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Education, employment, and labor force participation in the United States

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Abstract

This paper uses time series data from the United States to investigate the relationship between the employment-population ratio and labor force participation rates for various education levels: (1) Bachelor's Degree and Higher, (2) Some College or Associate Degree, (3) High School Graduates, and (4) Less Than a High School Diploma. Cointegration analysis supports a long-run relationship between these two variables, for each education level considered. Vector error correction models are estimated for the period prior to the COVID-19 pandemic. These pre-pandemic models are then used to create dynamic forecasts since the start of the COVID-19 pandemic. The pre-pandemic models do reasonably well at forecasting the actual values of the employment-population ratios beginning in 2022 for each education level. However, labor force participation rates for those with a high school degree or less have not yet returned to levels forecasted using pre-pandemic models.

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1. Introduction

The COVID-19 pandemic led to large and abrupt changes in unemployment and labor force participation in the United States. As the US economy continues to evolve and adjust in the post-pandemic era, it is important for macroeconomic policy to focus on understanding changes in the labor market. In the November 2021 post-FOMC press conference, Jerome Powell, Chair of the Board of Governors of the Federal Reserve System, noted that the Federal Reserve's mandate of maximum employment has become much harder to assess as "people are staying out of the labor market because of caretaking, [and] because of fear of COVID to a significant extent". This helps highlight the importance of examining relationships between labor force participation and employment.

Numerous studies have investigated potential long-run relationships between labor force participation and unemployment in various regions of the world. Some examples include Africa (see Raifu and Adeboje 2022), Canada (see Tansel and Ozdemir 2018, and Janko 2023), Italy (see Nemore, et.al. 2021), Spain (see Altuzarra, et.al. 2019), Sweden (see Österholm 2010), and the United States (see Emerson 2011, and Bernstein and Martinez 2021). The relationship between employment and labor force participation has important implications not only for theory, but also for empirical modeling and policy in the fields of labor economics and macroeconomics. One interesting aspect of the relationship between these variables involves the relevance of the unemployment invariance hypothesis, which suggests that the long-run unemployment rate is independent of the labor force (see Layard, et.al. 1991, and Karanassou and Snower 2004). Another example is the concept of discouraged worker effects (people have dropped out of the labor force because they believe there are no jobs available for them – discouraged workers are not counted as unemployed or as part of the labor force), which can affect the informational value of the unemployment rate as a macroeconomic indicator (see Gustavsson and Österholm 2006, and Murphy and Topel 1997).

Previous research has shown that, in the US, there is a long-run equilibrium relationship between labor force participation and unemployment (for example, Emerson 2011). Although research suggests that labor market dynamics were stable in previous decades, the dynamics may have changed during the COVID-19 pandemic (see Bluedorn, et. al. 2021). Bernstein and Martinez (2021) investigate these changing dynamics by estimating a model for male and female labor force participation and unemployment for the time period prior to the start of the COVID-19 pandemic and then comparing forecasts from that model with actual labor market outcomes since the start of the COVID-19 pandemic.

This paper investigates labor market dynamics in the United States for different levels of educational attainment: (1) those with a bachelor's degree or higher, (2) those with some college or an associate degree, (3) those with a high school degree, and (4) those with less than a high school diploma. Similar to Bernstein and Martinez (2021) who study labor market dynamics for males and females, we begin by focusing on the period prior to the start of the COVID-19 pandemic to identify any historical long-run equilibrium relationships between labor force participation and employment. We then investigate changing labor market dynamics by comparing forecasts from the pre-pandemic models to actual outcomes since the start of the pandemic and consider whether labor market adjustments vary based on level of education. Understanding how labor market dynamics differ by education level can help inform policymakers.

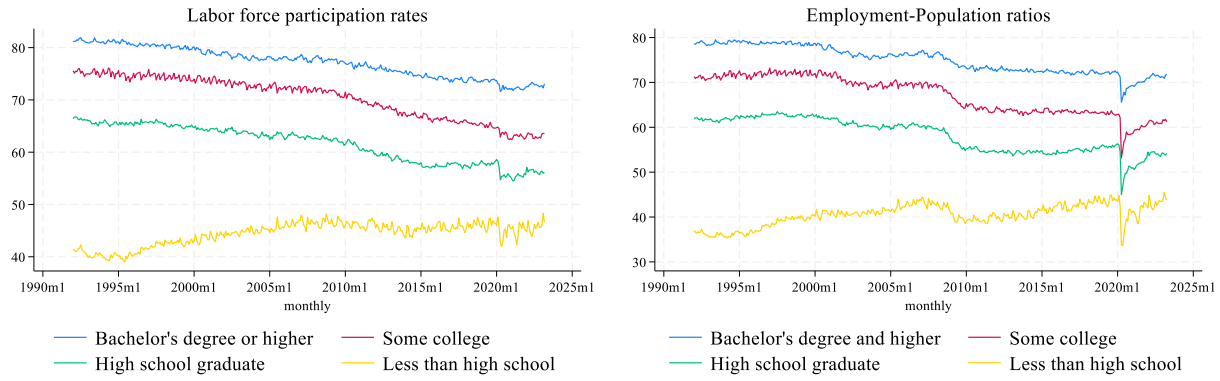
2. Data

Seasonally adjusted monthly data on labor force participation rates and the employment-population ratio, for people ages 25 years and older with different levels of education: (1) Bachelor's Degree and Higher, (2) Some College or Associate Degree, (3) High School Graduates, and (4) Less Than a High School Diploma; were obtained from Federal Reserve Economic Data (FRED: https://fred.stlouisfed.org). All data series span the period January 1992 – April 2023. The data series and descriptions from FRED are presented in Appendix Table 1. Individual time series plots of the data are presented in Appendix Figure 1.

Figure 1 presents the times series plots of LFPR for all education levels in a single graph and the time series plots of EPR in another graph. The time series plots in Figure 1 demonstrate that, perhaps unsurprisingly, both the labor force participation rate and the employment-population ratio are higher for those with greater educational attainment: (1) people with at least a Bachelor's degree (blue) have greater LFPR and EPR than those with some college (red); (2) people with some college or an associate degree (red) have higher LFPR and EPR than those with only a high school degree (green); and (3) people with a high school degree (green) have higher LFPR and EPR than those without a high school diploma (yellow). Further, the large impacts of the COVID-19 pandemic are evident in the employment-population ratios and labor force participation rates for all education levels.

Throughout the sample period, prior to the start of the COVID-19 pandemic in the US, a downward trend in both LFPR and EPR for those with a Bachelor's degree or higher is noticeable. Similar patterns, prior to the start of the COVID-19 pandemic, are also visible for those with some college or an associate degree and for those with a high school degree. However, for the same pre-pandemic period, LFPR and EPR both trended slightly upward for those without a high school diploma. For each education level, the graphs in Figure 1 and Appendix Figure 1 demonstrate that EPR and LFPR appear to move in the same direction – labor force participation rates seem to decrease when employment-population ratios decrease. This suggests that discouraged worker effects may be present, at least to some degree, for all education levels. We investigate this more formally in the analysis to follow.

Figure 1: Labor force participation and employment in the US



3. Analysis

We focus our initial analysis on the time period prior to the COVID-19 pandemic in the United States: more specifically, the initial sample period considered is January 1992 – February 2020. Following an approach similar to Österholm (2010), Emerson (2011), and others, for each education level, we consider a bivariate Vector Error Correction (VEC) model that includes labor force participation rates and employment-population ratios. The VEC model is a restricted VAR (or cointegrated VAR) that has the cointegrating relationship(s) built into the specification so that the endogenous variables are restricted to converge to the long-run equilibrium while allowing for short-run adjustment dynamics. In other words, if the unrestricted VAR is written as:

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \quad (1)$$

where y_t is a k-vector of variables considered in the model (k = 2 in our model). This unrestricted VAR can be rewritten in Vector Error Correction form as:

$$\Delta y_t = \mu + \pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

where

$\pi = \sum_{i=1}^{p} A_i - I$ and $\Gamma_i = -\sum_{j=i+1}^{p} A_j$.

Finally, if the coefficient matrix π has reduced rank r < k, then there exist k x r matrices α and β each with rank r such that $\pi = \alpha\beta'$ and $\beta' y_t$ is stationary. Therefore, under cointegration, r is the number of cointegrating relationships, each column of β is a cointegrating vector, and the elements of α are the adjustment parameters in the vector error correction (VEC) model.

Table 1: Univariate unit root tests

	Bachelor's Degree and Higher		**Some College or Associate Degree**		**High School Graduates**		**Less Than a High School Diploma**	
	LFPR	EPR	LFPR	EPR	LFPR	EPR	LFPR	EPR
DF-GLS	-1.036 (12 lags)	-1.525 (12 lags)	-0.461 (12 lags)	-1.540 (12 lags)	-1.218 (12 lags)	-1.205 (1 lag)	-1.473 (13 lags)	-1.816 (12 lags)
KPSS	0.273* (12 lags)	0.158* (12 lags)	0.608** (12 lags)	0.323* (12 lags)	0.416** (12 lags)	0.281* (12 lags)	0.567** (12 lags)	0.343* (12 lags)

Notes: DF-GLS is the test statistic from the Dickey-Fuller test with GLS detrending. Lag length for the DF-GLS test is chosen based on the Schwarz information criterion.
KPSS is the test statistic from the Kwiatkowski, Phillips, Schmidt, and Shin test.
Sample is January 1992 – February 2020.
** and * indicate significance at the 1% and 5% levels, respectively.

We begin by investigating the time series properties of the data. The first step of the analysis is to test for non-stationarity (unit root). Table 1 reports the results of the Dickey-Fuller test with GLS detrending (see Elliot et. al. 1996) and the Kwiatkowski, Phillips, Schmidt, and Shin test (see Kwiatkowski et. al. 1992) for each variable. The reported DF-GLS results test the null hypothesis that the data series has a unit root against the alternative hypothesis that the data

series is stationary about a linear time trend (DF-GLS with intercept and time trend included). Alternatively, the reported KPSS results test the null hypothesis that the data series is trend-stationary (intercept and trend included) against the alternative hypothesis that the data series is non-stationary. The results from Table 1 suggest that all variables are non-stationary. Based on these results, it seems reasonable to proceed with the analysis assuming that all variables considered have a unit root.

We continue the analysis by investigating the cointegrating relationships for each education level. Trace statistics (see Johansen 1988 and 1991) are used to determine the number of long-run cointegrating relationships in each model. If the variables are cointegrated, a long-run equilibrium relationship exists. However, the opposite would be true if the variables are not cointegrated. Regarding the economic implications, finding that the variables are cointegrated would, for example, lead us to conclude that the unemployment invariance hypothesis cannot be supported. The results of the cointegration rank tests are reported in Table 2. The number of lags included in the underlying vector autoregression (VAR) model is chosen based on the Hannan and Quinn information criterion. The reported trace statistics indicate that there is one cointegrating equation in each of the models. This suggests that there is a long-run equilibrium relationship between labor force participation rates and the employment-population ratios for each level of education considered.

Table 2: Cointegration rank tests

	Bachelor's Degree and Higher	**Some College or Associate Degree**	**High School Graduates**	**Less Than a High School Diploma**
	Trace Statistic	Trace Statistic	Trace Statistic	Trace Statistic
H_0: r = 0	17.472* [0.025]	51.886** [0.000]	19.732* [0.011]	27.015** [0.001]
H_0: r = 1	0.102 [0.750]	1.780 [0.182]	0.863 [0.353]	1.692 [0.193]
Observations	326	326	331	326
Number of lags	12	12	7	12

Notes: Lag length in the VAR (in levels) is selected using the Hannan and Quinn Information Criterion. p-values are reported in square brackets. Sample is January 1992 – February 2020. ** and * indicate that the null hypothesis is rejected at the 1% and 5% levels, respectively.

The Vector Error Correction Model (VECM) incorporates the cointegrating relationship so that the long-run behavior of the endogenous variables is restricted to converge to the long-run equilibrium while allowing for short-run adjustment dynamics. In other words, the first step of estimating the VECM is to estimate the cointegrating equation. The next step is to estimate a VAR in first differences including the error-correction terms (cointegrating vector) estimated in the first step. The estimated long-run cointegrating relationships are reported in Table 3. Column 1 of Table 3 shows the long-run cointegrating equation for those with a Bachelor's degree and higher: $LFPR - 1.005EPR + 0.420$ should be a stationary series. According to this long-run equilibrium relationship for those with a Bachelor's degree and higher, when the employment-population ratio changes by 1% the labor force participation rate will change by approximately 1.005% in the same direction in order to return to the long-run equilibrium. Similarly, columns 2,

3, and 4 show the long-run cointegrating equations for some college or associates degree ($LFPR - 1.263EPR + 17.641$); high school graduates ($LFPR - 0.943EPR - 5.797$); and less than a high school diploma ($LFPR - 1.012EPR - 4.383$). For each education level considered, the corresponding cointegrating equation suggests that the employment-population ratio and the labor force participation rate will tend to move in the same direction (with similar, but slightly different magnitudes) in order to maintain this long-run equilibrium (cointegrating) relationship.

Table 3: Estimated cointegrating equations

	Bachelor's Degree and Higher	**Some College or Associate Degree**	**High School Graduates**	**Less Than a High School Diploma**
LFPR	1	1	1	1
EPR	-1.005** [0.000]	-1.263** [0.000]	-0.943** [0.000]	-1.012** [0.000]
constant	0.420	17.641	-5.797	-4.383

Notes: Lag length in the VAR (in levels) is selected using the Hannan and Quinn Information Criterion. p-values are reported in square brackets. Sample is January 1992 – February 2020. ** and * indicate that the null hypothesis is rejected at the 1% and 5% levels, respectively.

The results in Table 3 indicate that the coefficient on EPR is statistically significant in the cointegrating relationship for each level of education. However, we must also test the statistical significance of LFPR in each cointegrating relationship. For completeness, we proceed by testing the appropriate restrictions on each of the cointegrating relationships presented in Table 3: $\boldsymbol{\beta} = (1\ \ 0)'$ and $\boldsymbol{\beta} = (0\ \ 1)'$. If we do not reject these restrictions, then we can conclude that the cointregration suggested by the trace statistics in Table 2 is not due to a long-run relationship between the variables but rather a single stationary variable (labor force participation rates in the first case and employment-population ratios in the second case). The results of the likelihood ratio tests of these restrictions are reported in the first two rows of Table 4. As can be seen, each of these restrictions on the cointegrating relationship is rejected for each model. Thus, we have established that a long-run relationship between employment-population ratios and labor force participation rates exists for each education level. The economic implication of the existence of these long-run relationships between labor force participation rates and employment-population ratios leads us to conclude that the unemployment invariance hypothesis cannot be supported.

Having established the existence of the long-run relationships between employment-population ratios and labor force participation rates, we are interested in whether there is any other information that our VECM can give us regarding the US economy. In this regard, both the cointegrating equation and the error-correction terms are of interest. As seen previously in Table 3, for each education level considered, the cointegrating equation suggests that the employment-population ratio and the labor force participation rate tend to move in the same direction in the long-run. We argue that the estimated long-run cointegrating equations can be interpreted as favoring discouraged worker effects. To see this, note that a lower employment-population ratio is associated with a lower labor force participation rate.

However, the cointegrating equations alone provide no information about whether labor force participation rates adjust to employment-population ratios (consistent with only a discouraged worker effect). We therefore, consider restrictions on the error-correction terms of the VECM. We are interested in testing the following restrictions on the error-correction terms: $\boldsymbol{\alpha} =$

$(\alpha_{LFPR}\ 0)'$ and $\boldsymbol{\alpha} = (0\ \alpha_{EPR})'$. The first restriction implies that the labor force participation rate adjusts but that the employment-population ratio does not. Whereas the second restriction implies that the employment-population ratio adjusts but that the labor force participation rate does not. The results of the likelihood ratio tests of these restrictions on the error-correction terms are reported in the last two rows of Table 4.

For those with a Bachelor's degree and higher, the restriction $\boldsymbol{\alpha} = (\alpha_{LFPR}\ 0)'$ is not rejected at the 1% or 5% levels of significance. This means that, for those with a Bachelor's degree and higher, the labor force participation rate adjusts to the employment-population ratio but not vice versa, a finding that further confirms our earlier statement regarding discouraged worker effects. Similarly, for high school graduates, the restriction $\boldsymbol{\alpha} = (\alpha_{LFPR}\ 0)'$ is not rejected at the 1% level of significance. This means for those with a high school degree, the labor force participation rate adjusts to the employment-population ratio but not vice versa, consistent with discouraged worker effects. These results provide additional evidence in support of discouraged worker effects for the education levels (1) Bachelor's degree and higher and (2) high school graduates.

However, we also see in Table 4 that both restrictions on the error-correction terms are rejected at any relevant level of significance for those with an education level of some college or associate degree and for those with less than a high school diploma. The fact that both restrictions can be rejected for these two education levels could possibly be due to some "deeper" omitted force that could cause more or less exogenous decisions to enter/exit the labor market, thereby also affecting the employment-population ratio.

Table 4: Tests of restrictions in cointegrated VAR

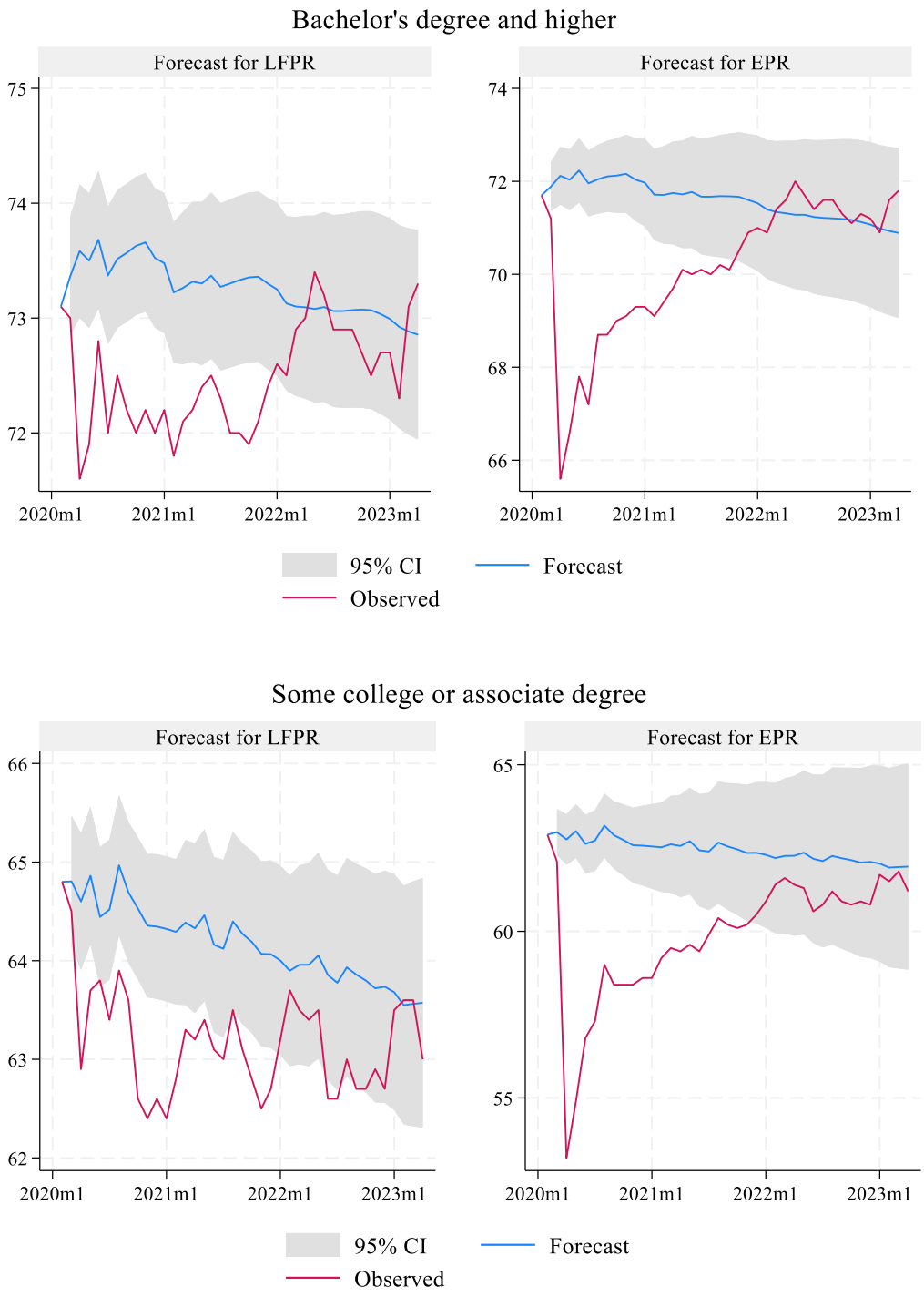
Restriction	Bachelor's Degree and Higher	Some College or Associate Degree	High School Graduates	Less Than a High School Diploma
$\beta_{EPR} = 0$	0.000	0.000	0.000	0.000
$\beta_{LFPR} = 0$	0.000	0.000	0.000	0.000
$\alpha_{EPR} = 0$	0.077	0.000	0.034	0.000
$\alpha_{LFPR} = 0$	0.002	0.000	0.000	0.000

Notes: The values reported are the p-values of the likelihood ratio test for the restrictions. Sample is January 1992 – February 2020.

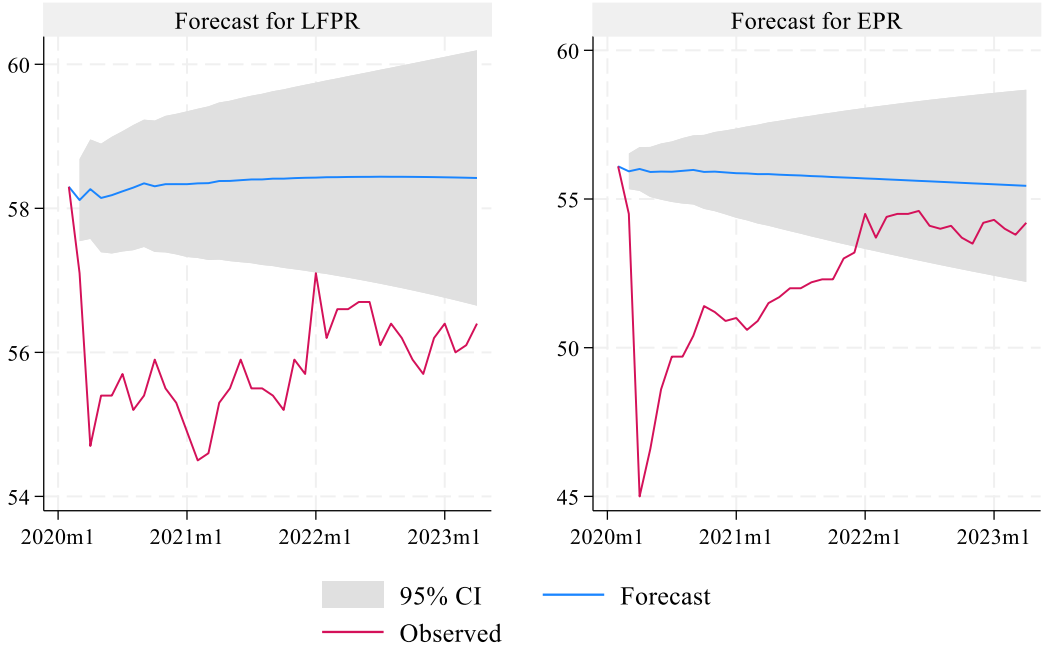
Having completed the initial analysis for the pre-pandemic sample period, we proceed by constructing dynamic forecasts based on the estimated Vector Error Correction Models (pre-pandemic) and comparing these forecasts with the observed data since the start the COVID-19 pandemic (March 2020 – April 2023). Figure 2 presents the observed data along with the forecasts (and the corresponding 95% confidence interval) for each education level.

For those with a Bachelor's degree and higher, we can see that the observed values of LFPR and EPR since the beginning of 2022 fall within the 95% confidence interval for the forecasted values using the pre-pandemic Vector Error Correction model. We see a similar result for those with some college or an associate degree, especially for EPR. Observed values of LFPR for those with some college or an associate degree fall mostly within the 95% confidence interval of the forecasted values since the start of 2022.

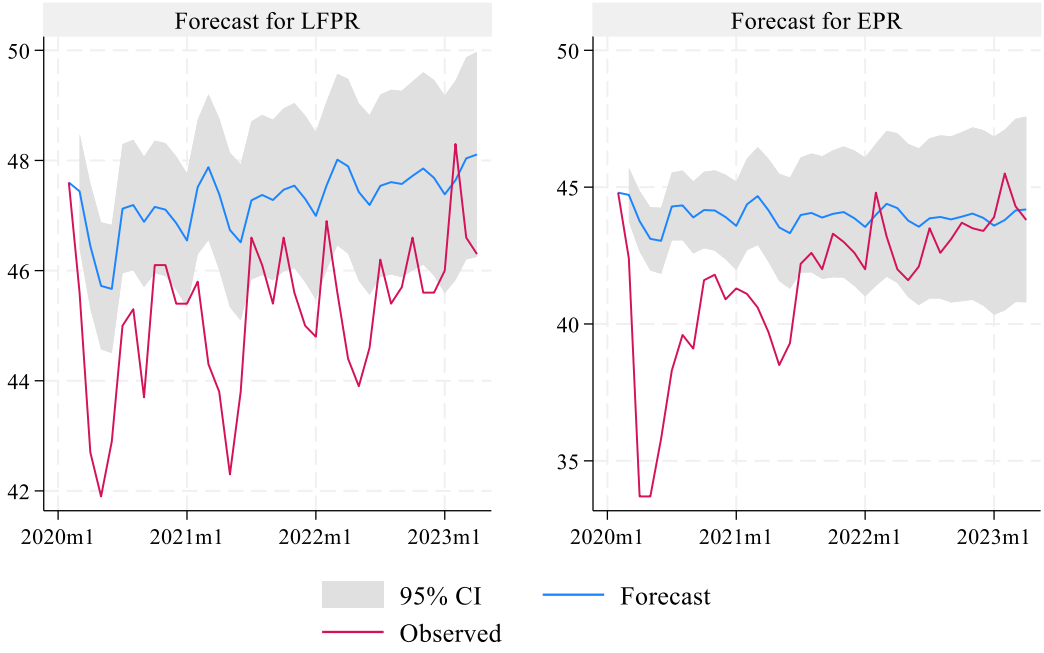
Figure 2: Forecasts and post-pandemic outcomes by education level



High school graduates



Less than a high school diploma



For high school graduates, observed values of EPR since the beginning of 2022 fall within the 95% confidence interval for the forecast. However, for high school graduates, the observed post-pandemic values for LFPR are always outside of the 95% confidence interval. Similarly, for those with less than a high school diploma, observed values of EPR fall within the 95%

confidence interval beginning mid-2021 but observed values of LFPR mostly fall outside of the 95% confidence interval.

4. Conclusion

In this paper, we provide evidence of the existence of a long-run equilibrium relationship between labor force participation rates and employment-population ratios for various levels of education in the United States. This evidence supporting long-run relationships between employment-population ratios and labor force participation rates further suggests that the unemployment invariance hypothesis does not hold for any of the education levels considered (1) Bachelor's Degree and Higher, (2) Some College or Associate Degree, (3) High School Graduates, and (4) Less Than a High School Diploma. This evidence against the unemployment invariance hypothesis is complementary to the results of Emerson (2011).

In addition to supporting the existence of long-run cointegrating relationships between employment-population ratios and labor force participation rates for each level of education, we also find evidence in support of discouraged worker effects for those with a Bachelor's degree and higher and for high school graduates.

We also use estimated Vector Error Correction models to construct dynamic forecasts of labor force participation rates and the employment-population ratios for each education level. The pre-pandemic VECMs appear to do reasonably well at forecasting the actual values of the employment-population ratios since 2022 for each education level. The pre-pandemic VECMs also do a reasonable job of predicting labor force participation rates since 2022 for those with at least some college.

However, labor force participation rates for those with a high school degree or less continue to be significantly below the levels forecasted using pre-pandemic models. This result could be indicative of more persistent structural changes (post-COVID) in the labor market for those with lower education levels (high school degree or less). This information can help inform policymakers. For example, additional policies focusing on members of the population who have only a high school degree or less may be needed to improve labor market outcomes. Potential policies could focus directly on improving labor market participation for this group. Alternatively, policies focused on improving opportunities for additional education and/or training might also improve outcomes.

Further research into this area appears to be warranted. Does education level impact male and female employment and labor force participation differently? How are the results affected if we can also account for race or other various demographics? Will the COVID-19 pandemic have longer-lasting effects on labor force participation and employment? If so, how will the magnitudes of these impacts compare for different demographic groups?

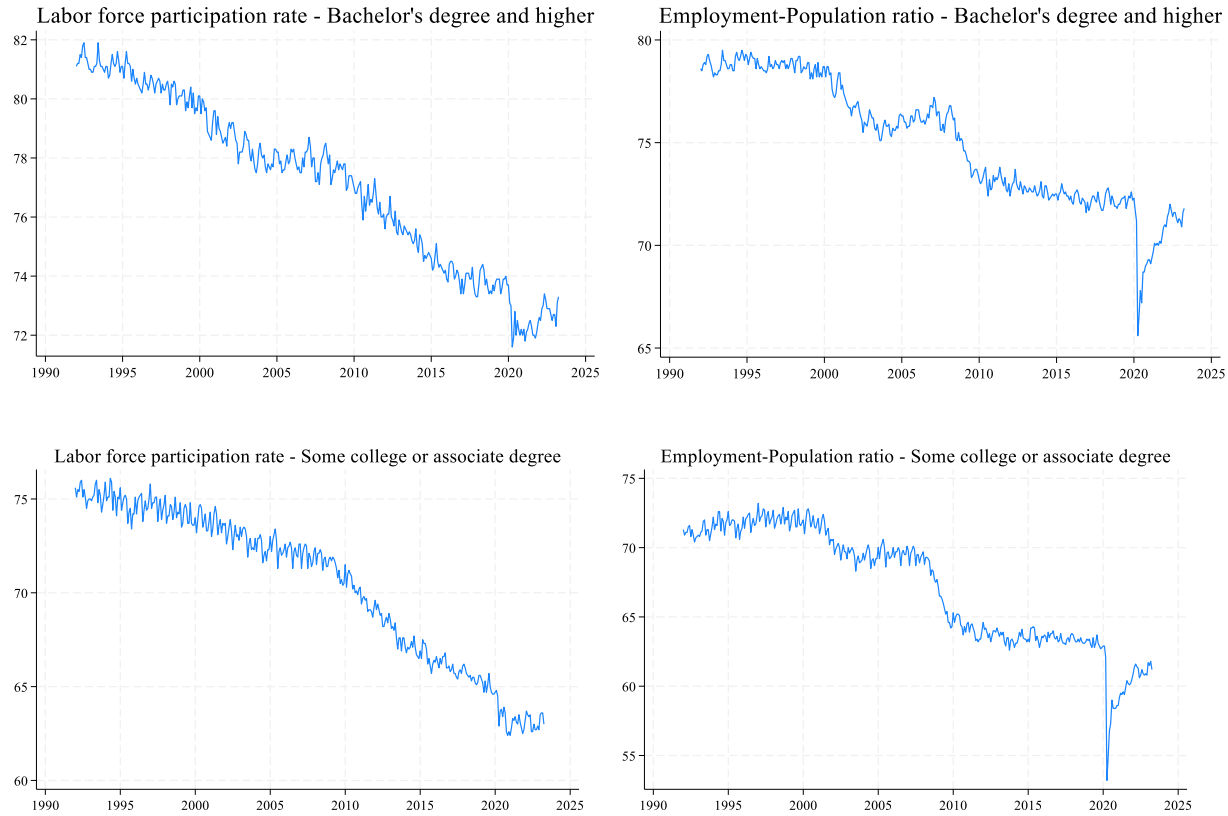
5. Appendix

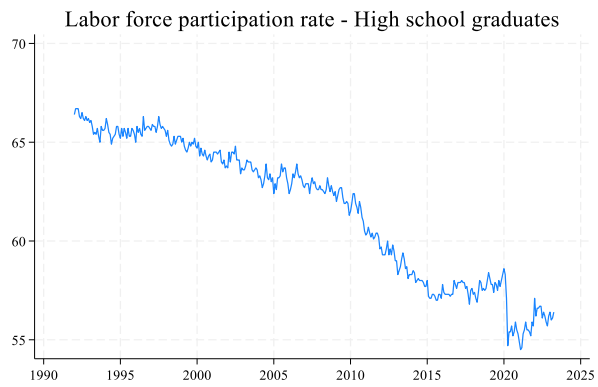
Data used in this paper were obtained from Federal Reserve Economic Data (FRED: https://fred.stlouisfed.org). The data series and descriptions from FRED are presented in Appendix Table 1. Time series plots of the data are presented in Appendix Figure 1.

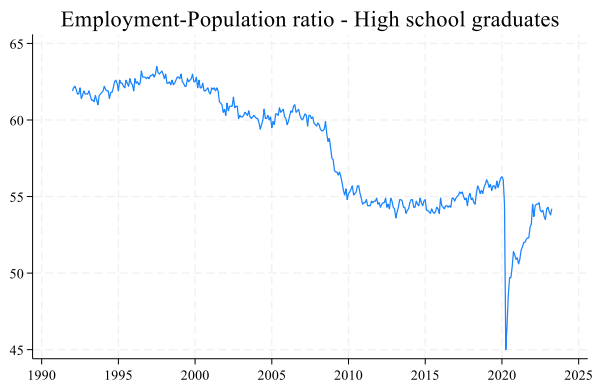
Appendix Table 1: FRED Data Series Descriptions

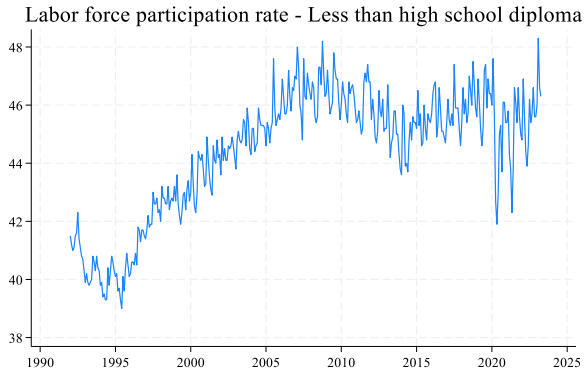
FRED Series	Description
LNS11327662	Labor Force Participation Rate - Bachelor's Degree and Higher, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS11327689	Labor Force Participation Rate - Some College or Associate Degree, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS11327660	Labor Force Participation Rate - High School Graduates, No College, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS11327659	Labor Force Participation Rate - Less Than a High School Diploma, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS12327662	Employment-Population Ratio - Bachelor's Degree and Higher, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS12327689	Employment-Population Ratio - Some College or Associate Degree, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS12327660	Employment-Population Ratio - High School Graduates, No College, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted
LNS12327659	Employment-Population Ratio - Less Than a High School Diploma, 25 Yrs. & over, Percent, Monthly, Seasonally Adjusted

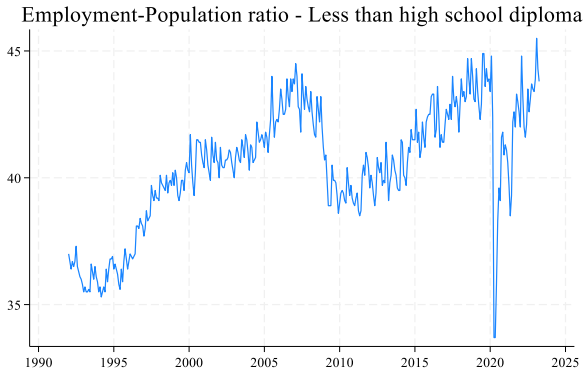
Appendix Figure 1: Labor force participation and employment in the US for different education levels











References

Altuzarra, A., Gálvez Gálvez, C., and A. González Flores (2019) "Unemployment and labour force participation in Spain" *Applied Economics Letters* **26**(5), 345-350.

Bernstein, D.H. and A.B. Martinez (2021) "Jointly modeling male and female labor participation and unemployment" *Econometrics* **9**(4), 46.

Bluedorn, J., Caselli, F., Hansen, N.J., Shibata, I., and M.M. Tavares (2021) "Gender and Employment in the COVID-19 Recession: Evidence on 'She-Cessions' " IMF Working Paper WP/21/95. Washington, DC: International Monetary Fund.

Elliot, G., Rothenburg, T.J., and J.H. Stock (1996) "Efficient tests for an autoregressive unit root" *Econometrica* **64**, 813-836.

Emerson, J. (2011) "Unemployment and labor force participation in the United States" *Economics Letters* **111**, 203-206.

Gustavsson, M. and P. Österholm (2006) "The informational value of unemployment statistics: a note on the time series properties of participation rates" *Economics Letters* **92**, 428-433.

Hobijn, B., Franses, P. H., and M. Ooms (2004) “Generalizations of the KPSS-test for stationarity” *Statistica Neerlandica* **58**, 483-502.

Janko, Z. (2023) “Unemployment and labor force participation in Canada” *Applied Economics Letters* **30**(12), 1647-1651.

Johansen, S. (1988) “Statistical analysis of cointegration vectors” *Journal of Economic Dynamics and Control* **12**, 231-254.

Johansen, S. (1991) “Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregression models” *Econometrica* **59**, 1551-1580.

Karanassou, M. and D.J. Snower (2004) “Unemployment invariance” *German Economic Review* **5**, 297-317.

Kwiatkowski, D., Phillips, P.C.B, Schmidt, P., and Y. Shin (1992) “Testing the null hypothesis of stationarity against the alternative of a unit root” *Journal of Econometrics* **54**, 159-178.

Layard, R., Nickell, S.J., and R. Jackman (1991) *Unemployment: macroeconomic performance and the labour market*, Oxford University Press, Oxford.

Murphy, K.M. and R. Topel (1997) “Unemployment and nonemployment” *American Economic Review* **87**, 295-300.

Nemore, F., Caferra, R. and A. Morone (2021) “Unemployment and labor force participation in Italy” *International Journal of Manpower* **42**(8), 1440-1449.

Ng, S. and P. Perron (2000) “Lag length selection and the construction of unit root tests with good size and power” *Econometrica* **69**, 1519–1554.

Österholm, P. (2010) “Unemployment and labour-force participation in Sweden” *Economics Letters* **106**, 205-208.

Raifu, I.A. and O.M. Adeboje (2022) "Labour force participation and unemployment rate: does discouraged worker effect hypothesis or unemployment invariance hypothesis hold in Africa?" *African Journal of Economic and Management Studies* **13**(2), 284-305.

Schwert, G. W. (1989) “Tests for unit roots: A Monte Carlo investigation” *Journal of Business and Economic Statistics* **2**, 147–159.

Tansel, A. and Z.A. Ozdemir (2018) “Unemployment invariance hypothesis, added and discouraged worker effects in Canada” *International Journal of Manpower* **39**(7), 929-936.