

Appendices:
Measuring the US Employment Situation Using Online Panels:
The Yale Labor Survey¹

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Appendix A. Details on Methods for Calculating Unemployment

This appendix describes the approach used by the YLS to assign respondents to E (employed), U (unemployed), and NILF (not in the labor force). Like the CPS, our survey divides the US population into these three groups through a series of sequential rules. The key questions and responses are contained in Appendix L.

- **Employed** persons either worked for pay in the reference week (WORKFORPAY = YES) or answered that they still received pay even though they did not work during the reference week (WORKSITUATION_WORKING = 3 or 4). The “work-for-pay” question is common with the CPS and represents the bulk of employed workers.

- **Unemployed** persons are those that did not work for pay during the reference week but still met two alternative conditions for the CPS’s definition of unemployment. To be unemployed, someone who did not work for pay must satisfy one of the following requirements:

- *Active search:* These respondents actively searched in the last four weeks (FINDWORK = 1) and were available for work within 7 days (AVAILABLE = 1),

- *On layoff or furlough and expecting to return to job:* Respondents could signal this expectation in two ways: (1) One question (WORKSITUATION) asked non-working respondents to characterize their work situation. Respondents could signal recall expectation by selecting option 1: “Laid off or furloughed from a job to which you expect to return.” Additionally, (2) respondents would need to respond “yes” to a separate question (RECALL), which asked, “If you recently lost your job, have you been given any indication that you will be recalled to work within the next 6 months?”²

- Persons who are **not in the labor force (NILF)** were neither employed nor unemployed.

² For a respondent selecting this option, we used another question to verify that the respondent did in fact lose a job within the past 12 months. This restriction had no material impact on the results.

Appendix B. Difference between BLS Unemployment Rate and 20+ Rate

The YLS reports results for respondents 20 years and over, whereas the CPS also includes persons aged 16 to 19. Because 16–19-year-olds generally have high unemployment rates, the CPS’s headline 16+ rate is always higher than its 20+ rate. This difference peaked in the 1970s and 1980s, and since that time has averaged about 0.4 percentage point. During the pandemic, the difference peaked in April and May 2020 at 0.5 and 0.6 percentage points, respectively. After May 2020, the gap between the 16+ and 20+ URs declined, equaling 0.3 percentage points in five of the six months from September 2020 to February 2021. Therefore, a reasonable correction would be to add 0.3 percentage points to the YLS unemployment rate for any direct comparison between this rate and the headline CPS rate.

Appendix C. The Problem of Measuring Absence from Work

In the first months of the pandemic, a significant issue arose in the CPS regarding workers *who are employed but absent from work*. Absent workers in the CPS are persons with jobs who do not work during the reference week because they are on vacation, sick at home, prevented from getting to work by bad weather, etc. Such absences can be either paid or unpaid.

Unfortunately, during the early months of the pandemic, many people considered themselves with jobs but “absent from work” because their employer has temporarily shut down. These people should not have been considered employed, but the structure of the CPS questionnaire caused millions of these workers to be included in the official employment category. Because these ostensible employment absences did not arise from usual reasons such as vacation or illness, they were grouped into an “other reasons” category.

To see how this misclassification arose, note that the CPS first asks respondents whether they worked for pay during the survey week. Respondents who answer “no” to the initial work-for-pay question are then asked whether they “had a job” during the survey week, including a job from which they were temporarily absent. Many persons displaced by the pandemic answered “no” to the initial work-for-pay question but “yes” when asked whether they had a job. These answers caused them to be classified as employed but absent from their jobs. An additional CPS question on the *reason* for absence should have prevented these displaced workers from being classified as employed-but-absent. Unfortunately, the unique nature of the coronavirus pandemic prevented this check from working as well as it should have. As a result, the coronavirus displacements were classified as employed but absent for “other reasons.”

Because the YLS employment classification has a different structure, it is less susceptible to this classification error. The YLS first asks a work-for-pay question like the one in the CPS. It then follows up by asking all respondents to characterize their work situation. The YLS’s “work-situation” question asks respondents if they worked in their usual place, if they worked at a different location, if they did not work but still were paid, or if none of these situations applied. Persons are classified as employed in the YLS if they answer yes to the initial work-for-pay question or if they indicate in the work-situation question that they either worked for pay or received pay. The YLS definition therefore avoids the ambiguity of whether someone who did not work and did not get paid should be counted as employed because they had a job from which they were temporarily absent.

In FAQs published with employment reports for March through June 2020, the BLS suggested that one way to assess the degree of CPS classification error is to reclassify as unemployed those persons who are recorded as employed but absent from their jobs for other reasons. The following is taken from the FAQ on the April 2020 CPS:

Of the 11.5 million employed people not at work during the survey reference week in April 2020, 8.1 million people were included in the “other reasons” category, much higher than the average of 620,000 for April 2016–2019 (not seasonally adjusted). BLS analysis of the underlying data suggests that this group included workers affected by the pandemic

response who should have been classified as unemployed on temporary layoff. Such a misclassification is an example of non-sampling error and can occur when respondents misunderstand questions or interviewers record answers incorrectly.³

We followed this suggestion (with some minor differences) to create the CPS U3-alt rate. Because the constructed CPS U3-alt rate corrects for the CPS classification error, it provides a more direct comparison with the unemployment rate in the YLS, where the CPS classification error is much less likely to occur.

In the early months of the pandemic, our estimated YLS unemployment rate tracked U3-alt closely. However, the size of the gap between the BLS calculation of U3 and U3-alt narrowed from around 5 percentage points in April 2020 to less than 1 percentage point by May 2021.

³ The FAQ for the April Employment Situation Release can be accessed here: <http://www.bls.gov/cps/employment-situation-covid19-faq-april-2020.pdf>.

Appendix D. Detailed Results and Results by Demographic Group

1. Detailed results by week

Table D-1 shows the detailed results for months of the survey.

2. Results by demographic group

We have examined the summary statistics for the 128 demographic groups to compare the YLS and the CPS for months from February 2020 to May 2021. The results contain some surprises. The first and most important result is that the under-reporting of employment and over-reporting of unemployment is virtually universal across all demographic groups. Focusing only on the demographically weighted results, 93% of cells over-report unemployment. By contrast, the over- and under-reporting of employment is virtually equally balanced among the 128 cells.

Figures D-1 and D-2 provide some visual evidence on these points for the 10 most populous demographic groups. Figure D-1 shows that none of these groups over-report employment, while Figure D-2 indicates a widespread over-reporting of unemployment. Additionally, college graduates of both genders provide relatively reliable responses to both employment and unemployment. By contrast, persons in the high-school-or-less category tend to underreport employment substantially yet are not particularly out of line on unemployment.

Summary Statistics, 20 years and over (Not Seas Adj), 2020-21

Month	Fraction of Population			Labor Market Status Rates		
	Employed	Unemployed	Not in Labor Force	Unemployment	Employment/Population	Labor Force Participation
February						
CPS	63.0	2.3	34.8	3.5	63.0	65.2
CPS-alt	62.7	2.5	34.8	3.9	62.7	65.2
YLS-X	na	na	na	na	na	na
March						
CPS	61.8	2.7	35.5	4.2	61.8	64.5
CPS-alt	61.0	3.5	35.5	5.5	61.0	64.5
YLS-X	na	na	na	na	na	na
April						
CPS	53.5	8.6	37.9	13.9	53.5	62.1
CPS-alt	50.3	11.8	37.9	19.0	50.3	62.1
YLS-X	52.1	11.6	36.3	18.3	50.7	63.7
May						
CPS	54.9	7.7	37.3	12.4	54.9	62.7
CPS-alt	52.8	9.9	37.3	15.8	52.8	62.7
YLS-X	56.0	11.5	32.5	17.0	54.6	67.5
June						
CPS	56.6	6.8	36.6	10.7	56.6	63.4
CPS-alt	55.5	7.9	36.6	12.5	55.5	63.4
YLS-X	56.2	10.0	33.8	15.1	54.8	66.2
July						
CPS	57.1	6.4	36.5	10.1	57.1	63.5
CPS-alt	56.0	7.4	36.5	11.7	56.0	63.5
YLS-X	57.8	8.6	33.6	13.0	56.4	66.4
August						
CPS	58.3	5.2	36.5	8.3	58.3	63.5
CPS-alt	57.5	6.1	36.5	9.5	57.5	63.5
YLS-X	58.2	7.6	34.2	11.6	56.8	65.8
September						
CPS	58.6	4.7	36.8	7.4	58.6	63.2
CPS-alt	58.0	5.2	36.8	8.2	58.0	63.2
YLS-X	58.9	7.2	33.8	10.9	57.5	66.2
October						
CPS	59.5	4.0	36.4	6.4	59.5	63.6
CPS-alt	59.1	4.5	36.4	7.1	59.1	63.6
YLS-X	59.7	5.7	34.6	8.7	58.3	65.4
November						
CPS	59.4	3.9	36.7	6.1	59.4	63.3
CPS-alt	58.9	4.4	36.7	6.9	58.9	63.3
YLS-X	59.4	7.0	33.6	10.5	58.0	66.4
December						
CPS	59.2	3.9	36.9	6.2	59.2	63.1
CPS-alt	58.6	4.5	36.9	7.2	58.6	63.1
YLS-X	59.2	7.4	33.3	11.2	57.8	66.7
January						
CPS	58.8	4.1	37.1	6.5	58.8	62.9
CPS-alt	58.2	4.7	37.1	7.5	58.2	62.9
YLS-X	59.2	7.0	33.8	10.6	57.8	66.2
February						
CPS	59.2	4.0	36.8	6.3	59.2	63.2
CPS-alt	58.7	4.5	36.8	7.1	58.7	63.2
YLS-X	59.8	6.2	34.0	9.4	58.4	66.0
March						
CPS	59.5	3.8	36.7	5.9	59.5	63.3
CPS-alt	59.0	4.3	36.7	6.8	59.0	63.3
YLS-X	58.8	4.9	36.3	7.8	57.4	63.7
April						
CPS	59.7	3.5	36.8	5.6	59.7	63.2
CPS-alt	59.2	4.0	36.8	6.3	59.2	63.2
YLS-X	62.1	4.1	33.7	6.2	60.7	66.3
May						
CPS	59.8	3.4	36.8	5.3	59.8	63.2
CPS-alt	59.4	3.8	36.8	6.0	59.4	63.2
YLS-X	60.4	4.7	35.0	7.2	59.0	65.0

Table D-1. Basic comparisons, YLS and CPS, February 2020 – May 2021

NOTE: YLS estimates are for the CPS reference week. The YLS Employment/Population ratio is adjusted by -1.4 percentage points to reflect those answering surveys who are not working for pay. Statistics are for the population 20 years and over and are not seasonally adjusted.

Employment-to-Population Ratio
 Most populous demographic groups under age 65

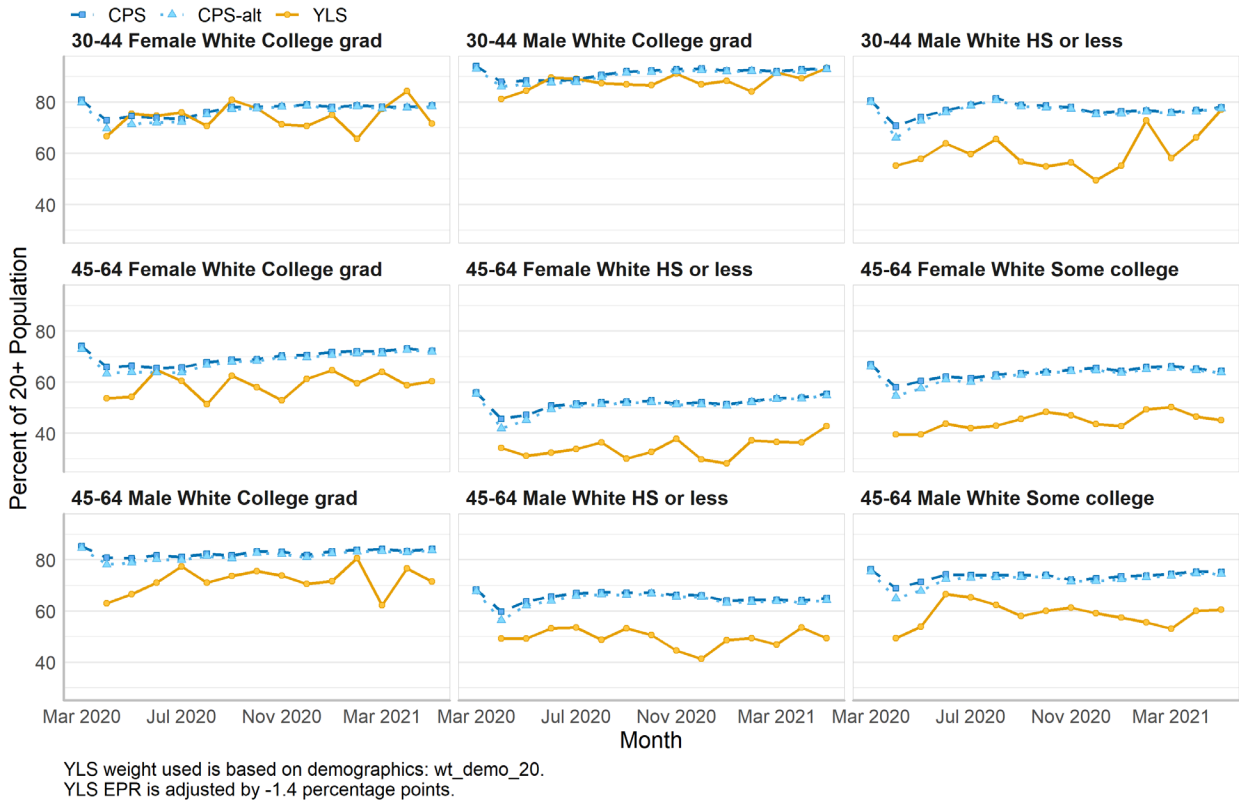


Figure D-1. Monthly results for demographic weighting for employment-population ratio for 10 most populous of 128 demographic groups under age 65

Unemployment Rate

Most populous demographic groups under age 65

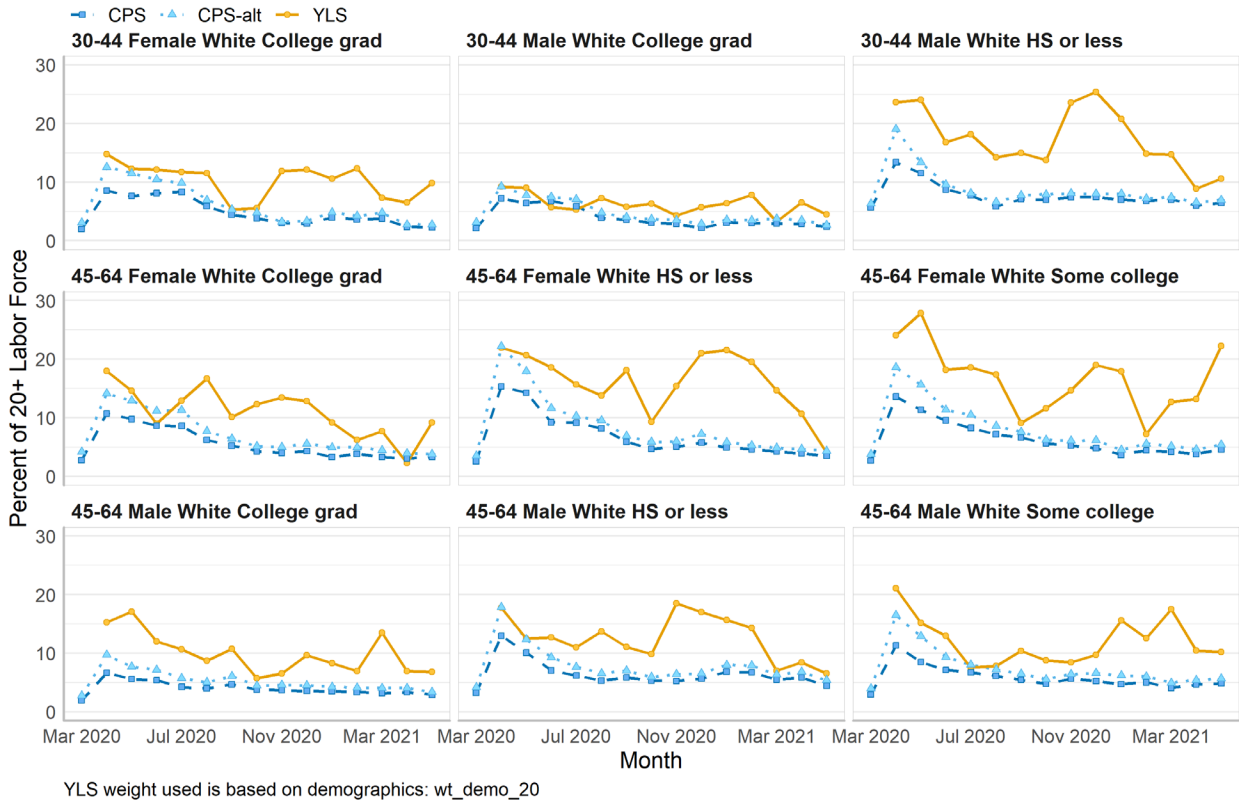


Figure D-2. Monthly results for demographic weighting for unemployment rate for 10 most populous of 128 demographic groups under age 65

Appendix E. Construction of Weights Using Labor Market Status

The definition of demographic weights (age, education, race, marital status, gender, and children) is largely conventional. However, incorporation of labor market status into these weights requires data that are not easily obtained as well as decisions on how to use them.

The basic approach is to assume that prior labor market status (LMS) proxies for unobserved individual factors that help determine current LMS. For example, if an individual was retired in February 2020, we assume that it is likely that the person remains retired in later months. A similar assumption holds for disability, school attendance, and other reasons for being out of the labor force. Similarly, if a person was employed despite low employment probabilities in her demographic group, her relatively strong labor force attachment would be represented by higher-than-average employment status in the prior LMS, and therefore in the current month as well.

At the same time, it should be recognized that the value of prior LMS will erode over time. This erosion is most likely for students who graduate and enter the labor force. Similarly, some may change the LMS as the economy transitions from tight to weak labor markets, or the reverse in mid-2020.

We constructed two variants of prior LMS: February and later. In the early months of the survey, February labor market status was derived from answers provided by the respondent in the October 2019–February 2020 period, collected by YouGov as part of its data collection on its panel participants. Where these data were not available, the YLS asked a recall question about February 2020 labor market status and additional questions about the current status.

As time passed, the February 2020 status was becoming less relevant due to the erosion of information discussed above. Therefore, in July 2020, the YLS added questions on labor market status in months after February 2020 as well as February 2020. Starting in July 2020, we constructed “final weights” that reflect labor market activity in months that are closer to the survey period. As an example, the YLS weights for the December CPS week use labor market status in each cell averaged from the October and November 2020 CPS microdata. These final weights roll forward over time as new CPS microdata become available.

Table E-1 shows how updated information on labor market status in prior months was incorporated into the “final weights” used in YLS. The column labeled “Feb-based weights” are ones that balance the YLS respondents’ labor market attachment in February 2020 to official CPS data for that month. The other columns refer to weights that balance labor market status in June through November 2020 (months after November were incorporated in a similar way). The final weight for any given YLS week was a weighted average of two month-specific weights, with the importance of each month in this average reported in the appropriate row.

Reference week	Reference Week Date	Feb	Jun	Jul	Aug	Sep	Oct	Nov	Row Sums
3	11-Apr-20	1.00							1.00
4	18-Apr-20	1.00							1.00
5	25-Apr-20	1.00							1.00
6	2-May-20	1.00							1.00
7	9-May-20	1.00							1.00
8	16-May-20	1.00							1.00
9	23-May-20	1.00							1.00
10	30-May-20	1.00							1.00
11	6-Jun-20	1.00							1.00
12	13-Jun-20	1.00							1.00
13	20-Jun-20	1.00							1.00
14	27-Jun-20	1.00							1.00
15	4-Jul-20	1.00							1.00
16	11-Jul-20	0.75	0.25						1.00
17	18-Jul-20	0.50	0.50						1.00
18	25-Jul-20	0.25	0.75						1.00
19	1-Aug-20		1.00						1.00
20	8-Aug-20		0.75	0.25					1.00
21	15-Aug-20		0.50	0.50					1.00
22	22-Aug-20		0.25	0.75					1.00
23	29-Aug-20			1.00					1.00
24	5-Sep-20			0.75	0.25				1.00
25	12-Sep-20			0.50	0.50				1.00
26	19-Sep-20			0.25	0.75				1.00
27	26-Sep-20				1.00				1.00
28	3-Oct-20				0.75	0.25			1.00
29	10-Oct-20				0.50	0.50			1.00
30	17-Oct-20				0.25	0.75			1.00
31	24-Oct-20					1.00			1.00
32	31-Oct-20					1.00			1.00
33	7-Nov-20					0.75	0.25		1.00
34	14-Nov-20					0.50	0.50		1.00
35	21-Nov-20					0.25	0.75		1.00
36	28-Nov-20						1.00		1.00
37	5-Dec-20						0.75	0.25	1.00
38	12-Dec-20						0.50	0.50	1.00
39	19-Dec-20						0.25	0.75	1.00
40	26-Dec-20							1.00	1.00

Table E-1. Construction of Final Weights in the YLS

This table shows the weights used in FINWT1. FINWT2 uses the most recent weight available, not a weighted average of the past two months. For example, for the survey for November 7, 2020, FINWT1 uses a combination of September and October CPS microdata, with a 75% and 25% weight, respectively. FINWT2 is simply the October-based weight itself.

Appendix F. Raking in Theory

The procedure used to create weights is iterative proportional fitting or “raking,” which was proposed by Deming and Stephan (1940) to balance samples on multiple characteristics. Raking requires only the marginal distributions of the control totals and can be computed quickly using the iterative proportional fitting (IPF) algorithm. This section describes the raking procedure followed here.

To fix ideas, first, consider cell weighting by a single covariate with K categories. The population proportion in category k is t_k and the number of sample respondents in category k is n_k , where $n_1 + \dots + n_K = n$. The proportion of sample respondents in category k is $s_k = n_k/n$, so the ratio of population to sample proportions is $w(k) = t_k/s_k$. If respondent i is in category $x_i = k$, then they are assigned weight $w_i = w(x_i) = t_{x_i}/s_{x_i}$. It follows that

$$\sum_{i=1}^n w_i = \sum_{k=1}^K n_k w(k) = n \sum_{k=1}^K t_k = n$$

and the weighted proportion of sample observations in category k is

$$\hat{t}_k = \frac{\sum_{i=1}^n w_i \mathbf{1}(x_i = k)}{\sum_{i=1}^n w_i} = \frac{n_k w(k)}{n} = t_k,$$

so the weights w_i do indeed adjust the sample margins to the control totals. Note that the function “ $\mathbf{1}(x_i = k)$ ” is an indicator function which takes the value = 1 when $x_i = k$ and = 0 otherwise.

Raking extends this procedure to balance multiple variables to their control totals simultaneously. We seek a set of non-negative weights $w_i = w(x_{1i}, \dots, x_{ji})$ ($i = 1, \dots, n$) which sum to sample size and satisfy the *marginal constraints*,

$$\hat{t}_{jk} = \frac{\sum_{i=1}^n w_i \mathbf{1}(x_{ji} = k)}{\sum_{i=1}^n w_i} = t_{jk} \quad \text{for } j = 1, \dots, J \text{ and } k = 1, \dots, K_j$$

J of these constraints are redundant, since both the sample and population proportions sum to one. If the marginals t_{jk} are consistent and none of the sample marginals is zero when the corresponding population marginal is non-zero, there will be multiple solutions that satisfy the marginal constraints. Thus, we desire weights that are “close” to the unweighted sample while satisfying the marginal constraints. Different definitions of closeness lead to different solutions. Ireland and Kullback (1968) argue for weights that minimize the Kullback-Leibler (KL) divergence between the weighted and unweighted sample distributions,

$$\text{KL}(\hat{p}^w, p) = \sum_{x_1, \dots, x_J} \hat{p}^w(x_1, \dots, x_J) \log \frac{\hat{p}^w(x_1, \dots, x_J)}{p(x_1, \dots, x_J)}$$

subject to the marginal constraints, where $\hat{p}^w(x_1, \dots, x_J)$ and $p(x_1, \dots, x_J)$ are the weighted and unweighted sample proportions in cell (x_1, \dots, x_J) . A result from information theory implies the existence of a unique minimizer obeying the marginal constraints that are of the form

$$p^*(x_1, \dots, x_J) = p(x_1, \dots, x_J) \prod_{j=1}^J \lambda_{j,x_j} = p(x_1, \dots, x_J) w^*(x_1, \dots, x_J),$$

where

$$w^*(x_1, \dots, x_J) = \prod_{j=1}^J \lambda_{j,x_j} = \frac{p^*(x_1, \dots, x_J)}{p(x_1, \dots, x_J)} \quad \text{for } j = 1, \dots, J \text{ and } x_j = 1, \dots, K_j$$

This shows that the effect of weighting by w^* is to balance the sample, since p^* satisfies the marginal constraints.

Iterative proportional fitting (IPF) is a simple iterative algorithm to calculate w^* . Initially, take each weight equal to one. Starting with the first marginal constraint, calculate the ratio $\lambda_{1k}^{(1)}$ of the control total t_{1k} to the weighted sample proportion for that margin (using the current weights). Adjust the weight by multiplying by the weights by $\lambda_{1k}^{(1)}$. This is referred to as *raking* the first sample margin; $\lambda_{j,x}^{(1)}$ is the multiplier which adjusts the first margin to its control total. Using the updated weight, rake the second sample margin to its control variable and cycle through the remaining margins to obtain a set of J raking factors $\lambda_{1,x_1}^{(1)}, \dots, \lambda_{J,x_J}^{(1)}$. Iterate this process until all of the raking factors $\lambda_{jk}^{(N)} \xrightarrow{N \rightarrow \infty} 1$. Ireland and Kullback show that the rate of convergence is geometric. The name “raking” derives from the picturesque analogy of raking sand first horizontally and then vertically and repeating until it is evenly distributed.

Appendix G. A Simple Example of Weighting for Prior Labor Market Status

Because the weighting is complex, this appendix uses a simple example to explain it. It also shows how a persistent bias in recall labor force status leads to an upward bias in the estimate of the unemployment rate.

For this example, we assume there are only two kinds of labor market status, unemployment (U) and not unemployed (NU). Further, we show the technique for the most disaggregated cell (of gender, education, age, etc.). For the appendix, we use the following terminology:

- **“Current LF status”** is the status calculated for “last week” using the full set of CPS questions (e.g., work for pay, absence, layoff, etc.). These estimates are compared each month to the CPS survey.
- **“Retrospective LF status”** is calculated using a streamlined and simplified set of questions that inquires as to *past* labor market status in prior months.

We take two months, M and $(M+1)$. To begin with, we assume that the actual labor market situation and the surveys are identical each month, with identical errors or biases in each month. Table G-1 shows the illustrative data for the CPS in part [A], the unweighted YLS survey for both months in part [B], and the YLS retrospective survey for month M looking back from month $(M+1)$ in part [C]. The total sample is assumed to be 100.

	[A]		[B]		[C]	
	CPS actual		YLS survey		YLS Retrospective	
	U	NU	U	NU	U	NU
Month M	20	80	20	80	10	90
Month (M+1)	20	80	20	80		

[A] = CPS data

[B] = YLS unweighted survey, current response

[C] = YLS unweighted retrospective data

Table G-1. Basic data for representative months

The next step is to construct the weights for month $(M+1)$. These are constructed using the CPS data for month M and comparing those to the retrospective LF status for month M . The weights are 20/10 for U and 80/90 for NU. These are shown in part [D] of Table G-2, which adds three columns to Table G-1.

	[A]		[B]		[C]		[D]		[E]		[F]	
	CPS actual		YLS survey		YLS Retrospective		YLS weights		YLS weighted survey		Error (% points)	
	U	NU	U	NU	U	NU	U	NU	U	NU	U	NU
Month M	20	80	20	80	10	90	2.000	0.889				
Month (M+1)	20	80	20	80					36	64	16	(16)

[A] = CPS data

[B] = YLS unweighted survey, current response

[C] = YLS unweighted retrospective data

[D] = weights using CPS for M relative to YLS retro for M.

[E] = YLS current, month (M+1), times YLS weights, normalized to sum to 100.

[F] = error from YLS estimates

Table G-2. Construction of YLS weights and weighted survey

The key calculation comes in columns [E]. To calculate the weighted YLS sample for month (M+1), we multiply the weights in [D] by the YLS survey results for month (M+1) in column B. These sum up to more than 100 and are then normalized so that they sum to the survey total of 100.

The weighted sample has a larger U and a smaller NU because the retrospective looking back to month M underreports U relative to the CPS actual in month M. The error is shown in columns [F]. Note that the error is [the actual CPS in month (M+1)] minus [the weights times the unweighted YLS survey results for month (M+1).]

Not surprisingly, if YLS is accurate, it will produce the correct result. Another case would be where the YLS is consistently biased in the current and the retrospective, shown in Table G-3. Here, the weighting produces the correct result.

	[A]		[B]		[C]		[D]		[E]		[F]	
	CPS actual		YLS survey		YLS Retrospective		YLS weights		YLS weighted survey		Error (% points)	
	U	NU	U	NU	U	NU	U	NU	U	NU	U	NU
Month M	20	80	10	90	10	90	2.000	0.889				
Month (M+1)	20	80	10	90					20	80	0	0

[A] = CPS data

[B] = YLS unweighted survey, current response

[C] = YLS unweighted retrospective data

[D] = weights using CPS for M relative to YLS retro for M.

[E] = YLS current, month (M+1), times YLS weights, normalized to sum to 100.

[F] = error from YLS estimates

Table G-3. Consistent errors in YLS are fixed using the weighting technique

Results with actual YLS results

We can use the same approach as shown in Table G-2 using the actual estimates from the YLS using the survey through April 2021. We have gathered the full set of duplicate responses – i.e., those where a respondent has both a current LF status and a later retrospective LF status for the same month that can be used for comparison (N = 54,949). Our tabulation found that the retrospective estimate of U (7.7% of the population) was lower than the current estimate (9.3% of the population). Table G-4 uses the same calculation as in earlier tables. The errors in the retrospective find a calculated upward bias for U of 1.02% of the population or 1.61% of the labor force. Note that this is just suggestive because it does not allow for differences by demographic group or by month and assumes a constant LF status over time. If the same approach is used for the three-way labor force classification, the estimates of the error are virtually the same.

While the approach used in Table G-4 is suggested by the analysis, the project was unable to undertake this analysis as the funds were spent.

	[A]		[B]		[C]		[D]		[E]		[F]	
	CPS actual		YLS survey		YLS retrospectiv		YLS weights		YLS weighted surve		Error (% points)	
	U	NU	U	NU	U	NU	U	NU	U	NU	U	NU
Retrospective	4.90	95.10	9.28	90.72	7.72	92.28	0.64	1.04				
Current	4.90	95.10	9.28	90.72					5.92	94.08	1.02	(1.02)

[A] = CPS data

[B] = YLS data

[C] = YLS data

[D] = weights using CPS for M relative to YLS retro for M, corrected for total

[E] = YLS current, month (M+1), times YLS weights

[F] = error from YLS estimates

Table G-4. Correcting bias will provide correct YLS estimates

Appendix H. Construction of the YouGov Panel

This appendix describes the selection of the panels for the YLS. Respondents were drawn from YouGov’s opt-in online panel, which is similar to other access panels commonly used for market research and public opinion polling. (Sudman and Wansink, 2002) YouGov recruits participants using internet-advertising campaigns (primarily Google Adwords, Facebook, and banner ads on popular websites, but also using co-registration, visitors to YouGov’s home page, and referrals from existing panelists). After confirming their email addresses (“double opt-in”), the individuals provided personal and demographic information to become registered panelists. There is no well-defined sampling frame or established probabilities of selection for panelists. Rather, the panel is a pool of respondents available for conducting individual research studies. People who join online panels exhibit biases that are similar to those who answer random telephone surveys (e.g., they are older, more likely to be white, and have more schooling). Attitudinal studies have found that online panelists are early adopters, less traditional, and more environmentally concerned. (Gittelman et al., 2020) Unlike in phone surveys, however, online panelists are approximately balanced on gender.

Samples for individual YouGov studies, like this one, are selected from the YouGov panelist pool that contains the target population (in this case, the US population 18 or older). The size of YouGov’s panel is much larger than the sample size needed for any individual study, but the company is conducting many studies simultaneously. At the time of this project, there were almost 200,000 active panelists.⁴ YouGov uses quota sampling to select respondents from the panel for receiving invitations and an allocation algorithm to assign responding panelists for particular studies, which we describe now.

For the YLS, panelists were allocated to 96 quota cells, based upon the cross-classification of their age (18–29, 30–44, 45–64, or 65+), gender (male or female), education (high school or less, some college, college degree, post-graduate degree), and race (white, black, or Hispanic).⁵ For each cell, a target number of respondents was selected that was proportional to the number of adults in the February 2020 CPS. For each panelist, a probability of response is estimated based upon past rates of participation and demographics. Panelists in each quota cell are randomly selected for being sent invitations until the expected number of responses in each cell equals the target number. The invitations do not describe the subject of the study, nor do they guarantee that the panelist will be assigned to any particular study.

Panelists who click on links in their email invitations are routed to one of the available studies according to an algorithm until the target number for the survey is reached or until

⁴ An active panelist for this purpose is defined as having completed a survey in the last month.

⁵ YouGov includes “Hispanic” as an answer option for the question “What best describes your race?” The Current Population survey asks separate questions about the respondents’ race and origin. In the CPS, we have grouped whites of Hispanic origin as Hispanic and blacks of Hispanic origin with Blacks. Whites include any non-Hispanics who are not black, including those identifying as Native American, Asian, Middle Eastern, and mixed race.

the field period (say, 24 hours) ends. The algorithm assigns a value to each panelist for each study that the respondent qualifies for. The value is based upon the number of additional respondents needed to fill the respondent's quota cell, divided by the length of time remaining for fielding the survey.

As compensation for participating in this study, panelists receive points that can be converted to cash after a minimum threshold has been reached. For this study, each respondent was awarded the equivalent of \$0.50 in points. The median time to complete the survey was 9 minutes.⁶

⁶ One interesting feature of the present survey is that respondents might consider that they are working for pay because they are compensated for answering online surveys. As we note in the discussion of "nuggets" in the main text, we correct for a misclassification of this group.

Appendix J. Sources of Error

A. Total Survey Error

As with other surveys, there are several reasons why unemployment and participation estimates generated by YLS could differ from underlying population values. Often called “total survey error,” they come from several sources: sampling error, non-response error, errors from differences in questionnaires and question wording, errors from interviewer vs. self-administered survey, and respondent error. (Lohr, 2010) The first type, sampling error, is easily calculated. The standard error of the estimate of the unemployment rate for weeks ranges from 0.7% for the CPS survey weeks to 2.8% for non-survey weeks.⁷

However, as in most surveys, non-sampling error, or bias, is likely to be a more important concern. A particular issue for online surveys is potential unrepresentativeness of the panel. Weighting adjustments attempt to remove selection bias related to observed variables.⁸ For the YLS survey, weighted estimates exhibited substantially less bias than unweighted estimates. For all surveys through May (N = 137,500), the unemployment rate averaged 15.3% for the unweighted sample and 12.2% for the weighted sample. Similarly, the employment-population ratio is 6 percentage points higher in the weighted than the unweighted sample.

This difference between weighted and unweighted estimates reflects the fact that the respondents in the YouGov online panel tend to have relatively more people unemployed and relatively fewer people employed than the weighted panel, even after controlling for demographics and recalled past employment status.

A third source of error in comparing the YLS to the CPS is survey-design error, or the extent to which the survey questions and procedures accurately reflect those in the CPS. The team has performed extensive testing, particularly for the components of unemployment, and has found no major errors in the questions or responses. For example, we have probed the search numbers and techniques, and these have been reasonably close to the details provided in the CPS.

B. Internal Consistency on Retest

A useful and easily calculated measure of survey error is the stability of the surveys, sometimes called reliability. Technically, we are measuring the reliability of recall in terms of the consistency of answers on retest. (See Lohr 2010, Chapter 13) The YLS has 29,003 duplicate responders, accounting for 93,168 of the 137,500 responses through wave 109. We tested the consistency of the responses for those age 20 and over. We expect some to

⁷ The present document uses standard statistical language. Often survey researchers use the term “margin of error,” which is two times the standard error of estimate.

⁸ Post-stratification weighting can also improve efficiency, but the main motivation is to remove bias.

be relatively accurate (age and gender), while others are more taxing (such as retrospective employment status). Table J-1 provides a tabulation of major variables for the duplicates. Most of the elementary answers are consistent. However, occupation and industry are highly inconsistent.

A key question is whether the recall of labor force status is accurate. Retrospective questions about work for pay in previous months are surprisingly consistent, reporting a different answer about 6% of the time. By contrast, those reporting “did not work” had higher error rates, between 11% and 16% in the cases examined. Errors in recall status pose problems because the raking/weighting of respondents is based in part on the retrospective estimates of labor force status. Preliminary estimates indicate a downward bias in the retrospective estimate of unemployment compared to the current estimate in the month of recall (these being calculated for duplicate respondents). This would lead to an upward bias in the estimated YLS unemployment rate because the retrospective labor force status is used to calculate the weights.

Appendix G shows how a bias in retrospective labor market status will bias the estimates in the YLS. It suggests that, for a highly simplified analysis, the bias in the retrospective responses may lead to a systematic upward bias of around 1½ percentage points in the YLS survey. Further research is needed to determine if this bias can explain the systematic bias and whether it can be corrected.

Question	Inconsistent answers
<i>Demographics</i>	
Gender	0.40%
Race	3.90%
Age	6.00%
Religion	6.40%
Education	6.80%
<i>Location and occupation</i>	
State	1.80%
Device	9.50%
City / suburb / town/ rural	9.20%
Income bracket	11.30%
Industry	33.10%
Occupation	34.10%
<i>Recalled status</i>	
Worked for pay - Feb 2020	6.90%
Worked for pay - Jun 2020	7.20%
Worked for pay - Jul 2020	6.60%
Worked for pay - Aug 2020	6.30%
Worked for pay - Sep 2020	6.20%
Worked for pay - Dec 2020	6.60%
Worked for pay - Mar 2021	5.20%
Status if did not work Feb 2020	12.00%
Status if did not work Jun 2020	15.60%
Status if did not work Jul 2020	15.50%
Status if did not work Dec 2020	14.40%
Status if did not work March 2021	11.20%

Table J-1. Consistency of responses over time of repeat responders

NOTE: The table shows the fraction of the time that the same question was answered differently by the same respondent.

Appendix K. Other Studies of Labor Markets During the Pandemic

VIII.A. Major approaches

The three main studies published to date are by Olivier Coibion, Yuriy Gorodnichenko, and Michael Weber (2020, CG&W), which relies on the Nielsen Homescan panel; a survey by Alexander Bick and Adam Blandin (2021, RPS), which relies on a Qualtrics panel; and a Census Bureau panel, the Household Pulse Survey (U.S. Census Bureau 2021, HPS), which began April 23, 2020 and has continued to the time of writing (October 2021).

1. *The CG&W study* relies on a panel that was fielded earlier in 2020 with employment questions and then was administered over the period April 2–6, 2020. The employment-population ratio in the CG&W study in April 2020 was 52%, similar to the 52.1% in the YLS (20+) and close to the April CPS estimate of 53% (ages 18+, not seasonally adjusted). The CG&W-estimated LFPR dropped by 7.5 percentage points between January and April, and the unemployment rate in the CG&W study in early April 2020 was 6.3%, far below both the YLS and the CPS. The discrepancy may result from CG&W's definition of unemployment (those on layoff not looking for work are all classified as NILF). There has been no update to CG&W at the time of writing.

2. *The Real-Time Population Survey (RPS)* by Bick and Blandin, in collaboration with the Federal Reserve Bank of Dallas, covers virtually the same period as the YLS, with the project ending in June 2021. RPS reports results among those aged 18–64. In October 2020, RPS introduced a new weighting procedure, similar to that which had been used in the YLS, which greatly improved the accuracy of their estimates, and further introduced a second adjustment to weighting in April 2021.

Both YLS and RPS have on average overestimated unemployment. In April 2020, the YLS estimated unemployment at 17.7% (18–64), slightly under the CPS U3-alt estimate of 19.1%, while RPS underestimated by 9.7 percentage points. Both the YLS and RPS tracked the ensuing decrease in unemployment throughout 2020, albeit with positive error: from May to December, the YLS overestimated CPS U3-alt by an average of 1.9 percentage points, while RPS overestimated CPS U3-alt by an average of 0.4 percentage points. RPS's unemployment rate error has been around 1% since January 2021, and while YLS's unemployment error jumped in November and December, error in the YLS has averaged 1% since January 2021 as well. From January 2021 to May 2021, RPS's average unemployment rate has been 7.8%; YLS has averaged 7.9%; both are above CPS's U3-alt average of 6.9%.

In April 2020, RPS found a 64% employment-population ratio (18–64) compared to 61% in YLS and 63% (59% using the U3-alt definition) among those aged 18–64 in CPS. As the CPS the employment-population ratio increased from its April low to its current level around 70% (18–64), both YLS and RPS have tracked this increase relatively closely. YLS has come closer to CPS in most months, undershooting EPR (alternate definition) by an average of 0.3 percentage points since June 2020; RPS estimates of EPR fall above those of YLS in most months, thus overshooting CPS by an average of 0.8 percentage points. The EPR estimated by the CPS and YLS leveled out or even fell slightly since October, averaging

70.4% (69.8% alt) and 69.6%, respectively; RPS-estimated EPR jumped to 71.2% in November and has stayed around 71%, averaging 70.9% in the same period overall.

The RPS has much the same design and goals as the YLS. It used slightly different survey designs and weighting approaches. It is interesting to note that it shares the result of relatively accurate results on employment and overestimates of unemployment.

3. *The Census-administered Household Pulse Survey (HPS)* of the population age 18+ has been published since April 2020 and has gone through several revisions. The HPS tracks several variables and is particularly useful in rapid estimation of employment (disregarding those absent from a job). It has posed a “work for pay” question similar to the CPS and the YLS since its inception. The estimates of the work-for-pay ratio in the HPS are close to those of the CPS for the CPS survey weeks (within 1% to 1.5% on average). HPS estimates also closely track YLS estimates throughout the period. However, the HPS does not attempt to calculate unemployment. So, there is no comparison between the HPS and other surveys on the labor force or the unemployment rate.

While the HPS has major advantages in being housed in a federal statistical agency, having governmental administrative data, and ample resources, it has not resolved the central issue of finding representative samples. The HPS utilizes the Census Bureau’s Master Address File as the source of sampled housing units. It employs extensive post-sample weighting using regions and population characteristics from the American Community Survey and other sources. In principle, this would provide an ideal sample for an online survey.

However, the response rate was only 7% in the first 21 weeks. Analysis by the Census Bureau indicates extensive remaining non-response bias even after the weighting, particularly for the income-related variables. (Peterson et al. 2021) However, the Peterson et al. analysis did not examine the bias in employment-related measures.

Without extensive statistical analysis of non-response error, the results of the HPS are difficult to interpret. Hermann and Sharon Cornelissen (2020) examine the characteristics of the YPS and find that the sample underrepresents significantly the older, white, and educated population (which, interestingly, is the opposite of the results of the YouGov sample before quota sampling). The week-to-week variability of the YPS is higher than that of either the YLS or the CPS. The low response rate suggests that much work needs to be done to make the HPS a survey that faithfully represents the population.

VIII.B. Other studies

In addition, three other surveys offer useful points of comparison: the COVID Impact Survey, sponsored by the Federal Reserve Bank of Minneapolis and the Data Foundation (Abigail Wozniak, Joe Willey, Jennifer Benz, and Nick Hart, 2020); a survey by Abi Adams-Prassl, Teodora Boneva, Marta Golin, and Christopher Rauh (2020); and one by the Pew Research Center (2020).

4. *The COVID Impact Survey*, sponsored by the Federal Reserve Bank of Minneapolis and the Data Foundation, found for April 2020 that 47% of people worked for pay, close to the YLS result of 46% from the same week. At the beginning of May 2020 and June 2020, COVID Impact finds work-for-pay rates of 49% and 51%, respectively; YLS results are

similar, with 51.3% in May and 51.9% in June 2020. In addition, COVID Impact estimates that 21% of those who did not work for pay were temporarily laid off/furloughed and 44% are retired, compared to 16% and 40% in YLS, respectively.

5. *Adams-Prassl et al.* conducted the second wave of their US survey on April 9–11, 2020, in which 18% of respondents (unweighted) report having lost their jobs within the last four weeks due to the coronavirus. In YLS for the same reference period, 18% (weighted) of respondents stopped working in March or April 2020 at the time.

6. *The 2020 Pew Research Center's American Trends Panel's* 65th wave was recorded on April 7–12, 2020. In that survey, 54% of respondents described themselves as employed full-time or part-time, compared to the 51% employment-population ratio of YLS. To our knowledge, Pew has not fielded questions assessing labor force status since.

Reviewing the main studies finds the following summary. Of seven studies, two have succeeded in using online panels to estimate the major characteristics of the labor market: The YLS and the Rapid Population Survey. While each has its strengths and weaknesses, they demonstrate the feasibility and low-cost of online surveys. More important, they show that online surveys can provide critical economic and demographic information with reasonable accuracy, although not at the precision of major governmental surveys. The other major survey, the Census Household Pulse Survey, is extremely promising given its position in the federal statistical system, but with such a low response rate of invitations, it needs much further work to present credible representative results.

Appendix L. Major Questions in YLS Survey from March 2020

Yale Questionnaire March 2020

Survey Designed by Staff of Yale Labor Survey

Survey Conducted by YouGov

Survey Approved by Yale IRB [Initial approval #2000027860 and subsequent approvals for revisions to survey]

The following is the text of the survey with coding removed. Note that this includes primarily the questions that are used to determine labor market status and excludes other less relevant questions.

This survey asks about your activities last week. For example, do you work, or on the other hand are retired, going to school, or taking care of family. The questions are detailed, and we appreciate your effort to answer them accurately.

We know that you sometimes take online surveys and may earn pay or rewards for participating. This survey is not about that. When we ask about your work and job, please do NOT include taking surveys as your work for pay.

WORK FOR PAY/ABSENT SECTION

Next are a few questions about work-related activities last week. “Last week” means the seven-day week beginning on Sunday January 31st and ending Saturday February 6.

“LAST WEEK, did you do any work for pay or profit?

<1> Yes

<2> No

“When you said you worked for pay or profit, were you referring to a job answering online surveys?

<1> Yes

<2> No

“Aside from answering online surveys, did you have ANY OTHER job where you worked for pay or profit?

<1> Yes

<2> No

“LAST WEEK, did you have a job, either full-or part-time? Include any job from which you were temporarily absent.

<1> Yes

<2> No

“What was the main reason you were absent from work LAST WEEK?”

- <1> On layoff (Temporary or indefinite)
- <2> Slack work/business conditions
- <3> Waiting for new job to begin
- <4> Vacation/personal days
- <5> Own illness/injury/medical problems
- <6> Child care problems
- <7> Other family/personal obligations
- <8> Maternity/paternity leave
- <9> Labor dispute
- <10> Weather affected job
- <11> School/training
- <12> Civic/military duty
- <13> Other reason [absent_reason_other]

“Which of the following statements describe why you were absent from your job LAST WEEK. Check all that apply.”

- <1> I was temporarily absent from a job due to my own illness
- <2> I was temporarily absent from a job due to an illness in my family
- <3> I was temporarily absent from a job due to a vacation (paid or unpaid)
- <4> I was temporarily absent from a job due to bad weather
- <5> I was temporarily absent from a job due to a labor dispute (for example, a strike)
- <6> I was temporarily absent from a job due to the coronavirus
- <7> None of the above

“What best describes your employment situation LAST WEEK?”

- <1> I worked for pay or profit at my usual place of work
- <2> I worked for pay or profit, not at my usual place of work but at home or at another workplace
- <3> I did not work, but still earned pay (for example, personal or sick leave)
- <4> I did not work, but my employer is still paying me (but not for the usual reasons for time off such as personal time or sick leave)
- <5> I did not work and was not paid

“In your job, what type of employer did you work for last week?”

- <1> Federal, state, or local government
- <2> Private-for-profit company
- <3> Non-profit organization (including tax-exempt or charitable organizations)
- <4> Self-employed

“In your job, do you work for yourself (including working as a contractor, freelancer, or “gig economy” worker) or do you work for a firm or other employer?”

- <1> I work for myself or my own firm
- <2> I am a contractor, freelancer, or “gig-economy” worker
- <3> I am paid a wage or salary

“In which month did you start working for your current employer?”

<2102> February 2021
<2101> January 2021
...
<2001> January 2020
<8888> Before January 2020

“How many hours did you ACTUALLY work for pay LAST WEEK?”

HAS NOT WORKED FOR PAY IN LAST WEEK

(only asked of people who have NOT worked for pay last week)

“You said that you did NOT work last week for pay or profit. What best describes your situation at this time?”

<1> Laid off or furloughed from a job to which you expect to return
<2> Looking for work
<3> Disabled
<4> Ill
<5> In school
<6> Taking care of house or family
<7> Retired
<8> Something else

Current Employment Status

<1> Employed
<2> Unemployed - ILF
<3> NILF
<4> Student

“Regardless of the reason you did not work LAST WEEK, did you earn any pay (or profit) for your time away from work?”

<1> Yes
<2> No

“When did you last work at a job or business?”

<2102> February 2021
<2101> January 2021
<2012> December 2020

...
<2001> January 2020
<1900> Before January 2020
<1899> Never worked
<1898 if 0> Not in labor force

“Have you been given any indication that you will be recalled to work within the next 6 months?”

<1> Yes

<2> No

“Have you been doing anything to find work during the last 4 weeks?”

<1> Yes, I have actively searched for work by doing things like submitting resumes to potential employers, answering employment advertisements, or asking friends and relatives about jobs

<2> No, I have not been actively searching, but I have occasionally checked job listings

<3> No, I have not been doing anything to find work within the last four weeks

“We now ask further questions about your job searches. During the past two months, have you used any of the following methods to search for a job?”

Please check all methods that apply. If you have not searched at all, check “none of the above.”

<1> Sent out a resume or filled out an application

<2> Contacted an employer directly or had an interview

<3> Looked at ads

<4> Contacted friends or relatives

<5> Contacted a public employment agency

<6> Contacted a private employment agency

<7> Checked union or professional registers

<8> Placed or answered ads

<9> Contacted a school employment center

<10> Attended job training programs or courses

<11> None of the above

“If someone offered you a job today, could you begin work within the next 7 days?”

<1> Yes

<2> No

“Do you currently want a job, either full or part time?”

<1> Yes

<5> Maybe/it depends

<2> No, I am retired

<3> No, I am disabled or unable to work

<4> No, I do not want a job for other reasons

“You indicated that you were not actively looking for work over the last 4 weeks. What is the MAIN REASON that you did not look for work?”

<1> No work is available in my line of work or area because of the current Covid-19 pandemic

<2> No work is available in my line of work or area because of other reasons

<3> I tried to find work, but could not find any

<4> Lack of child care, or other family or personal responsibilities

<5> Ill health or physical disability

<6> Some other reason

PAST EMPLOYMENT

“In which of the following months did you do any work for pay or profit?”

January 2021

December 2020

...

January 2020

“You said that you did not do any work for pay during <x>. What best describes your work status during <x>?”

<1> Available to work, but not looking for a job

<2> Available to work and actively seeking a job

<3> On layoff or furloughed from a job to which you expect to return

<4> Disabled or ill

<5> Retired

<6> In school

<7> Taking care of house or family

<8> Other

[Asked for relevant month]

EARNINGS/INDUSTRY

“Counting all of your sources of EARNED INCOME (wages, salaries, tips, and commissions, but before taxes and excluding government benefits), how much did YOU earn in 2020?”

<1> Less than \$10,000

<2> \$10,000-\$19,999

...

<15> \$140,000-\$149,999

<16> \$150,000 or more

<17> Prefer not to say

“What is your occupation?”

<1> Management, business, and financial occupations

<2> Professional and related occupations

<3> Service occupations

<4> Sales and related occupations

<5> Office and administrative support occupations

<6> Farming, fishing, and forestry occupations

<7> Construction and extraction occupations

<8> Installation, maintenance, and repair occupations

<9> Production occupations

<10> Transportation and material moving occupations

<11> Armed Forces

“Please tell us the industry of the organization that you worked for.”

<1> Agriculture, forestry, fishing, and hunting

<2> Mining

- <3> Construction
- <4> Manufacturing
- <5> Wholesale and retail trade
- <6> Transportation and utilities
- <7> Information
- <8> Financial activities
- <9> Professional and business services
- <10> Educational and health services
- <11> Leisure and hospitality
- <12> Other services
- <13> Public administration
- <14> Armed Forces

“Which of the following best describes your current employment status?”

- <1> Full-time
- <2> Part-time
- <3> Temporarily laid off
- <4> Unemployed
- <5> Retired
- <6> Permanently disabled
- <7> Homemaker
- <8> Student
- <9> Other

PROFILES

In addition, the survey asked for basic demographic information such as gender, education, age, race, state of residence, political preferences, voting behavior, and other. The panels were also asked about their experience with online panels.