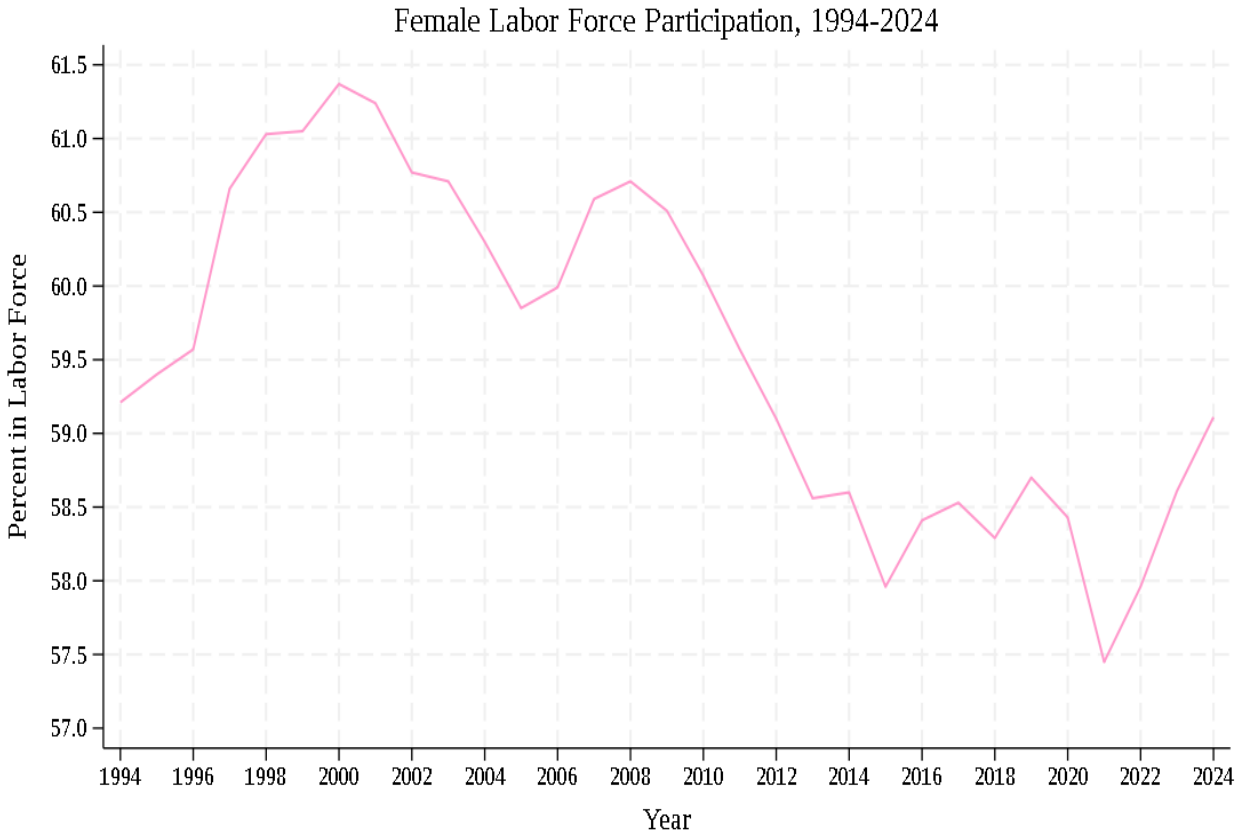
PREDOC Sample Data Task Solution Guide

Part 1: Labor Force Participation

Question 1

How has female labor force participation evolved since 1994? Please provide graphs and/or tables to support your answer.



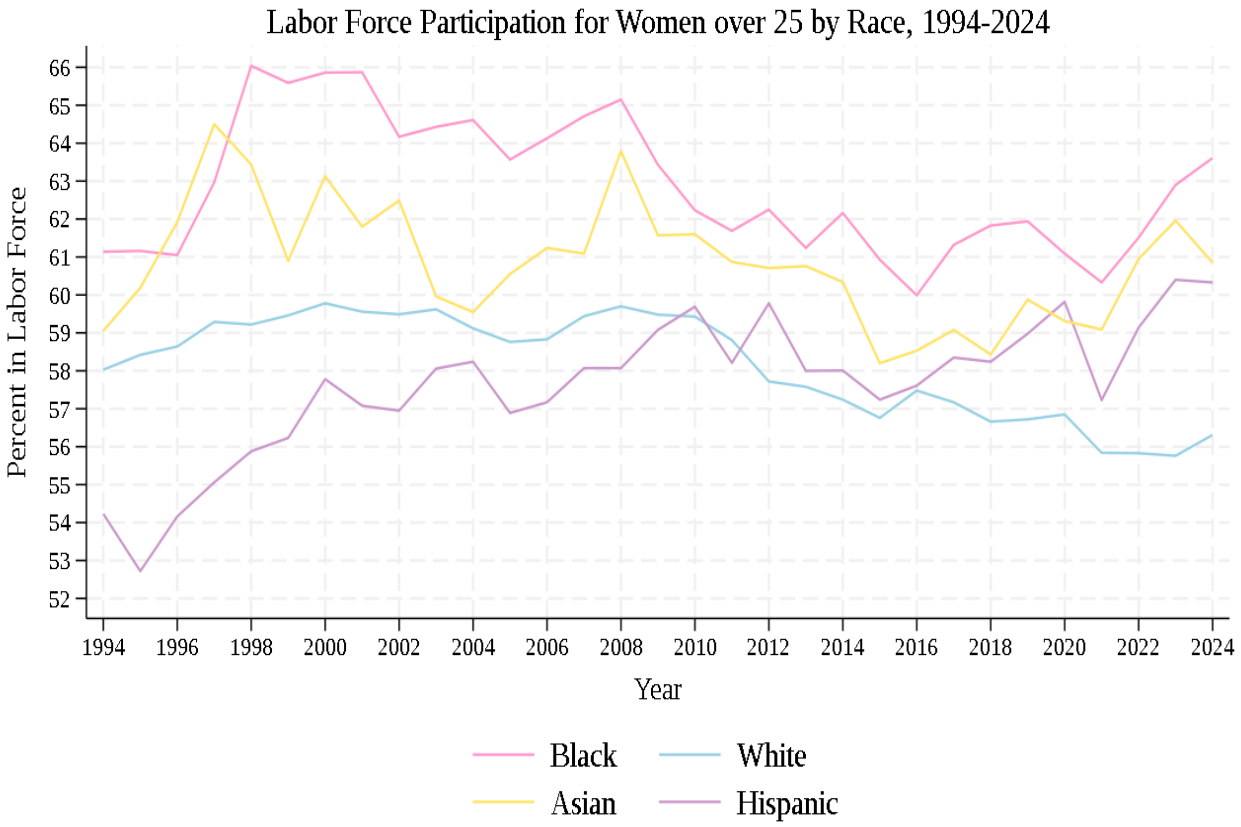
Suggested Response

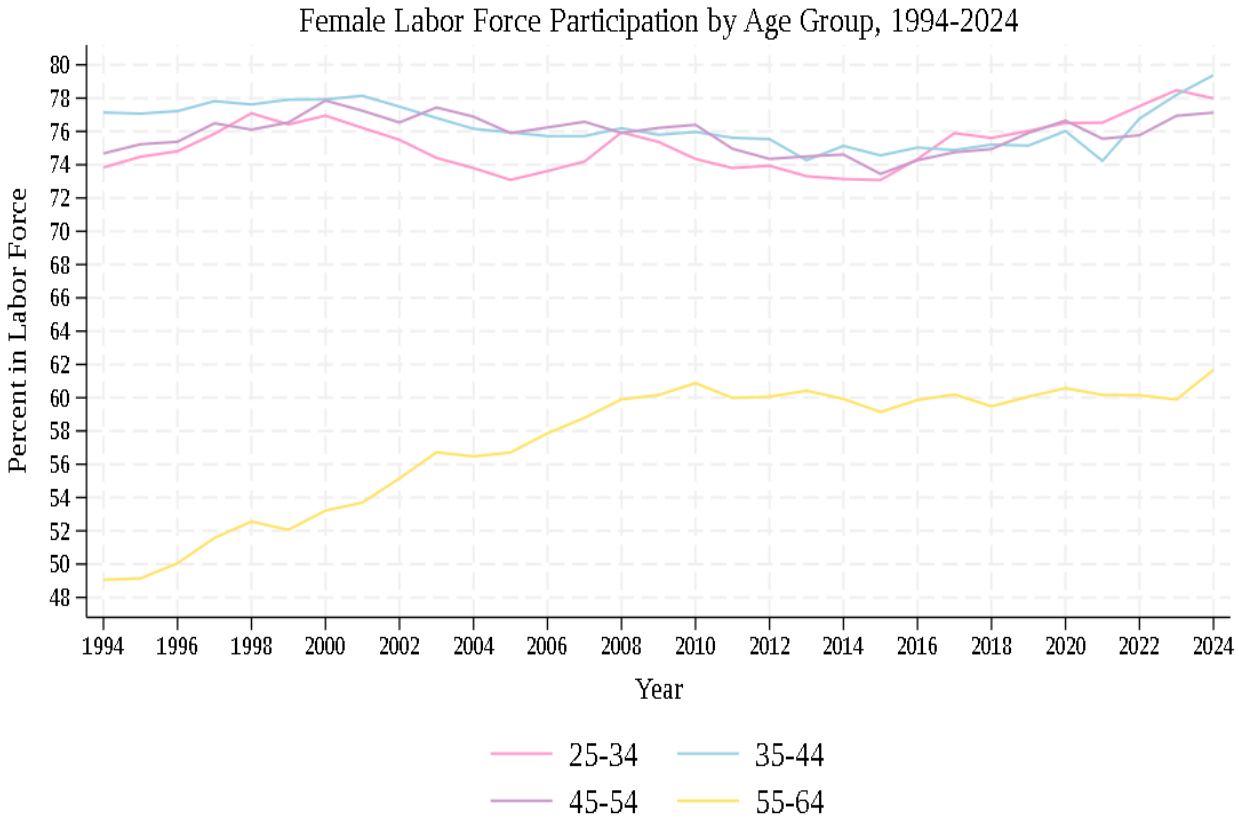
The female labor force participation rate in 2024 is about the same as it was in 1994 (about 59.5%). The participation rate steadily rose and peaked at 61% in 2000. It then fell again until 2005, when it began to recover sharply to 60.7% in 2008. However, in the first few years after the Great Recession, female labor force participation dropped steadily. By 2012 it had fallen to 59%, which was below the 1994 level. After remaining stagnant between 2013 and 2014, it dropped even lower to 58% in 2015. After a mostly continuous drop for seven years following the recession, female labor force participation began to recover

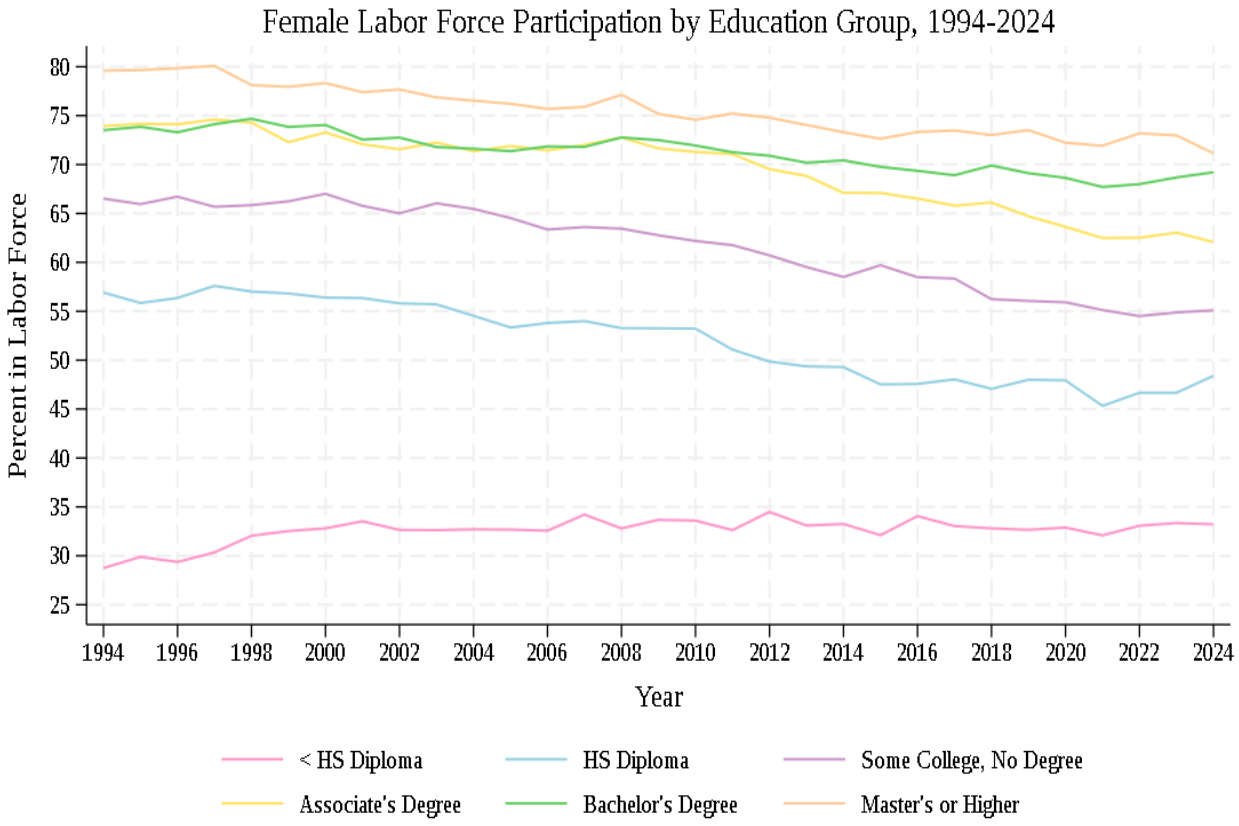
in 2015 until 2020. The participation rate reached its lowest point in 2021 during the Covid pandemic. Since then, it has increased steadily and returned to where it was in 1994.

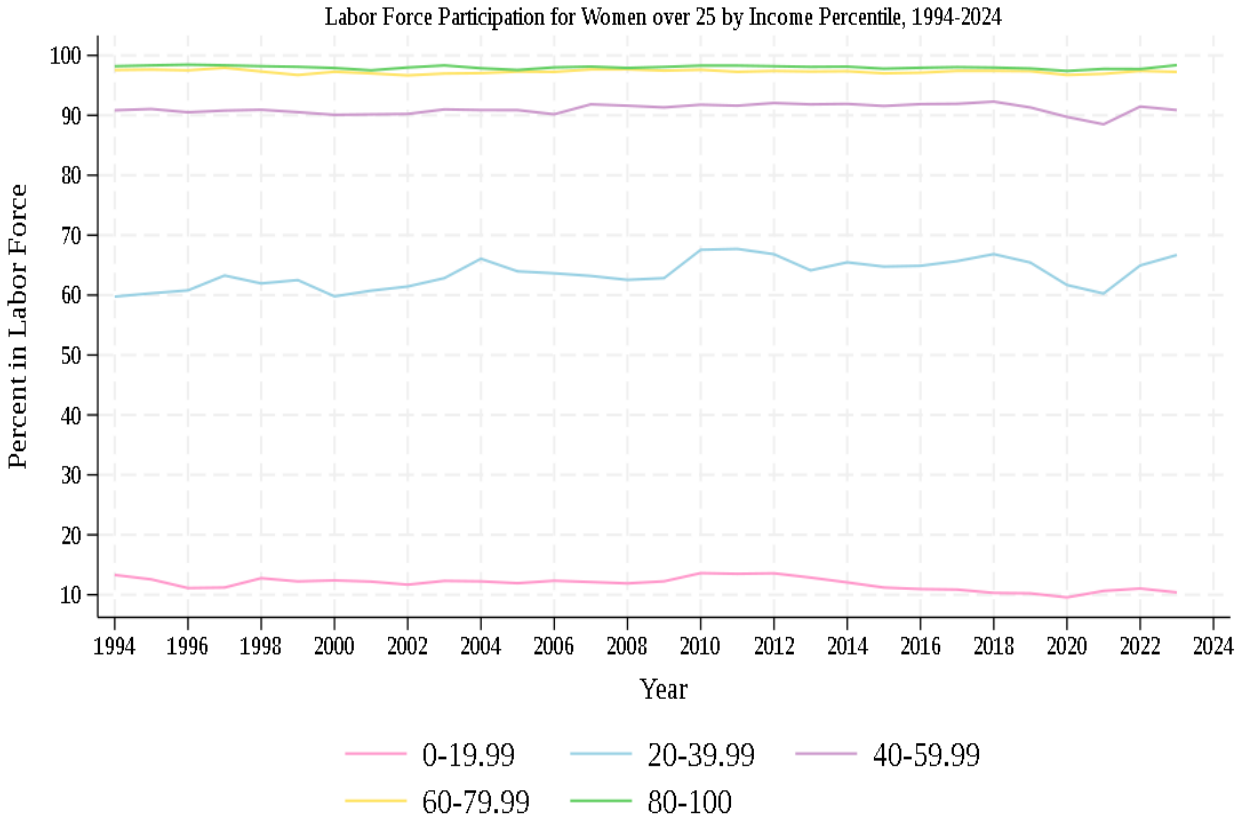
Question 2

Among women older than 25, which groups of people had the biggest changes in labor force participation since 1994?




Female Labor Force Participation by Age Group, 1994-2024
Percent in Labor Force
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50
48
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year
25-34
35-44
45-54
55-64


Female Labor Force Participation by Education Group, 1994-2024
Percent in Labor Force
80
75
70
65
60
55
50
45
40
35
30
25
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year
< HS Diploma
HS Diploma
Some College, No Degree
Associate's Degree
Bachelor's Degree
Master's or Higher



Suggested Response

Overall, among women over 25, the groups that experienced the largest change in labor force participation are Hispanic women, women in the 55-64 age group, and women with a master's degree.

Non-white women over 25 experienced an increase in LFP between 1994 and 2024, while their white counterparts experienced a 2% increase. Hispanic women over 25 had the largest increase of 6%. Non-white women also had more volatile changes over the 30 year span.

LFP increased by 11% for women who are ages 55-64. Younger age groups had smaller increases of around 2%. While all women between 25 and 54 experienced drops in LFP and recovered from them throughout the 30 year span, the drop and recovery cycles were much less frequent for the 25-34 age group.

LFP decreased notably for women over 25 who have at least a high school diploma. LFP was about the same in 2024 as it was in 1994 for women over 25 without a high school diploma. Women over 25 with a master's degree or higher had a more noticeable peak in LFP in 2008, while women over 25 without a high school diploma had a noticeable drop.

In addition, LFP was consistently higher for Black and Hispanic women over 25 relative to the average and other racial groups. This trend also applies to women over 25 with a

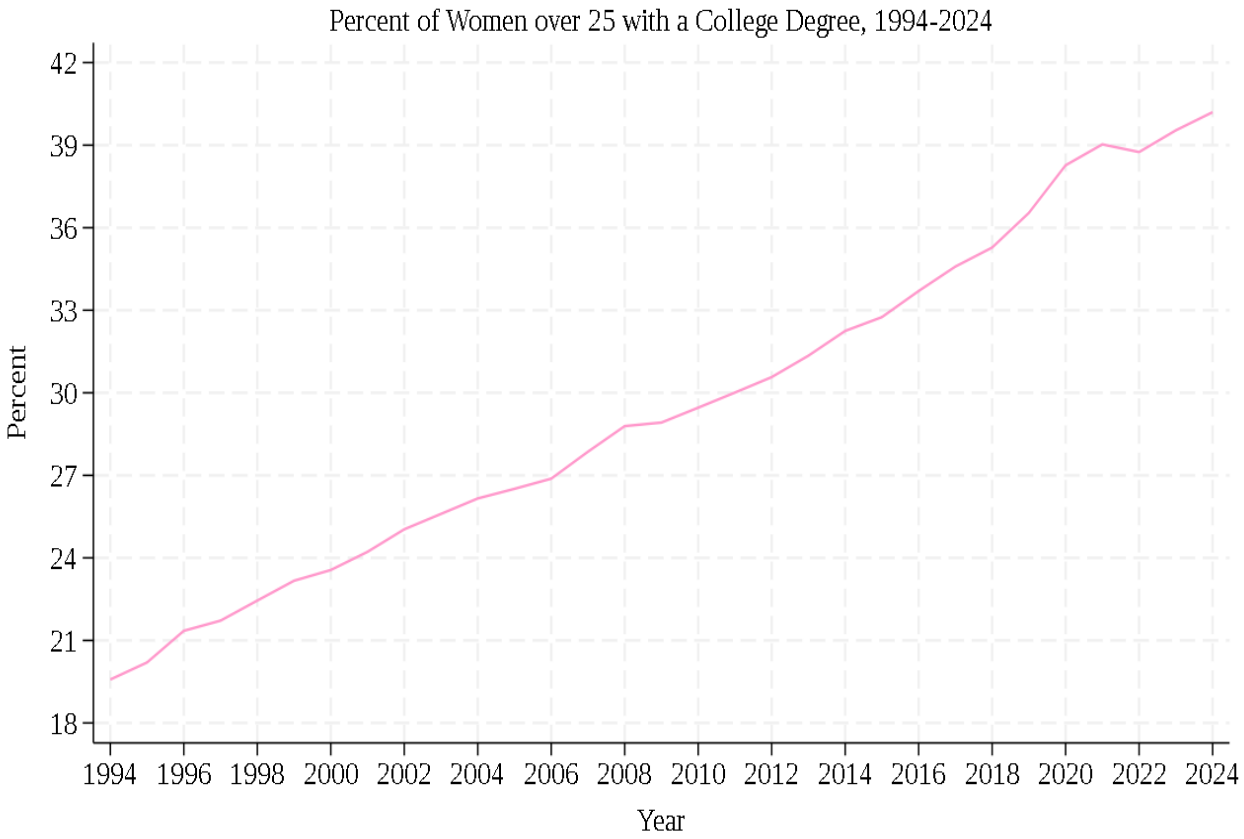
bachelor's degree or higher, while LFP for women over 25 without a high school diploma remained at around 30%.

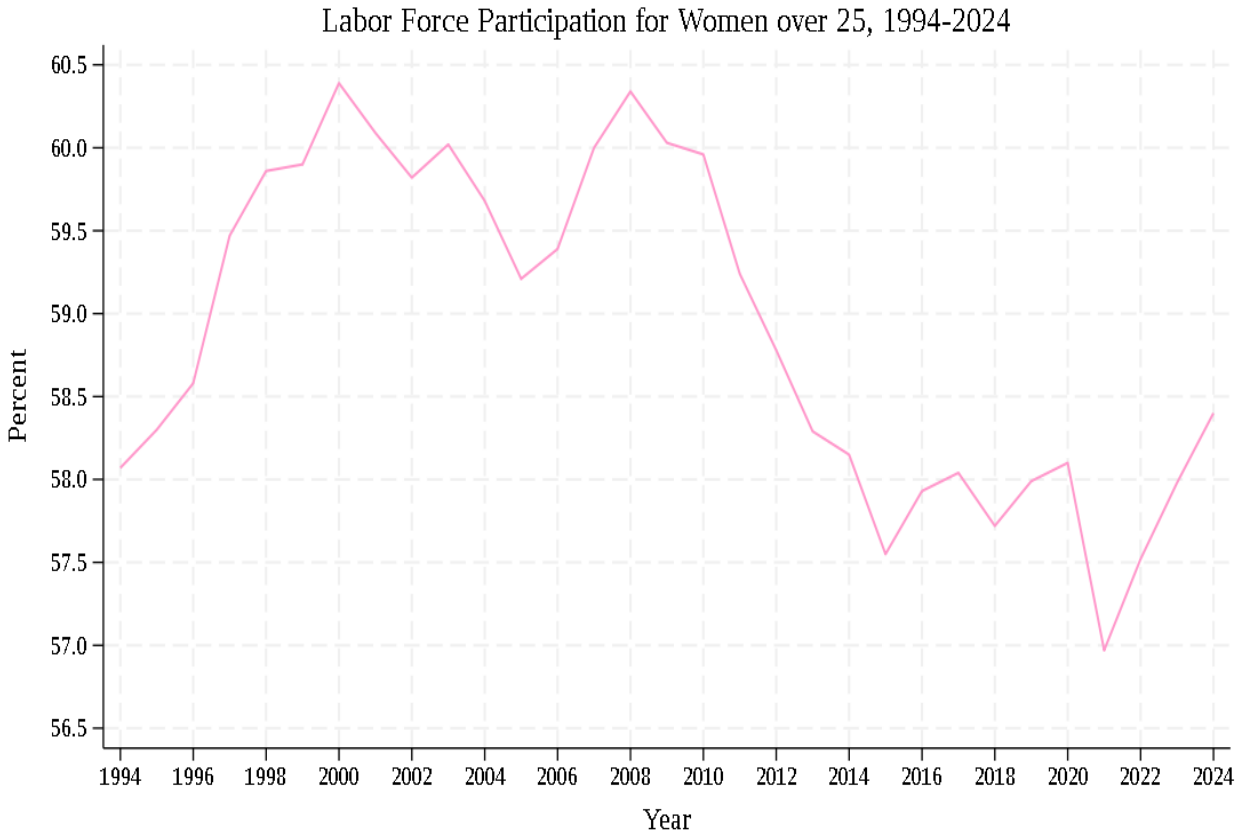
Question 3

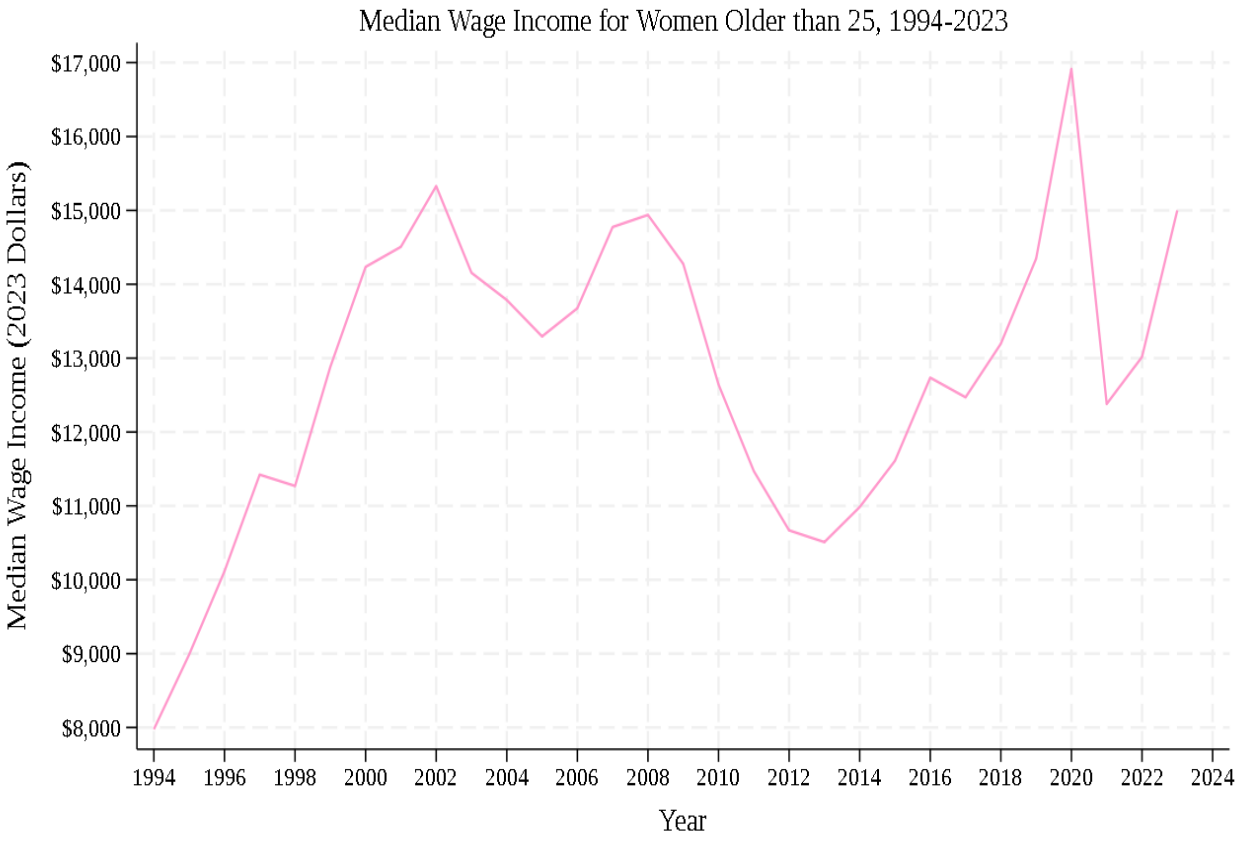
Use the data to examine trends among women older than 25 for each of the following factors from 1994 to 2024:

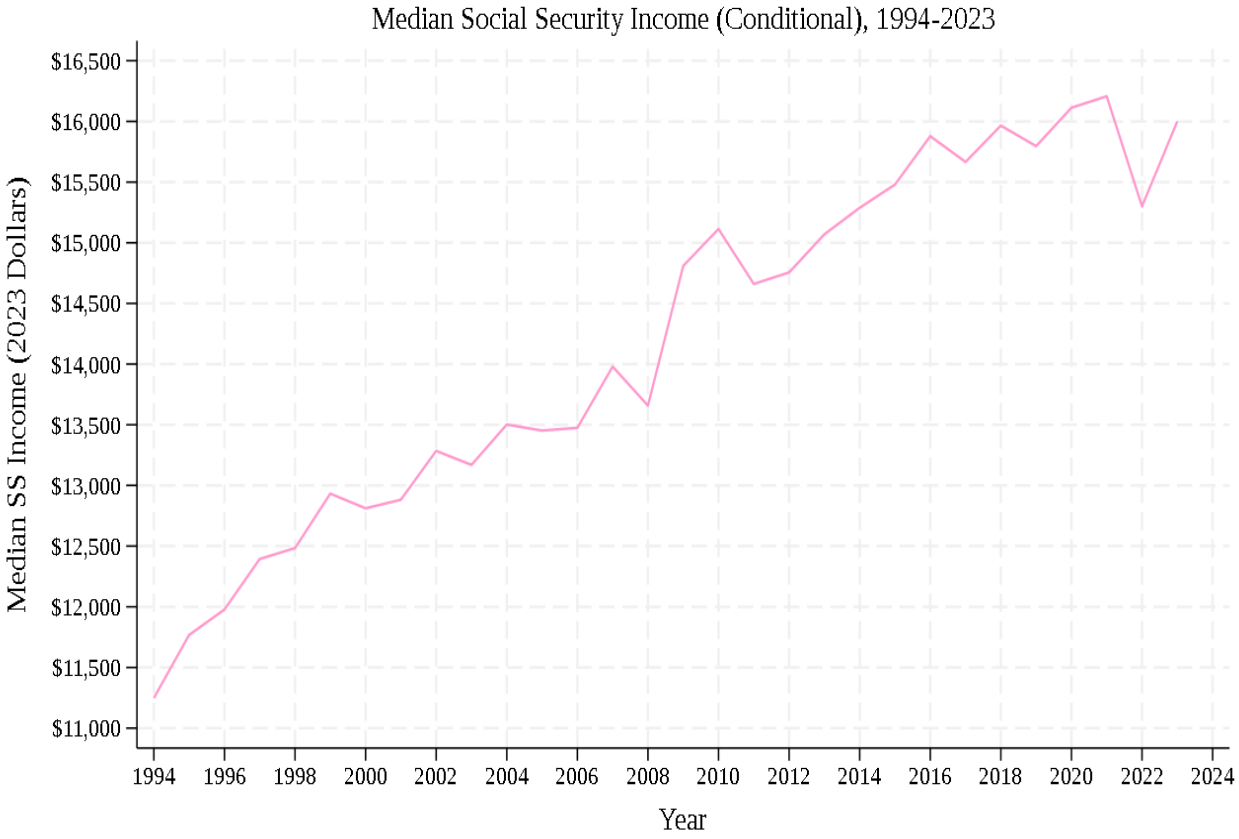
- Wage and salary income
- Social insurance income
- Education attainment

Based on these trends, what factors could be driving the patterns you found in Questions 1 and 2?




Labor Force Participation for Women over 25, 1994-2024
Percent
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year


Median Wage Income for Women Older than 25, 1994-2023
Median Wage Income (2023 Dollars)
$17,000
$16,000
$15,000
$14,000
$13,000
$12,000
$11,000
$10,000
$9,000
$8,000
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year


Median Social Security Income (Conditional), 1994-2023
Median SS Income (2023 Dollars)
$16,500
$16,000
$15,500
$15,000
$14,500
$14,000
$13,500
$13,000
$12,500
$12,000
$11,500
$11,000
1994
1996
1998
2000
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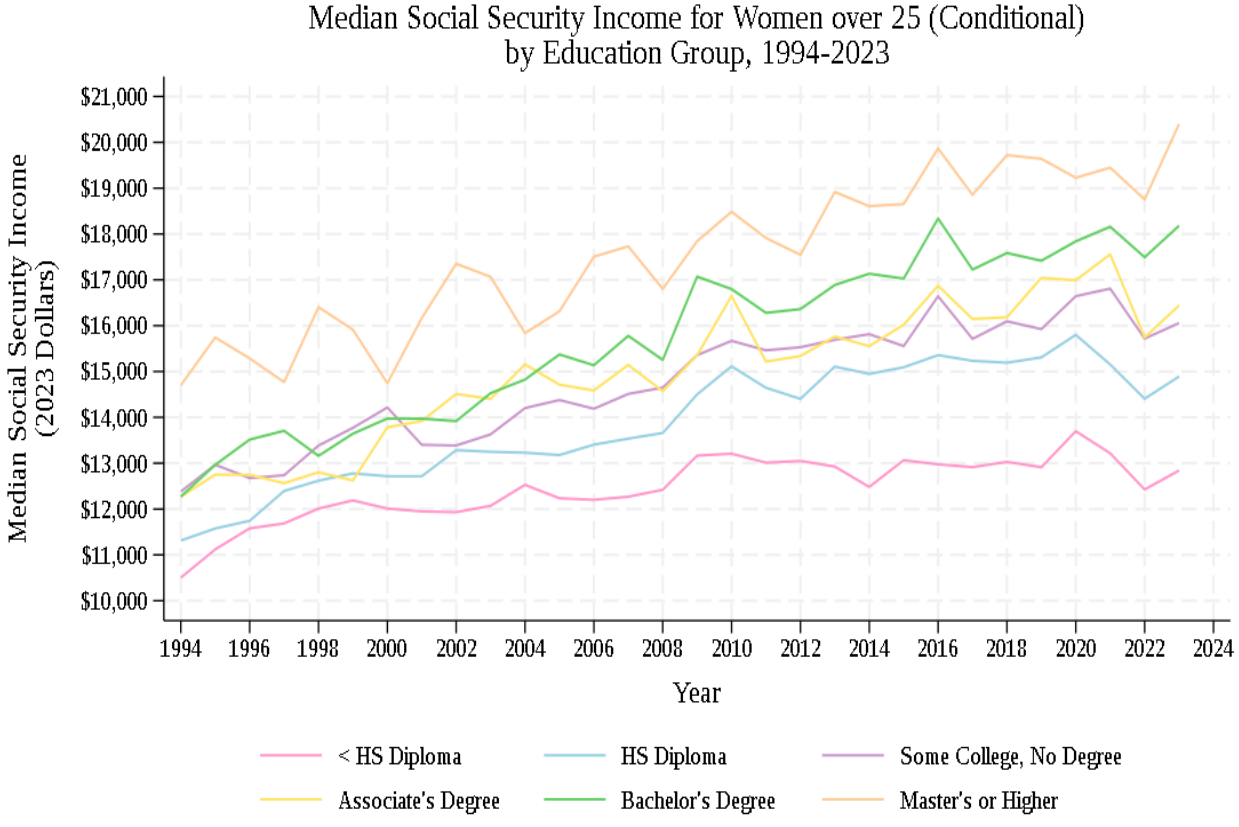
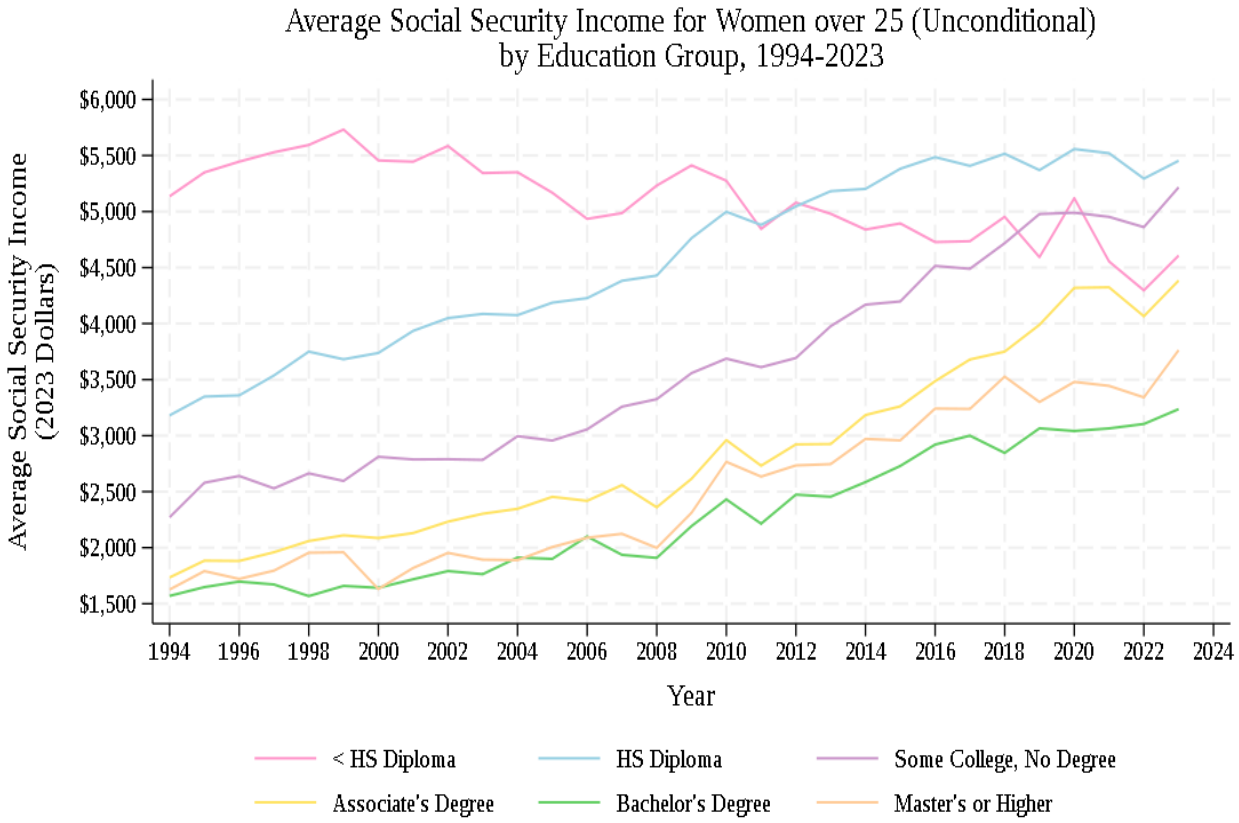
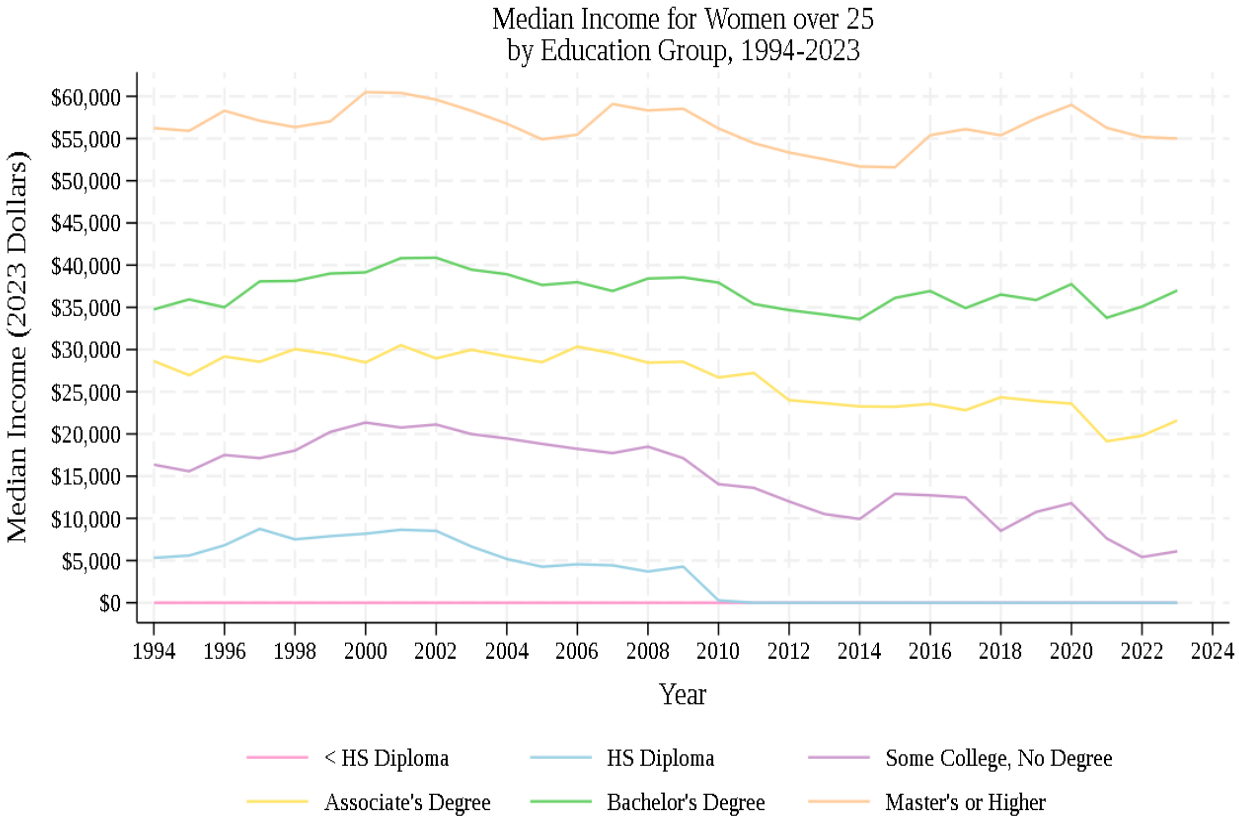
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year


Median Social Security Income for Women over 25 (Conditional)
by Education Group, 1994-2023
Median Social Security Income
(2023 Dollars)
$21,000
$20,000
$19,000
$18,000
$17,000
$16,000
$15,000
$14,000
$13,000
$12,000
$11,000
$10,000
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year
< HS Diploma
HS Diploma
Some College, No Degree
Associate's Degree
Bachelor's Degree
Master's or Higher


Average Social Security Income for Women over 25 (Unconditional)
by Education Group, 1994-2023
Average Social Security Income
(2023 Dollars)
$6,000
$5,500
$5,000
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year
< HS Diploma
HS Diploma
Some College, No Degree
Associate's Degree
Bachelor's Degree
Master's or Higher


Median Income for Women over 25
by Education Group, 1994-2023
Median Income (2023 Dollars)
$60,000
$55,000
$50,000
$45,000
$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
1994
1996
1998
2000
2002
2004
2006
2008
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2012
2014
2016
2018
2020
2022
2024
Year
< HS Diploma
HS Diploma
Some College, No Degree
Associate's Degree
Bachelor's Degree
Master's or Higher

Suggested Response

The first figure shows that LFP for women over 25 was about the same in 2024 relative to 1994 (between 58 and 58.5%). The second figure shows that the percent of women over 25 with a bachelor's degree steadily increased between 1994 and 2024. Yet, we see in question 2 that LFP for women with a bachelor's degree and higher decreased, while LFP for women without a bachelor's degree increased. Also, only about 13% of these women overall do not have a high school diploma, so it is implausible that they are offsetting the decrease in LFP for their more educated counterparts. Rather, this suggests that education is a weak determinant of changes to LFP, even if education and LFP rates are correlated.

On the other hand, the conditional median social security income has steadily increased for women over 25 (the unconditional median for social security income is zero in all years). We see this trend for women over 25 of all education levels except those without a high school diploma. However, the distributional patterns for unconditional mean social security income are different. Women with higher levels of education consistently receive lower levels of social security income, which may imply that they remain in the labor force for longer. This pattern may explain why LFP has steadily increased for women ages 55-64 (as seen in question 2).

Meanwhile, conditional on receiving social security income, women with higher levels of education earn more. The steady increase in women obtaining a college degree and staying in the labor force, along with more women over 55 entering or remaining in the labor force, may explain the increases in LFP right before the Great Recession and after the pandemic we saw in question 1. Increased LFP among women over 55 cannot offset, however, cyclical decreases in LFP during recessions. This pattern also does not explain the decrease in LFP between 2000 and 2006.

On the contrary, the median wage income (unconditional) is almost twice as high in 2023 as it was in 1994 for women over 25. We see in question 2 that LFP is not particularly volatile for any income group. Yet, median income falls and rises in sync with LFP rates between 1994 and 2023. This suggests that changes to LFP is more strongly correlated with changes to income rather than median income levels.

While higher levels of education yield increased earnings potential, our findings imply that education levels alone are not a strong indicator of LFP trends. Instead, we find that the increase in LFP may be explained by more women over 55 joining or staying in the labor force. It is also plausible that changes in LFP for women over 25 are most strongly correlated with changes in income. In other words, higher wages and earnings potential from obtaining a bachelor's degree may encourage people to remain in the labor force.

Question 4

Between 1994 and 2024, which year had the steepest increase in female labor force participation relative to the previous year? What factors do you think are driving this pattern? Support your hypotheses by using the data, referencing major events that happened around this time period, and/or citing previous studies.

Annual Change in Female LFP, 1994-2024

Year	Pct. Change
1994-1995	0.32
1995-1996	0.29
1996-1997	1.83
1997-1998	0.61
1998-1999	0.03
1999-2000	0.52
2000-2001	-0.21
2001-2002	-0.77
2002-2003	-0.1
2003-2004	-0.68
2004-2005	-0.75
2005-2006	0.23
2006-2007	1.00
2007-2008	0.2
2008-2009	-0.33
2009-2010	-0.73
2010-2011	-0.83
2011-2012	-0.79
2012-2013	-0.91
2013-2014	0.07
2014-2015	-1.09
2015-2016	0.78
2016-2017	0.21
2017-2018	-0.41
2018-2019	0.7
2019-2020	-0.46
2020-2021	-1.68
2021-2022	0.89
2022-2023	1.12
2023-2024	0.85

Suggested Response

Female labor force participation increased the most between 1996 and 1997. In 1997, female labor force participation was 1.83 percentage points higher than in 1996. Hayghe (1997) finds that increases in female labor force participation starting from 1994 is largely driven by increased participation for women with children.[1] It is therefore unsurprising that the increase in 1997 was sharpest for women ages

We also see a sharp increase around this time for all racial groups, suggesting that this trend was not driven by a particular racial group, but rather a policy. For instance, this trend may have accelerated in 1997 as a result of the Temporary Assistance for Needy Families (TANF) program in 1996.

Annual Changes by Race

	% Change			
Year	White	Black	Hispanic	Asian
1994-1995	0.62	-0.07	-2.96	2.08
1995-1996	0.15	0.1	2.07	3.32
1996-1997	1.15	5.22	2.25	3.85
1997-1998	0.07	2.66	2.31	-1.36
1998-1999	0.26	-0.35	0.46	-2.14

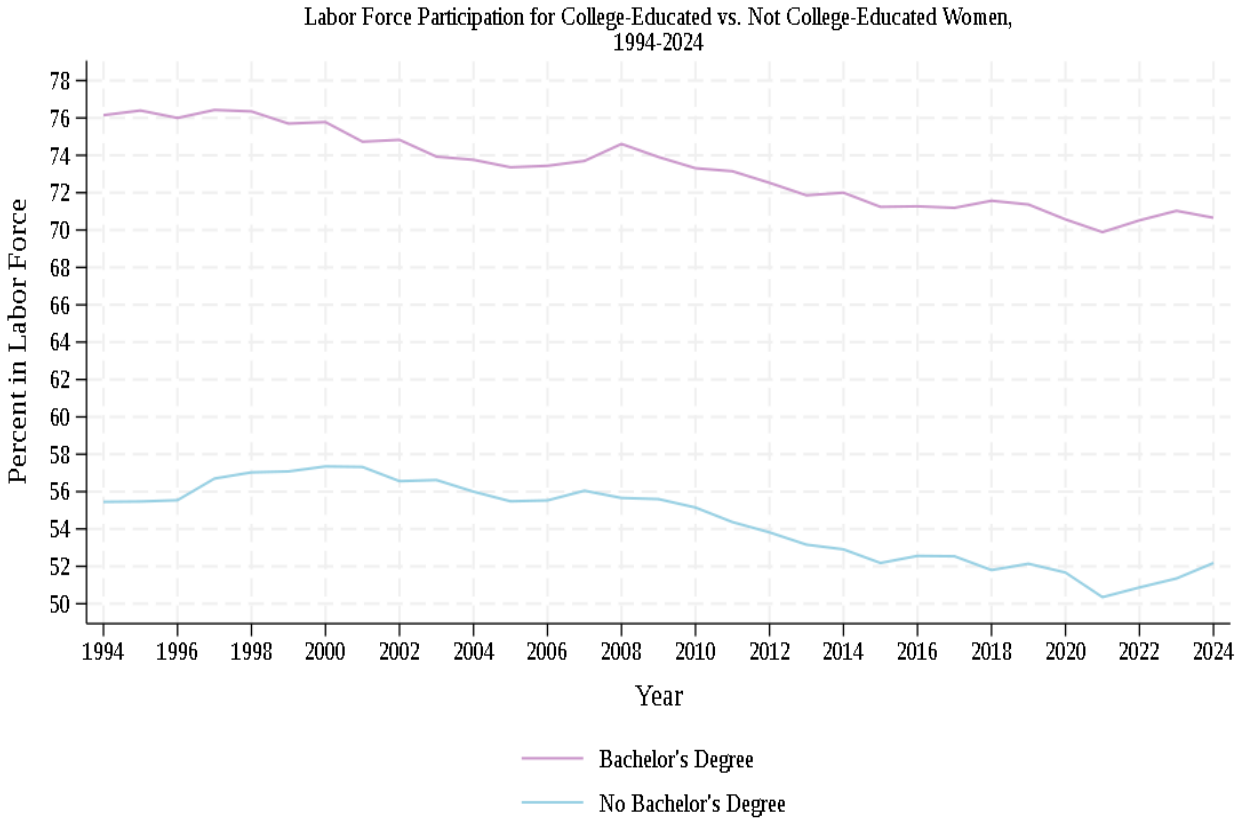
Annual Changes by Age Group

	% Change			
Year	25-34	35-44	45-54	55-64
1994-1995	0.24	0.87	-0.09	0.74
1995-1996	-0.64	0.44	0.19	0.2
1996-1997	3.86	1.4	0.78	1.47
1997-1998	0.43	1.62	-0.26	-0.5
1998-1999	-0.55	-0.87	0.37	0.56
1999-2000	-1.24	0.69	0.03	1.72

Question 5

How has labor force participation for college-educated and not college-educated women evolved since 1994? Please provide graphs and/or tables to support your answer.

[1] See Howard V. Hayghe, "Developments in women's labor force participation", *Monthly Labor Review*, September 1994. https://www.bls.gov/opub/mlr/1997/09/art6full.pdf



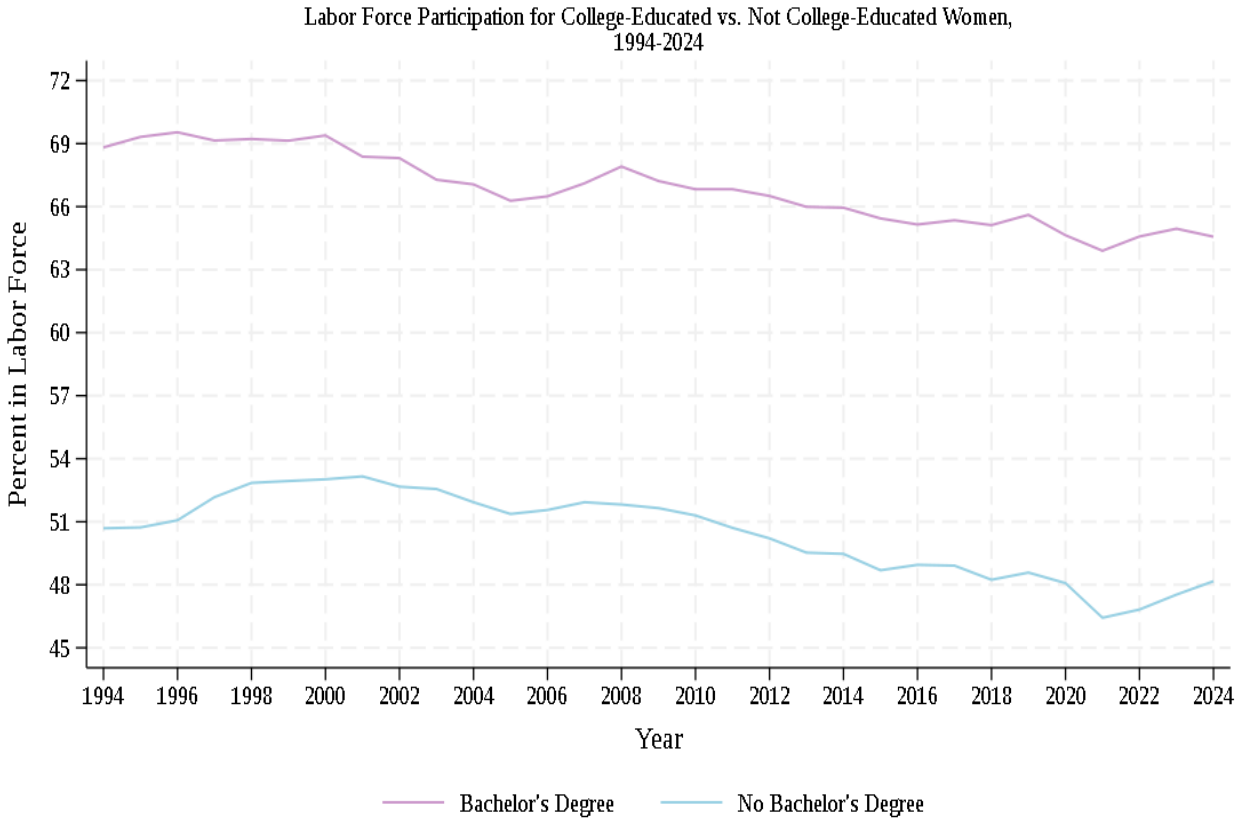
Suggested Response

Labor force participation decreased by 7.21 percentage points for women with a college degree and 5.9 percentage points for women without a college degree between 1994 and 2024.

Women with a bachelor's degree had a more steady decline over the 30 year period, while women without a bachelor's degree experienced an increase between 1996 and 2001. Female LFP increased overall between 1996 and 2001, which is likely driven by the increase in women without a bachelor's degree since it is a larger population.

Question 6

Create an alternative measure of labor force participation that excludes individuals from the labor force if they are self-employed in their main job ($lfp = 0$ if self-employed in main job). Using the new measure, describe how labor force participation for college-educated and not college-educated women has evolved since 1994. Please provide graphs and/or tables to support your answer.

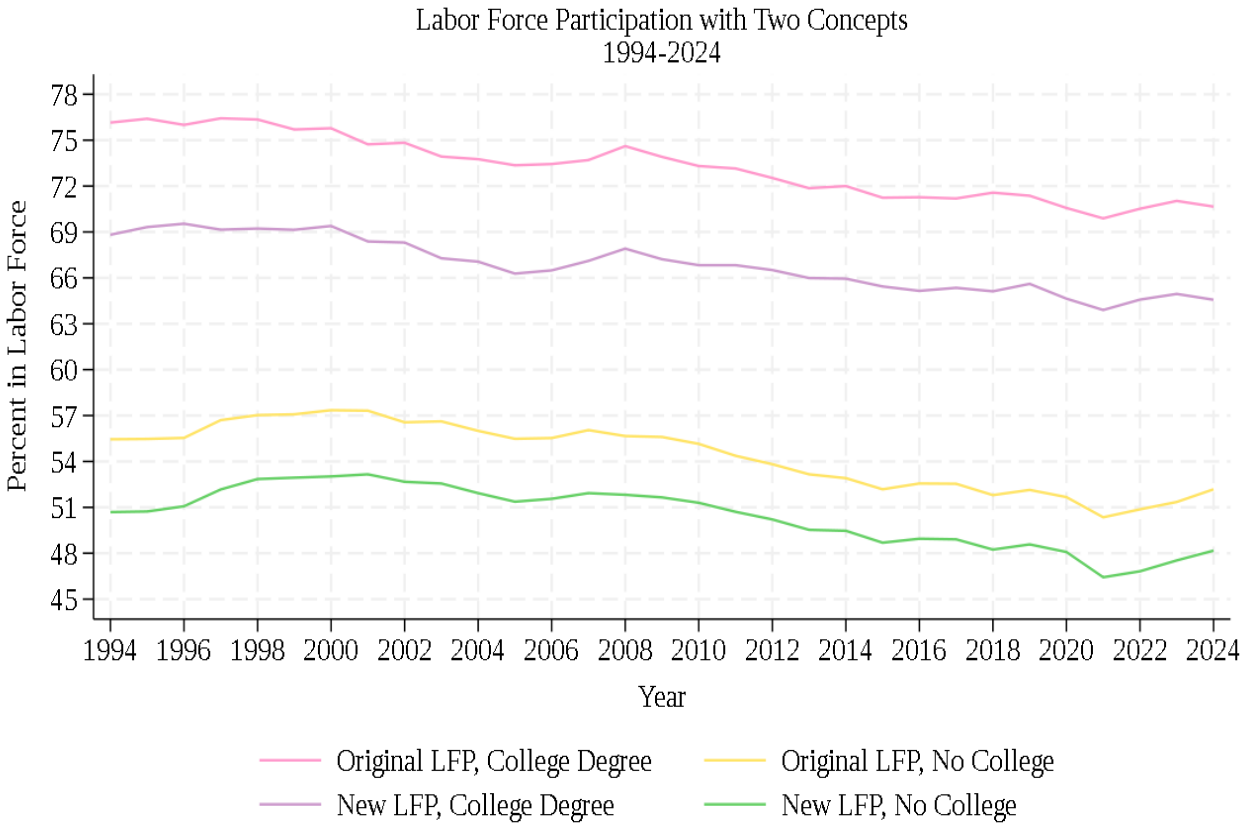


Suggested Response

Using the new measure, labor force participation decreased by 6.18 percentage points for women with a college degree and 4.97 percentage points for women without a college degree between 1994 and 2024.

Question 7

How does our labor market analysis change when we use the new measure? Which measure do you prefer? Explain.



Suggested Response

The trends in LFP between 1994 and 2024 for college and not college-educated women are similar across both measures and not self-employed individuals respond similarly to economic conditions. However, the self-employed population is not negligible, as about 10% of our sample are self-employed overall. This suggests that the labor supply of self-employed and not self-employed individuals respond similarly to economic conditions.

It makes more sense to include self-employed individuals when measuring labor force participation because we are unable to assume that self-employed individuals are comparable to individuals who are not in the labor force, such as discouraged, retired, or disabled individuals. The demographic composition and profiles of self-employed individuals and individuals who are not in the labor force are very different.

Part 2: Telework

Question 1

Since the rise of telework in 2020, how have wages, employment, and labor force participation changed for women who had telework from 2020-2024 and women who did not? Please provide at least three graphs and/or tables to support your answer.

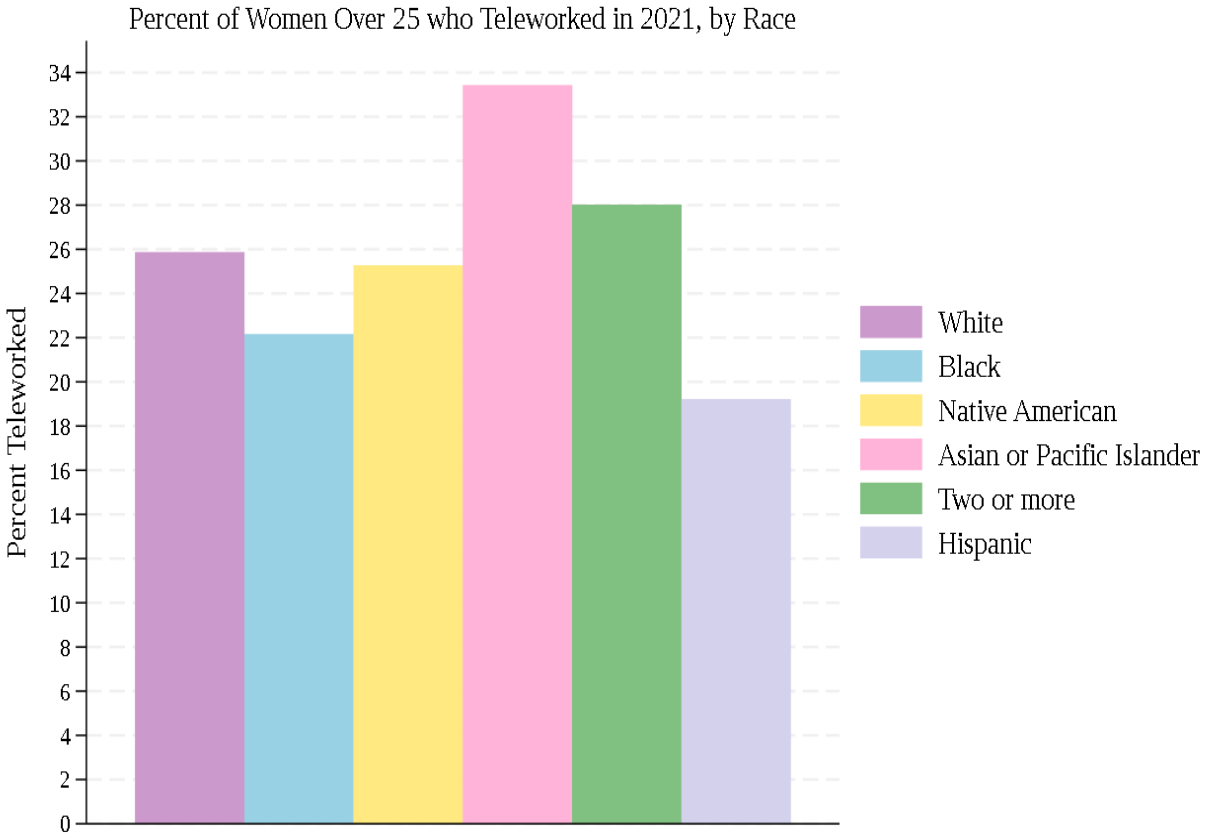
Suggested Response

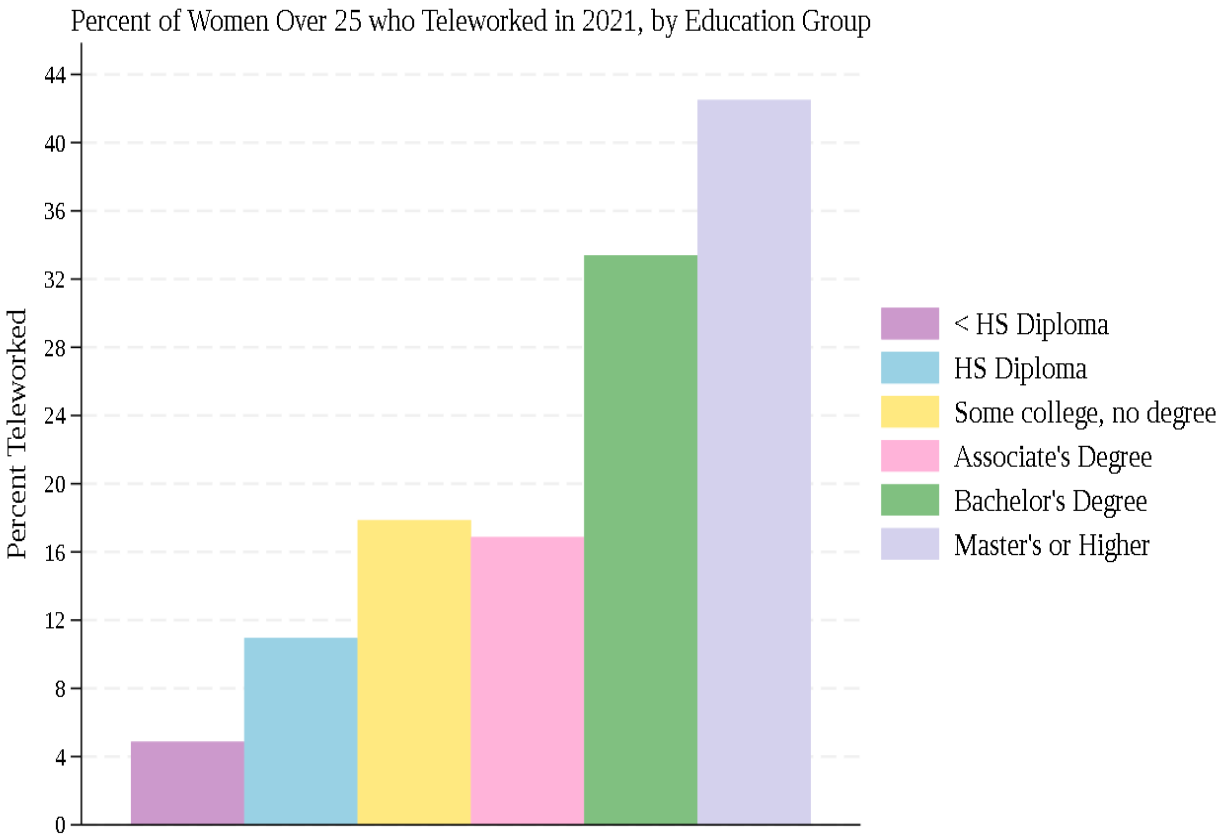
The data does not allow us to make a meaningful comparison between trends for women who had telework between 2020-2024 and women who did not. Only people who are employed (and therefore in the labor force) were asked if they had telework at any point during covid between 2020-2024. As a result, 100% of women over 25 who had telework were employed and in the labor force in 2020-2024. The telework variables have missing values for unemployed women over 25, so we don't know whether they had telework. Similarly, income is missing for every observation that answered the telework questions, so we are unable to examine median income for women over 25 who had vs. did not have telework.

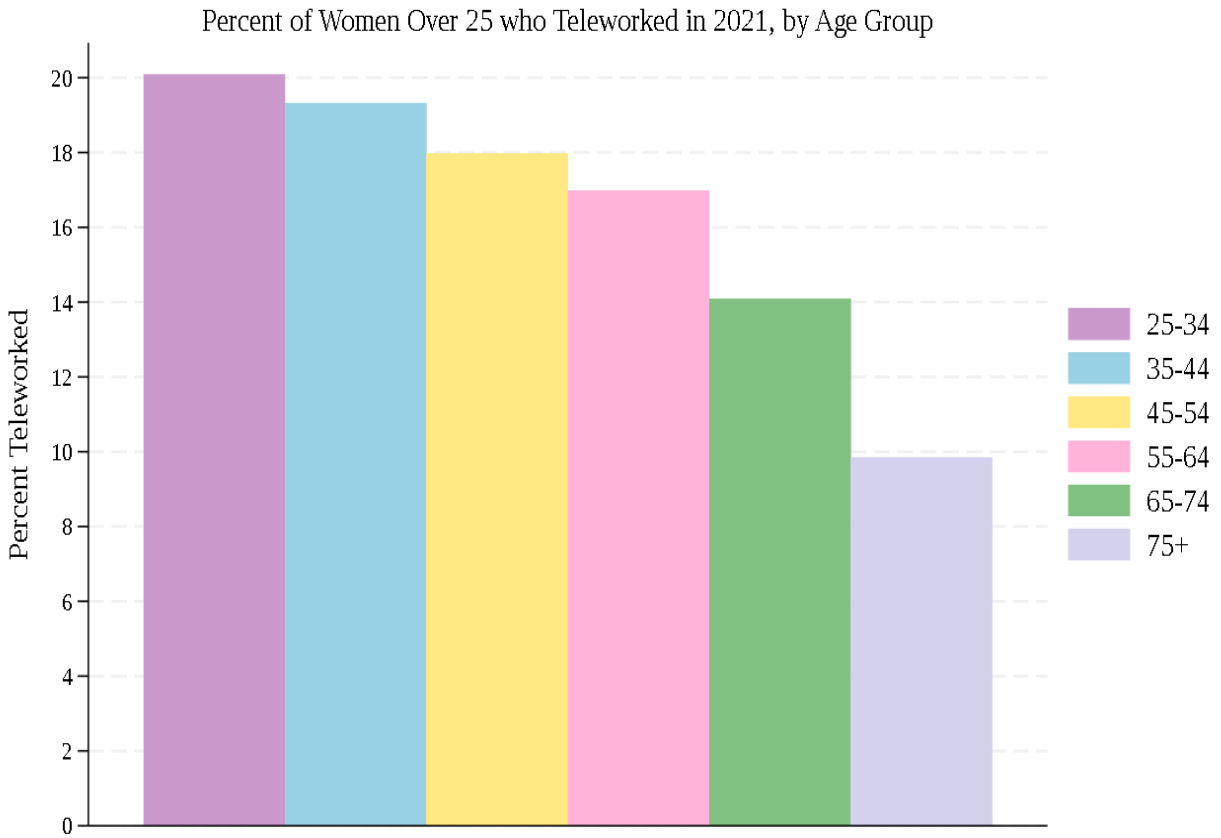
Note: This question is designed for you to practice looking for missing values and figuring out why they're missing. However, it is still possible to create graphs and make an interpretation, but the interpretation would not be meaningful to the question. If you're stuck, it may be a good idea to first try creating graphs and then look into how the missing values affect your graph.

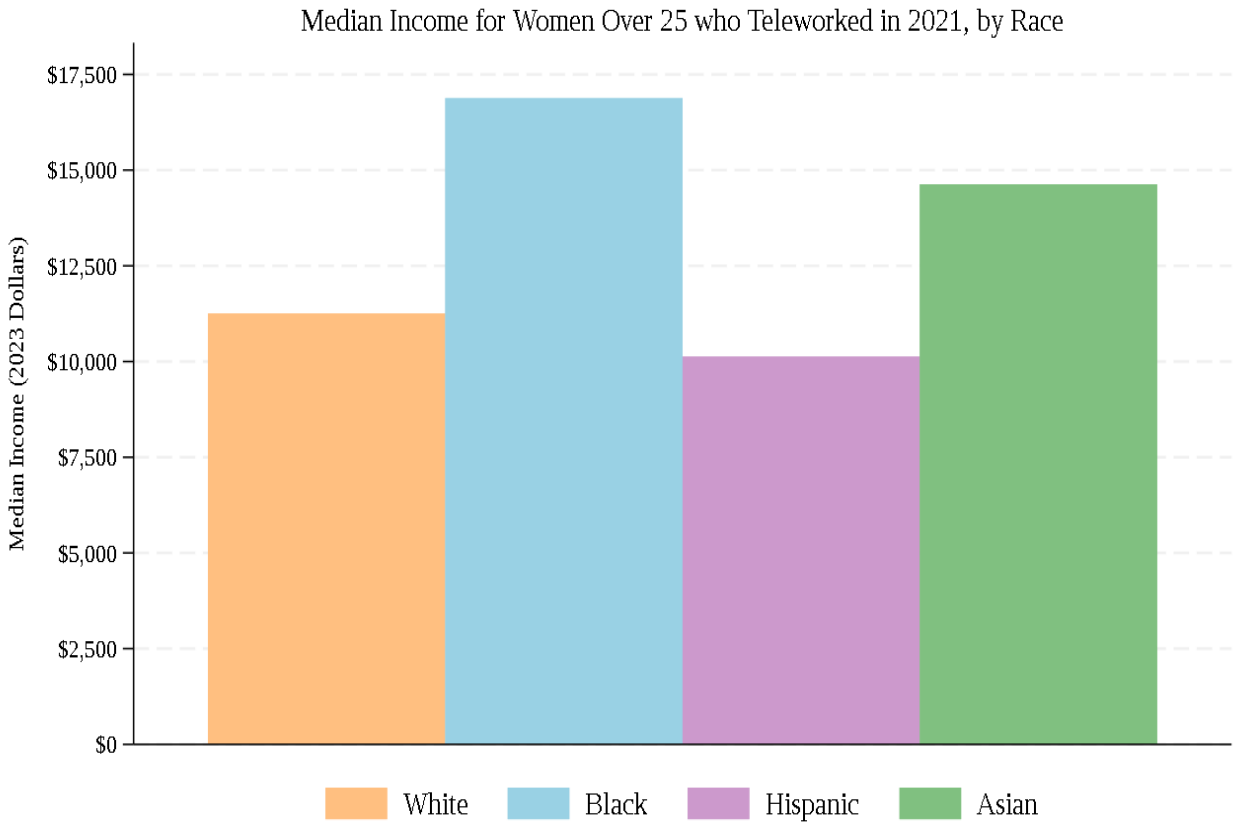
Question 2

For which groups of women older than 25 was telework due to the pandemic most common in 2021? Based on these patterns, what can you infer about the relationship between economic well-being and the ability to telework between 2021? Please provide at least three graphs and/or tables to support your answer.


Percent of Women Over 25 who Teleworked in 2021, by Race
Percent Teleworked
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
White
Black
Native American
Asian or Pacific Islander
Two or more
Hispanic


Percent of Women Over 25 who Teleworked in 2021, by Education Group
Percent Teleworked
0
4
8
12
16
20
24
28
32
36
40
44
< HS Diploma
HS Diploma
Some college, no degree
Associate's Degree
Bachelor's Degree
Master's or Higher


Percent of Women Over 25 who Teleworked in 2021, by Age Group
Percent Teleworked
0
2
4
6
8
10
12
14
16
18
20
25-34
35-44
45-54
55-64
65-74
75+


Median Income for Women Over 25 who Teleworked in 2021, by Race
Median Income (2023 Dollars)
$0
$2,500
$5,000
$7,500
$10,000
$12,500
$15,000
$17,500
White
Black
Hispanic
Asian

Suggested Response

In 2021, telework during the pandemic was most common for Asian women over 25, women over 25 with a bachelor's degree or higher, and women who are between the ages of 25 and 34.

Among Asian women over 25, about 1 in 3 had telework during the pandemic. Asian women over 25 are also most likely to have a bachelor's degree. Women over 25 with a bachelor's degree are more likely to telework, which plausibly explains why telework during the pandemic was most common for Asian women over 25.

However, Asians had a lower median income in 2021, which implies that unlike the relationship between education and telework, there is a lot of noise in the relationship between income and telework. Employees who were unable to telework hold a wide variety of occupations, such as cashiers, construction workers, or surgeons, so not being able to telework may not bbe indicative of having a low income. Rather, education level is a stronger indicator of whether someone was able to telework during the pandemic.

These patterns suggest that women over 25 who were able to telework experience better economic well-being overall, even if their income may not necessarily be higher. Women over 25 who had telework during the pandemic have higher levels of education, which yields better

labor market outcomes. Education also signals better economic well-being in the sense that individuals from higher income families are more likely to obtain a college degree.

Question 3

Predict what trends in employment, wages, and labor force participation for college-educated women from 2020 to 2024 would have looked like if telework was not an option. What does this tell you about the economic impacts of telework during the COVID-19 pandemic? Please support your answer with graphs and/or tables.

Hint: Look at trends from previous years that had similar economic contexts. Also, feel free to explore the variables you haven't used yet.

Percent of Women over 25 who Teleworked by Race, 2020-2024

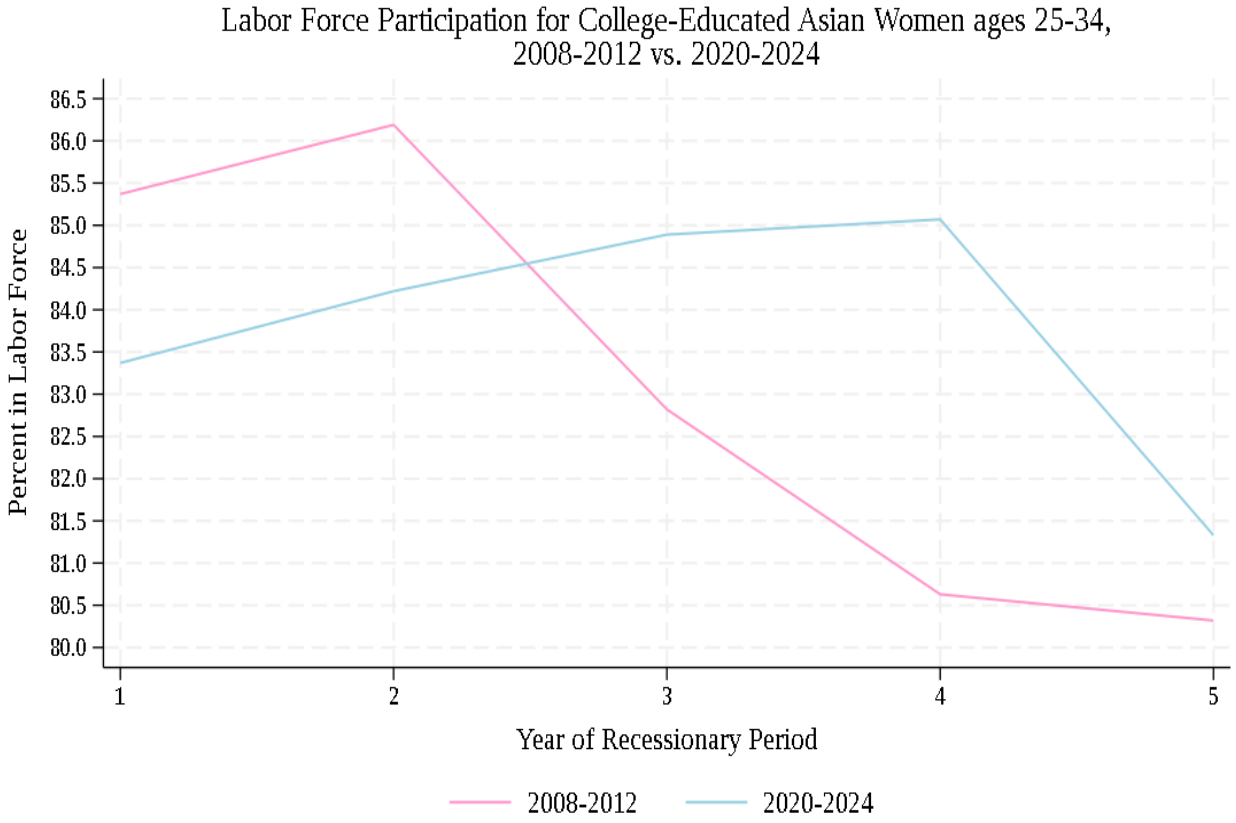
Race	2021	2022	2023	2024
White	25.87	11.74	21.34	25.2
Black	22.15	10.69	22.46	24.91
Asian	33.42	20.49	31.99	31.51
Hispanic	19.21	8.22	16.36	18.67

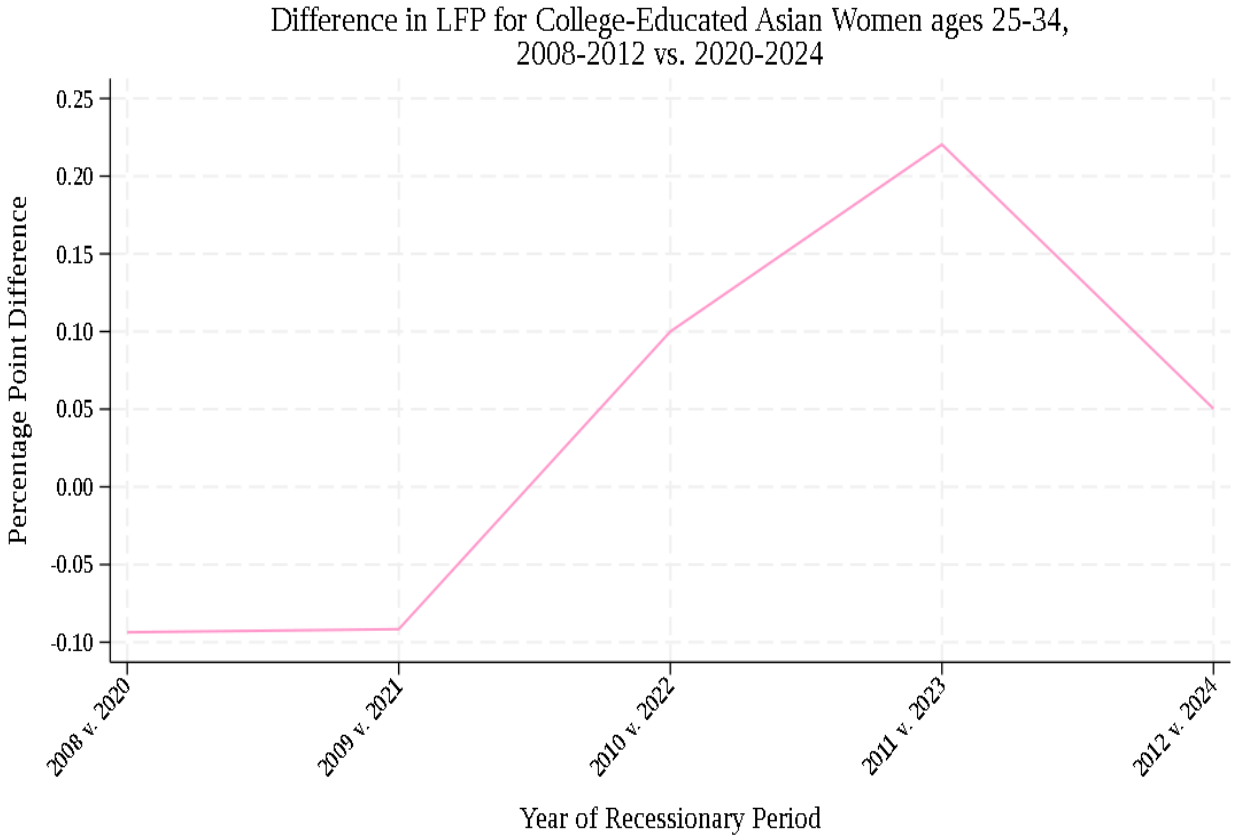
Percent of Women over 25 who Teleworked by Age, 2020-2024

Age	2021	2022	2023	2024
25-34	27.16	13.01	38.43	40.51
35-44	26.5	12.15	41.1	46.15
45-54	24.76	11.19	37.96	40.97
55-64	22.78	11.19	20.48	26.49
65-74	19.31	8.88	6.09	7.34

Percent of Asian Women over 25 who Teleworked by Age, 2020-2024

Age	2021	2022	2023	2024
25-34	45.43	27.91	52.56	44.72
35-44	34.92	18.9	47.68	52.79
45-54	31.78	19.34	49.65	42.57
55-64	19.77	17.13	25.45	31.45
65-74	19.8	13.68	5.77	4.11


Labor Force Participation for College-Educated Asian Women ages 25-34,
2008-2012 vs. 2020-2024
Percent in Labor Force
86.5
86.0
85.5
85.0
84.5
84.0
83.5
83.0
82.5
82.0
81.5
81.0
80.5
80.0
1
2
3
4
5
Year of Recessionary Period
2008-2012
2020-2024


Difference in LFP for College-Educated Asian Women ages 25-34,
2008-2012 vs. 2020-2024
Percentage Point Difference
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
2008 v. 2020
2009 v. 2021
2010 v. 2022
2011 v. 2023
2012 v. 2024
Year of Recessionary Period

Suggested Response

Telework was most common for Asian women over 25 and women ages 25-34. College-educated women over 25 are also much more likely to telework. In 2021, 2023, and 2024 almost 50% of Asian women ages 25-34 had telework. In 2022, about 30% had telework.

I will examine labor force participation trends for college-educated Asian women ages 25-34 from 2008-2012, a recessionary period when telework was likely far less common. I will compare this trend with trends from 2020-2024. The difference will capture the effects of telework on labor force participation. I will assume that the effects of telework on labor force participation are similar across all college-educated women over 25.

The ability to telework allows workers with health concerns to remain in the labor force. On average, between 2020-2024 about 40% of Asian women ages 25-34 were able to telework, however. Thus, changes to labor force participation for college-educated Asian women ages 25-34 during the pandemic may only be explained by macroeconomic conditions rather than health concerns for about 40% of this group. Consequently, my estimation on the effects of will be too large. I will address this by multiplying it by 0.4.

Using this strategy, in the first two years of a recessionary period, telework does not have a positive impact on female labor force participation. In the long run, however, telework increases LFP by percentage points. This implies that the ability to telework enabled women to remain in the labor force during covid-19. This is important for mitigating inequality in labor market outcomes and health outcomes, as well as maintaining a competitive labor market.

Note: Your answer may be drastically different. A thoughtful response should justify your prediction with figures or references that highlight trends from a previous four year period with similar economic conditions and discuss a broad range of economic impacts.