The Changing Cyclicality of Labor Force Participation

By Willem Van Zandweghe

The U.S. labor force participation rate—the percentage of the working-age population who are employed or looking for work—declined sharply in the aftermath of the 2007–09 recession, raising questions about the forces behind it. Typically, labor force participation is only mildly associated with the ebb and flow of economic activity. Although many workers lose their jobs in an economic downturn, most stay in the labor force looking for work, thereby dampening any decline in labor force participation. Indeed, studies of the cyclical behavior of labor force participation prior to the last recession have documented that the participation rate is relatively stable and only mildly procyclical (see, for example, Veracierto). Several studies of the most recent recession, however, have concluded that the recession had a substantial adverse effect on labor force participation (for example, Aaronson and others (2014), Council of Economic Advisers (2014), Erceg and Levin, Hotchkiss and Rios-Avila, and Van Zandweghe), suggesting a shift in the cyclical behavior of labor force participation.

In this article, I examine whether the labor force participation rate has become more cyclical over time. I find that cyclical fluctuations in the participation rate have become more pronounced, but the most notable shift occurred around 1984—well before the most recent

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recession. Specifically, the correlation between cyclical components of labor force participation and real gross domestic product more than doubled from the 1948–83 period to the 1984–2017 period. The increased cyclicality of the participation rate reflects an increased cyclicality of employment that was only partly offset by countercyclical fluctuations in unemployment. Notably, the participation rate has not become more cyclical for all segments of the labor force. Although the participation rate of prime-age workers (25–54) has become more cyclical over time, the participation rate of older workers has become countercyclical.

A decline in real wage rigidity could explain the increase in cyclicality of the labor force participation rate since 1984, as well as the divergent paths of prime-age and older workers. Wages do not necessarily adjust flexibly to economic conditions—they may be rigid. More flexible wages could discourage labor force participation during recessions, as lower real wages provide a disincentive to work or look for work. I find some evidence to support this real wage rigidity explanation. Comparing the responses of real wages and labor force participation to a technology shock in the 1948–83 and 1984–2017 periods indicates that real wages have become less rigid over time, consistent with the increased cyclicality of the participation rate. Furthermore, the response of prime-age workers' real wages is less rigid than those of older workers, consistent with prime-age workers' more cyclical labor force participation.

Section I reviews previous research on cyclical fluctuations in labor force participation. Section II introduces a method for calculating the cyclical component of the participation rate. Section III shows that labor force participation has become more cyclical since 1984. Section IV relates the changes in the dynamics of labor force participation to changes in real wage rigidity.

I. Labor Force Participation and the Business Cycle

The labor force participation rate (LFPR) is the percentage of the civilian, noninstitutional, working-age population (age 16 and older) who are active in the labor market, either as employed workers or as unemployed job seekers.[1] This article focuses on fluctuations in the LFPR associated with the business cycle, abstracting from the slower-moving, structural changes in the participation rate.

Previous business cycle research has emphasized two facts about cyclical fluctuations in the U.S. LFPR: they are relatively small and they are mildly procyclical, meaning the participation rate rises during economic expansions and declines during recessions. In particular, cyclical fluctuations are smaller in the LFPR than in employment, because changes in employment over the business cycle are partially offset by opposite changes in unemployment. Many workers lose their jobs in an economic downturn, but most stay in the labor force looking for work. The procyclical nature of the LFPR reflects that the procyclical fluctuations in employment dominate the countercyclical fluctuations in unemployment.

To analyze business fluctuations in the LFPR in a macroeconomic model, such a model must incorporate unemployment. Many business cycle studies, starting with Merz and Andolfatto, have incorporated unemployment arising from search and matching frictions, as pioneered by Mortensen and Pissarides.[2] Most of these studies, however, do not consider the participation rate explicitly. Instead, they either view the size of the labor force as fixed (see, for example, Merz) or they treat unemployment and inactivity as a single non-employment state (for instance, Andolfatto).

A few researchers model the LFPR's cyclical behavior explicitly, providing insight into the factors that shape it. In an early study, Tripier finds that by distinguishing between the statuses of employment, unemployment, and inactivity, a business cycle model with search and matching frictions counterfactually predicts that the unemployment rate is procyclical. Veracierto arrives at the same conclusion in another type of labor market search model that includes inactivity as a third possible labor market status in addition to employment and unemployment. Besides the procyclical unemployment rate, his model predicts that the LFPR is as cyclical as employment in contrast to the mild cyclicality observed in the data.

Theoretically, the LFPR could be either procyclical or countercyclical. The LFPR could be procyclical due to the "discouragement effect," which predicts that lower wages and fewer job opportunities in recessions tend to reduce labor force participation. But the LFPR could also be countercyclical due to the "added worker effect," which predicts that job loss by the main breadwinner in a household tends to spur another household member's entry into the labor force.

Which effect dominates may depend on the role of real wage rigidity. Recent business cycle studies modeling unemployment and labor force participation show that rigid wages are needed to explain a mildly cyclical participation rate and a countercyclical unemployment rate (Shimer; Nucci and Riggi). If wages are flexible, an economic expansion would cause wages to rise sharply, drawing more people into the labor force and thereby raising unemployment as more workers compete for jobs. Conversely, a downturn would lower wages and discourage workers from participating in the labor force, thereby lowering the unemployment rate.

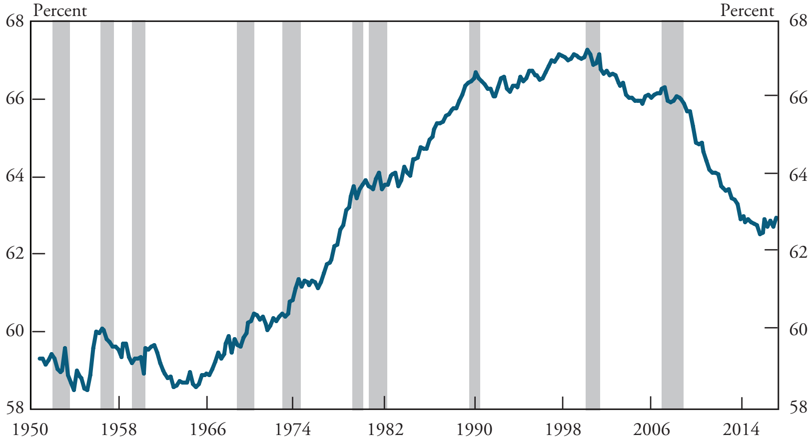
But if wages are rigid—unresponsive to economic conditions—then the discouragement effect is dampened, reducing the cyclicality of the LFPR and preventing unemployment from turning procyclical. At the same time, rigid wages strengthen the added worker effect in a downturn by strengthening the incentive for household members to join the workforce following a household income loss.[3] In this way, rigid wages dampen the discouragement effect and strengthen the added worker effect, reducing the cyclicality of the LFPR. As a result, real wage rigidities can account for the mildly procyclical LFPR observed in the U.S. data and could even account for a countercyclical LFPR.[4]

II. Measuring Cyclical Labor Force Participation

The first step in analyzing the business cycle properties of the LFPR is removing its trend. Chart 1 shows the distinctive pattern of the LFPR since 1948. The LFPR evolved in three distinct phases over this period: it was roughly stable from 1948 until the mid-1960s, rose steadily from the mid-1960s to 2000, and has been declining since. As with any broad economic indicator that spans multiple decades, the participation rate has been influenced by many slow-moving, structural trends that have played out or are still unfolding over a much longer period than the typical business cycle. These structural factors include the aging of the population, the secular increase in women's participation in the labor force from 1948 to 1999, the secular decline in men's participation since 1948, the increase in older workers' participation, and the decline in young workers' participation, among others.[5]

Chart 1

Labor Force Participation Rate



Note: Gray bars denote National Bureau of Economic Research (NBER)-defined recessions.
Sources: Bureau of Labor Statistics and NBER. All data sources accessed through Haver Analytics.

Rather than try to account for such structural factors directly, I follow the standard approach in business cycle analysis of using a statistical filter to remove the trend component of the participation rate. Statistical filters are designed to capture only the low-frequency movements in a time series—those associated with structural changes—and not those associated with the business cycle. The difference between the participation rate and its estimated trend obtained with the statistical filter is the cyclical component of the participation rate.

The Hodrick-Prescott (HP) filter is one of the most common statistical filters, but this filter has some well-known issues. As discussed by Hamilton, the HP filter produces spurious predictability in the cyclical component of a series.[6] Moreover, the standard values of the smoothing parameter used in most business cycle studies are much larger than is justified by a statistical formalization of the filter. Therefore, I use an alternative statistical filter proposed by Hamilton, though I also point out how the main conclusions would differ based on the HP filter.

Hamilton's recommended procedure regresses future values of the participation rate on a constant, its current value, and its first three lags. By choosing the future values at a typical business cycle horizon (two years, according to Hamilton), forecast errors from this regression should be largely due to unforeseen cyclical fluctuations. For example, if the realized participation rate two years from now is substantially below what could be expected based on its recent behavior, the most likely explanation for the shortfall would be a recession. Therefore, the residuals from the regression—the difference between the actual LFPR and the rate estimated with Hamilton's procedure—reveal the cyclical component of the participation rate.

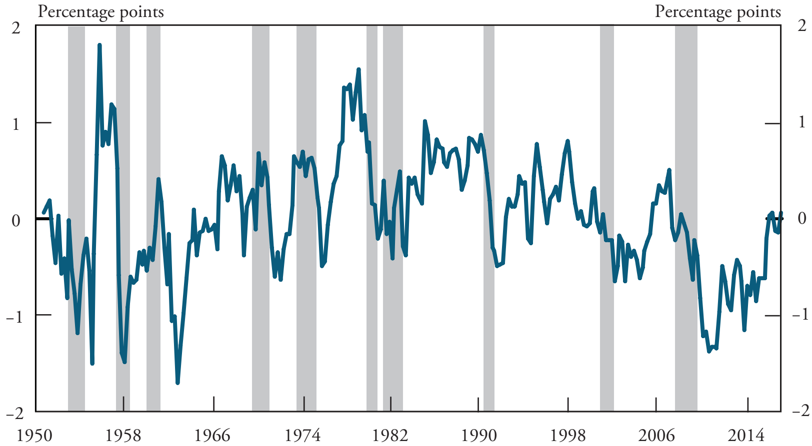
Chart 2 shows that this cyclical component of LFPR is mildly procylical, tending to rise during expansions and decline during recessions (shaded in gray). However, the correlation is far from perfect. In several expansions, the LFPR continued to decline for some time after the previous recession had ended, and it often peaked well before the next recession began. The procyclical pattern seems less pronounced in the early part of the sample: cyclical participation actually rose until nearly the end of the recessions of 1960–61 and 1969–70. Since the 1980s, however, the cyclical participation rate declined markedly during each of the four recessions (viewing the recessions of 1980 and 1981–82 as one long downturn).

In the last recession (2007–09), the trough in the participation rate was unusually deep. From the mid-1960s until 2007, the LFPR typically fell about 0.5 percentage point below trend in the aftermath of recessions. For instance, in the recessions of 1990–91 and 2001, the trough of the cyclical LFPR reached –0.6 percentage point on average. But in the third quarter of 2010, the LFPR fell 1.4 percentage points below trend and returned only gradually to trend by the first quarter of 2016.[7]

Relative to the depth of the last recession, however, the cyclical decline in participation was similar to that in previous recessions. Applying Hamilton's procedure to the log of real GDP shows that the trough in cyclical GDP reached –8.0 percent in the last recession, compared with –3.0 percent on average in the two prior recessions. Though the cyclical declines in the LFPR and GDP were almost three times larger during the last recession, the decline in the LFPR was similar in scale in the past three recessions at just under one fifth of the decline in GDP.[8]

The estimated cyclical decline in the LFPR in the aftermath of the last recession, based on Hamilton's procedure, is in line with other estimates.[9] Aaronson and others (2014, p. 231) and the Council of Economic Advisers (2014, p. 3) find that the cyclical LFPR declined

Chart 2
Cyclical Labor Force Participation Rate



Note: Gray bars denote NBER-defined recessions.
Sources: Bureau of Labor Statistics, NBER, and author's calculations. All data sources accessed through Haver Analytics.

by about 0.5 percentage point from the fourth quarter of 2007 to the second quarter of 2014, slightly less than the decline estimated in Chart 2 (0.65 percentage point). Hotchkiss and Rios-Avila find that the cyclical LFPR declined by 1.94 percentage points from 2005–07 to 2010–12, accounting for more than the full decline in the LFPR between these periods. Hamilton's procedure yields essentially the same cyclical decline between those periods (1.91 percentage points). Finally, Van Zandweghe attributes 58 percent, or 1.1 percentage points, of the 1.9 percentage points decline in the annual average LFPR from 2007 to 2011 to the cyclical component in his baseline estimation, though the cyclical decline in his alternative estimation accounts for 90 percent, or 1.7 percentage points, of the decline. Hamilton's procedure attributes the entire 1.9 percentage points decline to the cyclical downturn.

III. Changes in the Cyclicality of Labor Force Participation over Time

With the time series of the cyclical LFPR in hand, I can examine the business cycle properties of labor force participation. I find the cyclicality of the LFPR has increased over time and decompose the increase into the contributions from employment and unemployment.

I also examine whether the increased cyclicality of the LFPR has been consistent across major demographic groups and find the labor force participation of prime-age workers has become more procyclical, while the participation of older workers has turned countercyclical.

A change in cyclicality

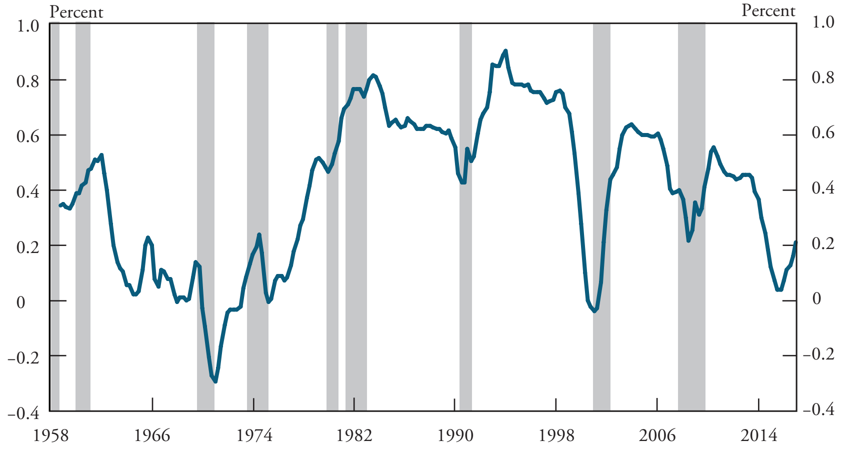
The LFPR has become more cyclical over time. The cyclicality of the LFPR is calculated as the correlation between the cyclical LFPR and the cyclical component of the log of real GDP (henceforth, cyclical GDP), both of which are obtained with Hamilton's procedure. As GDP is available at a quarterly frequency, I aggregate the monthly labor market data to quarterly levels before detrending. Chart 3 shows how the correlation changes over an eight-year rolling window and indicates the LFPR has become more cyclical over time. Indeed, the correlation increases particularly sharply in the early 1980s.

Rather than comparing correlations in different time windows within the sample period, I conduct a more formal test for a break in the correlation by splitting the data sample into two periods, calculating the cyclicality of the LFPR for each period, and testing whether the correlations in both samples are the same in a statistical sense. I perform this break test for each quarter in the time series, provided each subsample contains at least 40 observations. The test indicates that a significant break occurred in the first quarter of 1984.[10]

Adopting the break date of 1984, the cyclicality of the LFPR has more than doubled in the post-break period, while its volatility has remained roughly constant. The first and fourth lines of Table 1 summarize the volatility and cyclicality of the LFPR, respectively, and show the change between the two periods. The volatility, measured as the standard deviation of the cyclical LFPR relative to the standard deviation of cyclical GDP, has changed only slightly. The cyclicality, however, has increased significantly, from a mild 0.22 to a more substantial 0.56. To the best of my knowledge, previous studies have not noted this change.

The table also shows the business cycle properties of employment and unemployment, calculated as the cyclical component of the employment-population ratio (EPOP) and the unemployment-population ratio (UPOP), respectively. While the unemployment-population ratio

Chart 3
Correlation between Cyclical GDP and Cyclical LFPR



Note: Gray bars denote NBER-defined recessions.
Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, NBER, and author's calculations. All data sources accessed through Haver Analytics.

Table 1
Business Cycle Statistics

Variable	1948–2017	1948–83	1984–2017	Change
std(X)/std(Y)				
1. LFPR	0.18	0.17	0.20	0.03
2. EPOP	0.38	0.33	0.45	0.12
3. UPOP	0.27	0.26	0.30	0.04
corr(X,Y)				
4. LFPR	0.34	0.22	0.56	0.34***
5. EPOP	0.80	0.77	0.86	0.09**
6. UPOP	–0.79	–0.82	–0.81	0.01

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level
Notes: The variable *X* denotes the cyclical component of the LFPR, the employment-population ratio (EPOP), or the unemployment-population ratio (UPOP). The variable *Y* denotes cyclical GDP. The significance of the change in the correlation coefficient was tested using Fisher's z-transformation. No significance test was performed on the change in the relative standard deviation. The sample ends in the first quarter of 2017.
Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and author's calculations. All data sources accessed through Haver Analytics.

differs from the unemployment rate, which expresses unemployment as a percentage of the labor force, the cyclicality of both unemployment measures is nearly the same, as it is largely determined by fluctuations in unemployment rather than in the labor force or the population. Consistent with the studies discussed earlier, employment is more cyclical than the LFPR—the table shows that the EPOP's correlation with GDP (line 5) exceeds the LFPR's correlation with GDP (line 4)—and unemployment is countercyclical—its correlation with GDP (line 6) is negative. Moreover, employment has become more volatile relative to GDP and significantly more cyclical since 1984.

Labor force status decomposition

The change in cyclicality can be decomposed into the contributions from the two components of the LFPR: the EPOP ratio and the UPOP ratio. The labor force status decomposition is based on the formula for the covariance of a sum: if $X = X_1 + X_2$, then

$$\operatorname{cov}(X,Y)=\operatorname{cov}(X_1,Y)+\operatorname{cov}(X_2,Y).$$

With this formula, it is easy to show that the correlation of X and Y (denoted by ρ) is the sum of the correlations of its two components, weighted by their relative standard deviations (denoted by σ):

$$\rho_{X,Y}=\frac{\sigma_{X_1}}{\sigma_X}\rho_{X_1,Y}+\frac{\sigma_{X_2}}{\sigma_X}\rho_{X_2,Y}\ .$$

For the labor force status decomposition, Y denotes cyclical GDP, X denotes the cyclical LFPR, X_1 denotes the cyclical EPOP ratio, and X_2 denotes the cyclical UPOP ratio. The formula for the correlation of GDP and LFPR thus shows that the contributions of employment and unemployment to the cyclicality of the LFPR consist of their individual cyclicality weighted by the ratio of their standard deviation relative to that of the LFPR.

One minor complication is that although the EPOP ratio and the UPOP ratio sum exactly to the LFPR before detrending, their cyclical components do not necessarily add up. The discrepancy arises because the univariate trends of employment and unemployment do not sum to the trend LFPR. This discrepancy can thus be viewed as a statistical error without a clear economic interpretation.[11] After detrending, the LFPR is the sum of the EPOP ratio, the UPOP ratio, and the

Table 2
Labor Force Status Decomposition

Variable	1948–2017	1948–83	1984–2017	Change
1. LFPR	0.34	0.22	0.56	0.34
Contributions				
2. EPOP	1.67	1.45	1.90	0.45
3. UPOP	–1.17	–1.23	–1.18	0.06
4. DEV	–0.17	0.01	–0.16	–0.17

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and author's calculations. All data sources accessed through Haver Analytics

discrepancy or statistical error, denoted DEV (=LFPR–EPOP–UPOP). Thus, the decomposition of the cyclicality of the LFPR becomes:

$$\rho_{LFPR,Y} = \frac{\sigma_{EPOP}}{\sigma_{LFPR}} \rho_{EPOP,Y} + \frac{\sigma_{UPOP}}{\sigma_{LFPR}} \rho_{UPOP,Y} + \frac{\sigma_{DEV}}{\sigma_{LFPR}} \rho_{DEV,Y} .$$

The labor force status decomposition shows that employment accounts for the entire increase in the cyclicality of the LFPR. The first row of Table 2 repeats the correlations between the cyclical LFPR and cyclical GDP from Table 1, and the subsequent rows display the contributions from its three components. Employment's contribution increased by 0.45 from the pre-1984 period to the post-1983 period. This contribution accounts for more than the full increase in the cyclicality of the LFPR, as both the cyclicality and the standard deviation of employment increased relative to that of the LFPR. In contrast, unemployment's contribution is small (0.06). Although the discrepancy between the cyclical LFPR and cyclical employment and unemployment is also small, it accounts for some of the change in the cyclicality of the LFPR (–0.17), as it became mildly countercyclical in recent decades. In other words, the estimated trend LFPR tends to be higher than the sum of estimated trend employment and trend unemployment during expansions and below it during recessions.

Looking past the contribution of this statistical error, the LFPR has become more cyclical because employment fluctuations have become more volatile (in relative terms) and more procyclical, while unemployment fluctuations have changed little. From the perspective of a demand-driven business cycle, employment has become more responsive to economic downturns since 1984, resulting in greater declines in labor force participation rather than higher unemployment.

Demographic decomposition

The increased cyclicality of the aggregate LFPR does not necessarily reflect the experience of all labor force participants. The participation rate could be less cyclical—or even countercyclical—for certain demographic groups. Of the civilian, noninstitutional population age 16 and older, 15.1 percent were young people (age 16–24) in the first quarter of 2017, 24.3 percent were prime-age men (age 25–54), 25.2 percent were prime-age women, and 35.4 percent were age 55 or older. Table 3 shows the business cycle statistics for the participation rates of each of these groups. Each group's participation rate is multiplied by its population share, so the groups' weighted participation rates sum to the aggregate LFPR.

The table shows that while the volatility of each demographic group (relative to GDP) did not change much from the pre-1984 period to the post-1983 period, the cyclicality did. In line with the aggregate LFPR, the LFPR of prime-age workers, both men and women, became significantly more procyclical over time. The correlation of GDP and population-share-weighted LFPR increased by 0.35 for prime-age men and by 0.27 for prime-age women. In contrast, the negative sign on the coefficient for older workers in 1984–2017 shows that the LFPR turned countercyclical during this period, a significant shift of −0.35. The change in the LFPR of young workers was not statistically significant.[12]

The increased cyclicality of the aggregate LFPR since 1984 can be attributed to the more procyclical participation of prime-age workers, which more than offsets the effect of the countercyclical participation of older workers. Table 4 decomposes the cyclicality of the LFPR into the contributions of each demographic group, similar to the labor force status decomposition reported in Table 2. Once again, the decomposition has to contend with the discrepancy between the cyclical LFPR and the cyclical weighted participation rates of the demographic groups, DEV (=LFPR–LFPR_Y–LFPR_M–LFPR_F–LFPR_O). Nonetheless, a clear picture emerges: prime-age workers—men and women—account for the entire increase in the cyclicality of the LFPR (+0.34), while older workers make a substantial negative contribution. Specifically, the contributions of prime-age men and prime-age women increased by 0.21 and 0.13, respectively, while the contribution of older workers fell by 0.17. The contribution of the discrepancy, while sizeable, has no clear economic interpretation.

Table 3

Business Cycle Statistics for Demographic Groups

Variable	1948–2017	1948–83	1984–2017	Change
std(X)/std(Y)				
1. LFPR	0.18	0.17	0.20	0.03
2. LFPR_Y	0.13	0.14	0.10	–0.04
3. LFPR_M	0.09	0.08	0.11	0.03
4. LFPR_F	0.11	0.11	0.11	0.00
5. LFPR_O	0.09	0.08	0.10	0.02
corr(X, Y)				
6. LFPR	0.34	0.22	0.56	0.34***
7. LFPR_Y	0.17	0.18	0.37	0.18
8. LFPR_M	0.22	0.08	0.43	0.35***
9. LFPR_F	0.25	0.15	0.42	0.27**
10. LFPR_O	0.08	0.16	–0.19	–0.35***

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Notes: The variable *X* denotes the cyclical component of the LFPR and the population-share weighted LFPR of young workers (LFPR_Y), prime-age men (LFPR_M), prime-age women (LFPR_F), or older workers (LFPR_O). The variable *Y* denotes cyclical GDP. The significance of the change in the correlation coefficient was tested using Fisher's z-transformation. No significance test was performed on the change in the relative standard deviation. The sample ends in the first quarter of 2017.

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and author's calculations. All data sources accessed through Haver Analytics.

Table 4

Demographic Decomposition

Variable	1948–2017	1948–83	1984–2017	Change
1. LFPR	0.34	0.22	0.56	0.34
Contributions				
2. LFPR_Y	0.12	0.15	0.17	0.02
3. LFPR_M	0.11	0.03	0.24	0.21
4. LFPR_F	0.14	0.09	0.23	0.13
5. LFPR_O	0.04	0.07	–0.10	–0.17
6. DEV	–0.08	–0.13	0.01	0.14

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and author's calculations. All data sources accessed through Haver Analytics.

The increased cyclicality of the LFPR suggests that modeling labor force participation decisions may be important in studying business cycles, whether using models that focus on the prime-age population or the entire adult population. Abstracting from the dynamics of labor force participation, as most macroeconomic studies have done, could lead researchers to underappreciate the features of the labor market—such as real wage rigidities—that shape those dynamics.

IV. A Role for Real Wage Rigidity

The quantitative model analyses by Shimer and by Nucci and Riggi point to wage rigidity as a possible explanation for the change in the cyclicality of labor force participation. Their analyses make a clear prediction: less rigid wages imply a more procyclical LFPR, as they strengthen the discouragement effect and dampen the added worker effect.

Whether real wages are flexible or rigid remains an empirical question. Aggregate wage measures, such as average hourly earnings, the employment cost index, real hourly compensation, and median usual weekly earnings, are fairly acyclical—that is, insensitive to business cycle conditions. However, the acyclicality could be due to either wage rigidity or composition bias.[13] Composition bias reflects that low-wage jobs are more cyclical than high-wage jobs, thus dampening the rise in the overall wage level during economic expansions and the decline during downturns (Solon, Barsky, and Parker).[14]

With this caveat in mind, I examine differences in wage rigidity between the pre-1984 and post-1983 periods and between prime-age workers and older workers. Because the LFPR has become more cyclical since 1984, evidence of a decline in real wage rigidity would be consistent with the theoretical effect of wage rigidity on the cyclicality of labor force participation—though it would not rule out the possibility that wage rigidity has remained unchanged and composition bias has increased. Likewise, evidence of more rigid wages for older workers than for prime-age workers in the post-1983 period would provide an explanation for their less cyclical LFPR, though it could also point to greater composition bias among older workers.

I measure real wage rigidity by the persistence of the response of real wages to a technology shock, where a more persistent response indicates more rigid wages. Impulse responses are a common tool for assessing persistence in macroeconomics. Moreover, wage rigidity in the labor market search and matching model is usually defined in terms of the elasticity of wages with respect to labor productivity. To obtain responses to a technology shock, I estimate a vector autoregression model for labor productivity growth, the cyclical wage rate, the cyclical LFPR, and a measure of cyclical household wealth. Including the latter can control for fluctuations in non-labor income that may affect participation decisions, particularly for older workers.[15] I identify the technology shock by assuming no other shocks can have a long-run effect on labor productivity, following the method of Blanchard and Quah and of Gali.

The response of real wages to a technology shock has become less persistent since 1984, suggesting wages have become more sensitive to economic conditions. Chart 4 displays the impulse responses of real hourly compensation, the labor force participation rate, the ratio of net worth to disposable income, and labor productivity growth to a positive, one-standard-deviation technology shock.[16] Panel A shows the wage level increased more sharply and less persistently in response to a shock in the post-1983 period than before. The half-life of the wage response from its peak, a measure of persistence, was four quarters in the more recent period, compared with nine quarters in the earlier period. A shorter half-life indicates less persistence. Consistent with the reduced persistence of real wages, previous research finds that the sensitivity of real wages to the business cycle has changed over time. The survey paper by Abraham and Haltiwanger concludes that aggregate real wages have become more procyclical since 1970. The increased responsiveness of wages to a technology shock is consistent with a decline in real wage rigidity, although it might also reflect a diminished composition bias in the overall wage level.

The responses of the other variables are consistent with theoretical predictions. Panel B shows that the response of the LFPR was positive in the post-1983 period and negative in the pre-1984 period.

Chart 4

Impulse Responses in the Pre-1984 and Post-1983 Periods

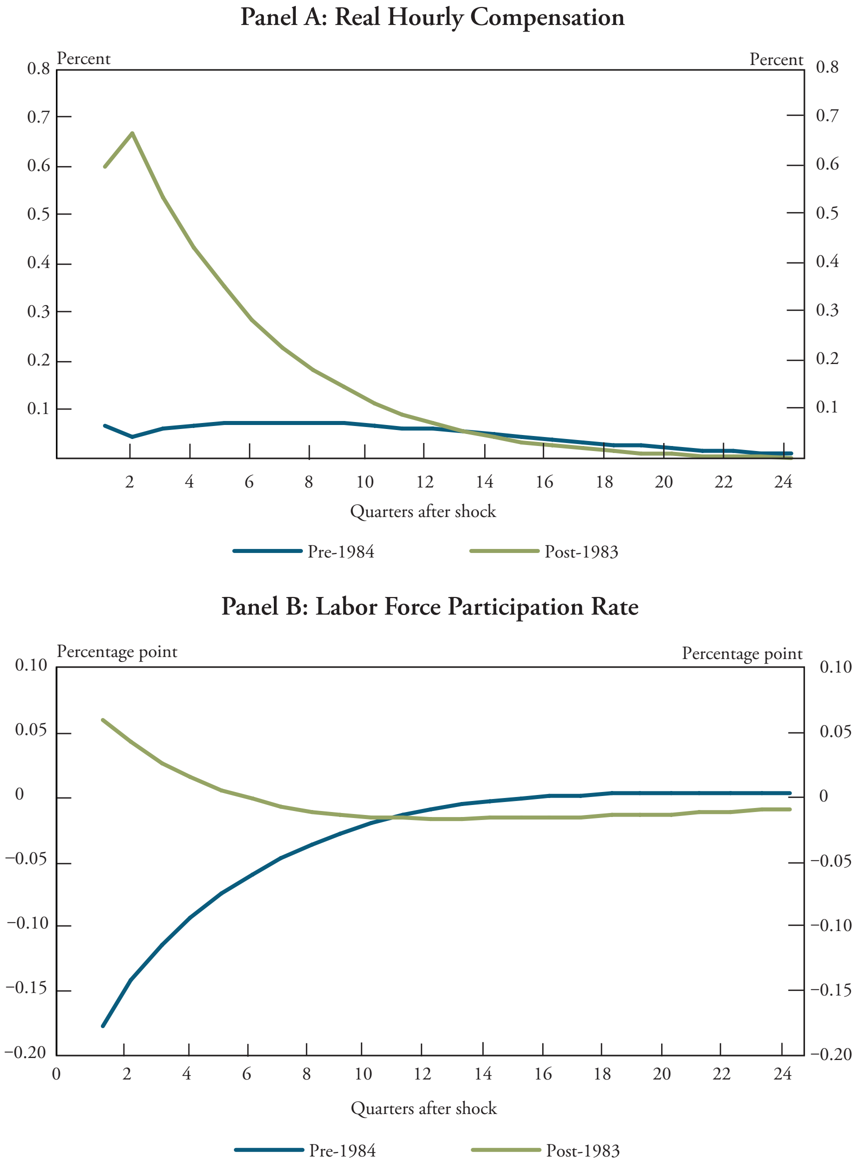
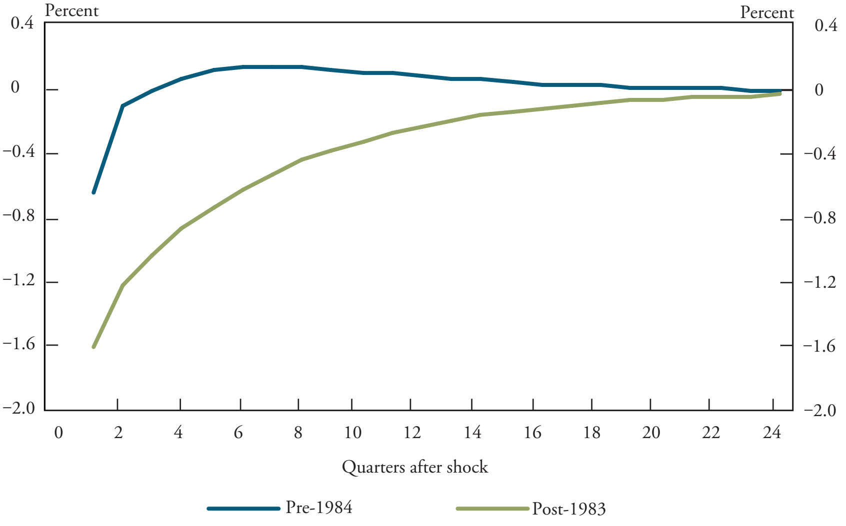
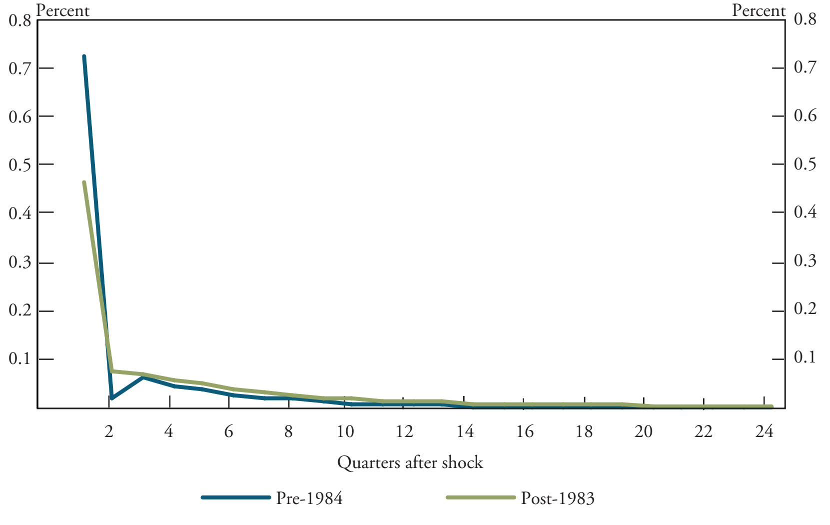


Chart 4 (continued)

Panel C: Net Worth



Panel D: Labor Productivity Growth



Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Board of Governors of the Federal Reserve System, and author's calculations. All data sources accessed through Haver Analytics.

This response is consistent with the theoretical prediction that more flexible wages strengthen the discouragement effect, which raises labor force participation during a boom, whereas more rigid wages strengthen the added worker effect, which lowers participation during a boom. Panel C shows that net worth declines relative to disposable income following the shock. The negative response is consistent with the predictions from a dynamic general equilibrium model. In Christensen and Bib's model, a positive technology shock lowers inflation and raises output; these opposite movements have offsetting effects on the nominal interest rate, which is set according to an interest rate rule. Hence, the real interest rate increases, thereby reducing net worth. Finally, the technology shock has a short-lived effect on labor productivity growth, although it permanently raises the level of productivity.

Focusing on the post-1983 period, the response of real wages to a technology shock appears somewhat more persistent for older workers, suggesting wages may be more rigid for these workers than for prime-age workers. Chart 5 displays the impulse responses of real median usual weekly earnings and labor force participation for prime-age workers and older workers along with those of net worth and labor productivity growth.[17] Panel A shows the response of real wages has a half-life of six quarters for prime-age workers compared with nine quarters for older workers. As the LFPR is procyclical for prime-age workers and countercyclical for older workers, the greater wage persistence for older workers suggests a stronger added worker effect and a weaker discouragement effect than for prime-age workers. However, the LFPR for older workers has a larger positive response to the technology shock than for prime-age workers, which contrasts with the unconditional business cycle statistics (Panel B). This response indicates that technology shocks are not an important driver of the cyclical dynamics of labor force participation. Finally, the responses of net worth and labor productivity growth, shown in Panels C and D, are similar to those in Chart 4.

Chart 5

Impulse Responses of Prime-Age and Older Workers

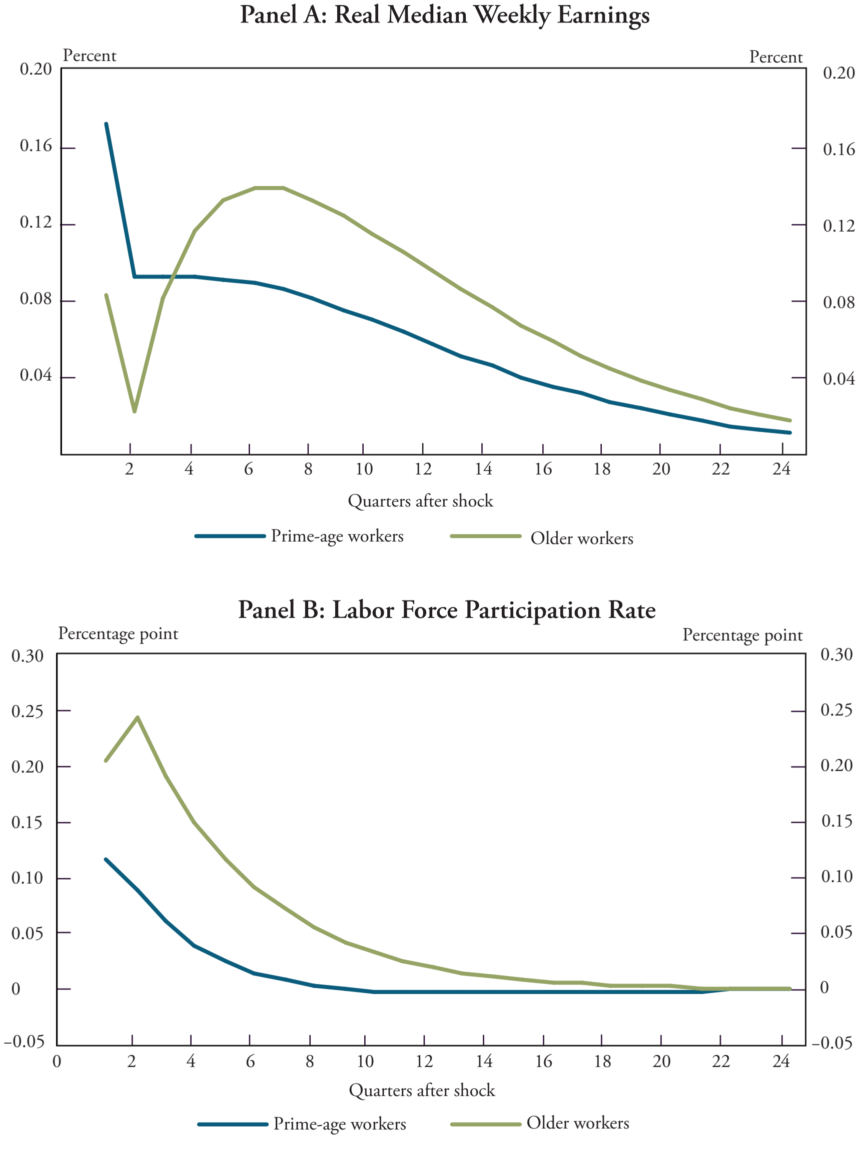
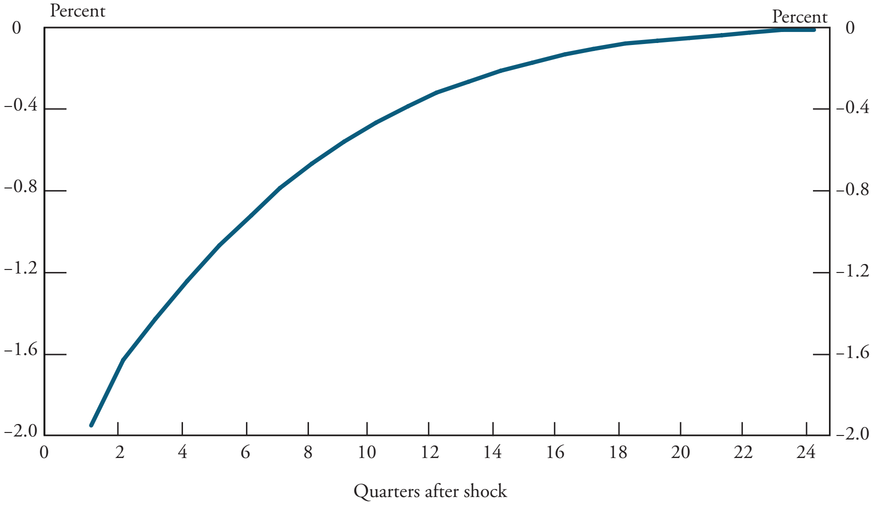
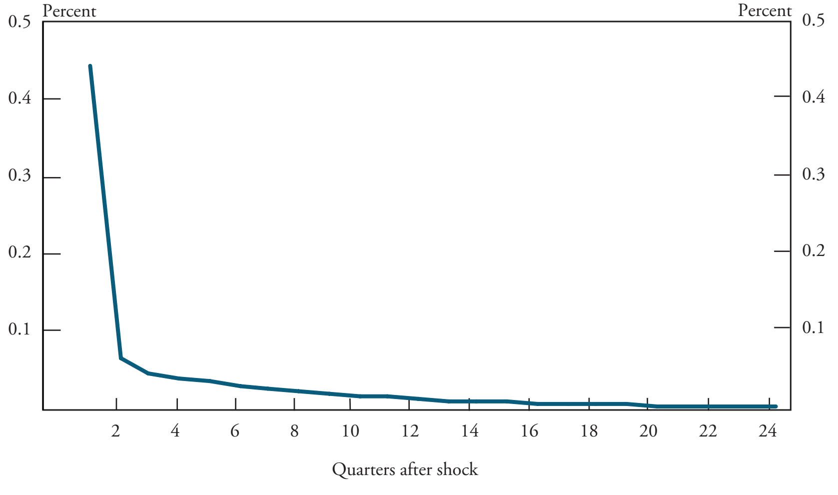


Chart 5 (continued)

Panel C: Net Worth



Panel D: Labor Productivity Growth



Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Board of Governors of the Federal Reserve System, and author's calculations. All data sources accessed through Haver Analytics.

V. Conclusion

Labor force participation has become more cyclical since the mid-1980s, due largely to more procyclical fluctuations in employment that have not been offset by more countercyclical fluctuations in unemployment. The increased cyclicality of the overall LFPR reflects the increased cyclicality of prime-age workers' LFPR, which has been partially offset by a decline in the cyclicality of older workers' LFPR. Furthermore, evidence indicates that real wages have become less persistent since the mid-1980s and are less persistent for prime-age workers than for older workers. Although inconclusive, the evidence points to real wage rigidity as a promising explanation for the change in the cyclicality of labor force participation over time and the differences in its cyclicality across demographic groups.

Understanding the cyclical properties of labor force participation is important for monetary policy makers who must estimate the degree of resource utilization in the labor market. As economic downturns have affected participation considerably since 1984, future downturns will likely see sizeable declines in labor force participation as well, affecting assessments of the degree of resource utilization in the labor market. Complicating such assessments is the fact that most business cycle models abstract from fluctuations in the participation rate, as the prevailing view is that workers' participation decisions have a limited association with the business cycle. The shifts documented in this article, however, challenge this view, underlining the potential importance of including labor force participation decisions in macroeconomic models.

Appendix
Estimation Results

This appendix contains the estimation results of the vector autoregressions discussed in Section IV. Table A-1 presents the reduced-form regression estimates for the impulse responses of real hourly compensation in the pre-1984 and post-1983 periods (Chart 4), and Table A-2 presents the associated residual covariance matrixes. Table A-3 presents the reduced-form regression estimates for the impulse responses of median usual weekly earnings of prime-age and older workers (Chart 5), and Table A-4 presents the associated residual covariance matrix.

Table A-1

Reduced-Form Vector Autoregression Estimates for Chart 4

Panel A: Sample from 1962:Q1 to 1983:Q4

Explanatory variables	DLP	CNW	CW	CLFPR
DLP(−1)	−0.1160 (0.1109)	0.4478 (0.2926)	−0.0332 (0.1012)	−0.0007 (0.0413)
CNW(−1)	−0.0387 (0.0282)	0.7614 (0.0745)	0.0216 (0.0258)	−0.0056 (0.0105)
CW(−1)	0.0329 (0.0617)	0.0277 (0.1627)	0.8564 (0.0563)	0.0452 (0.0230)
CLFPR(−1)	−0.4243 (0.1757)	−0.4045 (0.4638)	−0.1558 (0.1605)	0.8289 (0.0655)
Constant	0.6044 (0.1329)	−0.8780 (0.3508)	0.0036 (0.1214)	0.0438 (0.0495)
R^2	0.0739	0.6431	0.7883	0.6931

Table A-1 (continued)

Panel B: Sample from 1984:Q1 to 2016:Q4

Explanatory variables	DLP	CNW	CW	CLFPR
DLP(–1)	0.0051 (0.0888)	0.4238 (0.4498)	0.5052 (0.1622)	0.0035 (0.0340)
CNW(–1)	–0.0238 (0.0081)	0.9009 (0.0410)	0.0358 (0.0148)	0.0041 (0.0031)
CW(–1)	0.0561 (0.0249)	0.0647 (0.1263)	0.8136 (0.0455)	–0.0104 (0.0095)
CLFPR(–1)	0.0317 (0.0977)	–0.1623 (0.4949)	–0.0051 (0.1784)	0.9064 (0.0374)
Constant	0.5065 (0.0713)	0.0295 (0.3613)	–0.2291 (0.1302)	–0.0129 (0.0273)
R^2	0.0834	0.8196	0.7816	0.8243

Notes: DLP, CNW, CW, and CLFPR denote labor productivity growth, cyclical net worth, cyclical real compensation per hour, and cyclical LFPR, respectively. Standard errors are in parentheses.

Table A-2

Residual Covariance Matrixes for Chart 4

Panel A: Sample from 1962:Q1 to 1983:Q4

Dependent variables	DLP	CNW	CW	CLFPR
DLP	0.8179	0.1288	0.1912	–0.0474
CNW	0.1288	5.6980	0.3769	–0.0876
CW	0.1912	0.3769	0.6820	–0.1050
CLFPR	–0.0474	–0.0876	–0.1050	0.1135

Panel B: Sample from 1984:Q1 to 2016:Q4

Dependent variables	DLP	CNW	CW	CLFPR
DLP	0.3864	0.1587	0.1661	–0.0044
CNW	0.1587	9.9212	–0.3874	–0.1537
CW	0.1661	–0.3874	1.2893	0.0142
CLFPR	–0.0044	–0.1537	0.0142	0.0565

Notes: DLP, CNW, CW, and CLFPR denote labor productivity growth, cyclical net worth, cyclical real compensation per hour, and cyclical LFPR, respectively.

Table A-3
Reduced-Form Vector Autoregression Estimates for Chart 5

Explanatory variables	DLP	CNW	CWPR	CW55	CLFPRPR	CLFPR55
DLP(−1)	0.0213 (0.0905)	0.2260 (0.4520)	−0.1683 (0.1684)	−0.3296 (0.2532)	0.0186 (0.0601)	0.2115 (0.2453)
CNW(−1)	−0.0171 (0.0076)	0.9041 (0.0382)	−0.0103 (0.0142)	−0.0225 (0.0214)	0.0027 (0.0051)	−0.0013 (0.0207)
CWPR(−1)	0.0743 (0.0401)	0.1612 (0.2005)	0.7592 (0.0747)	0.3482 (0.1123)	−0.0074 (0.0267)	−0.0740 (0.1089)
CW55(−1)	−0.0110 (0.0271)	0.1272 (0.1357)	0.0549 (0.0506)	0.6235 (0.0760)	0.0013 (0.0181)	0.0301 (0.0737)
CLFPRPR(−1)	0.0139 (0.0916)	−0.2050 (0.4580)	−0.0160 (0.1706)	−0.1008 (0.2565)	0.7511 (0.0609)	0.1183 (0.2486)
CLFPR55(−1)	0.0361 (0.0241)	0.1311 (0.1206)	0.0636 (0.0449)	0.1163 (0.0675)	−0.0095 (0.0160)	0.7055 (0.0654)
Constant	0.4942 (0.0718)	0.1082 (0.3589)	0.1124 (0.1337)	0.2127 (0.2010)	−0.0031 (0.0477)	−0.0754 (0.1948)
R^2	0.1066	0.8290	0.6566	0.6443	0.5666	0.4987

Notes: DLP, CNW, CWPR, CW55, CLFPRPR, and CLFPR55 denote labor productivity growth, cyclical net worth, cyclical real median usual weekly earnings of prime-age workers, cyclical real median usual weekly earnings of older workers, cyclical LFPR of prime-age workers, and cyclical LFPR of older workers, respectively. Standard errors are in parentheses.

Table A-4
Residual Covariance Matrix for Chart 5

Dependent variables	DLP	CNW	CWPR	CW55	CLFPRPR	CLFPR55
DLP	0.3826	0.0786	0.0328	0.2715	0.0400	−0.1735
CNW	0.0786	9.5550	−0.2631	0.1451	−0.0705	−1.2587
CWPR	0.0328	−0.2631	1.3257	0.6451	−0.0194	0.1649
CW55	0.2715	0.1451	0.6451	2.9974	−0.0654	−0.2752
CLFPRPR	0.0400	−0.0705	−0.0194	−0.0654	0.1690	0.0451
CLFPR55	−0.1735	−1.2587	0.1649	−0.2752	0.0451	2.8154

Notes: DLP, CNW, CWPR, CW55, CLFPRPR, and CLFPR55 denote labor productivity growth, cyclical net worth, cyclical real median usual weekly earnings of prime-age workers, cyclical real median usual weekly earnings of older workers, cyclical LFPR of prime-age workers, and cyclical LFPR of older workers, respectively.

Endnotes

[1]The Bureau of Labor Statistics provides detailed monthly information on the population, employment, and unemployment.

[2]Earlier business cycle research emphasized the importance of incorporating labor market participation decisions in macroeconomic models by specifying household decisions for home production and market production (Benhabib, Rogerson, and Wright; Greenwood and Hercowitz). However, these studies focused on the dynamics of aggregate hours worked and did not consider the LFPR.

[3]In microeconomic terms, the discouragement effect functions as a substitution effect on households' labor supply, and the added worker effect functions as an income effect. In the presence of real wage rigidities, the positive income effect arising from the households' income loss in a downturn is not offset by a negative substitution effect from a lower wage.

[4]Tüzemen studies the role of on-the-job search in a model with unemployment and labor force participation. She finds that accounting for the dynamics of the job-to-job flow of workers ensures a mildly procyclical LFPR and a countercyclical unemployment rate. This is consistent with the effects of real wage rigidity mentioned in the text, as on-the-job search is a source of endogenous wage rigidity in her model.

[5]Many studies analyze one or a few structural factors in detail. For more comprehensive discussions of structural factors, see Aaronson and others (2014, 2006); DiCecio and others; Mosisa and Hipple; and Van Zandweghe.

[6]The case of a random walk provides a stark example of the spurious predictability of the HP filter. Although the innovations of the random walk process are white noise, the cyclical component obtained with the HP filter is highly predictable. See Hamilton for further discussion.

[7]Based on the HP filter, the trough of the cyclical LFPR reached a similar depth in the last recession as in the prior two recessions and rebounded more strongly in the current expansion: in the first quarter of 2017, the cyclical LFPR surpassed its previous peak.

[8]Other recent studies conclude, in contrast, that the sharp decline in the cyclical LFPR is unusual. Erceg and Levin argue "the LFPR is practically acyclical during 'normal times' but drops markedly following a large and persistent aggregate demand shock." Aaronson and others (2014) consider the same view, saying "although the traditional view on movements in labor force participation over the business cycle has generally emphasized the absence of a substantial cyclical response, the breathtaking drop in labor demand in 2008 and 2009 may mean that this time really is different."

[9]Nevertheless, conclusions regarding the relative importance of cyclical and structural factors for the recent decline in the LFPR range widely across recent studies. Erceg and Levin find that the cyclical component accounts for the bulk of

the decline in the LFPR for prime-age workers from 2007 until 2012. In contrast, Kudlyak estimates that the LFPR was close to its estimated trend in 2012. Fernald and others conclude that two-thirds of the decline in the LFPR from 2010 to 2016 was due to factors other than demographic change, but that the recession was only one of several possible factors.

[10]The test is analogous to a sup test for a structural break with unknown break date (Andrews). Here, the significance test of two correlation coefficients uses Fisher's z-transformation. The null hypothesis of no break is rejected most clearly in the first quarter of 1984, when the p-value is 0.0011. Another highly significant break appears in the fourth quarter of 1975 (when the p-value is 0.0013); however, I limit the analysis to a single break because the period from 1975 to 1984 is likely too short to calculate business cycle statistics precisely. In addition to the slightly smaller p-value for the break date of 1984, that date is appealing because it coincides with the start of the Great Moderation era of low volatility of real GDP and many other macroeconomic time series. Based on the HP filter, the test indicates a break in the fourth quarter of 1973.

[11]The discrepancy arises because the EPOP and UPOP ratios are added up first to obtain the LFPR, and the trend LFPR is calculated next. Reversing this order—calculating the trend EPOP and trend UPOP ratios first and summing them next—would avoid the discrepancy. However, that procedure would be somewhat arbitrary, because the labor force can be partitioned in many different ways (in addition to the breakdown into EPOP and UPOP) and the trend and cyclical LFPR would change according to the partition used.

[12]Partitioning labor force participation by education levels could also provide an interesting picture, although this data is not available until 1992, and the window may be too short to detect changes in cyclicality. Over the 1992–2017 period, the relative volatility of labor force participation is lower for higher levels of educational attainment, but there is no clear relationship between education level and the cyclicality of labor force participation.

[13]The employment cost index is designed to control for the composition of jobs in the economy. However, even this index contains a countercyclical component, as the experience profile of jobs changes over the business cycle (Ruser).

[14]Moreover, search and matching models imply that only wages for new matches between workers and jobs are relevant for labor market dynamics, not the wages of continuing matches. Pissarides reviews the empirical literature and concludes that wages of new matches are highly cyclical, but Gertler, Huckfeldt, and Trigari find that only wages from job-to-job movers are cyclical, whereas wages for new hires from unemployment are not.

[15]To compare the pre-1984 and post-1983 periods, wages are measured by real compensation per hour detrended with Hamilton's procedure. To compare wages of prime-age workers and older workers in the post-1983 period, nominal wages are measured by median usual weekly earnings, seasonally adjusted and deflated by the consumer price index. The resulting real wage measure is detrended

with Hamilton's procedure. Household wealth is measured as the detrended ratio of the net worth of households and nonprofits to personal disposable income, and labor productivity as output per hour in the business sector. Not including or not detrending the net worth variable does not qualitatively alter the results.

[16]I estimate the vector autoregression model on these four variables and a constant, and set the lag length to one as indicated by the Schwarz criterion.

[17]Unlike for Chart 4, which is based on a four-variable model estimated on two data samples, the impulse responses are generated by a six-variable model estimated on the sample starting in the first quarter of 1984. The lag length is set to one according to the Schwarz criterion.

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