction, wholesale and retail trade, finance, insurance and real estate, leisure and hospitality, and professional and business services).

To examine this further, the two-quarter increases in the labour composition index between 2019Q4 and 2020Q2 for each major industry are compared with the corresponding average two-quarter changes between 2000Q1 and 2019Q4 (see Table 1).[22] The mean of the absolute value of the two-quarter changes was calculated so that positive and negative changes do not offset each other. Looking at column (1), we see that the two industries with the greatest variability are mining and other natural resources and utilities, which is consistent with the figures. These are small industries, so the volatility is not that surprising.

Comparing columns (1) and (3), we can see that two-quarter changes between 2019Q4 and 2020Q2 are significantly larger than the long-run average for most industries. In 8 of the 14 major industries, the

21 High-wage occupations include management, business and financial operations, and architecture and engineering, while low-wage occupation include helpers, security, food services, and cleaning and maintenance—occupations that are more-easily outsourced.

22 Two-quarter averages were calculated because the changes in labour composition started in 2020Q1, but also to mitigate the impact of the quarter-to-quarter variation.

Table 1: Comparison of Two-Quarter Changes in Labour Composition Index by Major Industry

	(1)	(2)	(3)	(4)
	Absolute value of two-quarter changes 2000Q1 - 2019Q4		Change between 2019Q4 and 2020Q2	Standard deviations from mean
Major Industry	**Mean**	**Standard Deviation**		
Mining and other natural resources	1.49	1.33	1.48	0.01
Construction	0.48	0.40	1.10	1.55
Durable manufacturing	0.58	0.41	5.35	11.57
Non-durable manufacturing	0.73	0.60	5.82	8.54
Wholesale trade	0.67	0.49	1.29	1.26
Retail trade	0.41	0.33	1.82	4.33
Transportation	0.60	0.48	1.10	1.05
Utilities	1.47	0.90	0.75	0.81
Information	0.88	0.62	5.46	7.44
Finance insurance & real estate	0.44	0.32	2.26	5.62
Business & professional services	0.67	0.47	3.34	5.72
Health and education	0.46	0.35	2.14	4.79
Leisure and hospitality	0.54	0.40	1.81	3.15
Other services	0.72	0.57	3.12	4.20
Non-farm business sector	0.20	0.16	3.95	23.88

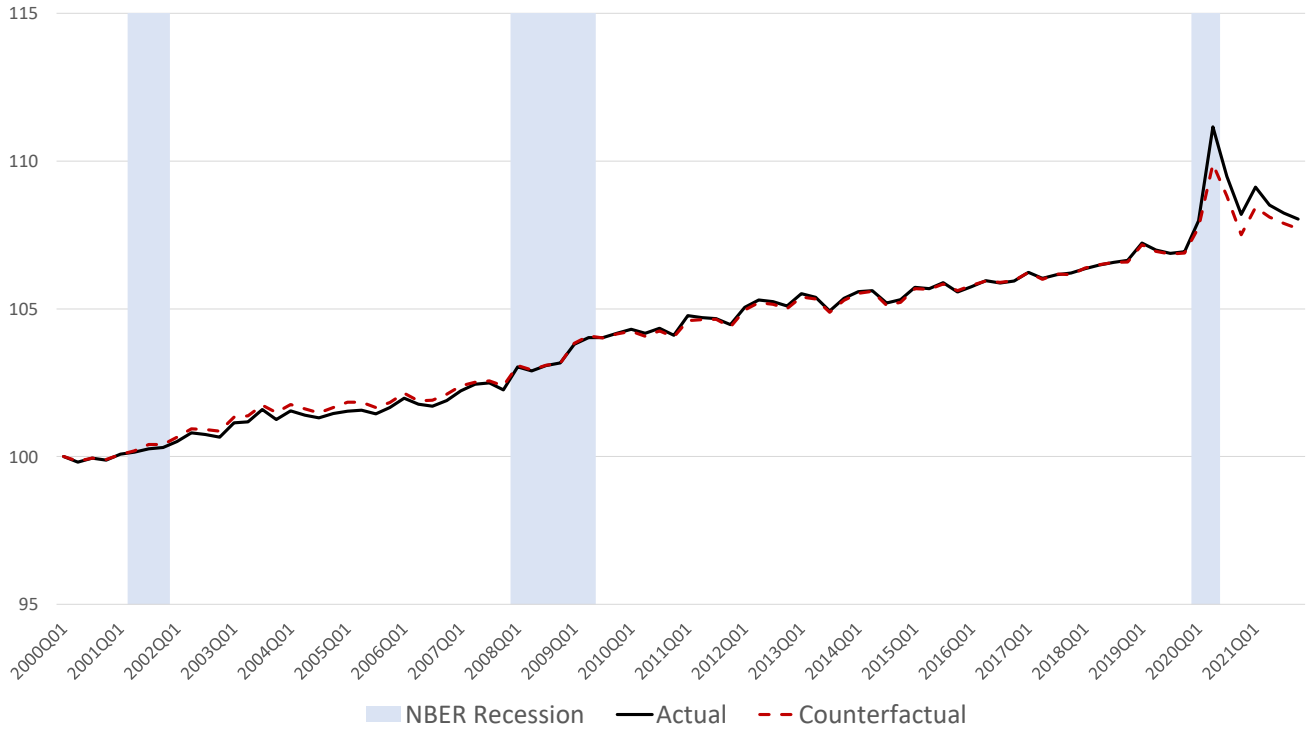
Note: Column (1) shows the average of the absolute value of the 2-quarter percent changes in the labour composition index. Column (2) shows the standard deviation. Column (3) shows the percent change in the labour composition index between 2019Q4 and 202Q2 (all changes are positive). Column (4) shows how far the changes in column (3) are from the long-run mean (in standard deviations).

increases in column (3) are more than three times as large as the average two-quarter changes in column (1). To put it into perspective, column (2) shows the standard deviation of the two-quarter changes in column (1), and column (4) shows how far (in standard deviations) the 2019Q4-2020Q2 changes are from their respective means. As one might have guessed from the figures, the 2019Q4-2020Q2 changes in the labour composition index are well within 2 standard deviations of the mean for mining and other natural resources, construction, wholesale trade, transportation, and utilities. Of the remaining industries, the 2019Q4-2020Q2 was the smallest for leisure and hospitality — just over three standard deviations — compared with more than four standard deviations for the other remaining industries. Interestingly, the increase for the non-farm business sector is nearly 24 standard deviations from the long-run mean. This suggests that changes in the industry composition of employment, specifically the decline in employment in low-wage industries like leisure and hospitality, may have played an important role in the spikes in the labour composition and labour productivity indexes.

The role of industry composition

To examine the contribution of changes in employment across major industries to the growth of labour composition, the labour composition index for the non-farm business sector was compared to a counterfactual index that holds major industry share weights constant between quarters. The counterfactual index accounts for within-industry changes in the labour composition indexes, but not changes in the distribution of workers across industries. The difference between actual and counterfactual indexes is a measure of the

Chart 5: Effect of Changes in Industry Composition



Source: Author's calculations from CPS data.

contribution of the changes that are due to industry composition.

The counterfactual growth rate is calculated as a weighted average of the major industry growth rates, where the weights are the two-quarter average of the industries' shares of the total wage bill:

$$Labour\ Comp\ Growth_q = \sum_{k=1}^{14} \bar{s}_{k,q} \times Labour\ Comp\ Growth_{k,q}$$

where $\bar{s}_{k,q}$ is the average labour cost share weight, which is defined as:

$$\bar{s}_{k,q} = \frac{1}{2}\left(s_{k,q} + s_{k,q-1}\right)$$

where

$$s_{k,q} = \frac{\widehat{W}_{k,q}}{\sum_{k=1}^{14} \widehat{W}_{k,q}}$$

and $\widehat{W}_{k,q}$ denotes total (predicted) wages in industry k in quarter q.

Chart 5 compares the actual and counterfactual labour composition indexes for the non-farm business sector. The two indexes track each other very closely through 2019Q4, except for a slight divergence in the mid-2000s. The largest difference (actual minus counterfactual) was −0.31 in 2005Q1, when the counterfactual index exceeded the actual series. However, the situation changed in 2020Q1 and dramatically so in 2020Q2, when the two series diverged sharply, with the actual index growing faster than the counterfactual.

Table 2 shows how growth rates and index values for the actual and counterfactual indexes changed just before and during the pandemic. The differences in growth rates and index values were small through 2019Q4. There is some divergence in 2020Q1. But in 2020Q2 (in bold), the difference between the actual and counter-

Table 2: Comparison of Actual and Counterfactual Composition Measures

Date	Actual Labour Composition			Counterfactual Labour Composition			Actual minus Counterfactual		
	Index	Growth	Annualized Growth	Index	Growth	Annualized Growth	Index	Growth	Annualized Growth
2019Q1	107.22	0.54	2.19	107.17	0.55	2.20	0.06	0.00	0.00
2019Q2	106.99	−0.22	−0.87	106.94	−0.21	−0.84	0.05	−0.01	−0.03
2019Q3	106.88	−0.10	−0.41	106.86	−0.08	−0.30	0.02	−0.03	−0.11
2019Q4	106.94	0.05	0.22	106.89	0.03	0.11	0.05	0.03	0.10
2020Q1	107.98	0.98	3.98	107.75	0.81	3.27	0.23	0.17	0.71
2020*Q*2	**111.16**	**2.94**	**12.30**	**109.89**	**1.99**	**8.18**	**1.27**	**0.96**	**4.12**
2020Q3	109.47	−1.52	−5.94	108.81	−0.98	−3.87	0.66	−0.54	−2.07
2020Q4	108.19	−1.17	−4.60	107.50	−1.20	−4.73	0.69	0.03	0.13
2021Q1	109.11	0.85	3.45	108.43	0.86	3.47	0.69	−0.01	−0.02
2021Q2	108.51	−0.55	−2.20	108.11	−0.30	−1.18	0.40	−0.26	−1.02
2021Q3	108.24	−0.24	−0.97	107.89	−0.20	−0.81	0.36	−0.04	−0.17
2021Q4	108.04	−0.19	−0.76	107.71	−0.17	−0.67	0.33	−0.02	−0.10

factual indexes was large — an annualized growth rate of 12.3 per cent vs. 8.2 per cent. Thus, had the major industry composition of the labour force remained the same, the growth of the labour composition index would have been 66.5 per cent of the actual growth. Thus, industry composition effects accounted for about 24 per cent (2.5 percentage points) of the increase in labour productivity between 2020Q1 and 2020Q2 (71.2 per cent of labour productivity growth due to labour composition × 33.5 per cent due to industry composition).

Both labour composition indexes fell in the following quarter (2020Q3), but the counterfactual index fell by more, indicating that employment in low-wage industries sectors grew by more than employment in high wage industries. As of 2021Q4, the actual labour composition index was still above the February 2020 level and above trend. The counterfactual labour composition index was still below the actual index, which indicates that employment in low-wage industries has not recovered as much as employment in high-wage industries. Data from the CES confirm this. Employment in most major industries had recovered almost fully. But an important exception is leisure and hospitality, where employment was still nearly 1.9 million (11 per cent) below February 2020 levels.

Given that some major industries are composed of high-wage and low-wage detailed industries, this decomposition underestimates the contributions of changes in employment in detailed industries within major industries. To illustrate, the other services major industry includes a range of more-detailed industries that vary in skill intensity. High-skill industries fall mainly into the repair and maintenance category (automobile, electronic and precision equipment, and commercial and industrial machinery), which were less likely to be affected by shutdowns and consumer hesitancy. The low-skill industries include personal care services, laundry services, and private household services, which were more likely to be impacted. Professional and business services is another major industry that includes both high-wage detailed industries (professional, scientific, and technical services) and low-wage detailed industries (for example, employment services, security, landscaping, and build-

ing services). The smaller 2020Q2 spikes in several major industries (mining, construction, wholesale trade, transportation, and utilities) indicate that job losses were distributed more evenly across skill levels and industries within these major industries.

Summary and Conclusions

The COVID-19 recession, which started in March of 2020, saw unprecedented job losses. In a span of just a few weeks, around 20 million jobs were lost. Because most of these jobs were low-wage, changes in the average skill level of the labour force, as measured by the labour composition index, increased sharply. This increase in the labour composition index accounted for about 71 per cent of the 10.3 per cent increase in labour productivity in 2020Q2. Of the 7.3 percentage point growth attributable to labour composition, about 76 per cent (5.5 percentage points) was due to within-industry changes and 24 per cent (1.8 percentage points) due to changes in the distribution of workers across major industries.

As of this writing (May 2022), employment in the US labour market has still not recovered completely. The labour composition index is still above the 2019Q4 level and above the pre-pandemic trend. The counterfactual index, which holds industry composition constant, lies below the actual index. This difference indicates that industry composition was still part of the story and is consistent with the fact that employment in the leisure and hospitality industry was still nearly 1.9 million (11 per cent) below the February 2020 level.

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