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Recent U.S. Labor Force Dynamics: Reversible or not?[1]

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Abstract

The U.S. labor force participation rate (LFPR) fell dramatically following the Great Recession and has yet to start recovering. A key question is how much of the post-2007 decline is reversible, something which is central to the policy debate. The key finding of this paper is that while around ¼–⅓ of the post-2007 decline is reversible, the LFPR will continue to decline given population aging. This paper's measure of the "employment gap" also suggests that labor market slack remains and will only decline gradually, pointing to a still important role for stimulative macro-economic policies to help reach full employment. In addition, given the continued downward pressure on the LFPR, labor supply measures will be an essential component of the strategy to boost potential growth. Finally, stimulative macroeconomic and labor supply policies should also help reduce the scope for further hysteresis effects to develop (e.g., loss of skills, discouragement).

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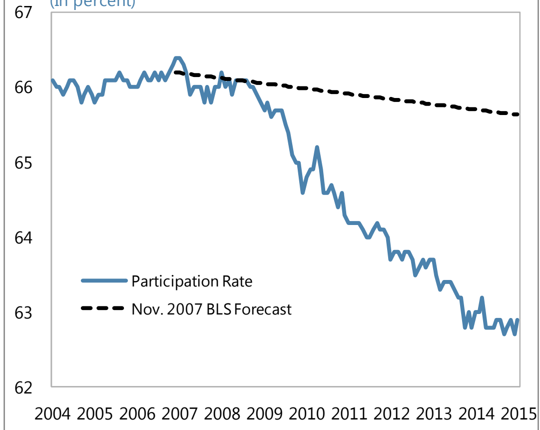
I. INTRODUCTION

The U.S. labor force participation rate (LFPR) fell dramatically following the Great Recession and has yet to start recovering (Figure 1). Indeed, the current LFPR of 62.8 percent is around the lowest rate since 1978. Taking a longer view of LFPR dynamics yields some important background to the recent decline (Figure 2). In particular, the LFPR increased sharply from just below 60 percent in the early 60s to above 66 percent by 1990, largely reflecting the baby boom generation (especially women) entering the labor force. Over the 1990s, the trend line flattened sharply, with the LFPR reaching a global peak of 67.3 percent in 2000Q3, as participation rates for new cohorts of women stopped increasing. Since the 2001 Recession, the LFPR has been largely on a secular decline.

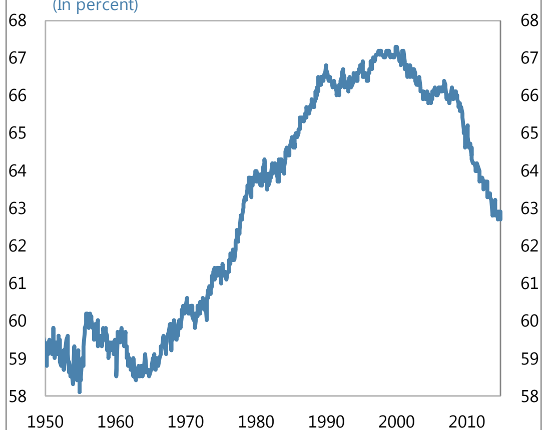
Figure 1. Labor Force Participation Rate
(In percent)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

A key question is how much of the post-2007 decline is reversible**.** LFPR dynamics can be driven by structural factors (e.g. population aging, increased college enrollment as education becomes more accessible, or later retirement due to better health) and cyclical ones related to job prospects. And forecasting is complicated by the fact that some structural factors could be reversible, (e.g. if the trend of increasing college enrollment reversed because the cost of college education for the marginal student became too high relative to the return), while part of the LFPR decline associated with cyclical factors could become irreversible (e.g. if the Great Recession led to more older workers to apply, and get accepted, for social security disability insurance).

Figure 2. Labor Force Participation Rate
(In percent)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

Explaining the post-2007 decline is at the center of the policy debate.[2] This is because understanding the extent to which the decline is reversible and hence the LFPR's future path is crucial to estimating the amount of slack in the labor market. With the Federal Reserve having a mandate for maximum employment as well as price stability, the degree of labor market slack is a key factor when determining the future course of monetary policy, in particular how gradually interest rates should rise if there is a large amount of slack.

[2] Key recent papers with important policy implications include Erceg and Levine (2013), Aaronson et al. (2014), and CEA (2014).

The future dynamics of the LFPR are also a key driver of potential output, explaining why labor supply policies are receiving a lot of attention.

Against this background, this paper addresses the following questions:

- How much of the decrease since the Great Recession is driven by demographics, cyclical, and other structural forces? How much is reversible?
- What is the baseline forecast for the LFPR over the next few years? What are the risks around this baseline? What is the current and projected level of labor market slack?
- What are the macroeconomic and supply-side policy implications?

An important contribution of the paper is the use of state level analysis to identify the magnitude of cyclical forces. Other work has used similar techniques to those found in this paper to quantify the role of demographic forces (e.g. Aaronson et al 2014 and CEA 2014). The use of a panel of state level data allows this paper to take a step further and precisely estimate the impact of changes in cyclical conditions on the LFPR. The paper also adds to Erceg and Levin (2013) state-level analysis by using the "Bartik shock"—which predicts employment growth based on states's industry mix—as an instrument to effectively strip out labor supply shocks from the cyclical conditions variable. Finally, the paper considers the impact of other structural but non-demographic forces such as the rising participation of older workers, falling participation of youths, and trends in social security disability insurance (SSDI).

The key finding of this paper is that while around ¼–⅓ of the post-2007 decline is reversible, the LFPR will continue to decline given population aging. With participation rates for older workers lower than for prime age workers, demographic models suggest that aging of the baby boom generation explains around 50 percent of the near 3 percentage points LFPR decline during 2007–13. And the state-level panel regression analysis suggests that about 30–40 percent of the decline is driven by cyclical factors. The rest is made up of non-demographic structural factors such as increasing college enrollment and fewer students working, and cohort effects. With some of the decline triggered by cyclical factors and non-demographic structural factors judged to be irreversible, only around a ¼–⅓ of the post-2007 decline is forecast to be reversed over the next few years as job prospects improve. And as population aging continues to weigh, this reversal only causes the LFPR to flatline in the near term projection, with the secular decline reasserting itself once the cyclical bounceback starts to wane.

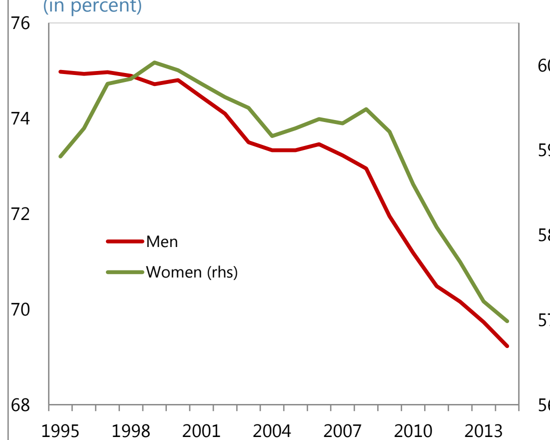
Remaining slack in the labor market points to an important role for macroeconomic and labor supply policies. This paper's measure of the "employment gap"—which includes participation and part-time worker gaps as well as the unemployment gap—suggests that labor market slack remains and will only decline gradually in the baseline scenario. This points to a still important role for stimulative macro-economic policies to help reach full employment. In addition, given the continued downward pressure on the LFPR, labor supply measures will be an essential component of the strategy to boost potential growth. Finally, stimulative macroeconomic and labor supply policies should also help reduce the scope for further hysteresis effects to develop (e.g., loss of skills, discouragement).

The rest of the paper is organized as follows. Section B estimates the structural decline in the LFPR that can be explained by population aging ("the demographic effect") using national level analysis by different age groups, as well as examining the importance of cohort effects. Section C uncovers the cyclical component of the recent decline in the LFPR by using state-level panel regression analysis. Section D discusses some key demographic and economic groups affecting recent LFPR dynamics, namely youths, social security disability insurance recipients, and older workers. Section E presents forecasts of the LFPR over the forecast horizon and proposes a broad measure of labor market slack. Section F concludes and discusses policy implications.

II. Population Aging and "Cohort Effects"

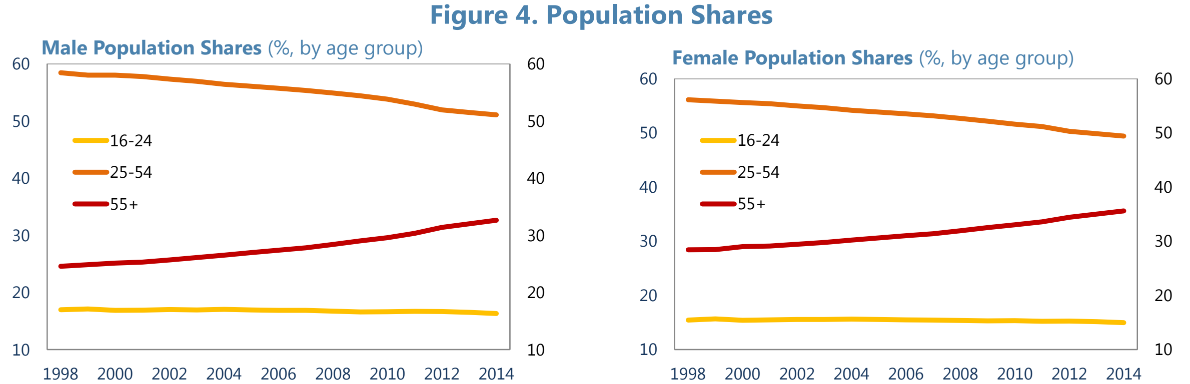
Aging is starting to weigh on participation rates for both males and females, although there are some differences across genders. Participation rates for males were already on a downward trend starting the mid 1990s (Figure 3), although their rate of decline accelerated markedly in the aftermath of the Great Recession. In particular, the participation rate of males declined by 0.1 percentage points (p.p.) per year between 1995 and 2007, compared to 0.6 p.p. per year between 2008 and 2014. Female participation rates, however, only started declining in the late 1990s, after which they have followed a similar pattern to those for males. The recent pattern of downward pressure on participation rates for both men and women is consistent with population aging (Figure 4).

Figure 3. Labor Force Participation Rates
(in percent)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

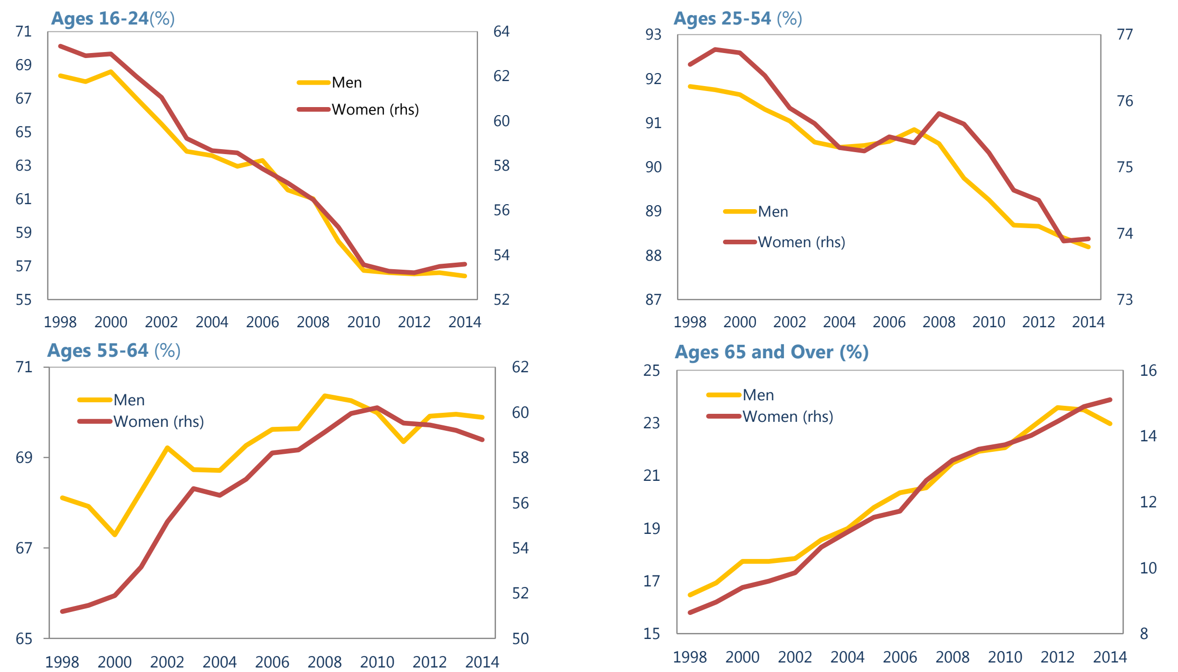
Figure 4. Population Shares



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

Older workers have increased their participation rates, whereas youths and prime-age workers have reduced them. 16–24 year-olds have been steadily reducing their participation rates since 2000. Similarly, although to a lesser extent, prime-aged workers have also reduced their participation rates (Figure 5). Older workers, however, have increased their attachment to the labor force: most notably those aged 65 and above, for whom participation rates have increased by almost 50 percent for males and nearly doubled for females since the late 1990s. We will return to the factors behind the trends for youths and older workers in Section IV.

Figure 5. Participation Rates



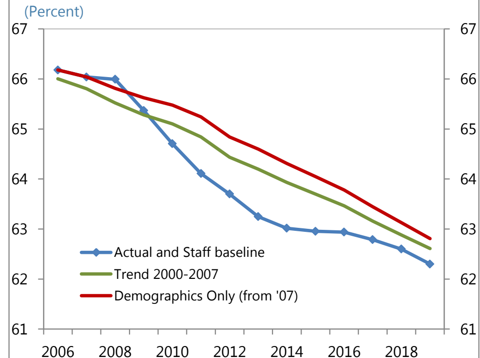
Sources: U.S. Bureau of Labor Statistics, Haver Analytics

To estimate the total demographic effect of these changes, population models and "shift share" analysis are used. Both approaches utilize detailed census and BLS data on population and labor force by age group and gender. Below we present the results of both approaches, with a more detailed description of the methodologies and robustness checks in Annex I.

A. Population Models

In our first population model we estimate the "demographic effect" of the participation rate decline by holding the participation rate of each age group constant at the level of a particular year—namely 2007 in our analysis—and letting the population shares of each group vary according to history. Doing so allows us to construct the aggregate participation rate that would have been obtained if the only changes through time stemmed from changes in the population share of each group (red line in figure 6).

Figure 6. Particpation Rates in Baseline Scenario
(Percent)



Sources: U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and IMF staff estimates.

A second approach is to estimate participation rate trends for each age group over a specific period—e.g., the years 2000 to 2007—and use the estimated trends to project the evolution of each age group's participation rate. These age-specific projections are then combined with population shares to calculate the aggregate participation rate (green line in figure 6). Note, however, that this approach comingles the effects from demographic changes (via changes in population shares) and from structural changes in the age-specific participation rates (as each group's participation rate follows its specific trend).

Both population models considered suggest a demographic effect of around ½ of the total decline in the labor force participation rate since 2007. These findings are very similar to estimates produced elsewhere (Table 1). Fujita (2013) relies on the Current Population Survey (CPS) micro dataset on 'Reported reasons for non-participation' to find that retirement and disability account for two-thirds of the decline in participation between 2000 and 2013, although the decline due to retirement has taken place after 2010. This implies that most of the decline in participation is likely to be irreversible, as retirees and disabled are unlikely to rejoin the workforce in large numbers even as job prospects improve. The CBO (2014) and CEA (2014), in turn, use similar approaches to our demographic models to examine long-term participation trends. They find that structural/demographic forces account for around 50–60% of the participation rate decline during 2007–13. Finally, Mishel *et al.*, (2012) find that the structural component—measured as the long-term trend of the participation rate—explains only one-third of the fall in participation between 2007 and 2011. However, this result partly stems from the authors' use of a longer-term trend of participation rates (for the period 1989–2007), which is consequently flatter than the trends estimated in this paper.

Table 1. Estimates of structural component in the reduction of the participation rate (various periods, in %)

	Period	Structural Component
Aaronson et. al.	2007-14	54%
CEA (2014)	2007-14	52%
CBO (2014)	2007-13	50%
Mishel, Bivens, Gould, and Shierholz (2012)	2007-11	33%
Fujita (2013)	2000-13	65%

B. Shift Share Analysis

Shift share analysis helps quantify the relative importance of changes in the population shares and participation rates of each age group.[3] The total change in the participation rate with respect to a base year can be approximated as the sum of (a) changes in the population share of each group weighted by their base-year participation rate (the so-called population share shift or "demographic effect"); and (b) changes in the participation rate of each group weighted by their base-year population share (the so-called participation rate shift):

$$(1)\ \ p_t - p_0 \approx \textstyle\sum_g \{\, p_0^g\left(s_t^g - s_0^g\right) + s_0^g\left(p_t^g - p_0^g\right) \},$$

[3] The decomposition uses data on population and labor force from the Household Employment Survey (*cf.* Annex I for more details).

where p_t stands for the aggregate participation rate, and p_t^g and s_t^g stand for the participation rate and the population share of age group *g* in year *t*, respectively.

In line with the population models, the population shift or demographic effect explains around 50 percent of the drop in the aggregate participation rate during 2007–2013, but this masks important differences by gender and age group (Tables 2–3). During 2007–10, the decline in male participation is largely explained by falling participation rates rather than the effects of aging, whereas during 2010–13 population aging is the main driver. For women, the decline in the LFPR was much smaller during 2007–10 and, interestingly, declining participation rates were more important than aging during 2010–13. Decomposing by age group, for males, both the young (16–24) and middle-aged (25–54) left the labor force in 2007–10, whereas during 2010–13 mostly the latter dropped out. For women, the young abandoned the labor force in 2007–10, whereas during 2010–13 middle aged and older workers started leaving.

Table 2. Shift Share Analysis: Deviations from Base Year

Total Population	Total LFPR Change	Population Shift	Participation Shift
2007-10	-1.3	-0.6	-0.8
2010-13	-1.5	-0.8	-0.7
Men			
2007-10	-2.0	-0.6	-1.5
2010-13	-1.5	-1.0	-0.4
Women			
2007-10	-0.7	-0.5	-0.2
2010-13	-1.4	-0.6	-0.8

Sources: U.S. Bureau of Labor Statistics, Haver Analytics and IMF staff calculations
Note: The total LFPR change equals the sum of the population shift, the participation shift, and the interaction term (cf. Annex I).

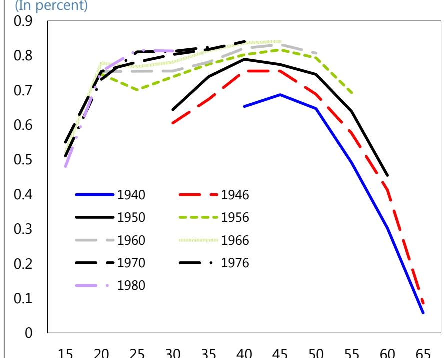
Table 3. Shift Share Analysis: Deviations from Base Year

	Men		Women	
	2007-10	2010-13	2007-10	2010-13
Total LFPR Change	-2.0	-1.5	-0.7	-1.4
Pop. Shift 16-24	-0.1	0.0	0.0	0.0
Pop. Shift 25-54	-1.4	-2.1	-1.2	-1.3
Pop. Shift 55-64	0.7	0.6	0.6	0.5
Pop. Shift 65+	0.2	0.4	0.1	0.3
Part. Shift 16-24	-0.9	-0.1	-0.6	-0.1
Part. Shift 25-54	-0.9	-0.5	-0.1	-0.7
Part. Shift 55-64	0.1	0.0	0.3	-0.2
Part. Shift 65+	0.2	0.1	0.1	0.1

Sources: U.S. Bureau of Labor Statistics, Haver Analytics and IMF staff calculations
Note: The total LFPR change equals the sum of the population shift, the participation shift, and the interaction term (cf. Annex I).

C. Cohort Effects

Figure 7. Female age-participation profile by birth cohort
(In percent)



Sources: U.S. Bureau of Labor Statistics, CBO, and IMF staff estimates

Apart from population aging, other structural factors that can be subsumed into unobservable "cohort" effects likely played only a minor role for the trend evolution of the LFPR over 2007–2013. It is well-known that the U.S. female age-participation profile was experiencing continuous outward shifts throughout much of the first half of the 20th century, reflecting evolving cultural trends and behavioral changes that affect lifetime participation (such as education, marriage, etc.). However, for cohorts born after the mid 1950s, the age participation profiles appear to have stopped shifting. Indeed, as Figure 7 illustrates, while lifetime participation profiles were continuously shifting outward for cohorts born between the 40s and mid-50s, the profiles of recent decades lie more or less on top of each other, particularly toward the end of the age distribution. Given our period of analysis starts in 2007, the bulk of the working-age females are from cohorts whose participation profiles didn't shift much, suggesting that unobserved cohort effects will not have had much of an impact on the aggregate LFPR trend post-2007. Instead, changes in the shape of the age-participation profile (lower in teen and early twenty years, higher in early prime-age, converging in middle-age) seem to suggest that structural changes that are specific to particular age groups have been playing a more important role—something we will come back to in section IV.

III. ESTIMATING THE "CYCLICAL EFFECT" USING STATE LEVEL DATA

To uncover the cyclical effect on the participation rate, we exploit the variation across states. Essentially, this section is focused on what share of the participation rate shift identified in Tables 2–3 can be attributed to cyclical factors, while Section IV looks at the share related to structural factors other than the demographic effect.

A. Panel Regression Analysis Across States

Underlying Model in Levels

To estimate the cyclical effect of labor demand on the participation rate, we start with a linear model determining the level of participation rate as:

(2)

$$PR_{st} = \alpha_s + \delta_{1s} * trend_t + \delta_{2s} * trend_t^2 + \sum_{k=0}^{l} \beta_k * cycle_{s,t-k} + \varepsilon_{st}$$

As at the national level, the participation rate in state *s* and year *t* may follow a linear and quadratic trend that accounts for aggregate aging dynamics and other structural forces not related to the business cycle. We allow the trends to be state-specific, accounting for evolution of structural forces that can follow different paths across states. Once de-trended, the participation rate evolves around a state-specific mean, which should capture unobservable state characteristics such as climate, geographic location, industrial specialization, etc, which in turn may affect the demographic composition and hence the mean participation rate across states. The main variable of interest is the measure of the state-specific business cycle (*cycle*) which should capture the annual variation in labor demand across states. The coefficient β_k therefore gives the effect of cyclical forces on the participation rate, allowing the adjustment to occur gradually over time via the lag structure.

Model on First Differences

Taking first differences of the level equation (2), we arrive at the following equation for the *change* in the participation rate:

(3)

$$\Delta PR_{st} = \delta_{1s} + \delta_{2s} * trend_t + \sum_{k=0}^{l} \beta_k * \Delta cycle_{s,t-k} + \xi_{st}$$

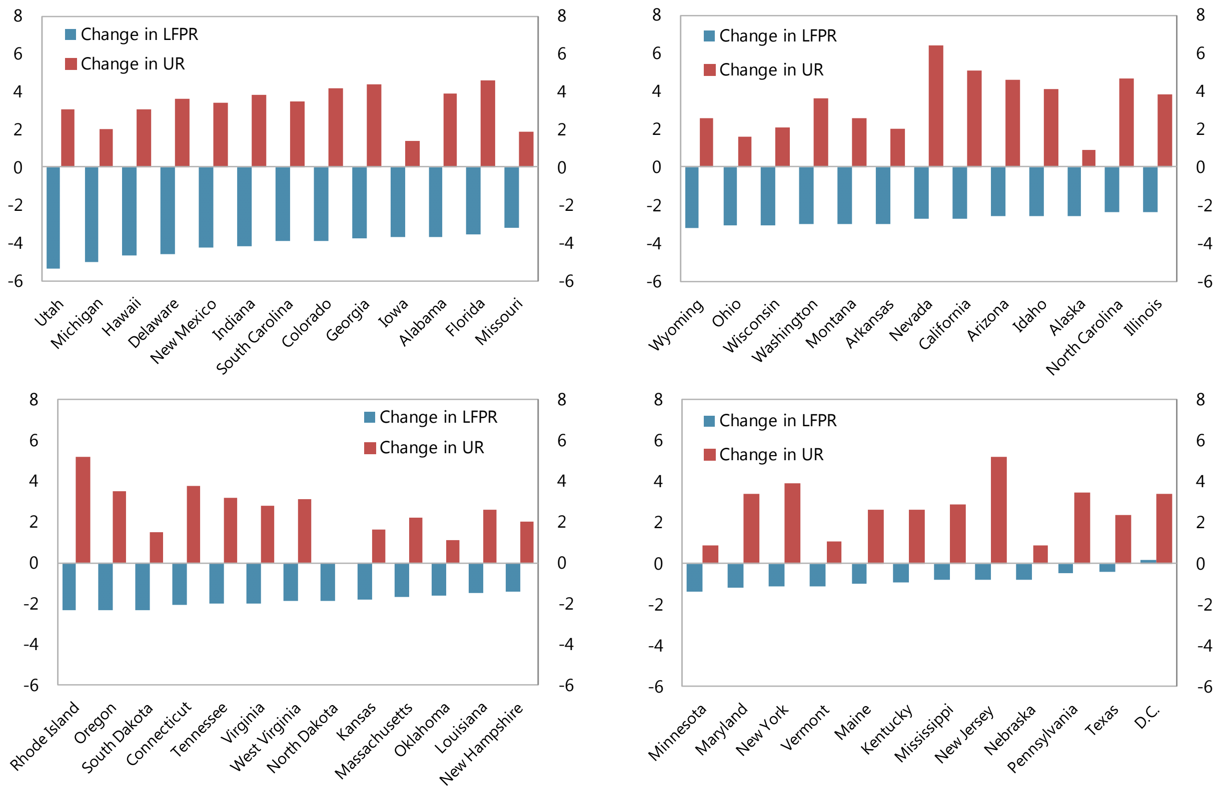
There are several advantages to estimating the model in first differences as opposed to levels: first, the level variable is likely non-stationary, which conventional unit root tests in fact suggest, possibly rendering the level estimation spurious. Second, the level of participation rate is highly persistent so that the level residuals are strongly auto-correlated, while this is no more the case in first differences. The constant and time trend are allowed to be state specific, reflecting state-specific linear and quadratic trends in levels of the LFPR, and hence capture differences in demographic and other structural trends across states.

We measure state labor demand or the cycle using two different measures of the employment gap at state level. The employment gap is calculated as the difference between payroll or household employment and its state-specific trend using a HP filter. As we want to measure changes to labor demand, we prefer these employment gap measures to the unemployment rate, which inevitably responds to endogenous changes in labor supply and the LFPR itself. To avoid that the HP filter fits a trend that is too close to actual data toward the end of the series, we adjust the end points as follows: For each state, we calculate the average annual employment growth between 2002 and 2005 (the last two years before the crisis where aggregate employment was at trend and unemployment close to NAIRU), and for all years starting with 2006, we impose trend growth rate to equal this average growth rate.

Instrumental Variables

The importance of taking account of endogeneity is evidenced by the lack of a clear relationship between state unemployment and participation rates since the Great Recession (Figure 8). The unemployment rate is often thought of as a good measure of cyclical slack. Hence, the relationship between the change in the unemployment rate and the change in the participation rate should illustrate how job prospects influence the decision to participate in the labor force. Strikingly, the participation rate change is only weakly correlated with the unemployment rate change (correlation coefficient of -0.16). For example, New Jersey and California experienced roughly the same increase in unemployment rate. Yet, the fall in participation rate in California was almost three times larger than in New Jersey. The participation rate fell by 2 p.p. in North Dakota and Virginia but relative to 2007, the unemployment rate was 2.8 p.p. higher in Virginia in 2012 but unchanged in North Dakota. The weak correlation could be the result of either: i) the unemployment rate not being a good proxy for cyclical slack, or ii) the participation rate being driven by other forces apart from cyclical ones, or both.

Figure 8. State Changes in LFPRs and Unemployment Rates (2007-2012)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics
Note: States are ordered by the magnitude of change in the Labor Force Participation Rate.

To solve the endogeneity problem, we use the "Bartik shock" as an instrument. The trend captures low frequency movements in employment potential, but cannot account for short-term shocks to labor supply, e.g. reactions to policy such as unemployment insurance benefit extension or temporary tax changes which also often vary at the state level. To control for these and other sources of endogeneity, we estimate equation (3) both with OLS and 2SLS, where the employment gap is instrumented by a measure of predicted employment growth based on a state's industry mix (*imix*):

$$imix_{st} = \sum_{j=1}^{J} \bar{\theta}_{sjt} * \Delta e_{jt} \quad (4)$$

This industry mix variable, often called the Bartik shock (Bartik, 1991), captures changes to a state's labor demand through an average of industry-specific employment growth at the national level (Δe_{jt}), weighted by the state's share of employment in each industry $\bar{\theta}_{sjt}$ (averaged over the previous five years). In other words, this is a measure of employment growth that would result if each industry's employment growth coincided with the national rate, and the sectoral distribution of employment by state did not fluctuate significantly from year to year. It is thus plausible to assume that this predicted employment growth is exogenous to state-specific shifts in labor supply.

Panel Regression Results

A significant cyclical effect is estimated, with some important lags of adjustment. Table 4 summarizes the regression results using the payroll employment gap as independent variable for the period 1976–2012. Similar results using state-level household employment are given in Annex II. The lower half of the table shows that the first stage coefficient is large, positive, and statistically significant (with very high F-statistics), making the industry mix variable a strong and appropriate IV for state-level labor demand. The 2SLS estimate is larger than with OLS, and the difference is statistically significant as implied by the p-value of the Hausman test.[4] They imply that a 1 percent increase in the employment gap leads to a 0.1 percentage point increase in participation rate in the same year, and another 0.1 percentage point increase in the subsequent two years. Weighting the states by their average population does not change the results substantially, suggesting that the average effect is not driven by peculiarities in some small or large states. While the estimates are relatively stable in the years prior to the crisis (not shown here), the dynamics during the Great Recession and recovery differ: the contemporaneous cyclical effect on the participation rate is reduced by half, and the adjustment is more persistent. The total effect of a 1 percent higher employment gap is still around 0.2 p.p., but distributed roughly evenly across 4 years.

Recasting the regression results to decompose the actual change in the aggregate LFPR gives a cyclical effect of 33–43 percent of the near 3 p.p. drop during 2007–13 (Table 4). Using the model from the last column of Table 4, owing to the size of the shock, cyclical conditions explain about 50 percent of the 1.4 p.p. drop in LFPR during the Great Recession. Post 2010, cyclical conditions still explain 20–35 percent of the LFPR decline. The latter reflects delayed adjustment as seen in the lag structure of the estimated regression model.

[4] The endogeneity is much more evident in the difference between OLS and 2SLS using household employment (see Table A2 in Annex II). This is not surprising, household employment, comes from the household survey and encompasses self-employment, which is more responsive to labor supply variation than payroll employment.

Table 4. State Level Regression Results

	Dependent variable: Δpr_t					
	OLS	2SLS				
			with lags	pop. weighted	1978-2007	2007-2012
$\Delta egap_t$	0.08***	0.11***	0.11***	0.11***	0.14***	0.07**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
$\Delta egap_{t-1}$			0.03***	0.03***	0.02	0.07***
			(0.01)	(0.01)	(0.01)	(0.02)
$\Delta egap_{t-2}$			0.04***	0.06***	0.06***	0.05***
			(0.01)	(0.01)	(0.02)	(0.01)
$\Delta egap_{t-3}$						0.05***
						(0.02)
Hausman test (p-val.)		0.000	0.004	0.004	0.005	0.925
1st stage:	Dependent variable: $\Delta egap_t$					
$imix_t$		0.76***	0.73***	0.77***	0.70***	0.91***
		(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
F-stat.		1432.8	985.5	841.7	668.5	413.1
N	1785	1734	1632	1632	1428	306
R^2	0.241	0.241	0.227	0.255	0.167	0.346

Sources: IMF staff calculations

Note: Column 1 estimates equation (3) with OLS and no lags in the employment gap variable. Column 2 instruments the contemporaneous employment gap with the industry mix based employment growth in equation (4). Columns 3 to 6 introduce further lags in the employment gap variable. Columns 4 to 6 weight the data by the average working-age population in each state. Column 5 and 6 splits the sample to sub-samples before and following the Great Recession. The Hausman test result reports the p-value of the null hypothesis that the contemporaneous employment gap is exogenous. The 1st stage panel reports the first stage coefficient for the contemporaneous employment gap and the first stage F-statistics. All specifications also include state-specific intercepts and trends (not shown). Standard errors are robust to heteroskedasticity and auto-correlation (using Newey-West kernel). ***, ** denote 1 and 5 percent statistical significance respectively.

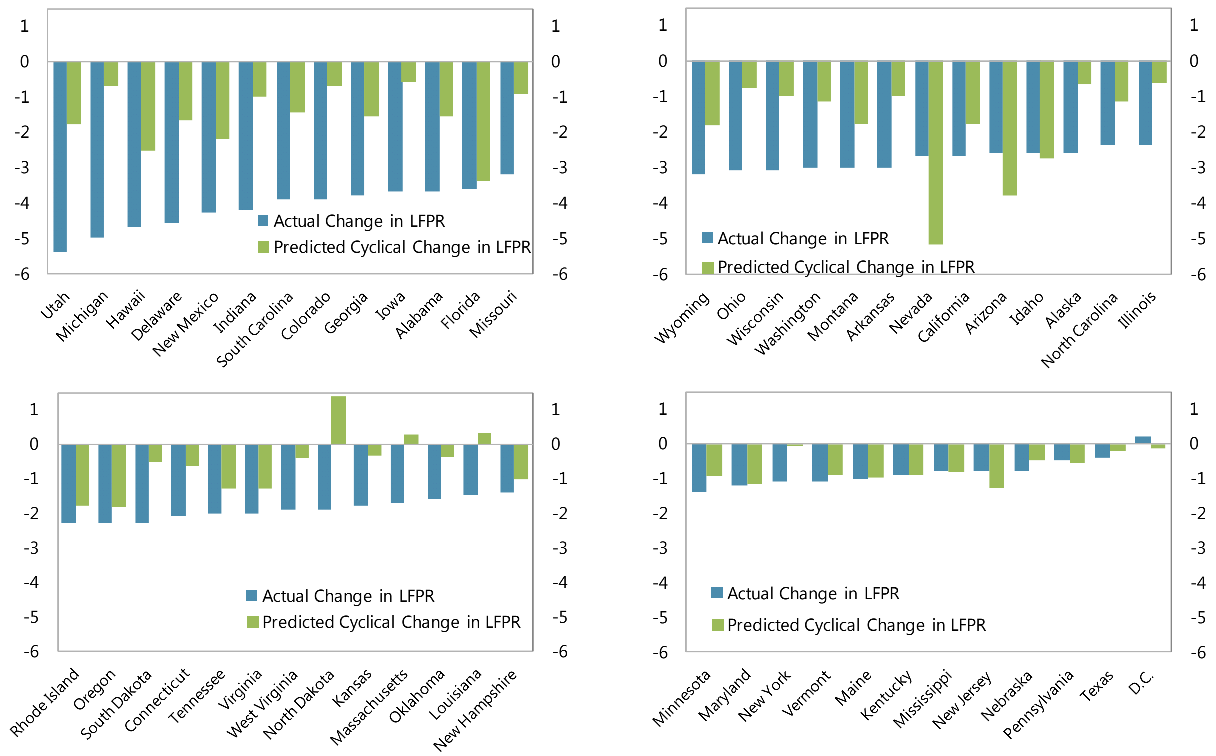
The cyclical effect can explain a significant amount of the drop in the LFPR for certain individual states, although there is substantial heterogeneity. Using the regression results for the average response of the participation rate to cyclical forces (Table 5, column 6), we can predict the cyclical change in state-level participation based on each state's change in its employment gap since the onset of the Great Recession (Figure 9). Overall, the predicted cyclical change in LFPR is correlated with the change in unemployment across states, although not perfectly (correlation coefficient -0.6). Thus the low correlation between changes in the unemployment rate and the LFPR shown in Figure 8 suggests that the unemployment rate by itself is not a good measure of labor market slack, particularly during and after the Great Recession (as it is endogenous to changes in LFPR itself). The model predicts much of the drop in LFPR in states that were hardest hit by the crisis, notably Nevada, Arizona, Florida, and California. It also correctly predicts either no change or even a rise in LFPR in states that were least affected by the crisis: DC, New York, and especially North Dakota.

Table 5. Decomposition of Aggregate LFPR Change Based on Regression Estimates

Period	Total Change in LFPR	*Model using:*	Cyclical Contribution in ppt	Cyclical Contribution in percent of total	Structural + Residual in ppt	Structural + Residual ppt per year
2000-2013	*-3.8*		*-0.8 ~ -1.2*	*21% ~ 32%*	*-2.6 ~ -3.0*	*-0.2*
2000-2007	-1.0		0 ~ 0.1	-13% ~ 0%	-1 ~ -1.1	-0.1 ~ -0.2
2007-2013	-2.9		-0.9 ~ -1.2	33% ~ 44%	-1.7 ~ -2.0	-0.3
2007-2010	-1.4	*payroll emp*	-0.7	53%	-0.6	-0.2
		household emp	-0.7	49%	-0.7	-0.2
2010-2013	-1.5	*payroll emp*	-0.5	35%	-0.9	-0.3
		household emp	-0.3	20%	-1.1	-0.4

Sources: IMF staff calculations

Figure 9. State Changes in LFPRs: Actual vs. Predicted (2007-2012)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics and IMF staff calculations
Note: States are ordered by the magnitude of change in the Labor Force Participation Rate. Predictions are based on the state-level model using the payroll employment gap (instrumented).

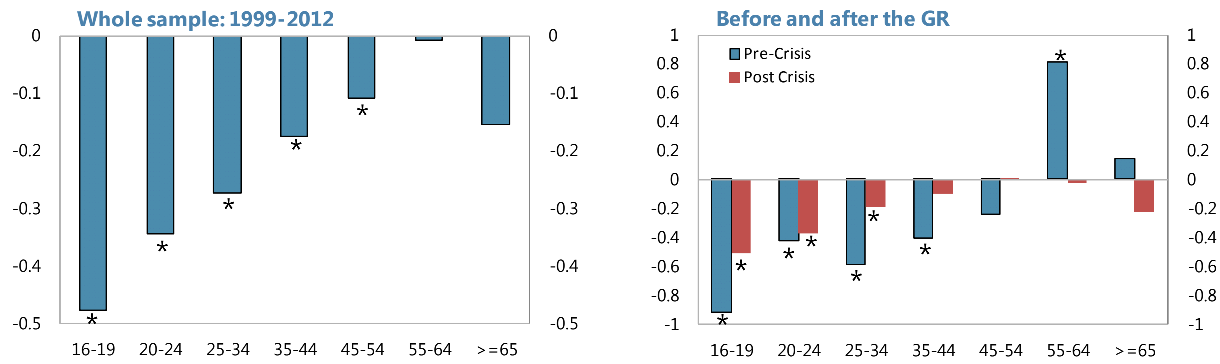
In most cases, the model predicts a smaller fall in LFPR than actually occurred, consistent with demographic and other structural forces additionally impacting the LFPR. In a few cases, most notably Nevada and Arizona, the model actually over-predicts the decline in LFPR. A detailed look at the data shows that in these two states, the decline in LFPR was dampened by an increase in participation among the older age groups (55 years and above). This could be a response to the housing bust and the associated loss in wealth for people in or close to retirement, who may have had to return or prolong their stay in the labor market.

B. Cyclical Effect by Age Group

The impact of the cycle on participation generally declines with age (Figure 10).[5] The youngest groups (teenagers and youth in their early 20s) are by far the most sensitive to cyclical conditions. Cyclical sensitivity declines as participants mature into prime working age (25–54) and become more attached to the labor force. During the crisis and recovery (right chart), the cyclicality actually decreased for young and prime-age groups (a result consistent with other findings in the literature, e.g., Shimer (2011) and Elsby et al. (2013)).[6]

Figure 10. Unites States: Cyclicality of participation rate by age groups, 1999–2012

(coefficient estimate of age-specific UR on LFPR, instrumented)



Sources: IMF staff calculations
*/ Statistically significant at the 5 percent level.

For older age groups, the cyclical sensitivity coefficients are volatile. The right hand chart in Figure 8 shows that their sensitivity to the cycle varies between normal years and crisis years. The group close to retirement age (54–64) had a counter-cyclical participation pattern before the crisis, likely because a strong economy translates into increasing housing and financial wealth and hence facilitates earlier retirement. However, post-2007, this effect becomes insignificant, possibly driven by heterogeneity between older workers in hard-hit states that

[5] Due to data availability by age groups, this section relies on the 'unemployment rate' model instead of the 'employment gap' model discussed above. We still instrument to avoid endogeneity.

[6] These authors show that during recessions, the unemployment pool is composed relatively more of workers of higher skill and wages compared to normal times (as a big shock hits workers of all ranks). As these workers also have stronger labor market attachment, the average rate of transitioning into non-participation declines during recessions.

had to increase participation (such as Nevada and Arizona) and those in less affected states who withdrew from the labor market due to poor job-finding prospects.

IV. Youths, SSDI, and Older Workers

Participation rate trends for youths and older workers and the impact of rising SSDI recipients are key components of the aggregate LFPR picture. However, disentangling how much of their respective changes since 2007 is cyclical, structural, or reversible is a complex issue. This section explores potential explanatory factors behind the behavior of these groups.

A. Youths

The majority of the reduction in youth participation rates is explained by the decline in those working while studying. Total school enrollment has risen quite significantly since 2000, driven by increasing enrollment of 18-24 year olds in college rather than 16–18 year olds in high school (Table 6). Even more striking has been the drop of those in school (high school or college) who are working; a decline that started before the Great Recession. Indeed by 2007, the share of those working while in school had declined from a peak of 46 percent in 2000 to less than 40 percent. A similar shift share analysis to that conducted in section B suggests that this latter trend rather than rising college enrollment has been driving most of the decline in the overall youth participation rate since 2000, including during and after the Great Recession (Table 7). Some of this likely reflects a lower employment share for teenagers (and a higher employment share of older workers and immigrants) within all industries and occupations (Dennett and Modestino, 2013), possibly due to higher skill and less flexible work-time requirements, or more stringent regulation.

Table 6. School Enrollment Statistics
(Ages 16-24)

	School Enrollement	Enrolled in HS	Enrolled in College	Enrolled in High School		Enrolled in College	
	(percent of CNIP ages 16-24)			Employed Full-Time	Employed Part-Time	Employed Full-Time	Employed Part-Time
Average 2000-2007	55.5	26.3	29.2	2.4	25.3	17.5	35.6
Average 2007-2010	57.6	25.5	32.1	1.4	17.3	14.4	33.3
Average 2010-2013	57.9	25.1	32.8	1.0	14.5	13.0	32.1
Average 2007-2013	57.8	25.3	32.4	1.2	15.9	13.7	32.7

Sources: U.S. Bureau of Labor Statistics, Haver Analytics

Table 7. Compositional Changes in Participation by School Enrollment
(Ages 16-24, annualized changes)

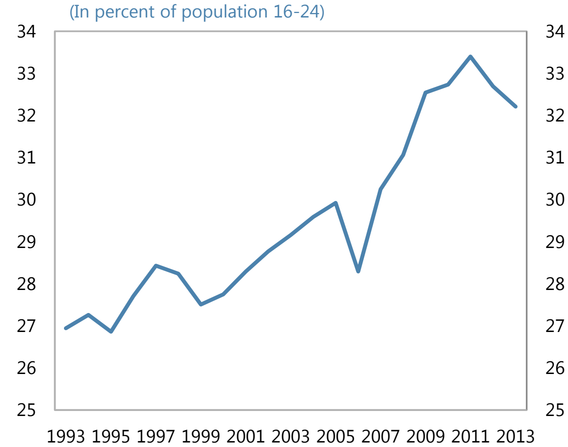
Period	Part. Rate Change	Enrolled Part. Rate Shift	Enrolled Population Shift	Unenrolled Partipcation Rate Shift	Unenrolled Population Shift
2000-2007 (8)	-0.7	-0.5	0.1	-0.1	-0.2
2007-2010 (3)	-1.2	-0.8	0.2	-0.2	-0.5
2010-2013 (3)	-0.3	-0.3	-0.2	-0.2	0.4
2007-2013 (6)	-0.8	-0.5	0.0	-0.2	-0.1

Sources: U.S. Bureau of Labor Statistics, Haver Analytics
Note: First colomn shows the total annualized change in LFPR; subsequent columns show the contribution of different factors based on the shift-share analysis.

There appears to be a mix of cyclical and structural factors behind the decline for youths, with much of the cyclical part likely to be reversible. It is expected that most students will join the labor force upon graduation. And while there clearly was a downward trend in the share of student workers before 2007, this share plummeted by nearly 5 p.p. in 2008–09, and has not recovered since. This suggests a sizable impact of the Great Recession and one that should be partly reversible as job prospects improve. In addition, after a secular increase since 2000, the share of students enrolled in college started to fall in 2012 (Figure 11). With the share in 2013 still 2 p.p. above that in 2007, this suggests an upside risk to youth participation rates if more students start working part time as the job market picks up and if college enrollment rates revert to pre-Great Recession levels (in part to help pay off student loans).[7]

Figure 11. College Enrollment

(In percent of population 16-24)



Sources: U.S. Bureau of Labor Statistics

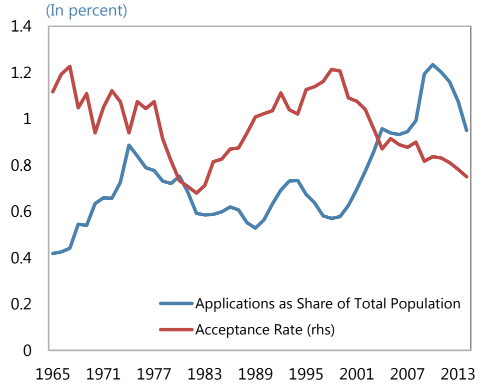
B. SSDI

Rising SSDI beneficiaries have weighed on participation for a while. The role of SSDI has been the subject of much academic debate (e.g. Autor 2011), which is unsurprising given the relentless rise in applications since early 2000s (Figure 12). These did spike up further during the Great Recession, but this was somewhat offset by the acceptance rate declining to a near historical low. Overall, when normalized by population size, the changes in SSDI recipients didn't shift significantly following the Great Recession (Table 8), and there doesn't seem to be a strong correlation between state-level changes in SSDI recipients and LFPRs (Figure 13). Notwithstanding these findings, the rising number of beneficiaries as well as applicants that were denied benefits have undoubtedly added downward pressure on the LFPR (the change in SSDI beneficiaries/population was 0.6 p.p. during 2007–13).[8]

[7] Indeed, reverting to pre-Great Recession average levels of school enrollment and employment rates for students would increase the youth participation rate by around 7pp from the current level of 54¾ percent.

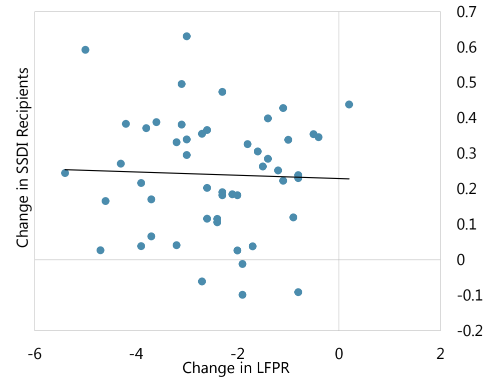
[8] Even those denied benefits can often spend one to three years out of the labor force until the appeals process is exhausted.

Figure 12. Social Security Disability Insurance
(In percent)



Sources: Social Security Administration

Figure 13. State SSDI and LFPR
(In percent of total population; 2007-2012)



Sources: Social Security Administration, U.S. Bureau of Labor Statistics, Haver Analytics

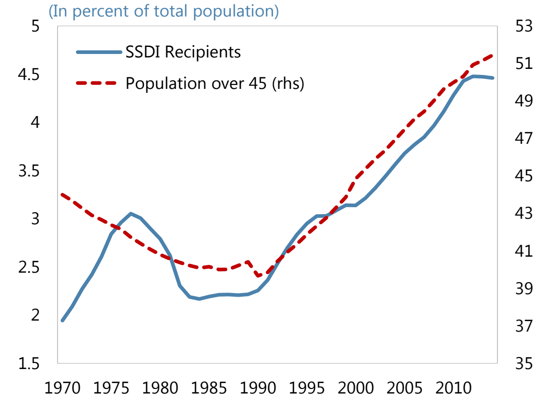
Table 8. Changes in Social Security Disability Insurance and Labor Force by Age
(Annualized changes, percent of population)

Period	Ages 45-49 SSDI Recipients	Ages 45-49 Labor Force	Ages 50-54 SSDI Recipients	Ages 50-54 Labor Force	Ages 55-59 SSDI Recipients	Ages 55-59 Labor Force	Ages 60 and above SSDI Recipients	Ages 60 and above Labor Force	Ages 45+ Percent of Total SSDI Recipients
2000-2007 (8)	0.2	1.4	0.3	2.0	0.5	3.6	0.3	1.2	74.3
2007-2010 (3)	0.1	-0.7	0.4	1.1	0.5	1.9	0.3	1.6	78.2
2010-2012 (3)	-0.1	-2.3	0.2	0.2	0.6	1.9	0.3	1.5	79.1
2007-2012 (6)	0.1	-1.3	0.3	0.8	0.6	1.9	0.3	1.5	78.5
2013	-0.2	-2.4	0.0	-0.4	0.4	1.4	0.1	0.8	79.6

Sources: Social Security Administration; Bureau of Labor Statistics; and Haver Analytics

While it is open to debate how much of the recent rise in SSDI recipients is structural or cyclical, most of it will be irreversible. SSDI recipients were rising sharply as a share of the population even before 2007. Given that the incidence of SSDI increases significantly with age (nearly 80 percent of SSDI recipients are above 45 years old), much of the rise appears related to population aging (Figure 14).

Figure 14. SSDI Recipients and Population over 45
(In percent of total population)



Sources: Social Security Administration, U.S. Bureau of Labor Statistics

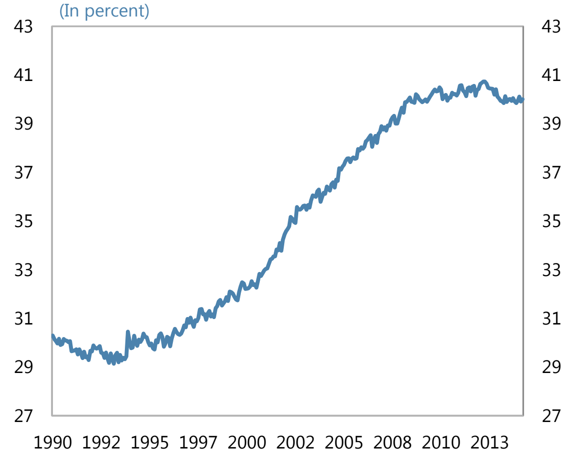
This is also consistent with the lack of a shift in the trend change in SSDI recipients following the Great Recession, as documented in Table 8. This would suggest that much of the increase in *recipients* is structural. However, there does appear to be a cyclical component to the spike in *applications* during the Great Recession. Regardless of how much of the rise is structural or cyclical, SSDI recipients tend to exit the labor force permanently and do not return as cyclical conditions improve (Daly, Hobijn, and Kwok 2010).

C. Older Workers

After a significant increase over the last twenty years, the future trajectory of the LFPR for older workers is an open question. Up until early 2009, the LFPR for workers above 55 was on a steep incline, increasing by around 10 p.p. from the mid-1990s (Figure 15). Since early 2009, the rate of increase slowed significantly and the LFPR started to decline slightly in early 2013, although it has remained stable at around 40 percent since late 2013. Some of the key factors behind the increase in the LFPR until very recently include: (i) better health and longer life-spans; (ii) stronger incentives to prolong work lives given the growing switch from defined benefit to defined contribution pension plans; and (iii) the rapid increase in healthcare costs and decreasing availability of retiree health benefits causing people to work to receive health insurance until they are eligible for Medicare (at 65). At the same time, some studies show an increasing sensitivity since 2000 of older workers' retirement decision to stock market performance (Daly, Hobijn, and Kwok 2009), which appears consistent with recent dynamics and the results shown in Figure 10. During the Great Recession, older workers stayed in the labor force given the need to rebuild net worth. Once this had been sufficiently replenished, they could afford to retire, as many have done since 2013.

Figure 15. LFPR of Population 55 and Over

(In percent)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

V. LFPR Forecasts and Slack Measures

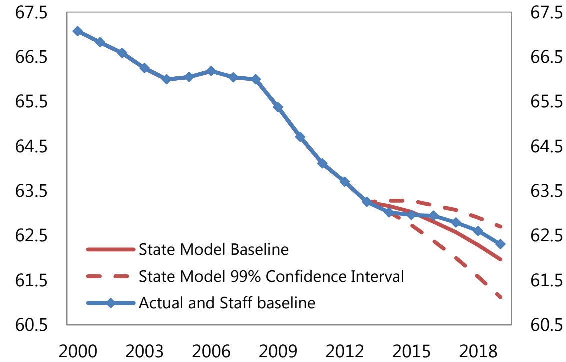
A. LFPR Forecasts

The preceding analysis suggests that while much of the post-2007 decline in the LFPR is irreversible, there should be a material cyclical bounceback over the next few years. Demographic models suggest that aging of the baby boom generation explains around 50 percent of the near 3 p.p. LFPR decline during 2007–13, while the state-level panel regressions suggest a cyclical effect of 33–43 percent. The demographic effect is considered irreversible and even some of the cyclical effect could be irreversible if it has led to more SSDI applications and ultimately recipients. As noted in section D, there has also been a complex interaction between cyclical and structural factors affecting youths and older workers. For youths, some cyclical bounceback is likely as job prospects improve, but for older workers, the incentive to retire as wealth is re-accumulated may offset any cyclical bounceback.

The state-level panel regression model points to a cyclical bounceback of around ¼–⅓ over the next 5 years but the LFPR continues to decline given the weight of structural forces. Equation 3 can be combined with forecasts of the employment gap to produce a projection of the cyclical bounceback. The forecasts of the employment gap utilize staff's GDP forecasts and an employment version of Okun's Law. Table 9 gives a range of estimates depending on which version of equation 3 is used, suggesting a cyclical bounceback of ¼–⅓ of the LFPR decline during 2007–13. Figure 16 shows the actual LFPR forecast and confidence bands (i.e. taking into account the structural and cyclical effects and the lag structure) from using the payroll employment version of equation 3 and the full sample. Despite the cyclical bounceback, the state-level panel regression suggests that the LFPR will continue declining as structural forces will more than offset the cyclical ones. The confidence bands reflect the sampling uncertainty around the coefficient estimates of the underlying state-level model. They do not, however, explicitly take into account alternative scenarios for shifts in demographic and behavioral trends that could introduce additional uncertainty to the path of the LFPR going forward.

Figure 16. Particpation Rates in Baseline Scenario

(Percent)



Sources: U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and IMF staff estimates.
Note: The 99 percent confidence band is obtained from 1000 clustered bootstrap resamples with replacement (clustered at state level).

Table 9. LFPR Bounceback

Underlying data:		*Closing the labor demand gap in the MT would increase LFPR by (in ppt):*	*99 pct confidence interval (bootstrapped)*
Payroll emp	*whole sample*	0.8	0.6-1.0
	07-12 sample	0.9	0.7-1.2
Household emp	*whole sample*	0.7	0.5-0.9
	07-12 sample	0.7	0.4-1.0

Sources: IMF staff calculations

The baseline scenario in this paper is based off the forecast from the state-level panel regression models, but applies some additional judgment and utilizes census population forecasts. Essentially, based on the preceding analysis, the baseline forecast is made up of three components: (i) a pure demographic effect, which holds age-group participation rates constant at 2007 levels and uses the census baseline population forecast; (ii) a cyclical bounce-back as the job market improves benchmarked off the state-level analysis; and (iii) judgment regarding non-demographic structural forces (i.e., college enrollment, share of students working, and retirement patterns).[9]

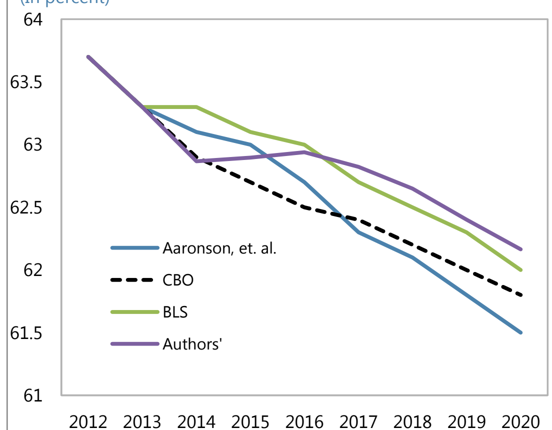
The baseline scenario has a more front loaded cyclical bounceback than the state model projection, and the LFPR at 2019 is around 0.3 p.p. higher. In the baseline, the LFPR of older and younger workers embed some additional judgment that the statistical model is not designed to capture. Specifically, the LFPR of younger workers is expected to bounce-back

[9] The census also produces three alternative population forecasts based on different migration assumptions. This makes little difference to the path of the aggregate LFPR, but can make a substantial difference to the path of labor force growth (see IMF 2014).

by around 2 p.p. as school enrollment declines a little more (closer to 2007 levels) and more students start working as job opportunities improve and given the need to pay off student loans. Older workers, however, are forecast to have no bounce-back given their participation rates continued going up during 2007–13 and as the recovery of wealth allows many who postponed retirement to finally do so. The projections are younger and older workers are also consistent with the cyclical sensitivities presented in Figure 10. However, the overall cyclical bounce back in the baseline is the same as in the state model (middle of the range given in Table 9) but more is taking place during 2014–16. In sum, the aggregate participation rate is roughly flat for the period 2014–16, as the cyclical and non-demographic structural forces offset the demographic effect, before resuming a downward trend from 2017 as the weight of the aging population begins to dominate. The higher LFPR in 2019 in the baseline relative to the state model projection is mainly driven by using actual Census population forecasts in the baseline.

Our baseline medium-term projection has a similar trend to that of other forecasters but more of a cyclical bounceback (Figure 17). In CBO's projection, downward pressure from population aging outweighs the cyclical bounce back by more than in our estimates over the medium term, resulting in the LFPR declining to 62 percent by end-2019 (relative to our forecast of 62.3 percent). Aaronson et al. (2014) also have a participation rate path lower than ours, as they assume that (negative) cohort effects (e.g., because of labor market polarization and rising disability rolls) will outweigh current trends of increasing longevity, educational attainment and changes in marriage and fertility. The Bureau of Labor Statistics has a 2020 forecast similar to the baseline, but has a different profile in the early years (cf. Toosi, 2013).

Figure 17. Labor Force Participation Rate Projections
(In percent)



Sources: U.S. Bureau of Labor Statistics, Haver Analytics

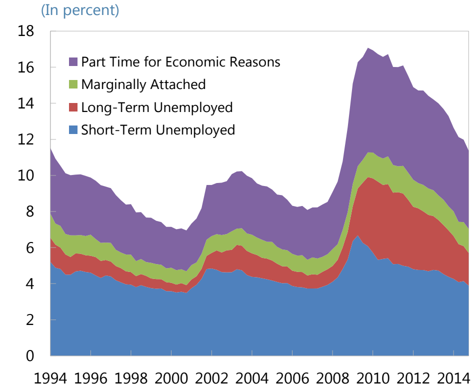
There are some important risks around our baseline that are beyond the confidence bands generated from the state-level model. As noted earlier, the confidence bands do not take into account alternative scenarios for shifts in demographic and behavioral trends that could introduce additional uncertainty to the path of the LFPR going forward. Specifically, as noted in previous studies, forecasting LFPRs for youths and older workers has proven to be incredibly challenging given various structural changes (Aaronson et al, 2006 and 2014). For example, it's not easy to predict what will happen to college enrollment. Will it continue the very recent decline as job prospects improve and the cost of college goes up, or will a rising skill premium encourage further enrollments? For older workers, which forces will dominate: increasing wealth or rising longevity and better health? And how do we forecast longevity and health?

Given these uncertainties, the range of estimates over the medium term can be wide depending on assumptions—e.g., up to 1 percentage point in Aaronson et al. (2014). Similarly, and as pointed out in CEA (2014), although most studies agree on the likely evolution of the aging trend, there is substantially more uncertainty regarding non-aging components. Among other factors, it is unknown whether the Great Recession will leave indelible scars in the labor market which could lead to the long-term unemployed finally dropping out of the labor force. For instance, in the CEA's study, by the mid-2020s, the participation rate could vary by up to 2 full percentage points depending on how much the non-aging components recover.

B. Labor Market Slack

Estimation of a trend LFPR and forecasting the actual one allows construction of a broader measure of labor market slack. The BLS produces various measures of labor market slack in addition to the unemployment rate (Figure 18). The broadest measure includes marginally attached workers and those working part time for economic reasons. This shows that while the unemployment rate has fallen to well within 1 percentage point of most estimates of the NAIRU, substantial slack still exists, especially given the number of part-time workers for economic reasons. Below an alternative measure is constructed, following Erceg and Levin (2013). Specifically, the "employment gap" or deviation of the employment-to-population from its natural rate is constructed. This can be approximated as the weighted sum of the unemployment and participation gaps (equation 5). We add to this measure, however, by taking account of "part time workers due to slack work or business conditions", which shows up as an adjustment to the unemployment gap in equation 5.[10]

Figure 18. Components of U-6 Rate
(In percent)

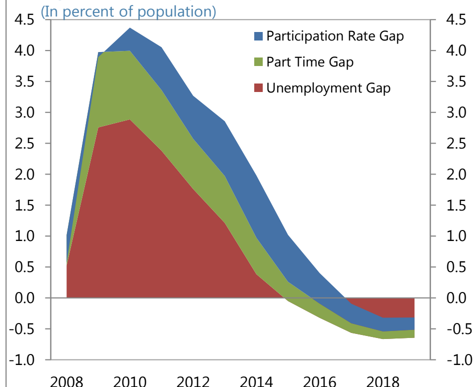


Sources: BLS, and staff estimates

(5) $$egap \approx (1-u^*)(LFPR - LFPR^*) + LFPR^*(u - u^*)$$

Despite the emergence of a substantial participation gap between 2008 and 2014, the unemployment gap still accounted for around three-fifths on average of the overall employment gap. As shown in Figure 19, the participation gap grew to almost a full percentage point by end-2014, and remains today the main component of the overall employment gap. Nonetheless, the unemployment gap has been the main driver

Figure 19. Employment Gap
(In percent of population)



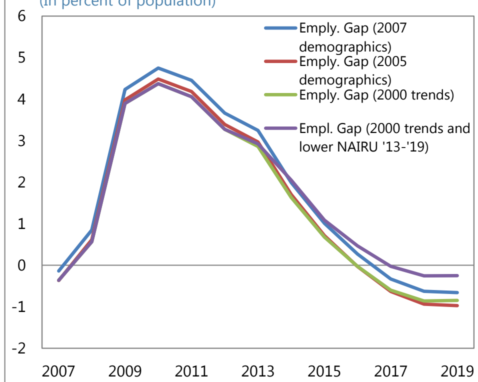
Sources: U.S. Bureau of Labor Statistics, CBO, and IMF staff estimates

[10] The adjustment suggested by Citibank (2014) is followed. Specifically, the part time adjustment is the product of: (i) the change in part time workers due to slack work or business conditions relative to the average for 1997-2007; and (ii) (1-the ratio of average part time hours/average full time hours). This adjustment is added to the unemployment rate (i.e. weighted by the trend LFPR).

behind the evolution of overall slack in the labor market since 2008.

The recent acceleration in the fall of the unemployment rate suggests the employment gap will close in 2016 (Figure 20). The broader employment gap peaked in 2010 at 4½ percent, when over half the gap reflected the unemployment gap. The overall gap fell to around 2¾ percent in 2013, with a declining unemployment gap offset by a rising participation gap. However, in 2014, the unemployment gap plunged on the back of a plummeting unemployment rate throughout the year, leaving the overall measure of slack at around ¾ of a percentage point by end-2014. Looking ahead, we expect that although the participation gap will close slowly, overall labor market slack will be closed in 2016.

Figure 20. Employment Gap Estimates
(In percent of population)



Sources: U.S. Bureau of Labor Statistics, and IMF staff estimates

Uncertainties surrounding the underlying structural components of the slack measure could extend the date of full labor market recovery by up to one year. The employment gap measure is most sensitive to changes to the NAIRU estimates, while assumptions around the closure of the part-time gap and the underlying participation rate trend have a lesser effect on the forecast. As shown in Figure 20, lower NAIRU estimates, a higher participation rate trend (such as the 2007 trend), or a lingering part-time gap would push the closing of the gap to 2017.

VI. Conclusions and Policy Implications

The key finding of this paper is that while around ¼–⅓ of the post-2007 decline is reversible, the LFPR will continue to fall given population aging. With participation rates for older workers lower than for prime age workers, demographic models suggest that aging of the baby boom generation explains around 50 percent of the near 3 p.p. LFPR decline during 2007–13. State-level panel regression analysis is used to tie down the cyclical effect, which is estimated to account for 33–43 percent of the decline. The rest is made up of non-demographic structural factors such as increasing college enrollment and fewer students working. With some of the decline triggered by cyclical factors and non-demographic structural factors judged to be irreversible, only around a ¼–⅓ of the post-2007 decline is forecast to be reversed over the next few years. However, with population aging continuing to weigh, this reversal only causes the LFPR to flatline in the near term, and the secular decline reasserts itself once the cyclical bounceback starts to wane.

There are some important risks around the forecast. In particular, over the last 20 years, forecasting LFPRs for youths and older workers has proven to be incredibly challenging given various structural changes. For example, it's not easy to predict what will happen to college enrollment. Will it continue the very recent decline as job prospects improve and the cost of college goes up, or will a rising skill premium encourage further enrollments? For older workers, which forces will dominate: increasing wealth or rising longevity and better health? And how do we forecast longevity and health?

Labor market slack remains, although it has closed considerably over the course of the recovery. This slack goes beyond that signaled by the unemployment rate, and takes account of the LFPR being below trend and many employees working part time "involuntarily". Moreover, the numbers of long-term unemployment are still close to the peak level reached during 1950–2007, suggesting that further hysteresis effects (e.g., loss of skills, discouragement) could still develop.

Policies to enhance labor supply and help offset the headwinds to potential growth from aging will also be important. The main drag to potential growth in staff's forecast is expected to come from aging and the retirement of the baby-boom generation. Indeed, staff projects the potential labor force to expand at below ½ percent per year over the medium term, half the average growth rate seen in 2000–13 and well below the long-run average of 1½ percent. Policy priorities include: (i) enhancing training and job search assistance programs (such as sectoral training), particularly those that engage industry and higher education institutions; (ii) better family benefits (including childcare assistance) to reverse the downward trend in female labor force participation rates; (iv) modifying the disability program to allow for part-time work by those receiving benefits; reducing the penalties for working during the application process; and re-examining eligibility rules to present misuse (especially for disability related to mental illness); (v) providing greater visa opportunities for high-skilled immigrants; and (v) expanding the EITC to childless workers and by lowering the age threshold from 25.

Appendix 1. Demographic Data and Analysis

As discussed in section B, in order to disentangle the effect of population dynamics on the participation rate, the chapter adopted a two-pronged strategy. First, we considered a 'demographic' approach that relies on disaggregated population and participation data by age group (10 groups) and gender to estimate the demographic component of the decline in participation rates. And second, to investigate the behavior of specific age groups, we considered a shift-share analysis.

We used data on labor force by gender and age groups (16-19, 20-24, 25-34, 35-44, 45-54, 55-59, 60-64, 65-69, 70-74, 75+) from the Household Employment Survey of the Bureau of Labor Statistics (BLS), for the period 1981 to present. Population data, including forecasts of population for 2014–2019, were obtained from the BLS, while the data on immigration used in the simulations described in section II of this Annex are from the US Census Bureau.

Regarding the shift share analysis, as noted in Section B, the total change in the participation rate with respect to a base year equals the sum of (a) changes in the population share of each group weighted by their base-year participation rate; (b) changes in the participation rate of each group weighted by their base-year population share; and (c) an interaction term that is typically small for years not too far from the base year:

(A.1) $p_t - p_0 = \sum_g \{ p_0^g(s_t^g - s_0^g) + s_0^g(p_t^g - p_0^g) + (p_t^g - p_0^g)(s_t^g - s_0^g) \}$,

where p_t stands for the aggregate participation rate, and p_t^g and s_t^g stand for the participation rate and the population share of age group *g* in year *t*, respectively.

Appendix 2. State-Level Regression Model Using Household Employment Data

Table A.2 below summarizes various regression results of estimating equation (3), using the household employment variable (as opposed to payroll employment, for which the same table is in the main text) to construct the employment gap as a measure of the state business cycle. The trend-cycle decomposition and end-point adjustment follows the same procedure as for the payroll employment (discussed above).

Table A.2 Regression results using household employment.

	Dependent variable: Δpr_t					
	OLS	2SLS				
			with lags	pop. weighted	1978-2007	2007-2012
$\Delta egap_t$	0.24***	0.15***	0.11***	0.11***	0.15***	0.04
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
$\Delta egap_{t-1}$			0.07***	0.07***	0.06***	0.10***
			(0.01)	(0.01)	(0.02)	(0.02)
$\Delta egap_{t-2}$			-0.00	0.03**	0.01	0.03
			(0.01)	(0.01)	(0.02)	(0.02)
$\Delta egap_{t-3}$						0.03
						(0.02)
Hausman test (p-val.)		0.000	0.000	0.000	0.000	0.000
1st stage:		*Dependent variable: $\Delta egap_t$*				
$imix_t$		0.56***	0.57***	0.63***	0.54***	0.74***
		(0.02)	(0.02)	(0.03)	(0.03)	(0.06)
F-stat		951.6	771.8	484.2	439.9	127.4
N	1785	1734	1632	1632	1428	306
R^2	0.416	0.393	0.348	0.371	0.333	0.362

Note: Column 1 estimates equation (3) with OLS and no lags in the employment gap variable. Column 2 instruments the contemporaneous employment gap with the industry mix based employment growth in equation (4). Columns 3 to 6 introduce further lags in the employment gap variable. Columns 4 to 6 weight the data by the average working-age population in each state. Column 5 and 6 splits the sample to sub-samples before and following the Great Recession. The Hausman test result reports the p-value of the null hypothesis that the contemporaneous employment gap is exogenous. The 1st stage panel reports the first stage coefficient for the contemporaneous employment gap and the first stage F-statistics. All specifications also include state-specific intercepts and trends (not shown). Standard errors are robust to heteroskedasticity and auto-correlation (using Newey-West kernel). ***, ** denote 1 and 5 percent statistical significance respectively.

Compared with the estimates using the payroll employment gap as the independent variable in Table 3 in the text, a few points stand out. First, the industry mix variable continues to be a very strong instrument for the employment gap if the household measure is used (positive, statistically significant first stage coefficients and large F-statistics). Second, the bias of OLS is positive and substantially larger than when using payroll employment. This is plausible, as household employment encompasses a wider definition of employment, including self-employment, and hence is more prone to an endogenous response to labor supply. As an increase in labor supply raises both the LFPR as well as self-employment, the OLS coefficient is biased upward. Moreover, the household employment variable is derived from the same survey as the LFPR, introducing possible mechanical correlation that could render OLS regression spurious. The instrumentation is therefore even more important when using the household employment variable to measure labor market slack, as is reflected in the Hausman test results.

Finally, when instrumenting using the industry mix variable, the estimates using household employment deliver very similar results. Accounting for sufficient lags, the total effect of a 1 percent increase in the employment gap leads to a total of 0.2 p.p. increase in LFPR within 2 years, the same as obtained using payroll employment (columns 3 to 5). Also, similar to the baseline result, the cyclical response has been more sluggish and persistent following the Great Recession, thought still adding up to the same total effect as estimated with the whole sample.

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