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UNEMPLOYMENT HYSTERESIS IN MIDDLE-INCOME COUNTRIES

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ABSTRACT

Business cycles pave the way for asymmetry in the unemployment rate behavior with rapid increases during recessions and slight decreases in expansions. It, in turn, may raise the non-accelerating inflation rate of unemployment and the cost in terms of inflation of any demand stimulus policy. The recent jump in unemployment worldwide due to the COVID-19 pandemic and the government's stimulus package following it raises questions about the cost of such a decision. We use the smooth transition model (STR) to analyze unemployment dynamics on quarterly data over the last two decades for fifteen middle-income countries. Our results suggest the absence of hysteresis except for Bulgaria, Mexico, and Ukraine. Our policy recommendation for these countries is the necessity of labor market reforms, as hysteresis will considerably reduce any economic stimulus on unemployment.

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Introduction

The COVID pandemic moved household consumption habits to online shopping (Baker et al., 2020; Guerrieri et al., 2020) and reduced job vacancies (Forsythe et al., 2020) as low-skilled workers are unable to work from home (Montenovo et al., 2020) therefore the fall in hours worked (Cowan, 2020). When it comes to unemployment, the debate is dominated by two major theories, the natural rate, and the hysteresis. Both respectively linked to the stationary and non-stationary unemployment rate. For (Friedman, 1995), who supports the natural rate theory, unemployment is a mean-reverting process, and the labor market's shocks are only temporary. On the one hand, the natural rate is the steady-state toward which the unemployment rate trend in the long run. On the other hand, hysteresis is high unemployment rates that labor market frictions do not explain (Blanchard & Summers, 1986). In general, hysteresis refers to the persistence of a phenomenon and the disappearance of the factors leading to it. In the unemployment case, hysteresis upholds this economic phenomenon even if the recession originating its rising levels becomes a thing of the past. Recent works confirmed the validity of the hysteresis hypothesis in unemployment series by Chang (2011), Fosten & Ghoshray (2011), Ball (2014), and Marques et al. (2017) for the OECD countries, Cheng et al. (2012) for the United States, Akdogan (2017) for Europe and Furuoka (2017) for Nordic countries.

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It seems important to revisit this subject, with the latest available data, as the world is facing a global rise in the unemployment rates due to the covid-19 pandemic. The government's stimulus package seems appealing as a solution for an economic recovery, but to reduce unemployment, one must first understand the dynamic conditioning its response to any policy. All the previous works consist of testing the existence of hysteresis, and most of them in a linear context. Some exceptions used a nonlinear approach, such as Hsi Chiung & Yi Chung (2012) for the G20 countries with no evidence of hysteresis in nine countries. The same result was also found by Güriş et al. (2017) for Turkey. Therefore, we intend to further analyze unemployment dynamics through its persistence and volatility in a nonlinear regime-changing approach. We focus on a group of middle-income countries, as labor markets in this particular group were hit the most by the pandemic. The latest Internation Labour Organization (2021) report issued in January 2021 estimated the working-hour losses in 2020 by 6.7% in low-income countries, 8.3% in high-income countries, and 18.6% in middle-income countries.

This paper uses the breakpoint unit root test to identify hysteresis in their unemployment rates and analyze its dynamics with the smooth transition model. The latter will make it possible to identify the threshold unemployment rate at which a regime switch happens. The model will also determine the volatility and persistence of unemployment in each regime. To our knowledge, no such work has been done for the group of countries we consider in this paper. The previous closest results to ours, Oliskevych (2015)for Ukraine, Akdogan (2017) for Bulgaria and Khraief et al. (2020) for Mexico among others countries, tested for the existence of the phenomenon in a single country or comparative studies without real focus on persistence or volatility as part of unemployment dynamics. Such features can be necessary first to determine which countries are the most vulnerable to labor market shocks and predict unemployment response to economic stimulus. The paper is organized as follows. Section 2 surveys the literature, section 3 presents the model. Section 4 details the results, while Section 5 contains the concluding remarks.

Literature review

In the early economic literature on hysteresis (Neftçi, 1984), the non-linearity of unemployment finds its roots, besides the distinctive factors of the labor market, within the business cycles itself. For Blanchard & Summers (1986) who support the hysteresis theory, hysteresis describes a "path-dependent" equilibrium, while for Roed (1997), it is a situation where transitory shocks affect the unemployment rate permanently.

The economic literature on the subject is rich but widely divided, with results susceptible to testing techniques. Camarero et al. (2006) found no hysteresis in the annual unemployment rate for the OECD countries from 1956 to 2001. In comparison, Liew et al. (2012), through unit root tests, found evidence of unemployment hysteresis in most OECD countries.

Logeay & Tober (2006) found unemployment hysteresis in the European countries, using the Kalman filter. Cuestas et al. (2011) and Gozgor (2013) confirm the presence of unemployment hysteresis in most central and eastern European countries, using the unit root tests and the Markov switching model. But Camarero et al. (2006), on monthly data from 1991 to 2003 for nine European countries, found that hysteresis disappear once the unit root tests allow the existence of structural breaks. Bolat et al. (2014) used a nonlinear panel root test with structural break and found no hysteresis in Europe on monthly data from 2000 to 2013.

Lee et al. (2010) focused on the annual unemployment rate from 1976 to 2004 for nine Asian countries, where he found evidence for hysteresis with structural break unit root tests. On the contrary, Furuoka (2014) found no trace of hysteresis on annual data from 1990 to 2009 for the 5-Asia-Pacific countries. Oliskevych (2015) used a structural vector autoregressive error correction model for Ukraine from 2002 to 2014 and found that technology shocks, labor demand, and labor supply shocks are the sources of unemployment hysteresis. Akdogan (2017) used linear and nonlinear unit root tests for thirty-one European countries, the USA, and Japan from 1983 to 2014. Out of these thirty-three countries, he found unemployment hysteresis in thirteen of them. Yaya et al. (2019) used the Fourier ADF test for forty-two African countries from 1991 to 2017 and found unemployment hysteresis in only seven countries. Khraief et al. (2020) used panel unit root tests with and without structural breaks for twenty-nine OECD countries from 1980 to 2013. They found evidence of unemployment hysteresis in only four countries.

Data and Research Methods

The International Monetary Fund is the the source of data which is quarterly and covers the period 2000Q01 to 2020Q01. The sample contains fifteen middle-income countries estimation is done through the Eviews program. Before estimating by the smooth transition approach, we test for hysteresis with breakpoint unit root tests. The standard ADF tests are biased with structural breaks when it comes to the non-rejection of the null hypothesis (Perron, 1989). These breaks were taken into account in analyzing unemployment dynamics by previous works (Cuestas et al., 2011; Ozdemir et al., 2013; Canarella et al., 2019; Enders, 2010). If the unemployment rate is stationary in level, we conclude that the natural rate theory fits better the data. Still, if the unemployment rate is integrated of order one, then the hysteresis theory is adequate. In fact, according to Blanchard & Summers (1986), pioneers of the hysteresis theory, a non-stationary unemployment rate induce the long-lasting effect of cyclical fluctuations on its levels.

The smooth transition models (STR) are a set of nonlinear models popularized by Terasvirta (1994, 1998) and Woodward & Anderson (2009). In these models, the dependent variable, in our case the unemployment rate, varies between two endogenously determined regimes through the transition function: . The maximum likelihood test is biased and cannot be used to test linearity in this case. Therefore Terasvirta (1994) replaced the transition function with a Taylor series approximation. The model takes the following form:

$$\mu_t = \phi' z_t + \theta' z_t G(\gamma, c, s_t) + \varepsilon_t$$
$$\mu_t = \{\phi + \theta G(\gamma, c, s_t)\}' z_t + \varepsilon_t \tag{1}$$

Where
μ_t is the unemployment rate
$\varepsilon_t \sim iid(0, \sigma^2)$ is the error term
$z_t = (1, \mu_{t-1}, \ldots, \mu_{t-p})$ is a vector of explanatory variables.
The transition function $G(\gamma, c, s_t)$ can be:

First order Logistic (L1STR):

$$G(\gamma, c, s_t) = \frac{1}{1 + e^{-\gamma(s_t - c)}} \tag{2}$$

Second order Logistic (L2STR):

$$G(\gamma, c, s_t) = \frac{1}{1 + e^{-\gamma(s_t - c_1)(s_t - c_2)}} \tag{3}$$

Exponential (ESTR):

$$1 - e^{-\gamma(s_t - c)^2} \tag{4}$$

Where γ and *c* are respectively the slopes and the value of the threshold, in comparison, s_t is the transition variable between the two regimes. Linearity tests choose between the model's different specifications. For Terasvirta (1998), the delay parameter is based on the smallest p-value of the LM statistic. The null hypothesis can be built from the Lagrange linearity multiplier test against the STAR alternative. $H04{:}b1 = b2 = b3 = b4 = 0$; $H03{:}b1 = b2 = b3 = 0$; $H02{:}b1 = b2 = 0$ and $H01{:}b1 = 0$. The $H0i$ test uses the $i - th$ order Taylor expansion $(bj = 0\ for\ all\ j > i)$ and all tests are based on the third-order Taylor expansion $(b4 = 0)$. The Terasvirta Sequential Tests with the null hypothesis: $H3{:}b3 = 0$, $H2{:}b2 = 0 \mid b3 = 0$ and $H1{:}b1 = 0 \mid b2 = b3 = 0$. The Escribano-Jorda Tests with the null hypothesis: $H0L{:}b2 = b4 = 0$ and $H0E{:}b1 = b3 = 0$.

Finding and Discussion

We conduct statistical analysis in Table 1, representing the mean, the median, the maximum, and the minimum values. The table also shows the standard deviations, skewness, and kurtosis to evaluate asymmetry and the Jarque-Bera statistics to assess the distribution of unemployment.

Table 1: Statistical Characteristics of The Unemployment Rate

	Mean	Median	Max	Min	Std Dev	Skewness	Kurtosis	Jarque-Bera	Prob
BULGARIA	10,789	10,42	20,03	4,7	4,112	0,582	2,556	4,915	0,086
CHINA	4,096	4,1	4,3	3,6	0,126	-0,837	5,582	25,25	0,000
COLOMBIA	11,141	10,8	16,57	7,85	2,242	0,522	2,423	4,449	0,108
IRAN	11,549	11,3	14,7	9,5	1,251	0,642	3,029	3,914	0,141
KAZAKHSTAN	6,764	6,35	12,67	4,9	1,799	0,864	3,226	8,611	0,013
MALAYSIA	3,334	3,32	4	2,74	0,289	0,416	2,572	2,809	0,245
MAURITIUS	7,993	7,8	10,4	6,1	0,868	0,52	3,354	2,766	0,251
MEXICO	3,981	4,025	6,15	1,5	1,085	-0,52	2,763	3,229	0,199
MOLDOVA	6,001	6,1	13	2,2	2,151	0,612	3,353	5,336	0,069
MONGOLIA	9,066	8,8	12,8	6,3	1,677	0,497	2,543	2,392	0,302
PERU	7,508	7,67	10,27	5,47	1,264	0,076	1,953	3,501	0,174
RUSSIA	6,858	6,585	12,4	4,6	1,675	0,833	3,26	8,771	0,012
SOUTH AFRICA	25,707	25,35	30,4	21	2,117	0,145	2,652	0,685	0,710
THAILAND	1,418	1,18	4,63	0,48	0,786	1,657	6,074	62,161	0,000
UKRAINE	8,536	8,7	12,2	5,2	1,572	-0,001	2,983	0,001	0,999

The mean and median have different values, which indicate asymmetry, especially in the case of Thailand. Skewness and kurtosis values, different from 0 and 3 respectively, for all cases, also indicate asymmetry. The highest volatility is observed in Bulgaria, with a 4.112 standard deviation and a vast difference between the minimum and maximum values of unemployment. The p-values of the Jarque-Bera test indicate the normality of the residuals at a 5% level except for China, Kazakhstan, Russia, and Thailand.

To verify the natural rate and hysteresis theory, so, necessary to carry out a unit root test. But because the standard unit root test may mislead us if the series suffers from a breakpoint. We opted for the Dickey-Fuller t-statistic breakpoint test based on the Akaike information criterion. Structural breaks are associated with particular events like the SARS epidemic in 2003, the global financial crisis in 2008, and the global outbreak of the Covid-19 pandemic in 2020. If the unemployment rate is stationary in level, we conclude that the first theory fits better the data. Still, if the unemployment rate is integrated of order one, then the hysteresis theory is adequate.

Table 2: Breakpoint ADF Unit Root Test

		Level			1st difference		
		Intercept	**Trend intercept**	**Trend**	**Inter-cept**	**Trend intercept**	**Trend**
BULGARIA	break date	2009Q2	2009Q3	2016Q3	2001Q1	2003Q3	2002Q3
	Test stat	-5.044	-4.106	-3.685	-7.209	-7.486	-7.103
	P-value	0.029	0.453	0.31	< 0.01	< 0.01	< 0.01
CHINA	break date	2008Q3	2008Q3	2016Q3			
	t-stat	-6.338	-6.338	-5.475			
	p-value	< 0.01	< 0.01	< 0.01			
COLOMBIA	break date	2004Q1	2004Q2	2004Q2			
	t-stat	-5.079	-5.066	-4.482			
	p-value	0.026	0.068	0.056			
IRAN	break date	2010Q1	2010Q1	2004Q2			
	t-stat	-5.073	-5.182	-4.334			
	p-value	0.027	0.049	0.083			
KAZAKHSTAN	break date	2002Q1	2012Q2	2012Q2			
	t-stat	-7.312	-7.037	-7.193			
	p-value	< 0.01	< 0.01	< 0.01			
MALAYSIA	break date	2015Q3	2010Q2	2013Q2			
	t-stat	-6.469	-6.535	-6.178			
	p-value	< 0.01	< 0.01	< 0.01			
MAURITIUS	break date	2006Q3	2006Q3	2007Q1			
	t-stat	-5.811	-6.005	-4.999			
	p-value	< 0.01	< 0.01	0.013			
MEXICO	break date	2008Q3	2008Q4	2012Q2	2002Q1	2002Q1	2002Q2
	t-stat	-2.922	-4.059	-3.438	-16.119	-16.001	-15.138
	p-value	0.9329	0.4805	0.4414	< 0.01	< 0.01	< 0.01
MOLDOVA	break date	2002Q3	2002Q3	2003Q2			
	t-stat	-7.22	-7.157	-7.105			
	p-value	< 0.01	< 0.01	< 0.01			
MONGOLIA	break date	2015Q4	2015Q4	2007Q3			
	t-stat	-5.636	-5.129	-4.538			
	p-value	< 0.01	0.0573	0.0485			

		Level			1st difference		
		Intercept	**Trend intercept**	**Trend**	**Inter-cept**	**Trend intercept**	**Trend**
PERU	break date	2018Q4	2012Q3	2018Q2			
	t-stat	-6.479	-6.542	-6.502			
	p-value	< 0.01	< 0.01	< 0.01			
RUSSIA	break date	2011Q3	2011Q3	2004Q3			
	t-stat	-6.448	-6.42	-4.902			
	p-value	< 0.01	< 0.01	0.017			
SOUTH AFRICA	break date	2005Q4	2005Q4	2007Q4			
	t-stat	-4.775	-5.231	-4.182			
	p-value	0.063	0.044	0.121			
THAILAND	break date	2004Q1	2004Q1	2004Q2			
	t-stat	-6.017	-5.761	-5.312			
	p-value	< 0.01	< 0.01	< 0.01			
UKRAINE	break date	2002Q1	2003Q1	2003Q2	2007Q3	2013Q3	2015Q2
	t-stat	-4.525	-4.803	-4.672	-16.416	-16.679	-16.324
	p-value	0.1229	0.1232	0.033	< 0.01	< 0.01	< 0.01

Source: Data Processed

Table 2 shows that the unemployment rate is stationary in all countries, except Bulgaria, Mexico, and Ukraine, where the unemployment is static in the first difference at 1% level. For the three countries, it is clear that the unemployment rate suffers from hysteresis. Now before testing linearity, we need to determine the optimal lag length for each country. Table 3 displays the optimal lag, which minimizes the log-likelihood (LogL). According to various criteria like the sequential modified LR test statistic (LR), the final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan-Quinn information criterion (HQ).

Table 3: Lag Length Selection For Middle Income Countries

	Lag	LogL	LR	FPE	AIC	SC	HQ
BULGARIA	5	-59.950	14.058*	0.408*	1.940*	2.136*	2.017*
CHINA	1	88.138	72.966*	0.003*	-3.076*	-3.004*	-3.048*
COLOMBIA	5	-49.280	27.948*	0.305*	1.650*	1.848*	1.728*
IRAN	5	-50.983	10.030*	1.014	2.849	3.102*	2.941*
KAZAKHSTAN	6	65.536	5.958*	0.008*	-1.951*	-1.707	-1.856*
MALAYSIA	4	8.384	5.522*	0.053*	-0.098*	0.064	-0.034*
MAURITIUS	8	-25.127	3.005	0.251*	1.452*	1.807	1.586*
MEXICO	5	-8.735	13.836*	0.096*	0.491*	0.701*	0.573*
MOLDOVA	5	-125.002	5.126	2.346	3.690	3.881*	3.766*
MONGOLIA	8	-60.460	4.640*	1.902*	3.473*	3.853	3.610
PERU	5	-33.336	14.603*	0.222*	1.333*	1.545*	1.416*
RUSSIA	7	-36.964	6.409*	0.276*	1.550*	1.835	1.661*
SOUTH AFRICA	7	-92.616	4.020*	0.959*	2.795*	3.048	2.896

	Lag	LogL	LR	FPE	AIC	SC	HQ
THAILAND	5	20.890	6.635*	0.037*	-0.458*	-0.257*	-0.379*
UKRAINE	5	-69.139	12.464*	0.472*	2.087*	2.277*	2.163*

* indicates lag order selected by the criterion
Source: Data Processed

In Bulgaria, all criteria indicate five lags, while in the case of Mexico and Ukraine, most criteria also point out five lags. To estimate the STR model, first, we must test for linearity and determine the value of the constant and the delay parameters.

Table 4: Linearity Tests

	H04	**H03**	**H02**	**H01**	**H3**	**H2**	**H1**	**H0L**	**H0E**
BULGARIA	2.085	2.085	2.085	2.385	1.657	1.657	2.384	1.080	1.429
	(.041)	(.041)	(.041)	(.048)	(.160)	(.160)	(.048)	(.382)	(.194)
CHINA	2.195	2.195	2.195	2.071	2.499	2.499	2.071	0.441	0.439
	(.060)	(.060)	(.060)	(.085)	(.120)	(.120)	(.085)	(.778)	(.780)
COLOMBIA	1.919	1.919	1.919	3.677	0.358	0.358	3.677	0.536	0.453
	(.062)	(.062)	(.062)	(.006)	(.875)	(.875)	(.006)	(.748)	(.912)
IRAN	2.398	2.398	2.398	1.188	3.238	3.238	1.188	1.064	2.545
	(.030)	(.030)	(.030)	(.335)	(.018)	(.018)	(.335)	(.379)	(.041)
KAZAKHSTAN	1.954	1.954	1.954	0.443	3.340	3.340	0.443	1.267	1.991
	(.053)	(.053)	(.053)	(.846)	(.009)	(.009)	(.846)	(.294)	(.061)
MALAYSIA	1.845	1.845	2.203	3.925	0.914	0.583	3.925	1.766	1.657
	(.067)	(.067)	(.039)	(.007)	(.440)	(.676)	(.007)	(.148)	(.173)
MAURITIUS	1.254	1.254	1.254	2.183	0.568	0.568	2.183	4.012	2.082
	(.303)	(.303)	(.303)	(.057)	(.793)	(.793)	(.057)	(.014)	(.080)
MEXICO	3.025	3.025	1.427	1.259	5.024	1.532	1.259	6.649	6.715
	(.002)	(.002)	(.198)	(.296)	(.001)	(.198)	(.296)	(.000)	(.000)
MOLDOVA	1.640	1.640	1.225	0.716	2.216	1.696	0.716	1.596	1.925
	(.094)	(.094)	(.294)	(.614)	(.066)	(.150)	(.614)	(.136)	(.064)
MONGOLIA	2.093	2.093	2.093	0.590	3.168	3.168	0.590	2.699	3.940
	(.075)	(.075)	(.075)	(.776)	(.024)	(.024)	(.776)	(.091)	(.029)
PERU	0.456	0.456	0.503	0.706	0.076	0.342	0.706	2.004	1.909
	(.921)	(.921)	(.880)	(.621)	(.784)	(.885)	(.621)	(.096)	(.112)
RUSSIA	1.695	1.695	1.527	2.218	2.208	0.878	2.218	1.077	1.187
	(.092)	(.092)	(.147)	(.050)	(.124)	(.533)	(.050)	(.401	(.338)
SOUTH AFRICA	1.201	1.201	1.201	1.368	0.170	0.170	1.368	1.080	1.115
	(.314)	(.314)	(.314)	(.236)	(.682)	(.682)	(.236)	(.390)	(.368)
THAILAND	1.582	1.706	0.922	1.742	2.938	0.220	1.742	2.035	1.790
	(.103)	(.082)	(.520)	(.140)	(.022)	(.953)	(.140)	(.053)	(.092)
UKRAINE	2.012	2.012	2.358	4.210	0.899	0.626	4.210	1.977	1.930
	(.036)	(.036)	(.020)	(.002)	(.447)	(.680)	(.002)	(.097)	(.092)

Note: p-value in parentheses
Source: Data Processed

The results in table 4 confirm that linearity is rejected only for Bulgaria, Mexico, and Ukraine. The Terasvirta Sequential Tests reject linearity at the 5% level using $H03$ and recommend the first-order logistic ($\Pr(H3) \leq \Pr(H2)$ or $\Pr(H1) \leq \Pr(H2)$). The Escribano-Jorda Tests reject linearity 5% level using $H04$ and suggest the first-order logistic with the nonzero threshold ($\Pr(H0L) \geq \Pr(H0E)$ with $\Pr(H0E) \geq .05$). All tests rejected linearity 5% level and the chosen specification is logistic.

Now we proceed with the smooth transition estimation for Bulgaria, Mexico, and Ukraine. The procedure is based on the HAC (Newey West) covariance method using observed Hessian to overcome serial correlation and heteroskedasticity. This approach is practical when the standard assumptions of regression analysis do not apply, as it uses kernel methods and supposes that autocorrelations between distant observations die out. The transition lag and volatility in each regime are determined by the sum of the squares of the residuals. We will refer to the sum of the threshold lag's coefficients in both regimes to identify the unemployment persistence level.

Table 5: Smooth Transition Regression

	Coeff	Prob	Coeff	Prob	Coeff	Prob
linear part						
UNEMP (-1)	1.425	.000	1.100	.000	1.151	.000
UNEMP (-2)	-0.126	.604	0.225	.191	-0.509	.002
UNEMP (-3)	0.058	.846	-0.531	.001	0.716	.010
UNEMP (-4)	0.706	.129	0.715	.000	0.119	.701
UNEMP (-5)	-0.987	.025	-0.499	.006	-0.436	.088
SLOPE	1.147	.210	327.26	1.00	132.87	1.00
THRESHOLD	8.711	.000	4.695	1.00	7.808	.987
nonlinear part						
UNEMP (-1)	-0.136	.588	-0.575	.005	-0.325	.127
UNEMP (-2)	-0.646	.065	-0.218	.283	-0.093	.758
UNEMP (-3)	0.784	.035	0.611	.001	-0.140	.670
UNEMP (-4)	-0.879	.093	-0.091	.687	0.371	.287
UNEMP (-5)	0.776	.093	0.242	.247	0.113	.688
	0.978		0.908		0.811	
	0.976		0.889		0.778	
SER	0.604		0.303		0.643	
	21.489		4.681		26.028	
Log L	-58.32		-7.505		-66.734	
DW stat	2.121		1.771		2.221	
Mean dep var	10.350		4.161		8.319	
S.D. dep var	3.874		0.908		1.366	
AIC	1.981		0.619		2.099	
SC	2.363		1.027		2.470	
HQC	2.133		0.780		2.248	

	Coeff	Prob	Coeff	Prob	Coeff	Prob
NORMAL	0.329	.848	1.648	.044	7.294	.260
SERIAL	0.809	.549	1.973	.101	1.244	.301
ARCH	0.392	.852	0.932	.468	0.432	.825

Source: Data Processed

The Breusch–Godfrey LM and the ARCH diagnostic tests of the residuals contained in Table 4 confirm the absence respectively at 5% level of serial correlation, with p-values of 0.549 in Bulgaria, 0.101 in Mexico and 0.301 in Ukraine, or Heteroskedasticity, with p-values of 0.852 in Bulgaria, 0.468 in Mexico and 0.825 in Ukraine. Also, the Jarque–Berra statistic results confirm the normality behavior at 5% level for Bulgaria and Ukraine and 10% level for Mexico. The Durbin-Watson Statistic is around 2, with 2.121 in Bulgaria, 1.771 in Mexico, and 2.221 in Ukraine, which indicates the absence of first-order serial correlation.

Table 5 also shows that the threshold variable chosen for Bulgaria is the unemployment's first lag with a significance level of 1% in the first regime. Once unemployment reaches 8.711%, the transition occurs at a speed of 1.147, while unemployment's persistence is measured as the sum of the autoregressive coefficients, unemployment's first lag is 1.289. One-third of Bulgaria's unemployment rate data, 30.99%, is below the threshold and falling under the first regime, while the remainder, 69.01%, is above the threshold. The second regime has a higher level of volatility, 11.5 compared to the first one with 9.99.

In the case of Mexico, the threshold variable chosen is the unemployment's third lag with a significance level of 1% in both regimes. The transition happens when unemployment reaches 4.7% at a speed of 327.26 while unemployment's persistence is 0.576. Two-thirds of the data in the Mexican's unemployment rate, 65.08%, are below the value of the threshold and fit in the first regime, while the rest, 34.92%, are above the threshold. The second regime has a lower level of volatility, 1.01, compared to the first one with 3.66.

Ukraine's results confirm that the threshold variable chosen is the unemployment's third lag with a significance level of 10% in the first regime. The transition occurs when unemployment reaches 7.81% at a speed of 132.87 while unemployment's persistence is 0.08. One-third of the data in the Ukrainian's unemployment rate, 30.67%, is below the value of the threshold and fits in the first regime, while the rest, 30.33%, are above the threshold. The second regime has a lower level of volatility, 11.86, compared to the first one with 14.17.

Our results in terms of unemployment hysteresis existence are similar to those of Akdogan (2017) for Bulgaria, Khraief et al. (2020) for Mexico, and Oliskevych (2015) for Ukraine. But our findings in terms of volatility are essential as they identify these three countries as the most vulnerable to labor market shocks since they suffer from unemployment hysteresis and high volatility. Economic stimulus seems a solution for these countries if we consider that recessions affect labor markets through low potential economic growth as in Ball (2014), but these three cases are different. A jobless recovery can occur if workers' skills decline due to lack of activity or become unsuitable to post-pandemic jobs creation as many large firms closed down in many countries. The labor market's response to an economic stimulus is different when unemployment dynamics display hysteresis since the labor market takes longer to recover than output, reducing the positive effects of an inflation costly economic stimulus. In addition, we found that higher volatility is associated with higher unemployment rates in

Bulgaria, Mexico, and Ukraine, inducing higher labor market risk. In this context, the absence of an economic stimulus is also welfare costly since volatility in unemployment is associated with volatility in individual earnings. Therefore, government spending should target the labor market by hiring subsidies as a cost-effective stimulus option, reducing firms' costs and stimulating hiring (Faia et al., 2013).

Conclusion

From a sample of fifteen middle-income countries, we found evidence of unemployment hysteresis only in three of them, namely Bulgaria, Mexico, and Ukraine, as shown by the results of the Dickey-Fuller t-statistic breakpoint test based on the Akaike information criterion. The linearity tests we conducted proved that the unemployment in these three countries is asymmetric and fits into a first-order logistic specification. Following that, we estimated a smooth transition autoregressive model STR using quarterly data for Bulgaria, Mexico, and Ukraine to analyze unemployment's dynamics over the last two decades. Among the three countries, Bulgaria is the most threatened by the rise of unemployment as unemployment volatility in its second regime is higher, and two-thirds of the data were higher than the threshold and fitted in the second regime. Suggesting a government's stimulus package might be a way out of the recession, but for sure, it will not reduce unemployment in countries where its dynamic exhibit hysteresis.

Moreover, inadequate response to recession will contribute to hysteresis as achieving a specific goal of low inflation after an untargeted costly government spending might create needlessly higher future unemployment rates. Therefore, hiring subsidies seems the best cost-effective stimulus option because they reduce the firm's costs, stimulating hiring. This measure targets the recruitment channel directly and slows down job losses. Besides hiring subsidies, our policy recommendations for these countries are the necessity of labor market reforms to increase labor market flexibility and improve the matching of unemployed workers and job vacancies.

References

Akdogan, K. (2017). Unemployment hysteresis and structural change in Europe. *Empirical Economics*, *53*(4), 1415–1440. https://doi.org/10.1007/s00181-016-1171-8

Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., & Yannelis, C. (2020). How does household spending respond to an epidemic? consumption during the 2020 COVID-19 pandemic. In *Review of Asset Pricing Studies* (Vol. 10, Issue 4, pp. 834–862). https://doi.org/10.1093/rapstu/raaa009

Ball, L. (2014). Long-term damage from the great recession in OECD countries. *European Journal of Economics and Economic Policies: Intervention*, *11*(2), 149–160. https://doi.org/10.4337/ejeep.2014.02.02

Blanchard, O. J., & Summers, L. H. (1986). Hysteresis and the European Unemployment Problem. *NBER Macroeconomics Annual*, *1*, 15–90. https://doi.org/10.2307/3585159

Bolat, S., Tiwari, A. K., & Erdayi, A. U. (2014). Unemployment hysteresis in the Eurozone area: Evidences from nonlinear heterogeneous panel unit root test. *Applied Economics Letters*, *21*(8), 536–540. https://doi.org/10.1080/13504851.2013.872755

Camarero, M., Carrion-I-Silvestre, J. L., & Tamarit, C. (2006). Testing for hysteresis in unemployment in OECD countries: New evidence using stationarity panel tests with breaks.

Oxford Bulletin of Economics and Statistics, *68*(2), 167–182. https://doi.org/10.1111/j.1468-0084.2006.00157.x

Canarella, G., Gupta, R., Miller, S. M., & Pollard, S. K. (2019). Unemployment rate hysteresis and the great recession: exploring the metropolitan evidence. *Empirical Economics*, *56*(1), 61–79. https://doi.org/10.1007/s00181-017-1361-z

Chang, T. (2011). Hysteresis in unemployment for 17 OECD countries: Stationary test with a Fourier function. *Economic Modelling*, *28*(5), 2208–2214. https://doi.org/10.1016/j.econmod.2011.06.002

Cheng, K. M., Durmaz, N., Kim, H., & Stern, M. L. (2012). Hysteresis vs. natural rate of US unemployment. *Economic Modelling*, *29*(2), 428–434. https://doi.org/10.1016/j.econmod.2011.11.012

Cowan, B. W. (2020). Short-run effects of COVID-19 on US worker transitions. *NBER Working Papers 27315*. https://ideas.repec.org/p/nbr/nberwo/27315.html

Cuestas, J. C., Gil-Alana, L. A., & Staehr, K. (2011). A further investigation of unemployment persistence in European transition economies. *Journal of Comparative Economics*, *39*(4), 514–532. https://doi.org/10.1016/j.jce.2011.09.002

Enders, W. (2010). Applied Econometric Times Series. In *John Wiley & Sons Inc, New York.*

Faia, E., Lechthaler, W., & Merkl, C. (2013). Fiscal stimulus and labor market policies in Europe. *Journal of Economic Dynamics and Control*, *37*(3), 483–499. https://doi.org/10.1016/j.jedc.2012.09.004

Forsythe, E., Kahn, L. B., Lange, F., & Wiczer, D. (2020). Labor demand in the time of COVID-19: Evidence from vacancy postings and UI claims. *Journal of Public Economics*, *189*. https://doi.org/10.1016/j.jpubeco.2020.104238

Fosten, J., & Ghoshray, A. (2011). Dynamic persistence in the unemployment rate of OECD countries. *Economic Modelling*, *28*(3), 948–954. https://doi.org/10.1016/j.econmod.2010.11.007

Friedman, M. (1995). The Role of Monetary Policy. In S. Estrin & A. Marin (Eds.), *Essential Readings in Economics* (pp. 215–231). Macmillan Education UK. https://doi.org/10.1007/978-1-349-24002-9_11

Furuoka, F. (2014). Are unemployment rates stationary in asia-pacific countries? New findings from fourier adf test. *Economic Research-Ekonomska Istrazivanja*, *27*(1), 34–45. https://doi.org/10.1080/1331677X.2014.947105

Furuoka, F. (2017). A new approach to testing unemployment hysteresis. *Empirical Economics*, *53*(3), 1253–1280. https://doi.org/10.1007/s00181-016-1164-7

Gozgor, G. (2013). Testing Unemployment Persistence in Central and Eastern European Countries. *International Journal of Economics and Financial Issues*, *3*(3), 694–700.

Guerrieri, V., Lorenzoni, G., Straub, L., & Werning, I. (2020). Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3570096

Güriş, B., Tiftikçigil, B. Y., & Tıraşoğlu, M. (2017). Testing for unemployment hysteresis in

Turkey: evidence from nonlinear unit root tests. *Quality and Quantity*, *51*(1), 35–46. https://doi.org/10.1007/s11135-015-0292-z

Hsi Chiung, C., & Yi Chung, Z. (2012). Unemployment hysteresis in G20 countries: Evidence from non-linear panel unit-root tests. *African Journal of Business Management*, *6*(49), 11887–11890. https://doi.org/10.5897/ajbm10.721

Internation Labour Organization. (2021). ILO Monitor: COVID-19 and the world of work seventh edition. In *International Labour Organization* (Issue April).

Khraief, N., Shahbaz, M., Heshmati, A., & Azam, M. (2020). Are unemployment rates in OECD countries stationary? Evidence from univariate and panel unit root tests. *North American Journal of Economics and Finance*, *51*. https://doi.org/10.1016/j.najef.2018.08.021

Lee, H. Y., Wu, J. L., & Lin, C. H. (2010). Hysteresis in east asian unemployment. *Applied Economics*, *42*(7), 887–898. https://doi.org/10.1080/00036840701720895

Liew, V. K. Sen, Chia, R. C. J., & Puah, C. H. (2012). Does hysteresis in unemployment occur in OECD countries? Evidence from parametric and non-parametric panel unit roots tests. *International Journal of Economics and Management*, *6*(2), 446–458.

Logeay, C., & Tober, S. (2006). Hysteresis and the Nairu in the Euro area. *Scottish Journal of Political Economy*, *53*(4), 409–429. https://doi.org/10.1111/j.1467-9485.2006.00387.x

Marques, A. M., Lima, G. T., & Troster, V. (2017). Unemployment persistence in OECD countries after the Great Recession. *Economic Modelling*, *64*, 105–116. https://doi.org/10.1016/j.econmod.2017.03.014

Montenovo, L., Jiang, X., Rojas, F. L., Schmutte, I. M., Simon, K. I., Weinberg, B. A., & Wing, C. (2020). Determinants of Disparities in COVID-19 Job Losses. *NBER Worikng Papers*, 1689–1699.

Neftçi, S. N. (1984). Are Economic Time Series Asymmetric over the Business Cycle? *Journal of Political Economy*, *92*(2), 307–328. https://doi.org/10.1086/261226

Oliskevych, M. (2015). Hysteresis, structural shocks and common trends in labor market: consequence for Ukraine. *Ikonomicheski Izsledvania*, *24*(4), 120–137.

Ozdemir, Z. A., Balcilar, M., & Tansel, A. (2013). International labour force participation rates by gender: Unit root or structural breaks? *Bulletin of Economic Research*, *65*(1), 142 164. https://doi.org/10.1111/j.1467-8586.2011.00419.x

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, *57*(6), 1361–1401. https://doi.org/10.2307/1913712

Roed, K. (1997). Hysteresis in Unemployment. *Journal of Economic Surveys*, *11*(4), 389–418. https://doi.org/doi.org/10.1111/1467-6419.00040

Terasvirta, T. (1994). Specification, Estimation, and Evaluation of Smooth Transition Autoregressive Models. *Journal of the American Statistical Association*, *89*(425). https://doi.org/10.2307/2291217

Terasvirta, T. (1998). Modeling economic relationships with smooth transition regressions. In *Handbook of applied economic statistics* (pp. 507–552).

Woodward, G., & Anderson, H. M. (2009). Does beta react to market conditions? Estimates of 'bull' and 'bear' betas using a nonlinear market model with an endogenous threshold parameter. *Quantitative Finance*, *9*(8), 913–924. https://doi.org/10.1080/14697680802595643

Yaya, O. O. S., Ogbonna, A. E., & Mudida, R. (2019). Hysteresis of unemployment rates in Africa: new findings from Fourier ADF test. *Quality and Quantity*, *53*(6), 2781–2795. https://doi.org/10.1007/s11135-019-00894-6