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Employment hysteresis in the United States during the COVID-19 pandemic

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ABSTRACT

In this paper, we test the validity of the employment hysteresis hypothesis. For this purpose, we use daily employment data at the national and state levels in the United States from January 8, 2020, to May 30, 2020. We apply the modified version of the Kapetanios-Shin unit root test, along with finite-sample critical values. We find that the employment hysteresis hypothesis is valid in the United States during the COVID-19 era. The validity of the findings does not change when data at the national and state levels are used. The evidence is also valid when the employment levels for all firms and small firms are considered. The results are also robust to employment levels for workers at different income levels and employment in five different sectors.

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1. Introduction

Macroeconomic theorists have long discussed whether labour market indicators (mainly unemployment rates) follow a unit root process, which would point to the validity of the hysteresis hypothesis of Blanchard and Summers (1986). Alternatively, if they follow a stationary process, this would imply that the natural rate hypothesis of Friedman (1968) is valid. Blanchard and Summers (1986) are the first researchers to define hysteresis as the significant relationship between current employment levels to previous levels. Blanchard and Summers (1986) observe significant hysteresis effects in European countries, but the evidence is weak in the United States.

According to Blanchard (2018), the validity of the hysteresis hypothesis has mostly been tested via unit root tests. If the unemployment rates follow a unit root process, this implies the validity of their hysteresis hypothesis. In other words, if unemployment rates follow a unit root stochastic process, this means that external shocks, such as the COVID-19 pandemic, permanently affect labour market outcomes. The validity

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of the hysteresis hypothesis is an indicator of the significant shift in business cycles. On the other hand, if unemployment rates follow a stationary process, this implies the validity of Friedman's natural rate hypothesis (1968) and means that external shocks, such as the COVID-19 pandemic, temporarily affect the labor market outcomes. Overall, analysing the stochastic dynamics of labour market indicators is essential for fiscal and monetary policy frameworks. This paper follows this strand in the literature to test the validity of the employment hysteresis hypothesis in the United States. For this purpose, we use new daily employment data at the national and state levels during the COVID-19 pandemic era.

To flatten the curve of the COVID-19 virus spread, governments have imposed general curfews or partial lockdowns, including closures of public spaces, schools, and workplaces, as well as enacting restrictions on domestic and international travel (Alvarez et al., 2021; Gozgor, 2020; Hale et al., 2020). Therefore, people postponed travel decisions and delayed durables purchases, hurting aggregate demand (Atkeson 2020; Coibion et al., 2020b). The COVID-19-related shocks have also changed household consumption habits, moving people to online shopping (Baker et al., 2020; Guerrieri et al., 2020). The arrival of the COVID-19 pandemic in early 2020 and the ensuing policy implications have caused unprecedented numbers of initial unemployment insurance in the United States (Coibion et al., 2020a). Meanwhile, job vacancies have collapsed, particularly since the second half of March 2020 (Forsythe et al., 2020). In the United States, many workers are unable to work from home (Montenovo et al., 2020). Notably, low-skilled workers (workers without a college degree) have lost their jobs during the COVID-19 pandemic. For example, Cowan (2020) observes reductions in participation rate and hours worked. Racial and ethnic minorities have been primarily affected by losing their full-time jobs or working reduced part-time hours. Overall, the COVID-19 pandemic has changed every macroeconomic policy dimension (Eichenbaum et al., 2020). Given this backdrop, we analyse the stochastic properties of employment levels in the COVID-19 era in the United States at the national and state levels to test the validity of the employment hysteresis hypothesis.

Nelson and Plosser (1982) is the first empirical paper to examine macroeconomic indicators' dynamic stochastic processes. Several papers have analysed stochastic dynamics of unemployment series, and most of these papers have applied traditional time-series, nonlinear parametric models and panel data unit root test techniques. For instance, Akdoğan (2017), Ball (2009, 2014), Chang (2011), Fève et al. (1999), Fosten and Ghoshray (2011), Furuoka (2017), Marques et al. (2017), and Røed (1996, 2002) have concluded that the hysteresis hypothesis is valid in unemployment series. Cheng et al. (2012) find significant hysteresis in the states of the United States. However, Song and Yangru (1997) and Canarella et al. (2019) observe weak evidence for the validity of the hysteresis hypothesis in the unemployment rates of 48 states and 20 metropolitan areas in the United States, respectively. Khraief et al. (2020) have also observed the validity of Friedman's (1968) natural rate hypothesis in 25 of 29 OECD countries from 1980 to 2013.

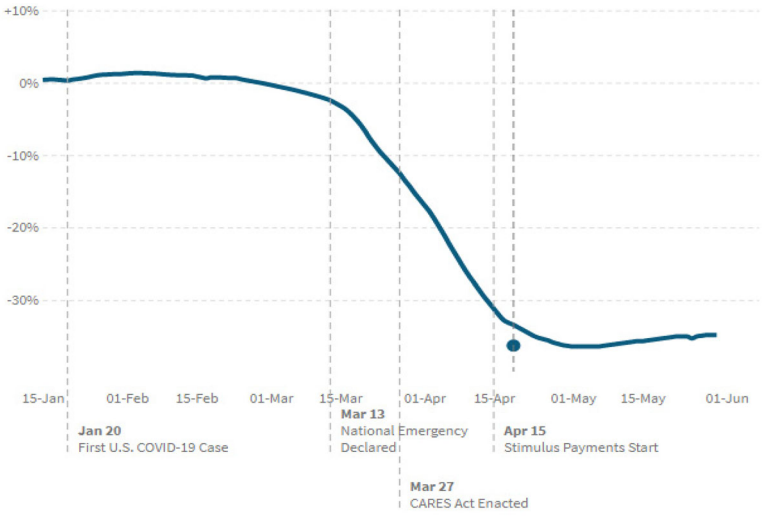
Note that employment hysteresis is a new concept, and it is an extended version of the unemployment hysteresis hypothesis. According to Austin et al. (2018),

geographical differences across states are the primary driver of less mobility (migration) across the United States. During the Global Financial Crisis of 2008–2009, the regions exposed to the highest unemployment increases took much longer to recover. This issue is explained by the fact that unemployed people did not migrate to other regions to apply for new jobs. Particularly, if workers' skills are limited, finding a job in a different sector or moving to a different region will be more difficult. Therefore, certain regions' employment levels remained relatively lower even after the economic uncertainty decreased at the national level (Yagan, 2019). This issue can create a significant hysteresis in local employment levels in the United States (Yagan, 2019). Specifically, Yagan (2019) defines this issue as "employment hysteresis" in various United States regions.

In addition to Yagan (2019), a few studies test the validity of the employment hysteresis hypothesis. For example, Gustavsson and Österholm (2007) use the aggregate employment-population ratios in several countries, including the United States, and find the validity of the hysteresis hypothesis at the United States national level.[1] Fallick and Krolikowski (2018) focus on state-level data and obtain evidence in favouring hysteresis in the employment-population ratios for low-skilled men workers. Amior and Manning (2018) observe significant hysteresis in the employment-population ratio in the United States at the local (commuting zones) level data. Aaronson et al. (2019) use the unemployment and non-participation rates data in the United States. The authors observe that the unemployment rates of black men, white men, and Hispanic women do not follow a unit root process, which is against the validity of the hysteresis hypothesis. The unemployment rate for white women is in line with the hysteresis hypothesis. The findings for black women and Hispanic men are mixed. Aaronson et al. (2019) also use non-participation rates, and they find significant unit-roots for each group related to ethnicity and gender.

In this paper, we test the validity of the employment hysteresis hypothesis in the United States during the COVID-19 pandemic. To this end, we apply the modified version of the Kapetanios-Shin Unit Root test (henceforth KSUR) introduced by Kapetanios and Shin (2008) with the modified critical values in Otero and Smith (2017). Thus, we address potential asymmetric effects, nonlinearity, and small sample sizes in the employment series. If we reject the validity of stationarity in the employment levels, the findings favour the employment hysteresis hypothesis. To test its validity, we consider daily employment data, as provided by Chetty et al. (2020), for employment in all businesses and small businesses, employment at different income levels, and employment in five industries. To the best of our knowledge, the current paper is the first empirical study to consider employment data, as proposed by Chetty et al. (2020), to test the stochastic properties of the employment levels in the COVID-19 period. By applying the modified version of the KSUR test rather than the linear unit root tests, we aim to address asymmetries and nonlinearity in the employment data. We observe that the employment hysteresis hypothesis is valid in the United States during the COVID-19 era.

The remainder of the study is organised as follows. Section 2 explains the details of the unit root test methodology and introduces the dataset. Section 3 discusses the empirical results. Section 4 concludes.



Data Source: https://tracktherecovery.org/

Figure 1. Total employment level in the United States during the COVID-19 crisis (% of relative change). Data Source: https://tracktherecovery.org/

2. Econometric methodology and data

2.1. KSUR test procedure

We apply the KSUR test procedure since it models nonlinearity and asymmetries in the time-series. According to Blanchard (2018), deviations from the natural rate hypothesis are related to nonlinearities due to the depth and length of the recession. It is associated with asymmetries due to Research & Development (R&D) activities and technological progress. The KSUR test can capture nonlinearities and asymmetries in the employment series, such as the declaration of a national emergency (on March 13), the enacting of The Coronavirus Aid, Relief, and Economic Security (CARES) Act (on March 27), and the start of stimulus payments (on April 15), which provide asymmetric and nonlinear patterns in the employment series (See Figure 1).[2]

The KSUR test is more powerful than the linear unit root tests if there are significant asymmetries (Dong et al., 2021). The KSUR test is an extended version of the seminal unit root test of Kapetanios et al. (2003). Kapetanios et al. (2003) introduce a model for an Exponential Smooth Transition Autoregressive (ESTAR) process, and it is based on the following univariate STAR(1) model:

$$y_t = \beta y_{t-1} + \gamma y_{t-1}\Theta(\theta; y_{t-d}) + \varepsilon_t \tag{1}$$

where $t = 1,2,3 \ldots T$ is the number of observations ($T = 144$ in our analysis). $\varepsilon_t \sim$ i.i.d.$(0, \sigma^2)$, β and γ are unknown parameters in a STAR model. In addition, $\Theta(\theta; y_{t-d})$ is a transition function, and it follows an exponential form. To define a stochastic process with a non-zero mean or time trend, Kapetanios et al. (2003) use a de-trending procedure on data by applying the Ordinary Least Squares (OLS). However, Kapetanios and Shin (2008) observe that the Generalized Least Squares (GLS) de-trending procedure executes higher power gains than the OLS de-trending

procedure. Therefore, Kapetanios and Shin (2008) introduce an extended unit root test – the GLS de-trending-based unit-root test – against the alternative of the ESTAR process. The test statistic can be provided as such:

$$\Delta\tilde{y}_t = \delta\tilde{y}_{t-1}^3 \sum_{j=1}^{p} \kappa_j \Delta\tilde{y}_{t-j} + u_t \tag{2}$$

Note that the different lags of the dependent variable are included to capture potential residual serial correlation in the time-series. In our analyses, the optimal number of lags is endogenously selected using Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC). Furthermore, a data-dependent procedure – the General-to-specific (GTS) algorithm of Hall (1994) – is used for significance levels of 5% (GTS05) and 10% (GTS10). In short, four approximated p-values are calculated.[3]

Otero and Smith (2017) also modify the KSUR test by running Monte Carlo simulations and response surface regressions. Following their contributions, we use the modified 1%, 5%, and 10% finite-sample critical values in Otero and Smith (2017).

When we obtain the stationarity of the series, we calculate the half-life (HL) of shocks in days. The HL can be obtained as follows:

$$HL = |\ln(0.5)|/|\ln(\rho)| \tag{3}$$

Note that ρ is the Autoregressive (AR) coefficient in the AR (1) process in the estimation for $Y_t = \rho Y_{t-1} + \varepsilon_t$

2.2. Data

We consider the daily employment series from January 8, 2020 to May 30, 2020. The employment series are a seven-day moving average of the total number of active employees. Total earnings of workers are also based on a seven-day moving average of earnings. All series are defined as relative percentage changes since they are divided by the average values between January 4 and January 31. The employment data are introduced by Chetty et al. (2020) at https://tracktherecovery.org/. The related data are collected by private sector firms (Earnin and Homebase).

Furthermore, we focus on employment data for all businesses and small businesses. Chetty et al. (2020) define small businesses as firms with fewer than 50 employees. This analysis makes sense since the reopening of temporarily shuttered businesses contributed significantly to the employment rebound in small businesses (Cajner et al., 2020). The employment data also perfectly matches the income data. We therefore not only use total employment data but also consider earnings data for workers at different median income levels: high (top quartile), middle (middle two quartiles), and low (bottom quartile). The findings have important policy implications because low-skilled workers are more open to job losses during times of external adverse shocks in general (Deming & Kahn, 2018) and the COVID-19 pandemic in particular (Cajner et al., 2020).

Table 1. Results of the KSUR test for employment levels (All business & workers at different income levels, national level).

Employment Level-All Businesses (All Workers)						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.484	(0.222)	−2.758	−2.139	−1.853	–
SC (2)	−1.484	(0.214)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.852	(0.612)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.852	(0.599)	−2.780	−2.205	−1.928	–
Employment Level -Workers in the High (Top Quartile) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (1)	−1.168	(0.384)	−2.758	−2.139	−1.853	–
SC (1)	−1.168	(0.376)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.564	(0.729)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.564	(0.720)	−2.780	−2.205	−1.928	–
Employment Level -Workers in the Middle (Middle Two Quartiles) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (8)	−0.869	(0.560)	−2.758	−2.139	−1.853	–
SC (2)	−1.369	(0.267)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.869	(0.603)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.869	(0.590)	−2.780	−2.205	−1.928	–
Employment Level- Workers in the Low (Bottom Quartile) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.258	(0.333)	−2.758	−2.139	−1.853	–
SC (2)	−1.258	(0.324)	−2.691	−2.102	−1.826	–
GTS05 (2)	−1.258	(0.388)	−2.836	−2.261	−1.979	–
GTS10 (2)	−1.258	(0.373)	−2.780	−2.205	−1.928	–

Notes: CV: Critical value. Critical values are calculated using Monte Carlo simulations for 130 observations with 50,000 replications. For details, refer to Otero and Smith (2017). The optimal number of lag is selected by AIC, SC, GTS05, and GTS10. The KSUR test is defined under the null hypothesis that employment levels are the unit root process.

Furthermore, we use employment data in five industries: manufacturing, retail trade, transportation and warehousing, health care and social assistance, and accommodation and food services. These data are also provided by Chetty et al. (2020).

3. Empirical results and macroeconomic implications

3.1. Baseline empirical results

Table 1 presents the KSUR test findings for total employment at the national level for all businesses and all businesses at different median income levels (top quartile, middle two quartiles, and bottom quartile). All results indicate that the employment series does not follow a stationary process.

Table 2 provides the KSUR test results for employment at the national level for all businesses in five sectors. The findings show that employment levels in all sectors follow an ESTAR process. These results in Tables 1 and 2 are also robust to different methods for optimal lag selection.

Table 3 reports the findings of the KSUR test for total employment at the national level for small businesses and the workers in small businesses at different median income levels (top quartile, middle two quartiles, and bottom quartile). All findings show that the employment series does not follow a stationary process.

Table 4 presents the findings of the KSUR test for employment at the national level for small businesses in five sectors. The results indicate that employment levels

Table 2. Results of the KSUR test for employment levels (All businesses & different sectors, national level).

Employment Level-Manufacturing						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (8)	−0.128	(0.820)	−2.758	−2.139	−1.853	–
SC (1)	−1.353	(0.275)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.128	(0.833)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.128	(0.826)	−2.780	−2.205	−1.928	–
Employment Level-Retail Trade						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.319	(0.301)	−2.758	−2.139	−1.853	–
SC (2)	−1.319	(0.292)	−2.691	−2.102	−1.826	–
GTS05 (2)	−1.319	(0.356)	−2.836	−2.261	−1.979	–
GTS10 (2)	−1.319	(0.340)	−2.780	−2.205	−1.928	–
Employment Level-Transportation and Warehousing						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−0.804	(0.597)	−2.758	−2.139	−1.853	–
SC (2)	−0.804	(0.594)	−2.691	−2.102	−1.826	–
GTS05 (2)	−0.804	(0.636)	−2.836	−2.261	−1.979	–
GTS10 (2)	−0.804	(0.623)	−2.780	−2.205	−1.928	–
Employment Level- Health Care and Social Assistance						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−0.571	(0.704)	−2.758	−2.139	−1.853	–
SC (2)	−0.571	(0.706)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.308	(0.796)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.308	(0.788)	−2.780	−2.205	−1.928	–
Employment Level- Accommodation and Food Services						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (3)	−0.479	(0.735)	−2.758	−2.139	−1.853	–
SC (3)	−0.479	(0.738)	−2.691	−2.102	−1.826	–
GTS05 (3)	−0.479	(0.754)	−2.836	−2.261	−1.979	–
GTS10 (6)	−0.532	(0.730)	−2.780	−2.205	−1.928	–

Notes: CV: Critical value. Critical values are calculated using Monte Carlo simulations for 130 observations with 50,000 replications. For details, refer to Otero and Smith (2017). The optimal number of lag is selected by AIC, SC, GTS05, and GTS10. The KSUR test is defined under the null hypothesis that employment levels are the unit root process.

in all sectors follow an ESTAR process. These findings in Tables 3 and 4 are also robust to different methods for optimal lag selection.

3.2. Robustness checks

In Online Appendix Tables I–XVIII, we report the results of the KSUR test for the level of employment at the state level.[4] We use total employment data for all businesses and small businesses and the workers in these business groups at different median income levels (top quartile, middle two quartiles, and bottom quartile). The KSUR test results for employment levels at the state level for five sectors, with small businesses and all businesses, are also provided. All results show that almost no employment series follow a stationary process. The only two exceptions are stationarity in small business employment for retail trade in South Carolina and transportation and warehousing in Iowa. The half-life values of the shocks are obtained as 47 and 22 days, respectively.

In short, employment in the United States has been significantly influenced by the COVID-19-related shocks. The findings remain valid when the employment data at the national and state levels for all businesses and small businesses, employment data

Table 3. Results of the KSUR test for employment level (Small businesses & workers at different income levels, national level).

Employment Level-Small Businesses (All Workers)						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.429	(0.247)	−2.758	−2.139	−1.853	–
SC (1)	−1.140	(0.393)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.733	(0.668)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.733	(0.656)	−2.780	−2.205	−1.928	–
Employment Level -Workers in the High (Top Quartile) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (8)	−0.441	(0.746)	−2.758	−2.139	−1.853	–
SC (1)	−1.228	(0.342)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.441	(0.764)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.441	(0.755)	−2.780	−2.205	−1.928	–
Employment Level -Workers in the Middle (Middle Two Quartiles) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.549	(0.196)	−2.758	−2.139	−1.853	–
SC (1)	−1.233	(0.338)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.886	(0.595)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.886	(0.581)	−2.780	−2.205	−1.928	–
Employment Level- Workers in the Low (Bottom Quartile) Median Income						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.379	(0.271)	−2.758	−2.139	−1.853	–
SC (2)	−1.379	(0.262)	−2.691	−2.102	−1.826	–
GTS05 (8)	−0.926	(0.574)	−2.836	−2.261	−1.979	–
GTS10 (8)	−0.926	(0.560)	−2.780	−2.205	−1.928	–

Notes: CV: Critical value. Critical values are calculated using Monte Carlo simulations for 130 observations with 50,000 replications. For details, refer to Otero and Smith (2017). The optimal number of lag is selected by AIC, SC, GTS05, and GTS10. The KSUR test is defined under the null hypothesis that employment levels are the unit root process.

for workers at different median income levels, and employment in five leading sectors are considered.

3.3. Macroeconomic implications

In terms of macroeconomic concepts, the employment hysteresis hypothesis's validity is a significant indicator of the significant shift in business cycles during the COVID-19 pandemic. The findings imply that external shocks, such as the COVID-19 pandemic, permanently affect labour market outcomes. The evidence may be related to the evidence that unemployed people did not migrate to other regions to apply for new jobs during the COVID-19 pandemic. Therefore, employment levels in certain regions remained relatively lower during the COVID-19 pandemic. Our results show that the low-skilled workers and the high-skilled workers have experienced job-losses during the COVID-19 pandemic. Macroeconomic policy implications should address both sides of the coin.

Besides, there is a significant reduction in the employment levels in every sector, especially the services. The results are not significantly changed when we consider the size of firms. Therefore, a fiscal macroeconomic package to stalled firms in different sectors can help enhance the employment levels to the pre-COVID-19 pandemic levels. Our results suggest that stimulus packages (e.g. direct transfer payments to the business world and small-medium firms) can help recover employment to pre-COVID-19 levels.

Table 4. Results of the KSUR test for employment levels (Small businesses & different sectors, national level).

Employment Level-Manufacturing						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (1)	−1.100	(0.424)	−2.758	−2.139	−1.853	–
SC (1)	−1.100	(0.416)	−2.691	−2.102	−1.826	–
GTS05 (1)	−1.100	(0.477)	−2.836	−2.261	−1.979	–
GTS10 (1)	−1.100	(0.462)	−2.780	−2.205	−1.928	–
Employment Level-Retail Trade						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−1.458	(0.234)	−2.758	−2.139	−1.853	–
SC (2)	−1.458	(0.225)	−2.691	−2.102	−1.826	–
GTS05 (2)	−1.458	(0.285)	−2.836	−2.261	−1.979	–
GTS10 (2)	−1.458	(0.270)	−2.780	−2.205	−1.928	–
Employment Level-Transportation and Warehousing						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (4)	−1.211	(0.359)	−2.758	−2.139	−1.853	–
SC (2)	−1.059	(0.441)	−2.691	−2.102	−1.826	–
GTS05 (4)	−1.211	(0.415)	−2.836	−2.261	−1.979	–
GTS10 (4)	−1.211	(0.398)	−2.780	−2.205	−1.928	–
Employment Level- Health Care and Social Assistance						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (2)	−0.421	(0.752)	−2.758	−2.139	−1.853	–
SC (2)	−0.421	(0.755)	−2.691	−2.102	−1.826	–
GTS05 (10)	−0.550	(0.934)	−2.836	−2.261	−1.979	–
GTS10 (10)	−0.550	(0.929)	−2.780	−2.205	−1.928	–
Employment Level- Accommodation and Food Services						
Criteria & Lag	KS-Stat	Probability	1% CV	5% CV	10% CV	Half-life (Days)
AIC (4)	−0.268	(0.790)	−2.758	−2.139	−1.853	–
SC (2)	−0.636	(0.679)	−2.691	−2.102	−1.826	–
GTS05 (3)	−0.428	(0.767)	−2.836	−2.261	−1.979	–
GTS10 (3)	−0.428	(0.759)	−2.780	−2.205	−1.928	–

Notes: CV: Critical value. Critical values are calculated using Monte Carlo simulations for 130 observations with 50,000 replications. For details, refer to Otero and Smith (2017). The optimal number of lag is selected by AIC, SC, GTS05, and GTS10. The KSUR test is defined under the null hypothesis that employment levels are the unit root process.

Finally, our findings also indicate that the job losses during the COVID-19 pandemic are not significantly different, for instance, in California compared to Florida. This evidence may be inconsistent with the intuition that Democratic and Republican states are differently affected by the COVID-19 pandemic. We observe that the COVID-19 pandemic has significantly affected all states in terms of job losses. We suggest that expansionary fiscal policy and loosen monetary policy (e.g. New Keynesian macroeconomic policies) can help mitigate the harmful effects of the COVID-19 pandemic on employment across the states.

4. Conclusion

In this paper, we used daily employment data provided by Chetty et al. (2020) at https://tracktherecovery.org/. We focused on the data for the period from January 8, 2020 to May 30, 2020. We applied the modified nonlinear unit root test procedures of the KSUR and the finite-sample critical values generated by Otero and Smith (2017). We observed significant evidence of the validity of the employment hysteresis hypothesis during the COVID-19 era. The results are valid for employment data at the national and state levels. The primary evidence is also valid when we consider the

employment levels for all firms and small firms. The results are also robust to employment levels among workers at different income levels and employment levels in different sectors. Notable findings are seen in small business employment for retail trade in South Carolina and transportation and warehousing in Iowa. The effects of shocks are dampened at 47 days and 22 days, respectively.

Our investigation gives insight into the crisis that will guide leaders and public organisations and help them achieve these crucial objectives and adapt to a new normal. However, our empirical evidence is still too raw to give us precise guidance for potential implications after the re-openings. Future studies can examine how the reopening of the United States' economy promotes employment levels across regions.

Notes

1. The authors also obtain some evidence for hysteresis in the unemployment rate in the United States.
2. We also implement the linearity test provided by Harvey et al. (2008), and the findings confirm the nonlinearity of the employment levels.
3. Fllowing Schwert (1989), we define the maximum number of lags in the test regression as $max\_lag = int\ (12 * (T/100) \wedge 0.25)$ where T is 144.
4. The findings from the GTS05 criteria of Hall (1994) is considered when the optimal number of lag is selected. Our findings are also robust to select other methods for the optimal number of lag.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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