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# CBO's Projection of Labor Force Participation Rates

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## Abstract

As part of its responsibility for producing baseline projections of the economy and the federal budget, the Congressional Budget Office regularly produces estimates and projections of labor force participation rates. Those projections serve as a key input to CBO's estimate of potential output and the agency's macroeconomic forecasts and budget projections. This paper describes the methodology used to produce CBO's projections of labor force participation rates.

The paper further examines the factors behind the recent trend decline in the overall and prime-age labor force participation rates and whether CBO expects those declines to persist over the next decade. Persistent weakness in the labor market following the 2007–2009 recession reduced the overall labor force participation rate by as much as 1.2 percentage points and the prime-age rate by as much as 1.3 percentage points. A strengthening labor market has pulled some workers back into the labor force in recent years, and further cyclical increases are estimated to occur in both the overall and prime-age rates over the next few years.

The estimates show, though, that the vast majority of the recent decline in the overall rate stems from the aging of the baby-boom generation into retirement, and CBO expects aging to cause further declines in that rate over the next 10 years. The recent decline in the prime-age rate is entirely unrelated to aging, and CBO expects that downward trend to stop over the next decade, as increases in educational attainment outstrip further declines in the participation rates of less educated, prime-age individuals.



*Keywords:* Labor force, labor force composition, labor force demographics, labor force participation, labor market forecasting, macroeconomic forecasting

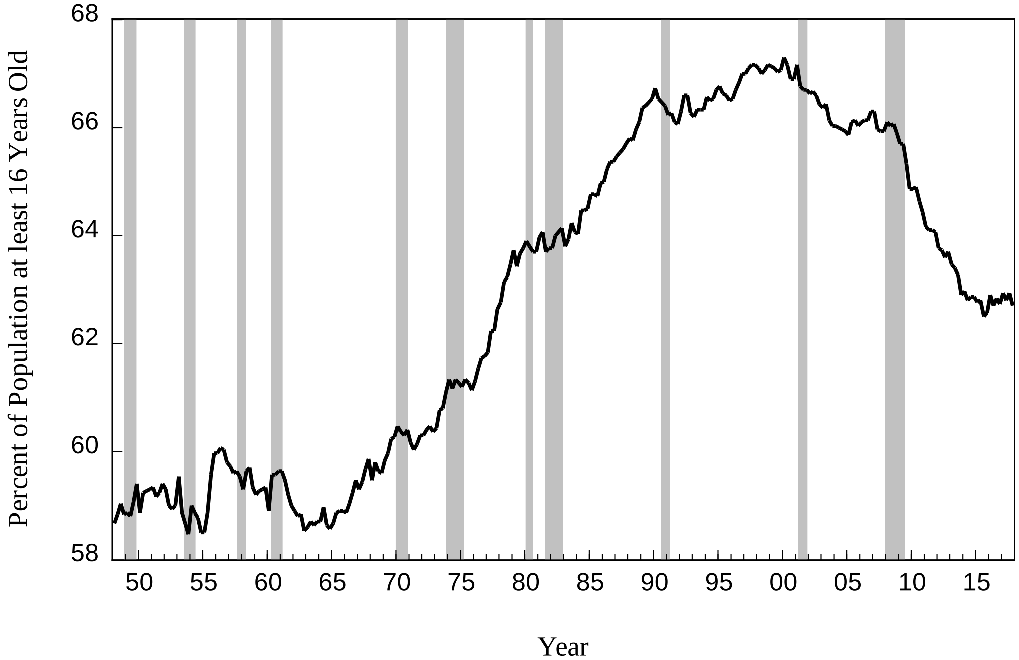
*JEL Classification:* E17, E24, E27, J21, J22

## Contents

# Introduction

After increasing for nearly four decades, the rate of labor force participation for individuals at least 16 years old began to fall in the first decade of the 2000s, from a peak of 67.1 percent in 2000 to 66.0 percent at the start of the 2007–2009 recession. Between the start of the recession and 2014, however, the rate fell even further, by a little more than 3 percentage points, to 62.9 percent. Since 2014, the labor force participation rate has stabilized, remaining at 62.8 percent in 2017 but still well below its pre-recession value (see Figure 1).[1]

**Figure 1. Labor Force Participation Rate, 1948-2017**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Forecasts of the rate of participation in the labor force are an important ingredient of the Congressional Budget Office's economic projections. Such estimates, along with the size of the population, determine the size of the labor force. A smaller labor force (or a lower labor force participation rate) is associated with lower gross domestic product (GDP) and lower tax revenues. It is also associated with larger federal outlays, because people who are not in the labor force are more likely to enroll in federal benefit programs.

Forecasts of the labor force participation rate depend importantly on the projection of the potential labor force participation rate, which is an estimate of the rate that would occur if the economy were at its maximum sustainable level of output. Furthermore, projections of the potential labor force participation

[1] For a review of the trends that contributed to changes in labor force participation rates by age and sex and the implications for the aggregate labor force participation rate, see Juhn and Potter (2006).

rate serve as a key input to CBO's estimate of potential output and its macroeconomic forecasts and budget projections. [2]

This paper examines factors that drive changes in the labor force participation rate and explores whether the recent decline may continue. Specifically, CBO constructs a birth-year cohort model to estimate labor force participation rates by age-sex-education-race/ethnicity subgroups. CBO augments the model's age-sex-education-race/ethnicity and birth-year cohort fixed effects with a measure of the business cycle and several observable structural determinants of labor force participation to measure how much variation in those rates is cyclical and how much is structural. CBO then aggregates the estimates of the group rates to construct an estimate of the aggregate labor force participation rate. The predicted structural portion yields an estimate of the potential labor force participation rate.

The results show that, despite no sustained increase in the observed labor force participation rate in recent years, there has been a significant cyclical increase in that rate. In 2014, the labor force participation rate was about 1.2 percentage points below its estimated potential rate—the largest that gap has been during or after the most recent recession. Since 2014, the labor force participation rate has recovered considerably relative to the potential rate, though slack in participation still remains. In 2017, the labor force participation rate was roughly 0.4 percentage points below its estimated potential rate, on average.

A relatively flat labor force participation rate in recent years represents cyclical strength in the current labor market because structural changes are placing significant downward pressure on the participation rate. By far the largest source of that downward pressure is the shifting age distribution of the population toward a greater proportion of workers in years beyond the prime working years. Specifically, the potential labor force participation rate began to decline in the middle to late 1990s, just as the first cohorts of the baby-boom generation began turning 50 years old. That decline averaged about 0.1 percentage point per year through 2010. Since 2011, when the first baby-boom cohort turned 65 and entered the traditional retirement years, the potential participation rate has declined by roughly one-quarter of one percentage point per year.

The potential labor force participation rate has continued to decline through 2017. In particular, the potential labor force participation rate fell from a peak of 67.0 percent in the middle of the 1990s to 65.8 percent in the fourth quarter of 2007, just before the start of the 2007–2009 recession, and has since fallen further to 63.2 percent at the end of 2017. The potential labor force participation rate is projected to continue to fall over the next decade, declining by another 3.0 percentage points to 60.2 percent by the end of 2028. As was the case over the past 20 years, aging will continue to be a significant driver in lowering the potential labor force participation rate over the next decade.

CBO's model builds on the cohort models of Stephanie Aaronson et al. (2006), Kudlyak (2013), Stephanie Aaronson et al. (2014), and Daniel Aaronson et al. (2014). The first three studies model labor force participation by age-sex subgroups that include both age-sex and birth year (cohort)-sex fixed effects, and the fourth study models participation by age-sex-education subgroups. All of those studies

[2] For more information on how the labor force projections feed into CBO's estimate of potential output, see Shackleton (2018). For more information on how the labor force projections are incorporated in CBO's 10-year macroeconomic forecast, see Arnold (2018).

identify the aging of the population as the most significant factor driving down the labor force participation rate in recent years and agree that decline will probably continue into the near future.

Although aging is the largest driver of the falling labor force participation rate for people ages 16 or older in CBO's projections through 2028, aging has little effect on the projection of that rate for people ages 25 to 54. The most important factors affecting the participation rate for prime-age workers are the anticipated rise in educational attainment and the dissipation of cyclical weakness, which are estimated to more than offset downward pressures (mainly from cohort effects and disability insurance) and result in an increase of 0.5 percentage points in that rate from 2017 to 2028.

# CBO's Approach to Estimating Labor Force Participation

CBO projects rates of labor force participation using a model that is an extension of those used by Stephanie Aaronson et al. (2006), Kudlyak (2013), Stephanie Aaronson et al. (2014), and Daniel Aaronson et al. (2014). The first three papers estimate labor force participation rates by age-sex subgroups, whereas the fourth paper estimates labor force participation rates by age-sex-educational attainment subgroups. All four papers, however, use a cohort model to estimate those subgroup rates. Cohort models are distinguished by the inclusion of dummy variables for each birth-year cohort to model how labor force participation rates may change as each respective cohort ages through its life cycle. Those models estimate labor force participation rates for subgroups of the population using a system of equations that holds the estimated value of the cohort effects constant across certain age groups. Thus, the cohort effects are meant to capture various birth cohorts' attachment to the labor force through long periods of time.

CBO uses a cohort model that estimates labor force participation rates by age-sex-education-race/ethnicity (race hereafter) subgroups. CBO treats age groups within each sex-education-race subgroup as a separate system of equations and estimates cohort effects that are constrained across the age group equations within each system. Those constraints keep the values of the estimated cohort effects the same across all age groups within each system. Each age group equation includes an age group specific fixed effect, cohort fixed effects, and an array of time varying covariates. CBO separates cyclical variation in labor force participation rates from underlying structural trends through the time varying covariates in order to identify the potential labor force participation rate—that is, the rate that would occur if the economy's output was at its maximum sustainable amount and other inputs were at their potential rates. This section details the data used in the analysis and CBO's modeling specifications.

## Data

The main datasets used in the analysis are the Current Population Survey's basic monthly micro files.[3] The CPS is jointly sponsored by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics and is the primary source of labor force statistics for the U.S. civilian noninstitutionalized population 16 years or older.[4] Each month, the Census Bureau administers the survey to a probability selected sample of roughly

[3] Census Bureau, "Current Population Survey (CPS)," www.census.gov/programs-surveys/cps.html.

[4] The noninstitutionalized population includes all people not in the armed forces and not in institutions (such as prisons or nursing homes).

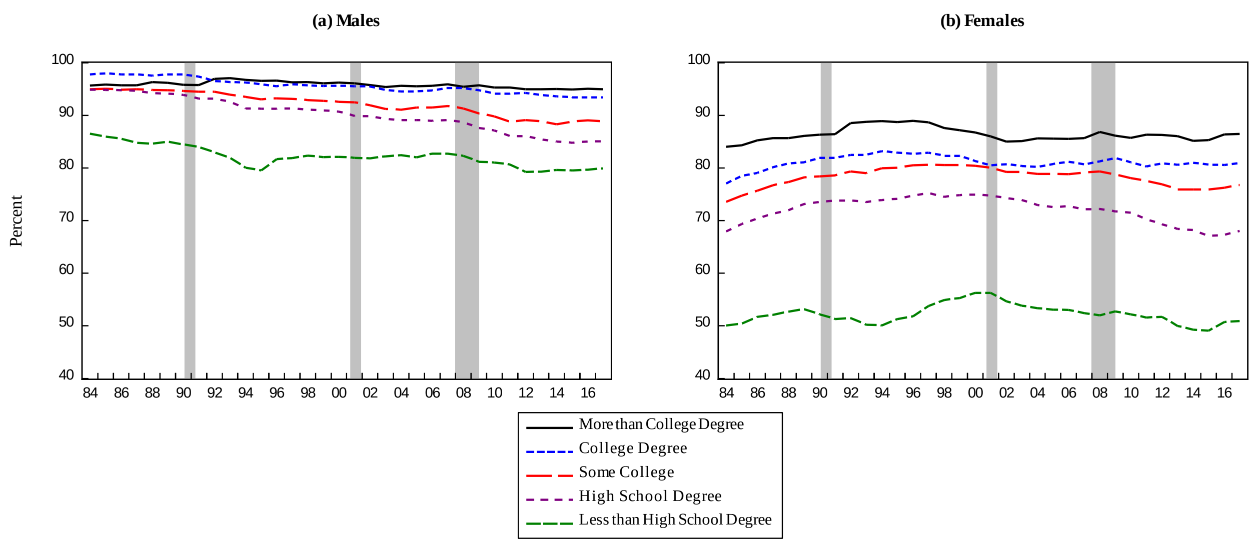
60,000 households from all 50 states and the District of Columbia, and a reference person in each household answers questions for all members of that household. Selected households participate in the survey for 4 months, rotate out of the survey temporarily for 8 months, and return to the survey for another 4 months before rotating out permanently. Respondents in their 4th and 8th months are referred to as the outgoing rotation group, since they are rotated out of the survey in the following month.

The survey questions reference the labor market activities of the household during the week that includes the 19th of the survey month. Those labor market activities include labor force participation, employment status, and school enrollment. Each month, the survey asks an additional set of questions to the outgoing rotation group subsample regarding pay and hours worked conditional on employment. For the entire sample, labor market activity questions are supplemented by a series of demographic questions that include age, sex, education level, race, marital status, and the presence of children. Although the CPS dates back to 1948, many of those questions were added to the survey much later. Because of the lack of historical data for some survey questions, the analysis in this paper spans the period from 1984 through 2017.

## CBO's Subgroup Classifications by Age, Sex, Education, and Race

The model has 516 age-sex-education-race subgroups. First, CBO divides the population by sex. The agency next subdivides each sex into age groups. The age groups typically cover a span of five single-year ages, with exceptions for the youngest and oldest people.

**Figure 2. Labor Force Participation Rates by Educational Attainment, Ages 25 to 54**

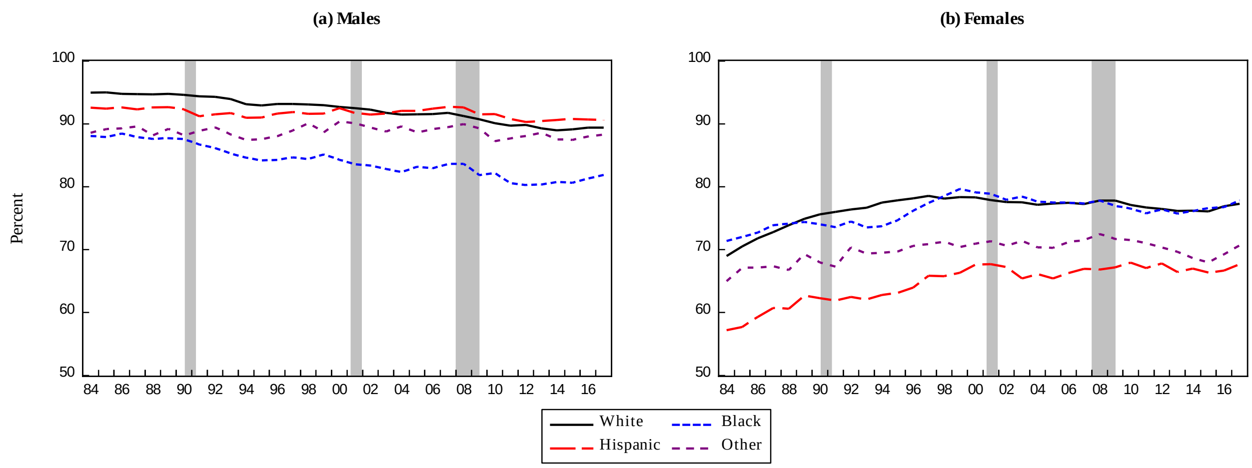



Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

CBO then divides each age-sex group into one of five levels of educational attainment spanning a range from people who have not finished high school to people with more than a bachelor's degree. Greater educational attainment is associated with greater participation in the labor market, and those differences appear to be stark. Furthermore, differences in participation rates across levels of educational attainment appear to be growing over time, particularly for prime-age workers (see Figure 2).[5]

The fall in labor force participation rates of workers with less than a college degree does not appear to be a cyclical phenomenon, driven by the most recent recession, but rather part of a long-term, steady decline that started more than four decades ago for males and more than 15 years ago for females (Congressional Budget Office 2018). For example, the difference in participation rates between prime-age males with college degrees and those with high school degrees grew from about 3 percentage points in 1984 to about 8 percentage points in 2017, whereas the difference in rates for prime-age females with college degrees and females with high school degrees grew from about 6 percentage points in 2000 to about 13 percentage points in 2017.

**Figure 3. Labor Force Participation Rates by Race and Ethnicity, Ages 25 to 54**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Finally, CBO partitions the age-sex-education categories into four race groups: white, black, Hispanic, and other.[6] There are clear differences in male participation rates across some race groups. Participation

[5] Although differences in labor force participation rates by education group are clear for the population ages 16 or older, changes in those rates over time include factors like the aging of the population and the fact that many young workers (less than 20 years old) only have high school diplomas or less. Those factors are less relevant for the population ages 25 to 54 and allow for a better understanding as to how labor force participation rates have evolved by education.

[6] CBO constructs the four race categories using the CPS basic monthly file questions asking respondents to report their race and whether or not they are Hispanic. The race question has evolved significantly over the sample period. Through 1988, the surveys provided three race categories (white, black, and other) from which respondents could choose. The 1989–1995 surveys provided five categories (white, black, American Indian/Aleut Eskimo, Asian or Pacific Islander, and other). The 1996–2002 surveys provided four categories (white, black, American Indian/Aleut Eskimo, and Asian or Pacific Islander). The number of race categories expanded significantly to 21 possible responses in 2003, with the additional responses allowing for individuals to identify as more than one race (e.g., instead of requiring a respondent to choose between white or black in 2003, an individual identifying as both white and black could choose to respond "white-black" or "black-Asian"). Those categories expanded even further in May 2012, providing individuals with 26 possible responses. To classify each worker in one of the four race categories used in this paper, CBO used the following rules: Classify an individual as Hispanic if that person answers the Hispanic-ethnicity question accordingly, regardless of that individual's response to the race question. Classify an individual as black if that person did not respond positively to the Hispanic-ethnicity question and responded to the race question with any race category that included black. Classify a person as other if that person did not respond positively to the Hispanic-ethnicity question, did not respond to the race question with a category that included black, and chose a category that included a race other than black or

rates for prime-age Hispanic males have been much higher than rates for every other category since the late 1990s (see Figure 3). Conversely, participation rates for black males have historically been much lower than rates for white males.[7]

Female participation rates also showed clear differences across race groups. However, those differences were the opposite of males. Whereas black males have had much lower participation rates than every other male race category, black females, along with white females, have had higher participation rates than other race categories through nearly the entire sample period. Hispanic females, conversely, have displayed the lowest participation rates among the female race categories—opposite to the pattern displayed by males.

**Table 1. Age-Sex-Education-Race Subgroups Included in the Model**

| | Educational Attainment | | | | | |
|---|---|---|---|---|---|---|
| Age-Sex-Race/Ethnicity Subgroups | Less than High School Degree | High School Degree | Some College | College Degree | More than College Degree | Total Number of Subgroups |
| 16 to 17; Male/Female; White/Black/Hispanic/Other | X | | | | | 8 |
| 18 to 19; Male/Female; White/Black/Hispanic/Other | X | X | | | | 16 |
| 20 to 24; Male/Female; White/Black/Hispanic/Other | X | X | X | X | | 32 |
| 25 to 29; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 30 to 34; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 35 to 39; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 40 to 44; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 45 to 49; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 50 to 54; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 55 to 59; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 60 to 61; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 62 to 64; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 65 to 69; Male/Female; White/Black/Hispanic/Other | X | X | X | X | X | 40 |
| 70 to 79; Male/Female; White | X | X | X | X | X | 10 |
| 70 to 79; Male/Female; Black | X | X | X | X | | 8 |
| 70 to 79; Male/Female; Hispanic/Other | X | X | X | | | 12 |
| 80+; Male/Female; White | X | X | X | X | X | 10 |
| 80+; Male/Female; Black | X | X | X | X | | 8 |
| 80+; Male/Female; Hispanic/Other | X | X | X | | | 12 |

Source: Congressional Budget Office. This table shows each of the age-sex-education-race subgroups for which CBO estimates labor force participation rates in the model. Education subgroups are omitted when the number of available responses in the CPS microdata are determined to be too few over a prolonged period to provide reliable estimates. Individuals responding as having an omitted level of education are combined with the highest non-omitted level of education for his or her particular subgroup. For example, an 18-year-old reporting as having a college degree would be reclassified into the high school degree subgroup. General education development degrees are classified as a high school degree. Those in the CPS reporting as both white and Hispanic, black and Hispanic, or other and Hispanic are classified as Hispanic.

white (e.g., Asian, American Indian, Hawaiian/Pacific Islander, etc.). Finally, classify an individual as white if that person did not respond positively to the Hispanic-ethnicity question and responded to the race question with the white-only choice.

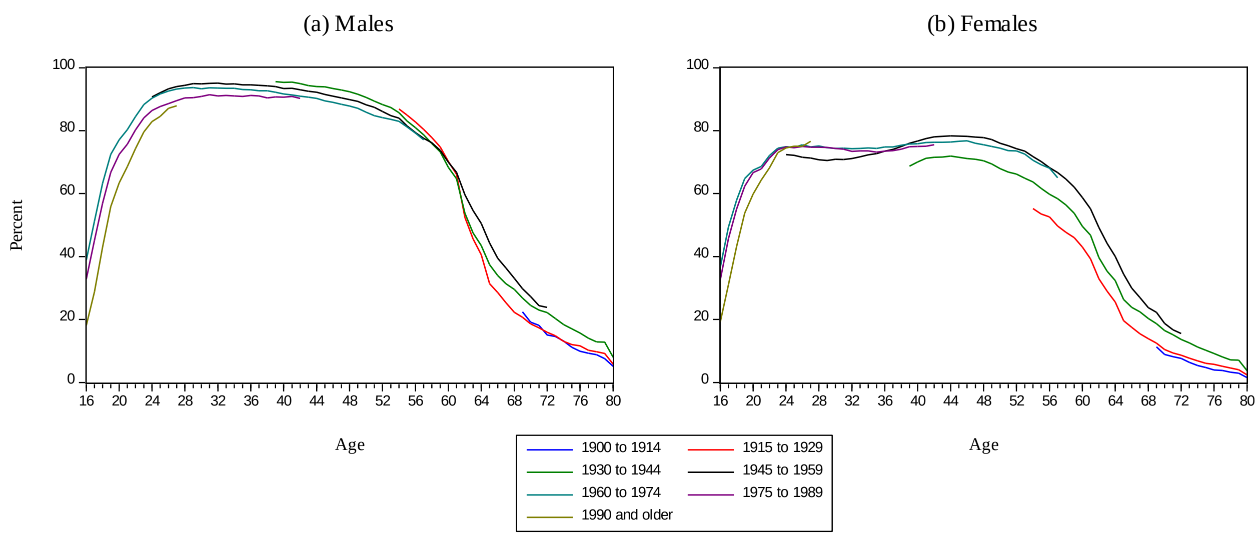
[7] For more on the relationship between race and labor force participation, see Altonji and Blank (1999) and Cajner et al. (2017).

Overall, those partitions yield 15 age groups for each sex-education-race subgroup (see Table 1). Some of the age-sex-education-race subgroups, though, may not have any survey respondents within a given month, making it impossible to calculate a labor force participation rate. Having no survey respondents within a subgroup is particularly common for groups that are younger than 20 years old with more than high school degrees throughout the entire sample period and for nonwhite individuals 70 or older that have high levels of education earlier in the sample period. To avoid issues in the estimation from those missing observations, some age-sex-race subgroups with higher levels of education are combined with groups having less education (e.g., 18- to 19-year-olds with some college or more are combined with 18- to 19-year-olds with high school degrees).

## CBO's Treatment of Cohort Effects

Many previous studies have shown the significance of cohort effects for long-term trends in participation.[8] How one specifies those effects can have considerable bearing on the historical estimates and the projections. The cohort effects are dummy variables included to capture any nonobservable structural factors that may increase or decrease an individual's likelihood of participating in the labor market throughout his or her life and that are correlated with his or her birth year. [9] Those effects are interpreted as a measure of a cohort's attachment to the labor force, relative to that of older and younger generations, and those varying propensities to participate are reflected in the shifts in the labor force participation rate age profiles by cohort for males and females (see Figure 4 where, for example, a declining attachment to the labor force across cohorts shows up as a downward shift in the lines).

**Figure 4. Labor Force Participation Rates by Age and Birth Cohorts**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

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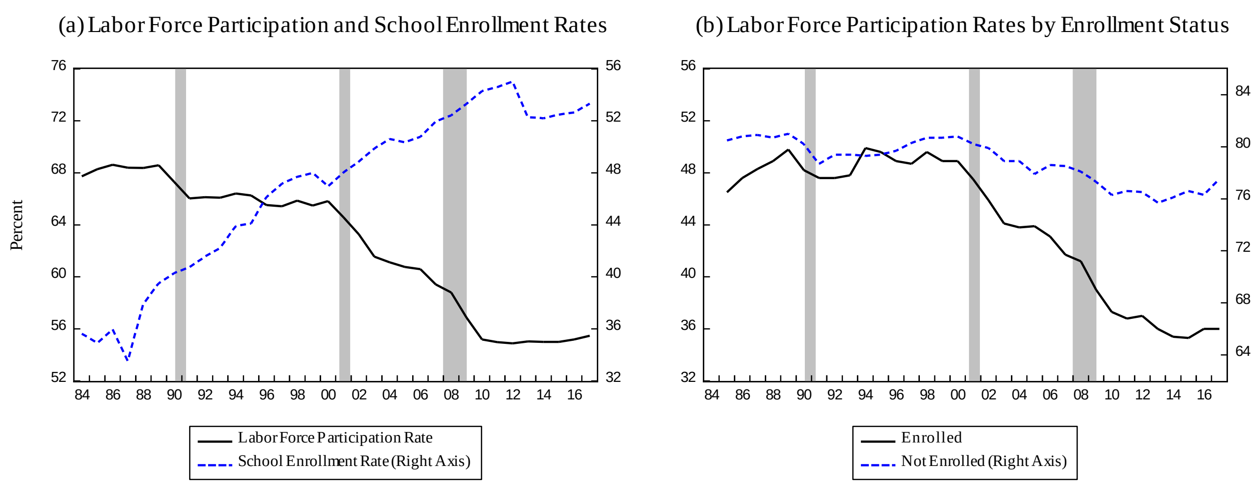
[8] See, for example, Goldin (2006), Stephanie Aaronson et al. (2006, 2014), Fallick and Pingle (2007), Kudlyak (2013), and Daniel Aaronson et al. (2014).

[9] For a detailed discussion of the necessary assumptions for identifying the fixed effects, see Fallick and Pingle (2007) and Stephanie Aaronson et al. (2014).

There are shifts in these age profiles with each subsequent cohort for both males and females. Male participation has fallen consistently with each successive birth cohort at each age through about 65, which can be seen by the downward shifts in the age profile lines until age 65 in panel (a) of Figure 4. Conversely, participation rates for older males have increased consistently with each successive cohort, as seen by the upward shift in the age profiles after age 65. Female participation, on the other hand, has increased considerably through the cohorts born in 1959. Since then, female participation appears to have leveled off across most age groups and has even started to consistently decline for females between ages 16 and 24 with each successive cohort.

One difficulty with the cohort model approach is reliably estimating the effect for the youngest cohorts because they have relatively few data points available (see, for example, Stephanie Aaronson et al., 2006, 2014). For instance, the sample period ending in 2017 has 16 quarters or less of data for cohorts born in 1998 or later. That issue is compounded for the recent young cohorts because of the negative effect on labor force participation caused by the 2007–2009 recession. For example, an individual born in 1991 would have turned 16 in 2007, and an individual born in 1985 would have turned 22 in that year. As a result, those individuals' primary labor market experience would have taken place during that recession and the subsequent slow recovery. For those recent cohorts, disentangling the cyclical effects from a birth-year cohort effect is particularly difficult.

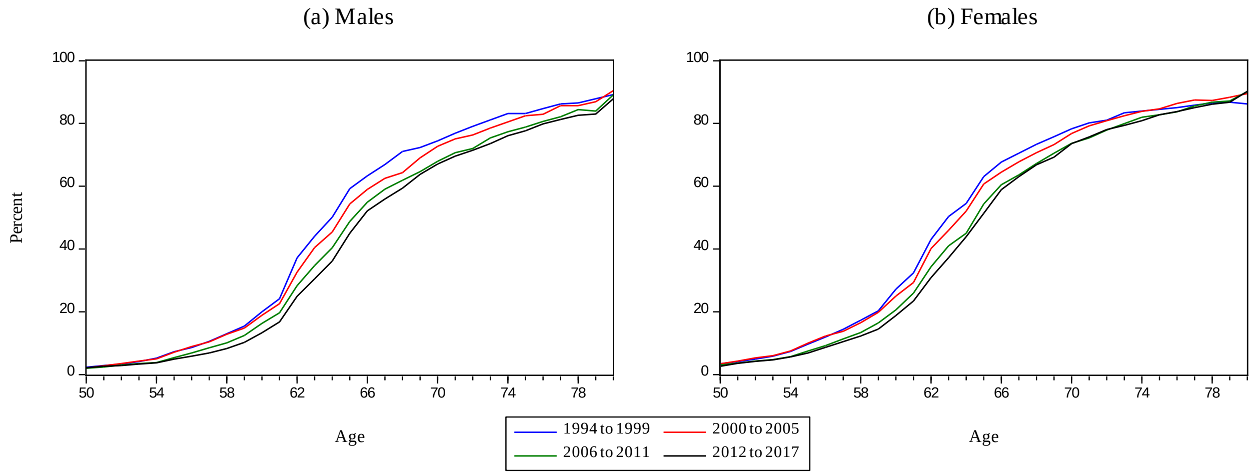
**Figure 5. School Enrollment and Labor Force Participation Rates for People Ages 16 to 24**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Furthermore, the labor force participation rate of people ages 16 through 24 fell by 11 percentage points between 2000 and 2010, a trend driven largely by both an increase in the fraction of people enrolled in school (who have lower participation rates, on average, than others) and a persistent decline in the participation rate of enrolled people that started around 2000 (see panels (a) and (b) of Figure 5, respectively). Including enrollment as a covariate may capture the average effect on participation of an increase in the fraction of people enrolled: More young people enrolled in school should lower the participation rate of that group. However, it would not fully capture the effect of the declining participation rate of the enrolled group. That decline is likely to affect people ages 16 through 24 in the future but will probably not affect the future participation rates of the young as they age. Since this decline started around 2000, it only affects the youngest of cohorts, who have the bulk of their observations in that age range. A cohort model might mistakenly estimate that decline as a permanent effect on that cohort. In that case, the model would project lower participation rates for those cohorts into the future rather than isolating that decline as unique to 16- to 24-year-olds.

**Figure 6. Retirement Rates, by Age, 1994 to 2017**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey. The retirement rate is calculated as the fraction of people of each age reporting as being out of the labor force because of retirement.

A second difficulty with the cohort model approach is reliably projecting labor force participation rates for older people. Participation rates for older workers—both male and female—have increased with each successive cohort as those workers have delayed retirement (see Figure 6). However, participation rates for older males have increased while those for males under age 65 have decreased for each successive cohort.[10] A cohort model could attribute much of the decrease in participation rates before age 65 to the cohort-specific fixed effects. However, those cohorts would carry those cohort effects into the traditional retirement years, and the model would project lower participation rates for those cohorts relative to past cohorts even though participation rates for males have been increasing with each successive cohort.

To avoid assigning unrealistically low cohort effects to the youngest cohorts (which stem from a declining participation rate among enrolled students) and to older workers (who are participating at higher rates with each cohort), CBO splits the system into four subsets instead of estimating a system of equations including all age groups 16 or older for each sex-education-race group. Those subsets include one for 16- through 24-year-olds, a second subset for those ages 25 through 64, a third subset for those 65–79 years old, and a fourth subset for those 80 or older. For each of the first three subsets, CBO estimates the system as a standard cohort model with a cohort-specific fixed effect that is constrained across all age equations within each sex-education-race group. Thus, three separate cohort effects are estimated for a birth year: one cohort effect for when that cohort is between 16 and 24 years old, a second

[10] Increases in participation rates for older people can reflect a number of underlying factors, including increases in life expectancy and the health capacity to work. For example, Coile, Milligan, and Wise (2016) find that older males have an additional health capacity to work of as much as 4.2 years relative to that capacity if the relationship between mortality and employment were as it was in 1977 or of 1.8 years if the mortality-employment relationship was at its 1995 level.

cohort effect for when a cohort is in working ages between 25 and 64 years old, and a third cohort effect for when a cohort is in the traditional retirement years between 65 and 79 years old. Furthermore, the estimated cohort effect for a given cohort in the 25- to 64-year-old range is independent of the estimated cohort effects for the same cohort in either the 16- to 24- or the 65- to 79-year-old range. The 80-or-older groups have too few observations, making it difficult to discern trends in participation among the covariates. For those groups, CBO simply calculates the five-year moving average labor force participation rate over the entire sample period and uses that rate as the projection.

Estimating separate cohort effects for those age subsets gives the model additional flexibility to capture harder to quantify trends that may be causing changes in participation across cohorts at various points in the life cycle. Doing so, for example, reduces the chance of carrying into the projection the lower participation rates from the 16–24 age group that may be more related to a structural decline in participation for those enrolled in school as opposed to a lower desire among the younger cohorts to participate in the labor market throughout their lifetime. Furthermore, that treatment better captures the change in behavior of recent 16- to 24-year-olds through that subset-specific cohort effect and some of the increases in participation rates of people 65 or older that result from hard to quantify reasons such as an increasing desire for individuals to delay retirement across cohorts. [11]

Estimating separate cohort effects for different age subsets, however, is still subject to the concern that the cohorts just entering the system have relatively few observations available to reliably estimate cohort effects. To address that concern, CBO drops the cohort effects for the youngest 10 cohorts within each subset over the sample period and extrapolates those cohort effects from the nearest next-oldest 5 cohorts.[12] Similarly, a lack of data for the oldest cohorts at the beginning of the sample makes the identification of their cohort effects difficult as well.[13] To avoid that identification issue, CBO drops the estimated cohort effects of the oldest 10 cohorts and instead linearly extrapolates those cohort effects from the next-youngest 5 cohorts.

## Model Specifications

The model is specified so that the unit of observation is an age-sex-education-race group in a given quarter. The estimation procedure in all cases uses ordinary least squares with quarterly data from 1984 through 2017.

The model is estimated separately for each sex-education-race subgroup. The exact specification of the model for each of those subgroups differs by age group. The model for 25- through 64-year-olds uses a

[11] Individuals' delaying of retirement is likely the result of a number of factors, some easier to quantify than others. For example, individuals may delay retirement as Social Security's full retirement age increases and payout ratios at different ages change. Those changes in payout ratios are easily quantifiable, so CBO models them in the participation equation for older workers. Other reasons, such as changing social attitudes toward working at older ages, are much harder to quantify and better estimated through a cohort effect.

[12] This follows the convention of Stephanie Aaronson et al. (2014). CBO's approach differs from that one, however, in that it only models separate cohort effects for three age subsets and drops the youngest and oldest 15 cohorts of those groups, whereas Stephanie Aaronson et al. (2014) models cohort effects for all people ages 16 or older but drops the youngest and oldest 10 cohorts. There is no clear consensus in the literature on how to handle the cohort effects for the youngest and oldest cohorts. Daniel Aaronson et al. (2014), for example, does not drop any of the estimated cohort effects.

[13] For example, the cohort born in 1908 has only a few observations in a sample beginning in 1984.

system of 9 equations, one for each of the 9 age groups in a sex-education-race subgroup. Those equations include cohort effects that are constrained to take the same value for all equations within each system. The base specification for each of those equations has the log of the average labor force participation rate of an age group during a calendar quarter explained by the following sets of variables:

- An indicator for the age group;
- Cohort fixed effects, which indicate whether people with a particular year of birth are in the age group during the calendar quarter and which are scaled by the number of single-year ages within each age group;
- Structural variables including measures of disability status, marital status, presence of young children, and other factors that vary over time; and
- Measures of the business cycle that vary over time—specifically a four-quarter lagged moving average of the aggregate unemployment rate gap in the contemporaneous quarter and that gap four and eight quarters earlier.[14]

The scaling by the number of single-year ages for the cohort effects is used because each age group includes individuals from multiple cohorts in any year. For example, the 30- to 34-year-old group contains individuals from 5 cohorts, and the 60- to 61-year-old group contains individuals from 2 cohorts. To account for the multiple cohorts, CBO scales the estimated birth cohorts by one-fifth in the first case and by one-half in the second case.

The equations for 16- to 24-year-olds and for 65- to 79-year-olds are each estimated as separate systems that have the same structure as those for 25- to 64-year-olds. For 16- to 24-year-olds, the system has three equations for the three age groups in each sex-education-race subgroup, whereas the system for 65-to 79-year-olds has two equations for the two age groups in each sex-education-race subgroup.

For people 80 or older, the model estimates their labor force participation rate using the historical five-year moving average for each sex-education-race subgroup and holds that average constant for the projection.

Furthermore, some subgroups, while having survey respondents in each period of the sample, routinely have so few respondents that it is hard to get reliable calculations of those subgroups' participation rates in any given period, and the calculated participation rates of those less populated groups can fluctuate drastically from quarter to quarter. That noise can be problematic for obtaining reliable coefficient estimates that are useful for projections. However, simple averages of the participation rates of those subgroups over time may help reduce the noise in those rates and provide more reliable estimates than estimating them within the system. Thus, to avoid any issues that noise from those less populated subgroups can create in estimating the system of equations, CBO removes those groups from the system and simply estimates each group's labor force participation rate using that group's historical five-year moving average and holds that average constant for the projection.[15]

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[14] The unemployment rate gap is defined as the difference between the quarterly average of the observed U-3 unemployment rate as reported by the Bureau of Labor Statistics minus CBO's estimate of the natural rate of unemployment—that is, the rate of unemployment that would occur if the economy were at its maximum sustainable level of output.

[15] To determine which groups' participation rates are too noisy to include in the system, CBO subtracts each subgroup's observed participation rate for a particular quarter from its 10-year centered moving average. CBO then calculates the standard deviation of

Finally, it is important to note that educational attainment is not strictly exogenous to the system in the same way as age, sex, and race—that is, the level of educational attainment is a choice variable that individuals can change in response to such developments as changes in the economy. For example, changing industry structure or cyclical fluctuations in output may spur some individuals to pursue more education with hopes of improving their labor market prospects; that adjustment would change the shares of people with different levels of education. That choice is not explicitly included in the model.

**Table 2. Explanatory Variables Included in Each Age-Sex-Education-Race Equation**

| Explanatory Variables | Included in: |
|---|---|
| Birth-Year Cohort Effects | Ages 16 to 79, Males and Females, All Education Levels, All Race Categories |
| Social Security Disability Insurance | Ages 18 to 64, Males and Females, All Education Levels, All Race Categories |
| Social Security Payout Rate | Ages 62 to 79, Males and Females, All Education Levels, All Race Categories |
| Family Structure: | |
| Married Males | Ages 18 to 79, Males, All Education Levels, All Race Categories |
| Married Females with Young Children | Ages 18 to 54, Females, All Education Levels, All Race Categories |
| Not Married Females with Young Children | Ages 18 to 54, Females, All Education Levels, All Race Categories |
| Married Females without Young Children | Ages 18 to 79, Females, All Education Levels, All Race Categories |
| School Enrollment | Ages 16 to 24, Males and Females, All Education Levels, All Race Categories |
| Real Wage | Ages 16 to 79, Males and Females, All Education Levels, All Race Categories |
| Minimum Wage-Median Wage Ratio | Ages 16 to 24, Males and Females, All Education Levels, All Race Categories; Ages 25 to 79, Males and Females, Some College or Less, All Race Categories |
| Federal Fiscal Policy* | Males and Females, Ages 16 to 64, All Education Levels, All Race Categories |
| Cyclical Variables | All Age-Sex-Education-Race Equations** |

Source: Congressional Budget Office.
*The federal fiscal policy effect is not an explanatory variable. Rather, it is an estimate of the labor supply effects of fiscal policy (including the Affordable Care Act and P.L. 115-97) calculated outside of the model that is added on to the estimates of the labor force participation rates after the model is estimated. For a more detailed discussion, please see the text.
**This table refers to estimated equations and does not reference the few subgroups that are not estimated but instead have their predicted observed and potential values set equal to the historical sample average.

## Population by Age, Sex, Education, and Race

CBO tabulates historical population levels for each age-sex-education-race subgroup using the CPS basic monthly files. To calculate quarterly population levels for those groups, CBO simply averages the monthly values for each group across the months in each quarter. The sum of the population levels across all groups equals the total civilian noninstitutionalized population for all individuals 16 years or older.

CBO projects population using a starting population by single year of age and sex. CBO uses its own projections of mortality, fertility, immigration, and emigration rates to project that starting population.

that de-trended series for each group, ranks each group by standard deviation from smallest to largest, and removes the groups in the upper fifth percentile of that ranking from the estimated system.

More specifically, the population of any given age and sex this year equals last year's population for that group minus the number of deaths plus the net number of immigrants.[16]

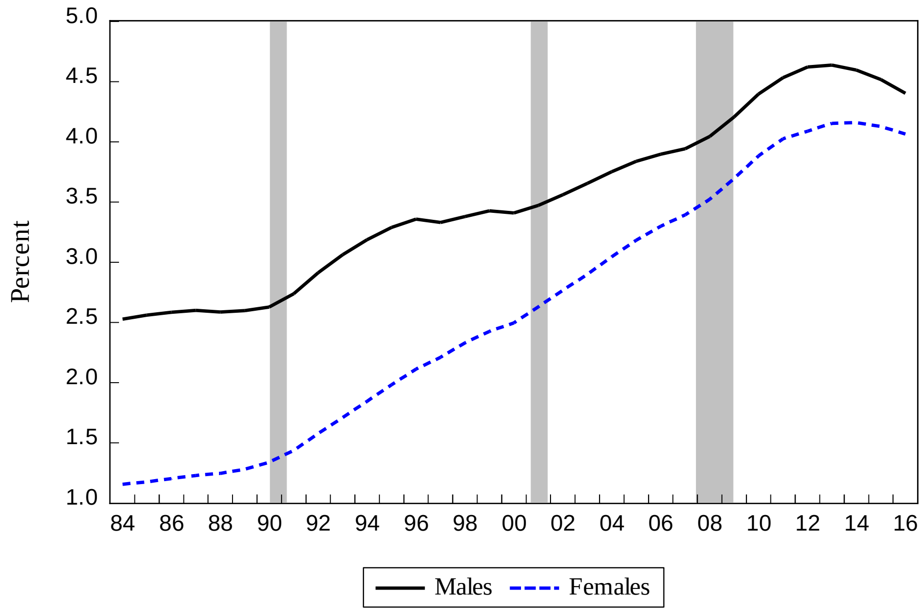
CBO projects educational attainment using the methodology of Aaronson and Sullivan (2001). That method estimates birth cohort trends in each of the five levels of educational attainment for each sex-race group used in this analysis. That method also estimates an age effect that is constant across birth cohorts but differs by sex and race.

CBO uses projections of the racial-ethnic composition of the population by sex and age from the U.S. Census Bureau (2014).

## Structural Variables

CBO includes a number of additional covariates in each equation to help explain the apparent structural changes in the labor force participation rates. Because some variables are likely to affect only certain subgroups, not all structural variables enter each equation (see Table 2). All historical values for the structural variables are calculated from the CPS micro data files unless otherwise noted.

**Figure 7. Disability Insurance Take-Up Rate, by Sex, for People Ages 18 to 64**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey and the Social Security Administration's data on disability caseloads.

*Social Security Disability Insurance.* Federal Social Security Disability Insurance (SSDI) provides a means of income replacement for those people deemed physically or mentally unable to work and thus reduces the incentive for eligible individuals to participate in the labor market. Furthermore, because the income-replacement rate for any potentially eligible individual is proportional to that individual's wage

[16] For more information about CBO's demographic projections, see Appendix A of *The 2017 Long-Term Budget Outlook* (March 2017), www.cbo.gov/publication/52480.

history and scaled to the economywide rate of average wage growth, individuals with low wages have much higher replacement rates than their higher wage counterparts.[17] As a result, the incentive to forgo paid employment and collect disability benefits is higher for less educated workers.

The share of people ages 18 through 64 receiving disability insurance benefits has trended upward over time (see Figure 7). Thus, CBO includes the fraction of individuals of those ages receiving SSDI for each age-sex-education-race subgroup.[18] Data on SSDI caseloads by age and sex come from the Social Security Administration. To calculate disability insurance take-up rates by age-sex-education-race, CBO multiplies the education-race shares calculated for each age-sex group in the CPS by the level of disability caseloads in the Social Security Administration's data to arrive at estimates of disability caseloads for each age-sex-education-race subgroup.

For the forecast period, CBO projects SSDI caseloads by age and sex based on CBO's projections of population growth and past trends in SSDI receipt. To calculate projections by age-sex-education-race, CBO extrapolates the education-race distribution within each of those subgroups from the distribution over the past 10 years.

*Social Security Primary Insurance Amount Payout Ratio*. CBO includes the Primary Insurance Amount (PIA) associated with Old Age and Survivors Insurance (OASI)—that is, the Social Security payout rate—for all sex-education-race groups of people ages 62 through 79. As shown in Figure 6, retirement rates increase rapidly once people are in their early 60s and continue that rapid increase through people's late 60s. Those retirement decisions are influenced by workers' eligibility to collect Social Security benefits and by the generosity of those benefits. The payout rate depends on a person's age when he or she retires. At the full retirement age, an individual can receive a full benefit amount.[19] Individuals can start collecting OASI at age 62 by claiming early retirement, but individuals who do so (claiming from age 62 up until the full retirement age) receive less than the full benefit amount. Conversely, individuals can delay retirement past the full retirement age and receive a benefit greater than the amount available at the full retirement age.

To calculate this variable, CBO includes the weighted average payout rate an individual would receive if he or she retired in a given age group each year, where the weight in each age group is the fraction of the total age group population that is a given age.[20] The projection of this variable is set equal to the Social Security payout rate schedule under current law.

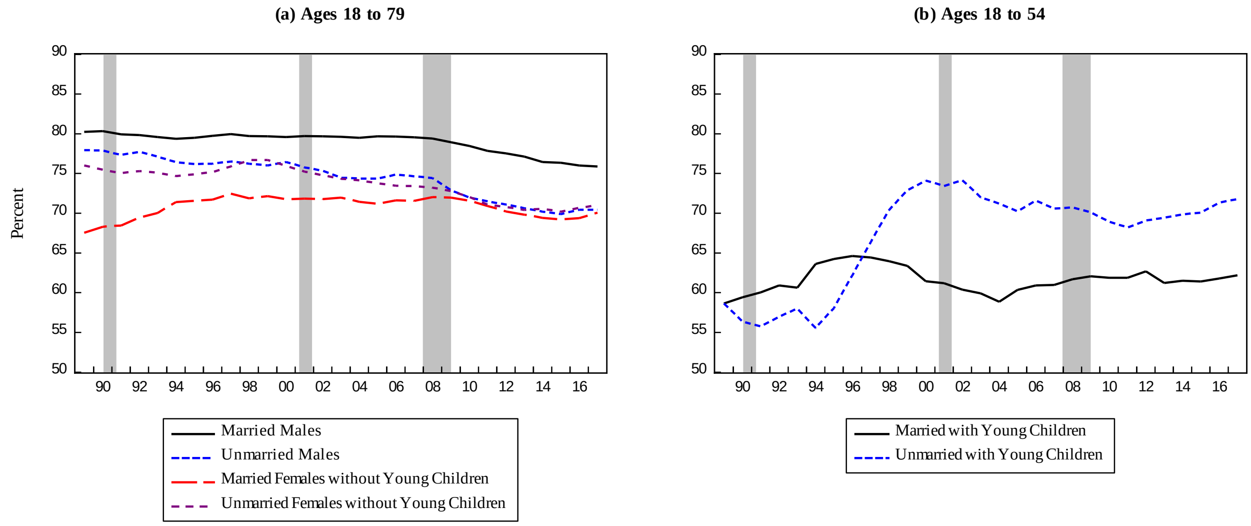
[17] For more details, see Autor and Duggan (2003) and Autor and Duggan (2006).

[18] Since 2003, age 65 is the maximum age at which an individual can collect disability insurance before being converted to retired worker status (at which point the individual is eligible to receive old-age insurance). Before 2003, eligibility for old-age insurance began at age 65 and eligibility for disability insurance ended at age 64.

[19] The full retirement age is 65 for people born in 1937 or earlier; it gradually increases to 67 for people born in 1960 or later.

[20] For example, the payout rate for the 62- through 64-year-old age group for a given year is calculated as the weighted average of the payout rates of 62-, 63-, and 64-year-olds in that year, where the respective weights are the 62-, 63-, and 64-year-olds' share of the total 62- through 64-year-old population.

**Figure 8. Labor Force Participation Rates, by Family Structure**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

*Family Structure.* The impact of family structure on labor force participation varies by sex. Because married males participate at higher rates than unmarried males, CBO includes one covariate for the fraction of married males in the equations for males 18- to 79-years-old (see panel (a) of Figure 8). Because observed participation rates dip for females at ages when it is most likely for a female to have a young child present in the household, CBO includes a covariate for the fraction of females ages 18 to 79 who are married without a child 5 years old or younger present in the household. As Stephanie Aaronson et al. (2014) point out, the labor force participation rates for females with young children appear to differ depending on whether the female is married or not (see panel (b) of Figure 8); to account for the association between participation and the presence of young children, CBO follows their convention and includes covariates for the fraction of females who are married and have a child 5 years old or younger and the fraction of females who are unmarried with a child 5 years old or younger.[21] CBO includes the two variables that indicate the presence of a young child for 18- to 54-year-old females.[22]

CBO forecasts the family structure variables as part of its long-term microsimulation model used in its long-term budget outlook. For more details, see Appendix A in Congressional Budget Office (2017).

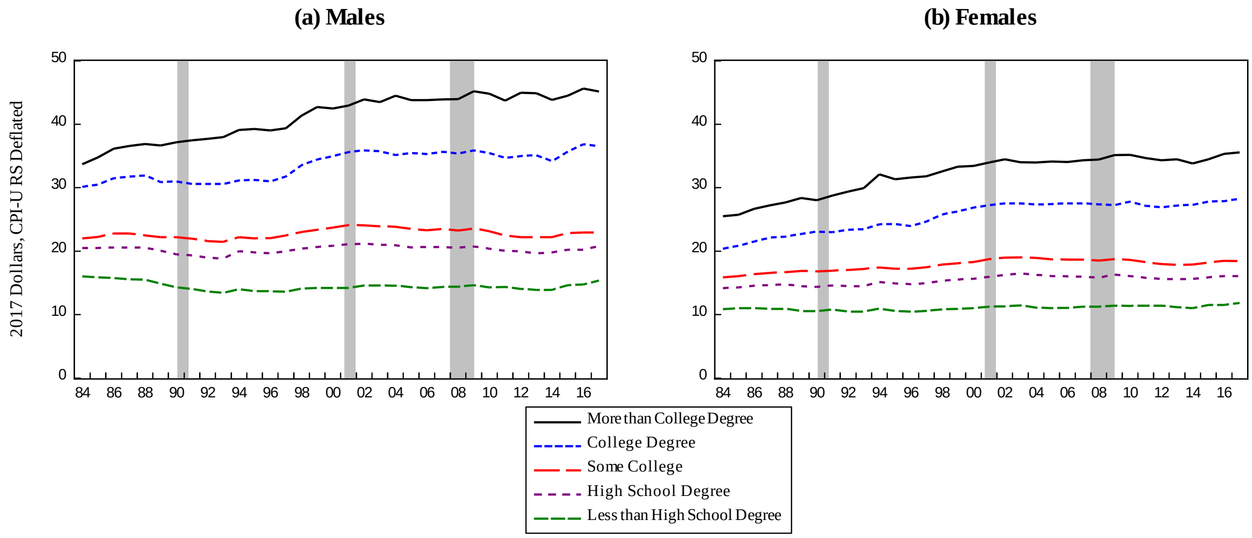
*School Enrollment.* CBO includes the fraction of each subgroup's population that is currently enrolled in a high school or a college/university for males and females ages 16 through 24. CBO only includes school enrollment for the younger ages because younger individuals are much more likely to be enrolled in

[21] In particular, participation rates since 2000 for females who are unmarried with young children have been about 10 percentage points higher, on average, than rates for females who are married with young children.

[22] In the middle of the 1990s, the labor force participation rate of unmarried females between the ages of 18 and 54 with young children grew substantially, surpassing the labor force participation rate of married females with young children. Those increases were largely because of the 1993 expansion of the earned income tax credit (EITC), which provides wage subsidies to the lowest income workers, and enactment of the Personal Responsibility and Work Opportunity Reconciliation Act in 1996, which increased the incentives for unmarried parents with children to work. For more on how expansions of the EITC and other welfare reforms of the 1990s affected labor supply and employment, see, for example, Dickert, Houser, and Scholz (1995), Meyer and Rosenbaum (2001), Ellwood (2000), and Grogger (2003).

school than older individuals and to have their enrollment decisions affect their labor force participation.[23] Although enrollment rates increased significantly since 2000, nearly all of the increase occurred through 2012. Since the end of the most recent recession, the trend in school enrollment has been flat. Thus, for the forecast period, CBO holds enrollment rates constant at their last observed value.

**Figure 9. Real Average Hourly Wages, by Workers' Sex and Educational Attainment**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey. Nominal wages are deflated using the research series for the consumer price index for all urban consumers (CPI-U RS).

*Real Hourly Wage*. Long-run shifts in the demand for workers of different education levels may also cause changes in the number of people supplying labor, with increases in the demand for workers with certain levels of education potentially boosting the participation of those groups and decreases in the demand for workers with other levels of education reducing the participation of those groups. All else being equal, changes in participation of a particular group that stem from long-run shifts in the demand for that group's labor should be reflected in corresponding changes in its real (inflation-adjusted) wage rate over time: Real wages should fall in response to a reduction in the demand for a group's labor (increasing the opportunity cost of nonwork activities, thus reducing the amount of labor supplied) and rise in response to an increase in demand (thus increasing the supply of labor). Indeed, real average hourly wages (in 2017 dollars) for the least educated males either fell or stagnated over the past 35 years, whereas real wages for the most educated males (college degree holders or more) increased by more than 30 percent (see Figure 9). Thus, movements in real wages by education level provide suggestive evidence of shifts in the long-run labor demand for those groups.[24]

[23] School enrollment rates have been increasing among 20- to 24-year-olds over the past 15 years. That increase, coupled with the continued increase in the proportion of the population with more than a college degree, suggests that school enrollment rates and their effect on the labor force participation decision may be becoming more meaningful for people older than 24. Unfortunately, for respondents ages 25 through 54, the CPS did not start asking until 2013 whether a respondent is currently enrolled in school. Before 2013, the survey response was limited to 16- through 24-year-olds.

[24] Research has focused on technological change as the key long-run driver decreasing the demand for less educated workers. To the extent that educational attainment is associated with job-related skill, improving technology has increased the relative return of high-skilled to low-skilled labor, thus reducing the demand for low-skilled workers and increasing the demand for high-skilled

CBO includes the log average real hourly wage earned by each age-sex-education-race group as calculated in the CPS outgoing rotation group files, converted to 2017 dollars using the research series for the consumer price index for all urban consumers (CPI-U). These variables are meant to proxy for the relative demand shocks for workers of different education or skill levels and capture the incentive to work.

CBO projects the average real hourly wage rate for each age-sex-education-race subgroup using a model similar to that of Card and Lemieux (2001). Variation in the supply of hours by skill and age groups and of relative wage rates are used to estimate two substitution parameters of an aggregate production function and a trend growth in relative demand. Card and Lemieux assumed a fixed relative efficiency of, for example, education and sex groups within skill levels. CBO's variation of their model allowed these relative efficiencies to continue.

*Minimum Wage.* Changes in the real minimum wage may affect labor force participation by increasing or decreasing the opportunity cost of nonparticipation, particularly for groups with lower wages.[25] Thus, CBO includes the ratio of the effective minimum wage to the median level of hourly earnings for all 16- to 24-year-old subgroups and for the 25-or-older subgroups with education levels of some college or less. The effective minimum wage is calculated as a population-weighted average of the state-level effective minimum wage, where the effective state-level minimum wage is the maximum between the federally mandated minimum wage and the state-level minimum wage. CBO accounts for future changes in state minimum wages that are already written into law in the projection of the effective minimum wage.

## Business Cycle Variables

To quantify participation rates' comovement with the business cycle, CBO uses the aggregate unemployment gap, which is the difference between the observed unemployment rate and CBO's estimate of the natural rate of unemployment. A positive unemployment gap signifies a cyclically weak labor market, whereas a negative unemployment gap signifies a cyclically strong labor market. To allow the

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workers as reflected in the relative wages of those workers (Katz and Murphy, 1992). Those declining economic opportunities for less educated workers, as evidenced through stagnating real wages, have reduced the incentive for those groups (particularly males) to participate in the labor market (Juhn, 1992).

More recently, technological change in the form of automation has reduced the demand for workers performing routine tasks that follow clear rules and can easily be computerized (Autor, Levy, and Murnane, 2003; Acemoglu and Autor, 2011). Routine jobs include manual jobs such as factory workers operating machines but also more cognitive, white-collar jobs such as bookkeeping that have historically been in the middle of the skill distribution. Thus, automation substitutes for workers with those skills. At the same time, automation tends to complement workers performing less routine and more complex tasks that require creativity, problem solving, and communication skills. Less routine jobs include professional and management occupations, which have historically been on the high end of the skill distribution, but also service occupations that have historically been on the lower end of the skill distribution. This "job polarization" has further increased the relative demand for more educated workers and decreased the relative return of less educated workers. For the less educated, this may result in an increase in nonemployment or nonparticipation of these workers or a reallocation into low-wage jobs (Cortes, Jaimovich, and Siu, 2017). In addition, there is evidence that job polarization speeds up during recessions (Jaimovich and Siu, 2012; Hershbein and Kahn, 2016), which is consistent with the observed pattern that the long-term fall in participation rates of less educated males is concentrated during and immediately after recessions.

[25] For example, a higher real minimum wage, all else being equal, increases the opportunity cost of leisure relative to work, thus encouraging more people to seek work. However, increases in the real minimum wage may also make it more costly for firms to employ workers, thus reducing the likelihood that a person seeking work finds a job (translating to higher unemployment). This model does not account for possible changes in unemployment from changes in the real minimum wage.

labor force participation rate to respond asymmetrically to positive and negative unemployment gaps, the model includes two variables: the unemployment gap multiplied by an indicator for a positive gap (that is, for a slack labor market) and the unemployment gap multiplied by an indicator for a negative gap (that is, for a tight labor market). In addition to the contemporaneous values of the positive and negative unemployment gaps, CBO also includes lags of those variables at 4 and 8 quarters in each equation to capture the dynamic response of participation to business cycle fluctuations. Finally, to capture the information between the contemporaneous quarter and quarters 4 and 8, CBO uses four-quarter moving averages of those terms. The forecast for the unemployment gap is taken from CBO's latest 10-year macroeconomic forecast.[26]

## Estimation Results and a 10-Year Forecast

This section discusses the results of the estimation and presents the model's forecasts of the actual and potential labor force participation rates for the working-age and prime-working-age populations. The estimation results show how well the model explains historical values of the aggregate participation rate and how much each factor in the model contributes to the model's explanation.

The forecasts in this paper will not appear in CBO's forthcoming economic projections, to be published in April 2018.[27] Those projections will be based on a previous version of this model. However, the model presented in this paper is similar to that previous version and is expected to be very similar to that used as the basis of CBO's next labor force participation rate projections.

The projections produced by the model show the labor force participation rate for individuals at least 16 years old continuing its trend decline from the past two decades, falling from an average rate of 62.8 percent in 2017 to 60.1 percent in 2028. The trend decline in the observed participation rate, though, is not expected to resume until after 2019. Over the next few years, the observed rate is projected to remain roughly constant, as it has over the past four years. That temporary constant rate reflects the balancing of cyclical factors that are pushing the rate up and long-term structural factors that are pushing the rate down.

The aging of the population is the most significant structural factor causing the decline in the aggregate participation rate over recent history and for the coming decade, although other structural factors, such as cohort effects and increases in disability rates, play a role, too. The results also show that cyclical effects stemming from the 2007–2009 recession led to a large decline in the participation rate over the past decade, though the cyclical decline from the recession has largely abated and is now putting upward pressure on that rate.

CBO also projects that the long-term declines in participation rates among the less educated are likely to continue over the next decade. CBO expects, however, that populationwide increases in educational attainment will mitigate the effect of those declines on the aggregate participation rate.

[26] See Congressional Budget Office (2017).

[27] See Congressional Budget Office (forthcoming).

## Estimation Results: Historical Fit of the Labor Force Participation Rate

Although there are too many equations to present summary statistics for each one, the overall fit of the model, as reflected in the mean absolute and root mean square errors of the participation rate for people who are at least 16 years old is close, but the fit does vary over subsamples (see the first two columns of results in Table 3). For example, the mean absolute error is about 0.2 and the root mean square error is about 0.3 for the entire sample period, but the estimated rate best fits the data from 2001 through the middle of 2007, when the mean absolute error was about 0.1 and the root mean square error was about 0.2. The mean absolute error is larger in the subsamples from the middle of 1990 through the end of 2000 and from the end of 2007 through the end of 2017, whereas the root mean square error is larger over the first half of the sample.

**Table 3. Model Fit: Mean Absolute Error and Root Mean Square Error**

| | Population at least 16 Years Old | | Population 25 to 54 Years Old | |
|---|---|---|---|---|
| | Mean Absolute Error | Root Mean Square Error | Mean Absolute Error | Root Mean Square Error |
| *Sample Period* | | | | |
| 1984q1-2017q4 | 0.22 | 0.29 | 0.22 | 0.28 |
| 1984q1-1990q2 | 0.18 | 0.30 | 0.14 | 0.17 |
| 1990q3-2000q4 | 0.32 | 0.36 | 0.28 | 0.34 |
| 2001q1-2007q3 | 0.13 | 0.16 | 0.12 | 0.16 |
| 2007q4-2017q4 | 0.21 | 0.27 | 0.27 | 0.33 |

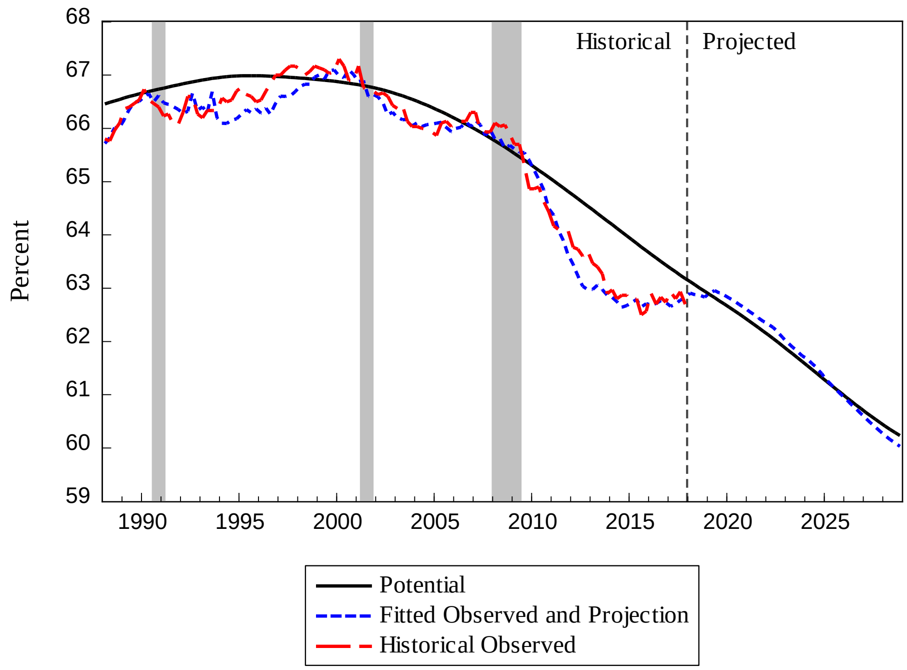
Sources: Congressional Budget Office; author’s calculations.

Subsamples are chosen to coincide with peak-to-peak business cycles. The exception is the first subsample, which starts with the sample at the beginning of 1984 and goes through the end of that cycle in 1990q2.

Another way to measure the performance of the model is to compare its estimate of the participation rate to the observed historical rate. CBO computes the aggregate rate in a given quarter by summing the fitted values for that quarter from each of the model’s 516 groups for that quarter, weighted by that group’s share of the population.

The model fits the historical data well throughout most of history (see Figure 10). Interestingly, comparing the fitted rate with the observed rate in Figure 10 shows that the model fits the data well for most of the period from the end of 2007 through 2017 and that the larger mean absolute and root mean square errors for that period are the result of a larger miss from the middle of 2011 through the middle of 2013. For example, both the model’s fitted values and the observed historical rate are at about 66 percent in the fourth quarter of 2007, and the fitted model nearly mirrors the fall in the observed rate through the second quarter of 2011. From the third quarter of 2011 through the third quarter of 2013, the model *over* predicts the fall in the observed participation rate. Its largest miss over that period is for the fourth quarter of 2012, as it predicts a rate 0.7 percentage points below the observed 63.7 percent. The predicted and observed rates again converge by the fourth quarter of 2013, and the two rates are nearly identical through the end of the sample.

**Figure 10. Aggregate Labor Force Participation Rate**




Sources: Congressional Budget Office; author's calculations using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Before 2007, the model still fits the observed data well, on average, but shows a few periods of prolonged misses. Again, the larger mean absolute and root mean square errors for the period from the middle of 1990 through the end of 2000 is the result of a shorter miss in the middle of that decade rather than a prolonged miss over the entire decade. The most prolonged deviation of the predicted from the observed rate occurs from 1994 through 1998, when the predicted rate stays about 0.4 percentage points below the observed rate. After 1998, the predicted and observed rates converge and are almost identical through 2007, with only small deviations in a few quarters.

## Estimation Results: History and Projection of the Potential Labor Force Participation Rate

The model can be used to compute an estimate of the potential rate of labor force participation, a measure of the participation rate that removes the effects of the business cycle in order to focus on the effect of structural factors.[28] That estimate increases through the middle of the 1990s.[29] The potential rate then starts an uninterrupted fall in the latter half of the 1990s that is projected to continue through at least 2028. That decline results from the aging of the baby-boom generation. Specifically, the start of the decline coincides with the first cohorts of the baby-boom generation turning 50 years old, roughly the age

[28] Mechanically, the potential labor force participation rate for any subgroup is calculated by setting the cyclical terms equal to zero in that group's estimated equation and using only the structural terms to calculate the predicted value. Then, the overall potential labor force participation rate is calculated by taking a weighted sum of each subgroup's potential rate, where the weights are each group's share of the total population.

[29] CBO smooths each subgroup's potential labor force participation rate using a Hodrick-Prescott filter. Once CBO aggregates those smoothed subgroups to the overall potential labor force participation rate, the agency then smooths once more using the HP filter with a smoothing parameter of 1,600.

at which labor force participation rates begin to fall along the age profile, as can be seen in Figure 2. Thus, as many studies have shown, a large part of that fall stems from the aging of the baby boomers out of their working years and into their retirement years.

Over the period from the fourth quarter of 2007 (just before the start of the most recent recession) through 2017, the aggregate potential participation rate—which measures the effect of structural factors, including the aging of the population, on the labor force participation rate—fell by about 2.6 percentage points, from 65.8 percent to 63.2 percent, as shown in Table 4. Males contributed the most to that decline, though the decline was significant for females, too. Moreover, there is considerable heterogeneity in the potential labor force participation rates by subgroups. For example, the potential participation rate for the young (people 16 to 24 years old) fell by 1.8 percentage points from the fourth quarter of 2007 through the fourth quarter of 2017. The potential participation rate for people 65 years or older increased substantially over the past 10 years, by about 3.1 percentage points. Finally, the potential participation rate for prime-age individuals fell by 0.8 percentage points from the end of 2007 through the end of 2017, with the potential rate for prime-age males falling by almost two times as much as the potential rate for prime-age females. The estimates for prime-age people are explored below in more detail.

**Table 4. Changes in the Potential Labor Force Participation Rate, 2007q4-2028q4**

| | | Potential Labor Force Participation Rate | | | | |
|---|---|---|---|---|---|---|
| | | Levels (Percent) | | | Changes (Percentage Points) | |
| | | 2007q4 | 2017q4 | 2028q4 | 2007q4 - 2017q4 | 2017q4 - 2028q4 |
| *16 Years or Older* | Total | 65.8 | 63.2 | 60.2 | -2.6 | -3.0 |
| | Males | 72.7 | 69.3 | 66.4 | -3.4 | -2.9 |
| | Females | 59.5 | 57.5 | 54.5 | -2.0 | -3.0 |
| *16 to 24 Years Old* | Total | 60.0 | 58.2 | 58.2 | -1.8 | 0.1 |
| | Males | 62.1 | 59.9 | 59.9 | -2.3 | 0.0 |
| | Females | 57.8 | 56.5 | 56.5 | -1.3 | 0.0 |
| *25 to 54 Years Old* | Total | 82.9 | 82.0 | 82.3 | -0.8 | 0.3 |
| | Males | 90.2 | 89.1 | 89.3 | -1.1 | 0.2 |
| | Females | 75.8 | 75.2 | 75.6 | -0.6 | 0.4 |
| *55 to 64 Years Old* | Total | 63.8 | 63.8 | 64.0 | 0.1 | 0.2 |
| | Males | 69.4 | 68.3 | 69.0 | -1.1 | 0.7 |
| | Females | 58.5 | 59.7 | 59.4 | 1.2 | -0.3 |
| *65 Years or Older* | Total | 16.1 | 19.2 | 17.2 | 3.1 | -2.1 |
| | Males | 20.8 | 23.9 | 21.7 | 3.2 | -2.2 |
| | Females | 12.7 | 15.4 | 13.3 | 2.7 | -2.1 |

Sources: Congressional Budget Office; author’s calculations using information from the Bureau of Labor Statistics’ and U.S. Census Bureau’s Current Population Survey. The numbers in the table may not sum because of rounding.

The model predicts that, over the next decade, the potential labor force participation rate will continue to fall. In particular, the potential labor force participation rate is expected to reach 60.2 percent by the fourth quarter of 2028, a 3.0 percentage-point fall from its estimated value in the fourth quarter of 2017.

CBO expects both males and females to contribute significantly to that decline. Interestingly, the potential rate for prime-age workers is projected to increase by about 0.3 percentage points over the next decade, with the potential rate for prime-age males increasing by about 0.2 percentage points and the potential rate for prime-age females increasing by 0.4 percentage points. The sources behind these changes in both the overall and prime-age rates are discussed in detail below.

## Estimation Results: Aggregate Labor Force Participation Rate Decomposition

A decomposition of the estimate of the labor force participation rate into its component parts can help shed light on this continued downward pressure on the participation rate. Following the 2007–2009 recession and the subsequent slow recovery, a key question is how much of the fall in participation since 2007 is the result of the aging of the population versus other structural factors. A second key question is how much of the fall is the result of cyclical weakness associated with fluctuations in the business cycle that would disappear as the labor market recovers.[30]

### Decomposition: Structural Factors

The model allows for the decomposition of the change in the potential rate over any given period into the changes from the age, sex, educational attainment, and race distributions, the cohort fixed effects, and the observed structural variables. The estimated potential labor force participation rate is constructed by setting the cyclical terms in the equation equal to zero and then calculating the rate that corresponds only to the structural factors. CBO examines two periods: the fourth quarter of 2007 to the fourth quarter of 2017 (recent history), and the projection period through the end of 2028 (see Table 5).

*Age Distribution.* By far the largest driver of the fall in the potential participation rate since the 2007–2009 recession and over the next decade is the aging of the baby boomers into retirement. That demographic development reduced the aggregate potential participation rate by 2.5 percentage points from the end of 2007 through the end of 2017, all else being equal, and is expected to reduce the aggregate labor force participation rate by an additional 2.8 percentage points over the next decade. That is, the aging and retirement of the baby-boom generation make up 95 percent of the projected 5.6 percentage-point fall in the potential participation rate from the end of 2007 through the end of 2028. For perspective, the next largest driver of the potential participation rate over that period is the changing educational attainment distribution, which is projected to increase the potential participation rate by roughly 1.9 percentage points, or one-third of the magnitude attributed to aging.

*Sex Distribution.* The evolving sex distribution is estimated to have a very small, albeit positive effect on the potential participation rate—roughly 0.1 percentage point over the past 10 years and another 0.1 percentage point over the next 10 years. This quantitatively small effect is not surprising, though, as the male share of the civilian noninstitutionalized population has increased slightly over recent history and is

[30] Relatedly, Abraham and Kearney (2018) examine why the overall employment-to-population ratio declined between 1999 and 2016, studying many of the same dimensions as this paper does on the labor force participation rate. They highlight the importance of aging in contributing to the decline in the employment-to-population ratio, but also the importance of within-age-group declines. Their review of the evidence suggests the most significant factors are changes in the labor demand for certain skill groups because of exposure to international trade and increases in the use of robotics in production. They also find that increases in participation in disability insurance programs played a smaller but nontrivial role.

projected to continue that trend into the next decade.[31] Because males have higher potential rates of participation in history relative to females and are projected to continue having higher rates than females, this compositional change increases the overall potential labor force participation rate.

*Educational Attainment Distribution.* The educational attainment distribution is estimated to have increased the potential participation rate by 0.9 percentage points from 2007 through the end of 2018 and is projected to continue increasing the potential labor force participation rate by an additional 1.0 percentage point through 2028. The increase in educational attainment has largely been driven by an increase in the proportion of the population attaining bachelor's degrees, and CBO expects that trend to continue over the projection period. Together, the changing age and educational attainment distribution contributed toward a net 1.6 percentage-point decline in the potential participation rate since 2007 and is expected to contribute toward a further net 1.8 percentage-point decline in the aggregate participation rate over the projection period.

**Table 5. Decomposing the Change in the Potential Labor Force Participation Rate, 2007q4-2028q4**

| | Contribution to Change (Percentage Points): | |
|---|---|---|
| | History | Projection |
| Explanatory Variables | 2007q4 → 2017q4 | 2017q4 → 2028q4 |
| Age Distribution | -2.5 | -2.8 |
| Sex Distribution | 0.1 | 0.1 |
| Educational Attainment Distribution | 0.9 | 1.0 |
| Race/Ethnicity Distribution | -0.1 | -0.1 |
| Birth-Year Cohort Effects | -0.4 | -0.4 |
| Disability | -0.3 | -0.1 |
| PIA Ratio | -0.1 | -0.3 |
| Married Males | -0.3 | -0.1 |
| Married Females with Young Children | 0.1 | 0.0 |
| Not Married Females with Young Children | 0.0 | 0.0 |
| Married Females without Young Children | 0.1 | 0.0 |
| School Enrollment | -0.1 | 0.0 |
| Real Wage | 0.0 | -0.1 |
| Minimum Wage-Median Wage Ratio | 0.0 | 0.0 |
| Federal Fiscal Policy | -0.3 | 0.0 |
| Interaction Residual | 0.3 | -0.1 |
| Total Change | -2.6 | -3.0 |

Sources: Congressional Budget Office; author's calculations using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

*Race/Ethnicity Distribution.* The evolution of the race and ethnicity distribution is estimated to have contributed to a small decline of about 0.1 percentage point in the overall potential labor force participation rate over the past 10 years. Over the next 10 years, the further evolution of that distribution is projected to lower the potential participation rate by another 0.1 percentage point. These small effects are the counterbalancing of two trends within the distribution. Among males, the share of Hispanics has

[31] The share of the civilian noninstitutionalized population that is male has been rising since the 1980s, which is probably driven by changes in the mortality rates for men and women. Since 1950, males and females have had similar average improvement in mortality rates. Rates for females, however, improved earlier in that period (before 1980), and rates for males improved later in the period (after 1980). That is largely because of smoking, which males tended to take up earlier and quit somewhat earlier.

increased and is expected to continue to increase while the share of whites has decreased and is expected to continue to decline. Because Hispanic males participate at higher rates than any other racial/ethnic group, a composition shift from white to Hispanic males raises the overall participation rate. This change in composition toward a higher share of Hispanics is similar for females. However, Hispanic females have historically participated at lower rates than white females, so this compositional change puts downward pressure on the overall participation rate. These changes together largely balance each other out.

*Cohort Effects.* The cohort effects are meant to capture any nonobservable factors that may increase or decrease an individual's likelihood to participate in the labor market throughout that individual's life and are interpreted as a measure of a cohort's attachment to the labor force, relative to that of older and younger generations. The cohort effects contribute to changes in the potential participation rate over time as older cohorts leave the labor force and new, young cohorts enter the labor force. The estimated cohort effects reduce the aggregate potential labor force participation rate, both in recent history and over the projection. The model estimates that from the end of 2007 through 2017 the cohort effects reduced the potential participation rate by 0.4 percentage points and are projected to further reduce the potential participation rate by another 0.4 percentage points through 2028. The age profiles of the labor force participation rate by birth-year cohort shown in Figure 4 foreshadow these results. The cohort profiles for females shifted up significantly through the 1945-to-1959 cohort before leveling off with each subsequent generation. Participation rates for males through about age 65, on the other hand, fell with each cohort.

*Disability*. Increasing disability insurance caseloads considerably reduced the potential labor force participation rate since the end of 2007, though that trend is projected to slow some over the projection. In particular, increases in disability insurance caseloads reduced the potential participation rate by 0.3 percentage points over the past 10 years and are expected to reduce the participation rate by an additional 0.1 percentage point by 2028. That fall in the participation rate from increases in disability is largely concentrated among the less educated and continues a trend that started around 2005.

*Social Security Primary Insurance Amount Payout Ratio.* The model's estimates imply that changes in the PIA payout ratio reduced the overall participation rate by 0.1 percentage point over the past 10 years. In addition, the model predicts that further changes in the payout ratio will lower the aggregate potential participation rate by 0.3 percentage points from 2018 through the end of 2028. The payout ratio varies by single-year age groups, and changes in the ratio, if any, tend to provide a lower benefit for a given age over time. The model, however, estimates participation rates for broader age groups. Although payout ratios within single-year ages tend to decline over time (if they change at all), it is possible for age group payout ratios to increase over time if the population within those groups shifts toward ages with higher payout ratios.

The decline over the projection follows from the aging of the population within the age groups for people 62 or older. That aging increases the average payout ratio for many of those groups. An increasing payout ratio increases the incentive for an individual to retire, thus lowering the participation rate.

*Family Structure.* The number of married males as a share of the male population decreased since the end of 2007 and is expected to continue decreasing over the next decade, though at a slower pace. Because married males have higher participation rates than unmarried males, this change in composition places downward pressure on the labor force participation rate. In particular, the decreasing share of married males reduced the potential participation rate by 0.3 percentage points over recent history and is projected to reduce the potential participation rate by an additional 0.1 percentage point by 2028, as the pace of the decline in the share of married males slows.

Conversely, the decline in the fraction of females who are married with young children has boosted the potential participation rate in recent history. Married females with young children have lower rates of labor force participation than do other females. A decreasing share of married females with young children raised the potential participation rate by 0.1 percentage point since the end of 2007. Over the projection period, the share of married females with young children is expected to change little; therefore, this factor is expected to have little effect on the potential participation rate. The share of females who are married without young children has also boosted the potential participation rate by about 0.1 percentage point in recent history, but that share has a negligible effect over the projection. The share of females who are unmarried with young children has modest effects on the potential participation rate both in recent history and over the projection.

*School Enrollment.* Increases in school enrollment since the 2007–2009 recession are associated with significant reductions in the participation rates of people ages 16 through 24. Since 16- to 24-year-olds make up a relatively small share of the population, the large reduction in participation of the young associated with increases in school enrollment translates to a relatively small reduction in the aggregate rate. Since 2007, increases in school enrollment are estimated to have reduced the aggregate potential rate by 0.1 percentage point. Over the projection period, the school enrollment rate is expected to change little and does not contribute meaningfully toward changing the aggregate rate.

*Real Hourly Wage.* Changes in the log real hourly wage by group have had negligible effects on the potential participation rate since 2007 but are projected to lower it by 0.1 percentage point through 2028. Because log real hourly wages are included as a proxy for shifts in the relative demand for workers with different levels of education, the declines in participation from changing log real hourly wages are concentrated, not surprisingly, among workers with less education.

*Minimum Wage to Median Wage Ratio.* Changes in the real minimum wage to median wage ratio are estimated to have negligible effects on the overall potential participation rate in both recent history and over the projection.

*Federal Fiscal Policy.* CBO estimates that federal fiscal policy, on net, lowers the projected potential labor force participation rate by reducing the incentives to work. An important impact of federal fiscal policy on labor force participation comes from various provisions in the Affordable Care Act (ACA). The ACA raises effective tax rates on earnings—workers with higher earnings receive fewer subsidies in the health care marketplaces—and thus reduces the amount of labor that some workers choose to supply.[32] CBO estimates that those provisions have reduced the potential labor force participation rate by roughly

[32] The mechanisms driving the labor supply effect are summed up on page 33 of Congressional Budget Office, *An Update to the Budget and Economic Outlook: 2015 to* 2025 (January 2015), www.cbo.gov/publication/50724: “That effect occurs partly because the health insurance subsidies that the act provides through the expansion of Medicaid and the exchanges are phased out for people with higher income, creating an implicit tax on the additional earnings of some people, and partly because the act directly imposes higher taxes on the labor income of other people.” For more on how CBO estimates the effects of fiscal policy on labor supply, please see Edward Harris and Shannon Mok, *How CBO Estimates the Effects of the Affordable Care Act on the Labor Market*, Working Paper 2015-09 (Congressional Budget Office, December 2015), www.cbo.gov/publication/51065.

0.3 percentage points since 2007. However, CBO estimates that most of the effects of the ACA on participation have already taken place and, as a result, expects any further effects to be small over the projection.

In addition to the ACA, other forms of fiscal policy affect individuals' willingness to supply labor. In particular, the recently enacted Public Law 115-97 (originally called the Tax Cuts and Jobs Act) lowers effective marginal tax rates, motivating individuals to increase their supply of labor. Furthermore, P.L. 115-97 eliminated penalties associated with the ACA's mandate that people obtain health insurance, thus reducing some of the effects of the ACA on the labor force participation rate. Altogether, the various provisions of P.L. 115-97 increase the potential participation rate by as much as 0.3 percentage points from 2021 through 2025 in CBO's estimates. However, many of the provisions of P.L. 115-97 are scheduled to expire starting in 2025, and as a result, the increase in potential participation from that legislation will dissipate. On net, the change in the potential participation rate from the end of 2017 through the end of 2028 is estimated to be positive but slight.

The effects of fiscal policy on labor force participation are not estimated directly in this model. Rather, the effects are estimated outside of the model and then added to the model's projection. CBO attributes the ACA's effects on labor supply to individuals ages 16 through 64 and allocates them among the age-sex-education-race subgroups in the model.[33] Specifically, the agency calculates the average uninsured shares of each age-sex-education-race subgroup as a fraction of the 16-to-64 population from 2000 through 2009. CBO applies those average, historical uninsured shares to the total level change in the labor force resulting from the ACA to arrive at the total change for each age-sex-education-race subgroup of the population. That results in the effects of the ACA on the labor force participation rate being disproportionately concentrated among the young, those in the early retirement years (55 to 64), and those in the prime working years with lower levels of educational attainment.

To attribute the effects of P.L. 115-97 to the various subgroups of the model, CBO apportions them according to each subgroup's share of the population ages 16 through 64.

*Interaction Residual.* To separate changes in the aggregate potential labor force participation rate into changes from the evolving age, sex, education, and race distributions and from changes in group-specific participation rates, CBO uses a shift-share analysis. However, the sum of the changes to the aggregate labor force participation rate stemming from changes in age, sex, educational attainment, race, cohort effects, and the structural variables in the model do not equal the change in the overall participation rate. The difference (or residual) arises because of interactions between changes in the distributions (that is, the share of people of a given age, sex, educational attainment, and race) and the group rates (which are determined by the cohort effects and the structural variables in the model).[34] Since the end of 2007, these

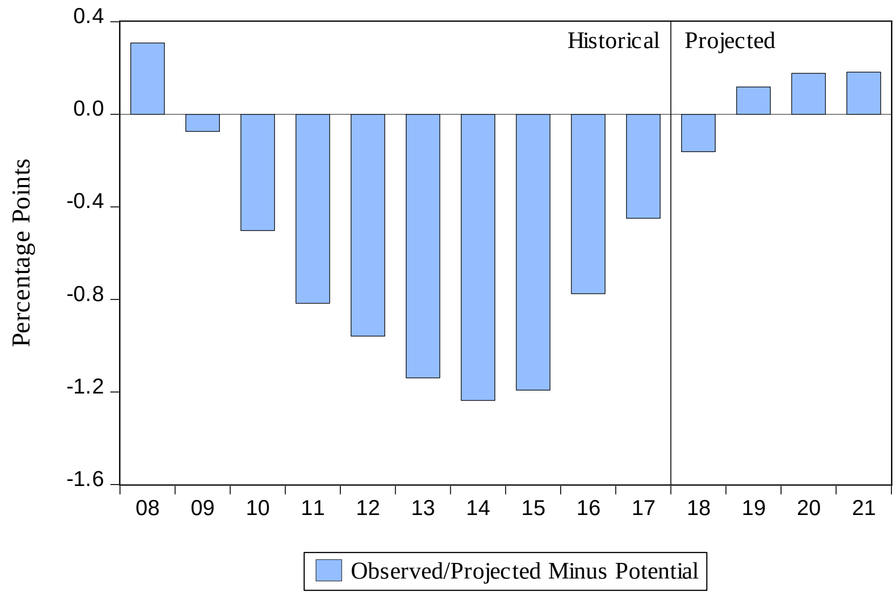
[33] At age 65, individuals become eligible for Medicare.

[34] In particular, a simple shift-share decomposition of the change in the aggregate labor force participation rate at time $t$ relative to fixed reference date in history, time $0$, takes the following form:

$$LFPR_t - LFPR_0 = \sum_g s_0^g \left(lfpr_t^g - lfpr_0^g\right) + \sum_g lfpr_0^g \left(s_t^g - s_0^g\right)$$

interactions are estimated to have increased the aggregate rate by 0.3 percentage points. Over the projection, CBO estimates those effects to be much smaller and slightly negative, reducing the potential participation rate by about 0.1 percentage point.

**Figure 11. Labor Force Participation Rate Cyclical Gap, 2008 to 2021**




Sources: Congressional Budget Office; author's calculations using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

### Decomposition: Fluctuations With the Business Cycle

The labor force participation rate shows clear cyclical patterns, falling relative to its potential during and after recessions and increasing relative to its potential during expansions. The estimated cyclical effect on labor force participation is simply the difference between the potential and observed labor force participation rates. After the most recent recession, the labor force participation rate reached its cyclical trough in 2014, about five years after the end of the recession. Though this cyclical decline lasted longer than previous recessions, both the 1990 and 2001 recessions also saw cyclical declines that lasted well beyond the end of the recession—about three years after each of those recessions—suggesting that participation rates react to the business cycle with long lags. However, after remaining near its cyclical trough for an additional year or so after each of the past three recessions, the participation rate started a

$$+\sum_g \left(lfpr_t^g - lfpr_0^g\right)\left(s_t^g - s_0^g\right)$$

where $LFPR$ is the aggregate labor force participation rate, $lfpr^g$ is the labor force participation rate of each group, and $s^g$ is each group's share of the population. The first term on the right-hand side of the equation holds each group's share of the population constant at its time 0 value and allows the aggregate participation rate to change solely by changes in group rates. The second term holds the group rates constant and allows the aggregate participation rate to change solely by changes in the group shares of the population. The third and final term is an interaction residual of the changing group shares and changing group participation rates.

clear recovery, and the rate of that recovery appeared to increase the closer the observed rate got to its estimated potential.[35]

The cyclical gap in the labor force participation rate has decreased considerably over the past three years. The cyclical gap reached its largest estimated value in 2014, averaging about 1.2 percentage points below potential and has been declining since (see Figure 11). The estimates indicate that the labor force participation rate was still below its potential by about 0.4 percentage points in 2017. However, CBO's model predicts that the cyclical gap in the labor force participation rate will mostly close by the end of 2018, as the potential participation rate is projected to fall by about one-quarter of one percentage point while the predicted rate remains mostly flat over that year. That flat predicted observed participation rate reflects a balancing of structural and cyclical factors in the model, as structural trends are placing significant downward pressure on the labor force participation rate while the continuing cyclical recovery is placing significant upward pressure on the labor force participation rate. This counterbalance also probably explains the relatively flat observed labor force participation rate since the end of 2013, which has displayed only small fluctuations around 62.8 percent.

**Table 6. Comparisons of Labor Force Participation Rate Projections**

| | Annual Average, in Percent | | | |
|---|---|---|---|---|
| Year | CBO | Social Security Administration | Bureau of Labor Statistics | Macroeconomic Advisers |
| 2018 | 62.9 | 63.1 | 62.3 | 62.8 |
| 2019 | 62.9 | 63.3 | 62.1 | 63.0 |
| 2020 | 62.7 | 63.3 | 62.0 | 63.2 |
| 2021 | 62.5 | 63.3 | 61.8 | 63.1 |
| 2022 | 62.2 | 63.1 | 61.6 | 62.9 |
| 2023 | 61.9 | 62.9 | 61.4 | 62.7 |
| 2024 | 61.5 | 62.6 | 61.3 | 62.5 |
| 2025 | 61.1 | 62.4 | 61.1 | 62.2 |
| 2026 | 60.8 | 62.3 | 61.0 | 61.9 |
| 2027 | 60.4 | 62.2 | | 61.7 |
| 2028 | 60.1 | 62.1 | | 61.6 |

Sources: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey; the Social Security Administration (unpublished projections); the Bureau of Labor Statistics (projections are from Lacey et al., 2017); and Macroeconomic Advisers by IHS Markit (projections are from their February 2018 macroeconomic forecast).

### Comparisons With Other Forecasts of Labor Force Participation Rates

CBO's projection for the labor force participation rate, based on the model described above, is generally similar to the projections of other forecasters. In the near term, CBO's forecast is in the middle of those forecasts over the next few years (see Table 6). CBO projects that the labor force participation rate will fall from an average rate of 62.9 percent in 2018 to 62.2 percent in 2022. That projected path lies above the path from the Bureau of Labor Statistics (BLS), whose participation rate projection reaches 61.6

[35] Van Zandweghe (2017) finds that cyclical fluctuations in labor force participation became more pronounced after 1984. Erceg and Levin (2014) use state-level data to show that labor force participaiton rates of prime-age workers by state were highly responsive to changes in prime-age unemployment rates in those states during and immediately after the 2007–2009 recession.

percent in 2022, but below the projected paths of both the Social Security Administration (SSA) and Macroecononic Advisers (MA), whose participation rate projections reach 63.1 percent and 62.9 percent, respectively.[36]

Over the latter half of the next decade, however, CBO projects the participation rate will fall at a faster pace than other forecasters project. The CBO model predicts that the labor force participation rate will fall from an average rate of 62.2 percent in 2022 to 60.8 percent in 2026 and 60.1 percent in 2028—an average decline of roughly 0.3 percentage points per year over that six-year period. CBO's projected participation rate over this period, though, is not meant to capture business cycle dynamics but rather the trend rate that results largely from demographics and the other structural factors described above. Indeed, that decline reflects the decrease in CBO's estimated potential participation rate over that period. For comparison, BLS projects the participation rate will fall to 61.0 percent in 2026, whereas the SSA's and MA's projections have the participation rate falling to 62.1 and 61.6 percent, respectively, in 2028. Those declines average about 0.2 percentage points per year.

## Labor Force Participation Rate of Prime-Age Workers

An advantage of CBO's model is that it allows for an analysis of the participation of many potentially important subgroups of the population. One group that is particularly important in examining the health of the labor market is the prime-working-age population—that is, people ages 25 through 54.[37] As was the case for the participation rate for people at least 16 years old, the overall fit of the model, as reflected in the mean absolute and root mean square errors of the participation rate for people who are between 25 and 54 years old, is close overall but with some misses in the subsamples (see the last two columns in Table 3).

A visual comparison of the fitted rate with the observed rate shows that the model fits the data well for most of the sample, with only a few years of deviations causing any increase in the mean absolute or root mean square errors (see Figure 12). As was the case for the aggregate rate, the prime-age estimates miss the most during 2012 and 2013, as the estimated rate is above the historical data by about 0.5 percentage points, on average, for those years. The fitted rate is also below the observed rate from 2014 through the middle of 2015, though by a smaller amount than in 2012 and 2013—about one-quarter of one percentage point, on average. However, the model's predictions return to be near the observed data by the end of history.

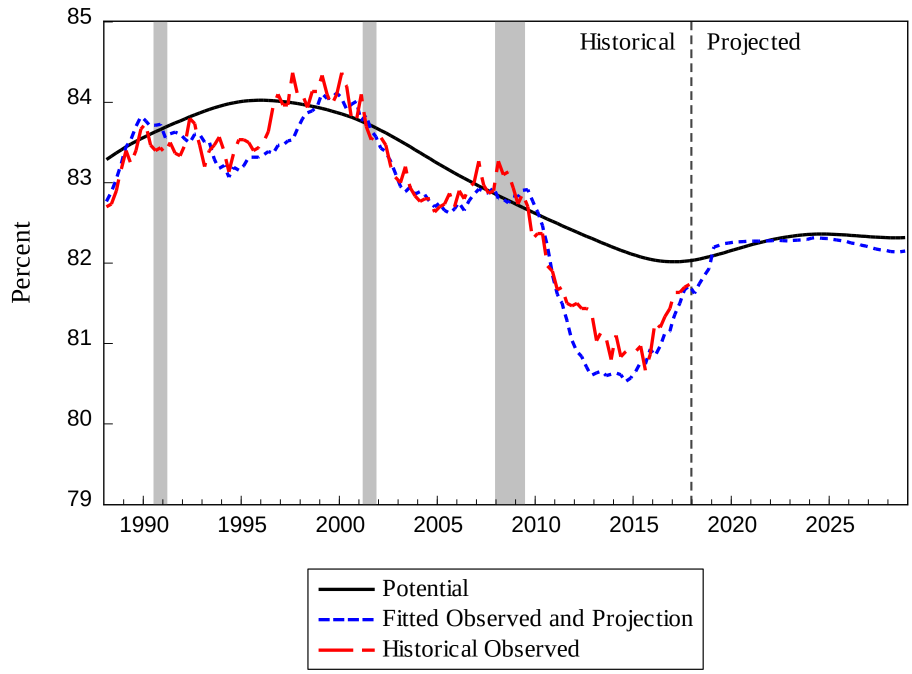
The potential prime-age labor force participation rate follows a pattern similar to that of the potential aggregate labor force participation rate over history: It increases through the 1980s and early 1990s, peaks in the middle of the 1990s, and then starts a continuous decline in the late 1990s that persists through about 2017. The magnitudes of the changes in rates giving rise to that pattern, though, are much smaller than the changes in the aggregate rate. In particular, the potential prime-age labor force participation rate

[36] The BLS projections are from Lacey et al. (2017) and use historical data through 2016 to project the particpation rate from 2017 through 2026. The SSA projections are unpublished and use historical data through 2017 to project the participation rate from 2018 through 2091. The MA projections are unpublished and use historical data through 2017 to project the participation rate from 2018 through 2028.

[37] For a broader discussion of factors affecting the labor force participation rate of prime-age workers, see Congressional Budget Office (2018).

fell by 2.0 percentage points over the past roughly two decades, from its peak of 84.0 percent in the middle of the 1990s to 82.0 percent by the end of 2017. However, that decline is entirely unrelated to aging. Interestingly, that downward trend stops over the projection period, when CBO expects that the net change in the potential prime-age participation rate will be slightly positive at about 0.3 percentage points.

**Figure 12. Prime-Age Labor Force Participation Rate**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

The prime-age potential labor force participation rate fell by 0.8 percentage points from the end of 2007 through the end of 2017. The largest contributors toward a falling prime-age potential participation rate are, by far, the cohort effects (a 1.0 percentage-point decline over the previous 10 years), increasing disability rates (0.6 percentage points), federal fiscal policy (0.4 percentage points), and declining marriage rates for males (0.4 percentage points). Those declines are largely concentrated in groups with less education (see Table 7).

Part of the decline in recent history has been offset by an increase in educational attainment. An increasing share of the population in recent years has received bachelor's degrees, and that trend is expected to continue through the projection period. Because individuals with higher levels of educational attainment participate at higher rates, shifting the population toward more education tends to raise participation. In particular, the changing educational attainment distribution contributed to an increase of 1.1 percentage points in the prime-age potential labor force participation rate since the end of 2007. That increase, however, was not enough to offset the decline resulting from other variables.

Over the next decade, the prime-age potential labor force participation rate is projected to *increase* by about 0.3 percentage points, from 82.0 to 82.3 percent by 2028. The prime-age potential participation rate increases over the projection because CBO expects that educational attainment will continue to increase over the next 11 years as it has over the past 10 years, while the factors lowering the potential rate in recent history will do so to a lesser degree over the projection. That continued increase in overall educational attainment is expected to contribute to an additional increase of 1.2 percentage points in the potential prime-age rate.

**Table 7. Decomposing the Change in the Prime-Age Potential Labor Force Participation Rate, 2007q4-2028q4**

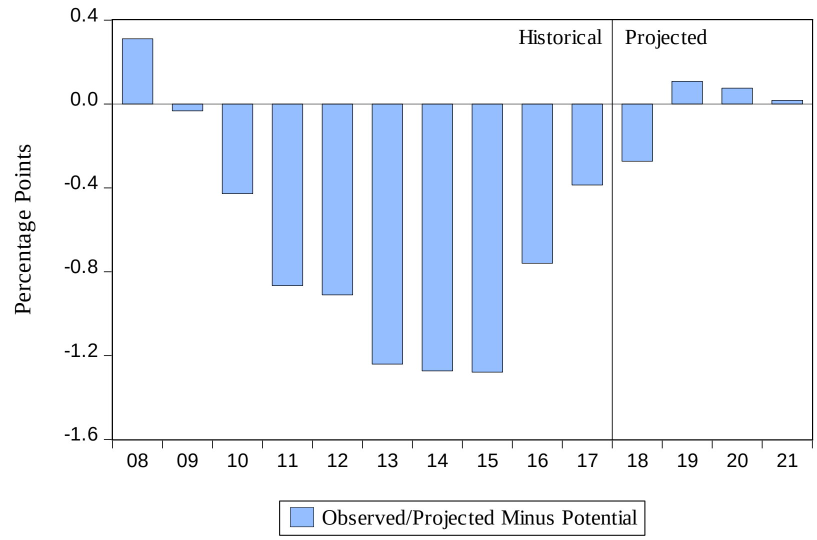
| | Contribution to Change (Percentage Points): | |
|---|---|---|
| | History | Projection |
| Explanatory Variables | 2007q4 → 2017q4 | 2017q4 → 2028q4 |
| Age Distribution | 0.0 | 0.1 |
| Sex Distribution | 0.1 | 0.1 |
| Educational Attainment Distribution | 1.1 | 1.2 |
| Race/Ethnicity Distribution | -0.1 | -0.1 |
| Birth-Year Cohort Effects | -1.0 | -0.6 |
| Disability | -0.6 | -0.2 |
| PIA Ratio | n/a | n/a |
| Married Males | -0.4 | -0.1 |
| Married Females with Young Children | 0.3 | 0.0 |
| Not Married Females with Young Children | 0.1 | 0.0 |
| Married Females without Young Children | 0.2 | 0.1 |
| School Enrollment | n/a | n/a |
| Real Wage | 0.0 | -0.1 |
| Minimum Wage-Median Wage Ratio | 0.0 | 0.0 |
| Federal Fiscal Policy | -0.4 | 0.0 |
| Interaction Residual | 0.0 | 0.1 |
| Total Change | -0.8 | 0.3 |

Sources: Congressional Budget Office; author's calculations using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Between 2017 and 2028, however, the prime-age potential labor force participation rate is projected to increase by as much as 0.3 percentage points before falling back to 82.3 percent by the end of 2028. The increase and then decrease in the potential prime-age rate over the next decade results from the structure of P.L. 115-97. That legislation lowers effective marginal tax rates through 2024, incentivizing individuals to increase their supply of labor and increasing the prime-age potential participation rate. However, as many of the provisions of P.L. 115-97 are scheduled to expire starting in 2025, the increase in the prime-age potential rate from the legislation will dissipate, thus lowering that rate.

Other factors, though, are expected to reduce the potential prime-age participation rate in the projection. Again, the largest contributor toward a reduction in that rate is the cohort effects, which are projected to reduce the prime-age potential rate by an additional 0.6 percentage points. Increases in disability rates are projected to lower the prime-age potential rate by 0.2 percentage points, a contribution about one-third of that over the past 10 years as increases in disability caseloads are projected to slow. Additionally, declining real wages are projected to reduce the prime-age potential rate by about 0.1 percentage point through 2028. Again, these projected declines are largely concentrated in groups with less education.

**Figure 13. Prime-Age Labor Force Participation Rate Cyclical Gap, 2008 to 2021**




Sources: Congressional Budget Office; author's calculations using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Similar to the aggregate rate, the prime-age labor force participation rate shows clear cyclical patterns, falling relative to its potential during and after recessions and increasing relative to its potential during expansions. The estimates indicate that the cyclical gap for the prime-age labor force participation rate reached its largest estimated values between 2013 and 2015, averaging about 1.3 percentage points below potential across those years (see Figure 13). Since 2015, the cyclical gap has been declining at an increasing pace, though notable slack still remains. In 2017, the cyclical participation gap for prime-age workers was estimated to be 0.4 percentage points. CBO expects slack among prime-age workers to remain in 2018, with the cyclical gap averaging about 0.3 percentage points, before the gap closes by 2019.

## Estimates for Prime-Age Workers by Educational Attainment: Potential and Future Trends

Labor force participation rates for prime-age workers vary significantly across levels of educational attainment for both males and females. Furthermore, the labor force participation rates for less educated workers have been falling throughout the entire sample period for males and since 2000 for females, while the participation rates for the most educated were relatively flat. Those trends have led to a growing divergence in labor market attachment between the most and least educated individuals. [38]

Because the model is constructed to estimate labor force participation rates by age-sex-education-race groups, it can help answer a number of questions: What is the impact of the diverging trends in prime-age labor force participation rates between the most and least educated on the overall rate? How much of the

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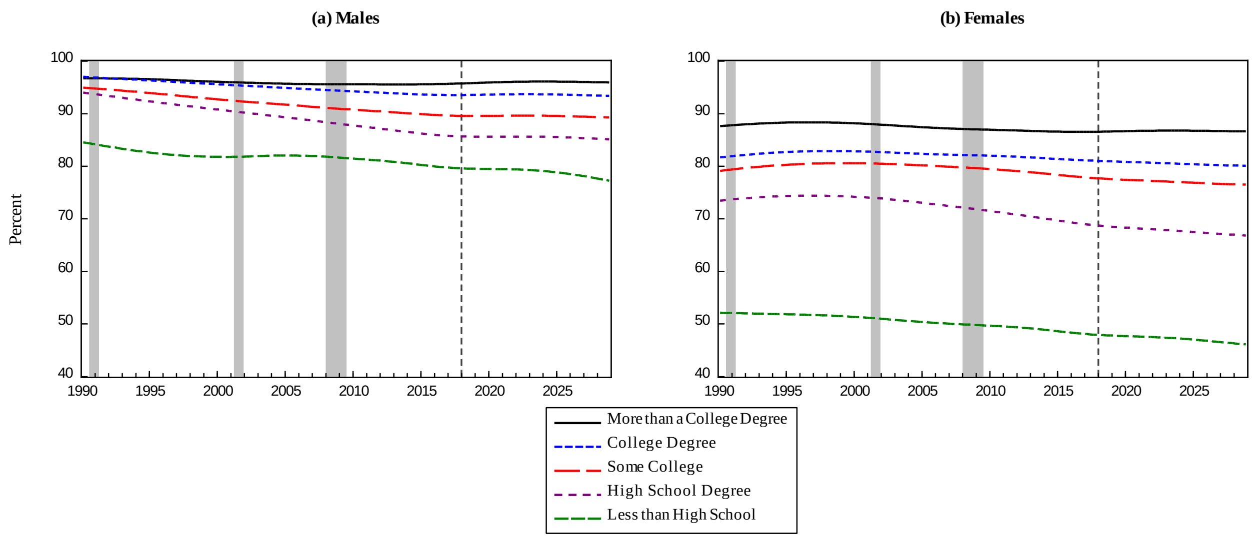
[38] Council of Economic Advisers (2016) shows that the labor force participation rate for prime-age males has been declining since the middle of the 1960s and that the decline has been largely concentrated among the less educated. They argue that this persistent decline reflects the long-term reduction in the demand for low-skilled male labor, as evidenced by the long-term decrease in wages for this group relative to males with more education.

fall in the labor force participation rates of the less educated over the past decade stems from cyclical weakness or from declining potential participation rates?

**Figure 14. Potential Labor Force Participation Rates, by Educational Attainment, for Prime-Age Workers**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

*Potential Labor Force Participation Rates for Prime-Age Workers by Educational Attainment.* The estimated potential participation rates by sex and educational attainment capture the general trends illustrated in Figure 2. For males, participation rates have been relatively flat for those with more than a college degree, with an estimated potential rate of between 96 percent and 97 percent for the entire sample and projection period (see panel (a) of Figure 14). Potential participation rates for every other level of educational attainment have been trending downward, with faster declines at each lower level of educational attainment—consistent with the historically observed data.

For females, participation rates for nearly all levels of educational attainment increased through about 2000, consistent with the increase in the overall female rate over that period (see panel (b) of Figure 14).[39] However, after 2000, the rates of the most and least educated began to diverge, largely driven by falling rates among the least educated females. The participation rates for females with more than a college degree remained relatively flat since 2000, whereas the participation rates fell at a faster rate for females at each lower level of educational attainment, driven largely by females with high school degrees. The end result has been a growing divergence in participation between the most and least educated males and females.

The potential labor force participation rates for males with college degrees and males with less than college degrees are projected to decline further into the next decade. The fall in the rates for males with college degrees, some college, and high school degrees is projected to slow, with each declining by less than a percentage point to 93 percent, 89 percent, and 85 percent, respectively, in 2028. Potential

[39] Participation rates for females with less than high school degrees declined slightly over that period.

participation rates for males with less than high school degrees, though, are expected to fall by an additional 2 percentage points over the projection to 77 percent—a decline similar to that of the previous decade.

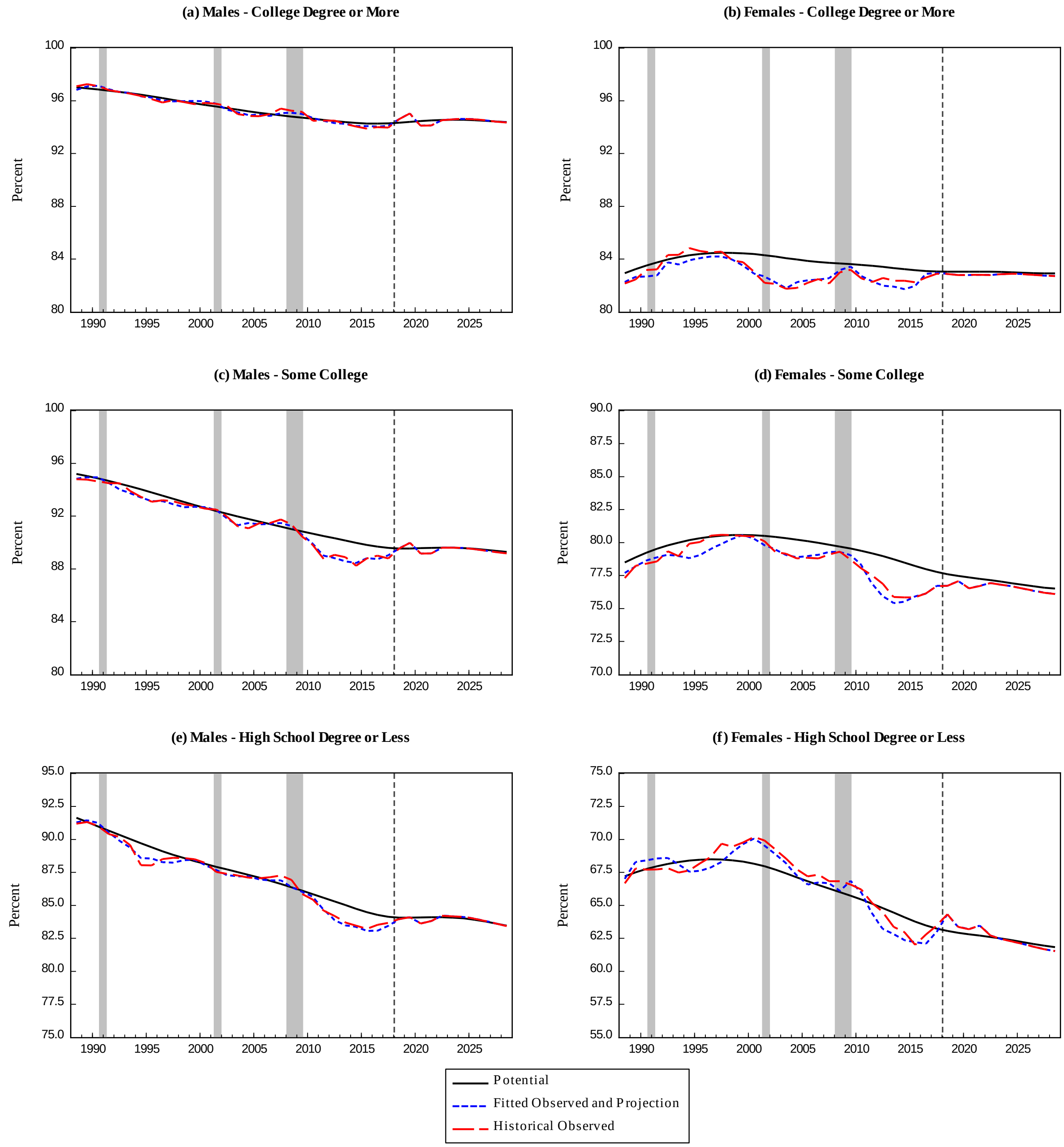
The potential labor force participation rates for females show similar qualitative patterns. Females with more than college degrees are estimated to have a stable potential participation rate over the projection at 87 percent. Potential rates for females with college degrees are projected to fall slightly through 2028, by about 1 percentage point, to 80 percent, whereas potential rates for females with high school degrees are expected to fall by about 2 percentage points, to 67 percent.

*Cyclicality in Prime-Age Labor Force Participation Rates for Prime-Age Workers.* The fit of the model is again very good for all age-sex-education groups in the prime-working-age population. There are few periods from 1984 through 2017 that display a significant, consistent deviation of the estimates from the observed data. Additionally, there is clear heterogeneity across sex-education groups in the amount of cyclicality the observed participation rates show: Some show almost no cyclicality at all, whereas others have wide fluctuations from potential over the business cycle.

Males with college degrees or more display little, if any, cyclicality.[40] The observed participation rate for males with college degrees or more does fall below its estimated potential rate following each of the past three recessions, but rarely by more than three-tenths of one percentage point (see panel (a) of Figure 15). That group's observed rate follows the estimate of its potential rate almost exactly, with only small deviations at any point.

[40] For conciseness, CBO combines the college degree and more than college degree groups and the high school degree and less than high school degree groups.

**Figure 15. Labor Force Participation Rates, by Educational Attainment, for Prime-Age Workers**




Source: Congressional Budget Office, using information from the Bureau of Labor Statistics' and U.S. Census Bureau's Current Population Survey.

Females with college degrees or more, however, show a somewhat surprising pattern. Although the observed rate for that group displays the traditional u-shaped pattern, its timing with the business cycle is inconsistent across each of the past three recessions. The observed rate for females with college degrees increased through the 1991 recession until the middle of the1990s and then declined through the 2001 recession until the middle of the 2000s. Furthermore, the observed rate remained below its estimated potential since the late 1990s. Since the most recent recession, however, the observed rate for the most educated females follows the business cycle much more closely. That rate peaked in 2009 and fell through 2011. It remained flat through 2015 before showing signs of a pickup. By 2017, the gap between the potential and observed rates for that group nearly closed, as the observed rate was only 0.2 percentage points below its potential rate (see panel (b) of Figure 15).

Both males and females with some college show evidence of a clear and potentially large cyclical response on the participation margin, even as those groups' participation rates have trended downward for significant periods (see panels (c) and (d) of Figure 15). The cyclical gap for males with some college that opened following the 2007–2009 recession peaked at roughly 1.7 percentage points below the potential rate in 2014. That gap closed substantially in recent years, but the observed rate for males with some college still remained about 0.8 percentage points below its potential rate in 2017. The cyclical gap for females with some college has been larger than that of males, peaking at roughly 3 percentage points below the potential rate in 2014. That gap has closed considerably in recent years but is still estimated to be about 1.1 percentage points below the potential rate in 2017.

The participation rate for males with high school degrees or less also shows clear cyclicality associated with each of the past three recessions—the rate falls below its estimated potential around or during the recession, remains low relative to its potential for several years following the recession, then increases relative to its potential for the remainder of the cycle (see panel (e) of Figure 15). Following the 2007–2009 recession, the participation rate for prime-age males with high school degrees or less fell as much as 1.3 percentage points below its estimated potential rate in 2013, and that cyclical gap remained at that level through 2015. Since 2015, the rate for males with a high school diploma or less has increased but still remained about 0.5 percentage points below its potential rate in 2017.

Females with high school degrees or less also show increases and declines in their participation rate that are consistent with economic expansions and recessions (see panel (f) of Figure 15). However, that group's participation rate remained mostly above its potential rate from the late 1990s through the 2007–2009 recession. This surprising result suggests that the participation rate of females with high school degrees or less had a particularly large cyclical response to the strong economy of the late 1990s. The relatively mild recession of 2001 lowered the observed rate only to its potential rate and was not a large enough downturn to push it down further. That rate fell substantially below its potential during the slow recovery to the 2007–2009 recession, reaching a trough of about 1.8 percentage points below potential in 2015. Since 2015, however, the participation rate for females with high school degrees or less has increased considerably and that gap closed by 2017.

Overall, participation rates for both prime-age males and females show clear cyclical movements, though the cyclical responses are larger for females than for males and larger for those with less education than for those with more education. Furthermore, there still appears to be room for a cyclical increase in the participation rates of prime-age workers over the next few years. Cyclical effects aside, though, the potential participation rates of most education groups of prime-age workers examined here are projected to continue falling through the projection period, putting downward pressure on the overall participation rate. Those trends and their impact on the aggregate labor force participation rate warrant further investigation.

# Conclusion

This paper details CBO's methodology for estimating and projecting labor force participation rates. CBO constructs a birth-year cohort model of the labor force participation rate that estimates labor force participation rates by age-sex-education-race subgroups. Using the estimated model to project rates over the next decade, CBO expects the overall rate to decline by 2.7 percentage points, reaching 60.1 percent by 2028.

Most (2.5 percentage points, or about 80 percent) of the 3.2 percentage-point decline since the 2007–2009 recession in the labor force participation rate for the population at least 16 years old is the result of aging. That decline continued a trend that began in the late 1990s and early 2000s as the early baby-boom cohorts began to turn 50 years old, the age at which individuals tend to start reducing their participation in the labor force. CBO projects that the continued aging of the population will further reduce the overall participation rate over the next 11 years by an additional 2.8 percentage points, as most baby boomers age into retirement.

Although aging is the primary driver of the falling labor force participation rate, it is not the only driver, as other structural factors are driving down some group-specific participation rates. First, the members of younger birth cohorts, who are replacing baby boomers in the labor force, have participated in the labor force at lower rates, and CBO projects that this trend will continue to weigh down the participation rate over the next decade. Second, the share of people receiving disability insurance benefits is generally projected to continue rising, and people who receive such benefits are less likely to participate in the labor force. Third, the marriage rate has declined and is projected to continue decreasing, especially among men, and unmarried men tend to participate in the labor force at lower rates than married men. Finally, elements of fiscal policy, including various provisions of the ACA, have increased effective marginal tax rates and reduced the incentive for individuals to supply labor in recent years. The effects of many of these structural factors have been concentrated among the less educated, contributing greatly to the decline in the participation rates of these groups.

Cyclical weakness was also an important factor weighing down the labor force participation rate over much of the previous decade, even as that rate has had much cyclical improvement in recent years. CBO's estimates show that the drag on the overall participation rate from discouraged job seekers leaving the labor force was as much as 1.2 percentage points in 2014. Since then, many discouraged workers have reentered the labor force, and that cyclical weakness has diminished considerably. CBO estimates that the labor force participation rate remained only 0.4 percentage points below its potential rate in 2017, and that gap will close entirely in the coming years.

Increases in populationwide educational attainment have helped boost the participation rate since 2007, on the other hand, as more of the population now holds a bachelor's degree. CBO estimates that increases in educational attainment have increased the observed labor force participation rate by nearly a full percentage point over the past decade, all else being equal, highlighting the importance of modeling educational attainment in projections of the labor force participation rate. CBO projects these trends to continue over the next decade, boosting the participation rate by almost another full percentage point.

Although most of the decline in the overall labor force participation rate comes from the aging of the baby-boom generation, the decline in the prime-age labor force participation rate over the past decade is entirely unrelated to aging. Instead, other structural factors, including the declining propensity of successive cohorts to participate in the labor market, the increase in disability insurance incidence, the declining male marriage rate, and fiscal policy, have contributed most to the decline in that rate. The contribution of most of those factors to the declining prime-age labor force participation rate has been concentrated among the less educated. CBO expects the contribution of some of those factors to dissipate over the next decade—namely the declining male marriage rate and fiscal policy—whereas others will continue to weigh down the prime-age rate over the next decade.

Furthermore, CBO finds that the effects of the 2007–2009 recession reduced the prime-age labor force participation rate considerably and that lingering cyclical weakness from the aftermath of that recession still lowers that rate some. The agency estimates that cyclical weakness reduced the prime-age rate by as much as 1.3 percentage points in 2014 and 2015. Although the improving economy and labor market have pulled some discouraged prime-age workers back into the labor market, CBO estimates that the prime-age labor force participation rate was still 0.4 percentage points below its potential in 2017.

As was the case for the overall participation rate, part of the decline in recent history of the prime-age rate has been offset by the evolving educational attainment distribution. Because individuals with higher levels of educational attainment participate at higher rates, the shift toward more education in the population results in higher rates of participation. The changing educational attainment distribution contributed to an increase in the prime-age potential labor force participation rate of more than a percentage point since the end of 2007. That increase, however, is not enough to offset the decline resulting from other variables.

Over the next decade, as the downward pressure from other structural factors on the prime-age labor force participation rate is expected to dissipate, CBO projects that increases in educational attainment will fully offset downward pressure on that rate from those other factors. In addition to the upward pressure from continued increases in educational attainment, CBO expects further cyclical improvement to draw more individuals who had been discouraged from seeking work back into the labor market. As a result, CBO expects those factors to drive an increase in the observed prime-age labor force participation rate over the next decade, from 81.7 percent in 2017 to 82.1 percent in 2028.

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