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Hysteresis Effects on Post-Crisis Economic Recovery: Recent Evidence from Central European Economies

Albert Molnar
Obuda University

Abstract: This study investigates hysteresis effects in unemployment within the European Union, with a particular focus on the Visegrád Four (V4) countries—Czech Republic, Hungary, Poland, and Slovakia—over the period 2000Q1 to 2024Q2. Using Eurostat quarterly unemployment data, we employ Augmented Dickey-Fuller tests with structural breaks for 2008–2009 and fractional integration methods to test the hysteresis hypothesis against the natural rate framework. The results provide little evidence of hysteresis: unemployment rates in both the EU27 and V4 countries are stationary once structural breaks are accounted for, with estimated fractional differencing parameters below unity. This implies that shocks such as the 2008 financial crisis and the COVID-19 pandemic had transitory rather than permanent effects on unemployment. Among the V4, all four countries display mean reversion, with differences in adjustment speeds but no persistence consistent with hysteresis. These findings support the natural rate hypothesis and suggest that unemployment dynamics in Central Europe are more resilient than often assumed. Policy implications emphasize the importance of stabilizing demand during downturns but indicate that long-term scarring in labor markets has been limited.

Keywords: Emerging economies, Natural rate hypothesis, Output hysteresis, Unemployment

Introduction

Economic shocks, such as financial crises or pandemics, are typically expected to have only temporary effects on unemployment, with economies reverting to a natural rate of unemployment as proposed by the natural rate hypothesis (Friedman, 1968). The pandemic and its aftermath have significantly reshaped the economy and individual behaviour patterns. The 2008 crisis also brought about a significant behavioural shift in financial thinking, which has been further reinforced by the pandemic (Csiszárik-Kocsir, 2023). In contrast, the hysteresis hypothesis (Blanchard & Summers, 1986) argues that even temporary shocks can lead to permanent increases in unemployment due to factors such as skill loss, labor force withdrawal, or insider–outsider wage-setting dynamics. Following the 2008 global financial crisis and the 2020 COVID-19 pandemic, concerns about long-lasting unemployment effects in Europe reignited debate over the presence of hysteresis (Cerra et al., 2021).

This study investigates whether unemployment in the European Union, and specifically in the Visegrád Four (Czech Republic, Hungary, Poland, and Slovakia), exhibits hysteresis. Using Eurostat quarterly unemployment data from 2000Q1 to 2024Q2, we apply Augmented Dickey-Fuller tests with allowance for structural breaks and fractional integration methods to distinguish between persistent but stationary dynamics and true hysteresis. The results provide strong support for the natural rate hypothesis: unemployment series across the EU27 and the V4 are mean-reverting once structural breaks around 2008 are considered. Fractional integration estimates yield

$d<1$ for all countries, rejecting the presence of hysteresis. While unemployment shocks did lead to sizable short-term increases during the financial crisis and the pandemic, these effects gradually reversed, indicating resilient labor markets in Central Europe. The paper proceeds as follows: Section 2 reviews the literature on hysteresis in unemployment. Section 3 describes the data and methodology, including unit root and fractional integration approaches. Section 4 presents empirical results, with emphasis on country-specific persistence estimates and

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structural breaks. Section 5 discusses policy implications, followed by conclusions in Section 6. This analysis contributes to the debate on unemployment persistence in transition economies by showing that the feared hysteresis effects are not evident in the Visegrád Four.

Literature Review

The study of hysteresis in unemployment has gained renewed relevance in the wake of recent global economic disruptions, particularly the 2020 COVID-19 pandemic, which exacerbated labor market vulnerabilities and raised concerns about long-term scarring effects on employment (Cerra et al., 2021). With European economies still recovering from the pandemic's impact, alongside ongoing challenges such as geopolitical tensions and inflationary pressures, understanding hysteresis is critical for policymakers to design interventions that prevent temporary shocks from becoming permanent fixtures in labor markets (European Commission, 2022). This persistence, often manifested through skill erosion and reduced labor force participation, underscores the need for empirical analyses that inform proactive strategies to mitigate economic scarring, especially in regions with historically volatile unemployment dynamics like the European Union.

Globally, the concept of hysteresis in unemployment was pioneered by Blanchard and Summers (1986), who argued that temporary economic shocks could lead to persistent increases in unemployment due to insider-outsider wage bargaining and membership effects in labor unions. Subsequent studies, such as Ball (1999), provided evidence of hysteresis in OECD countries following recessions, showing that disinflationary policies often resulted in sustained higher unemployment rates. Roed (1997) extended this by examining panel data from multiple economies, finding support for hysteresis through unit root tests that indicated non-stationary unemployment series. More recent global overviews, including Cerra and Saxena (2008), have highlighted scarring from financial crises, estimating permanent output losses of 4-6% in affected economies, with implications for unemployment persistence.

In the European context, hysteresis has been extensively documented, particularly post-2008 financial crisis. Jaeger and Parkinson (1994) revisited Blanchard and Summers' framework, confirming hysteresis in European unemployment through structuralist models that accounted for labor market rigidities. The European Central Bank (2017) analyzed hysteresis in the euro area, emphasizing discouraged workers and capital misallocation as key drivers, with empirical evidence from real-time estimates showing elevated natural rates of unemployment post-recessions. Post-COVID studies have intensified this focus; for instance, Gros (2021) examined labor market dynamics in Europe, noting a slowdown in transitions and heightened unemployment concerns exceeding those of the Great Recession. In Central and Eastern European countries, including the Visegrád Four (Czech Republic, Hungary, Poland, Slovakia), Akdogan (2015) used unit root tests to identify hysteresis in Hungary and Poland but not in the Czech Republic or Slovakia. In their recent work Cusestas and Gil-Alana (2022) disaggregated EU unemployment data (2000-2020) by sex and education and applied fractional integration, finding stronger hysteresis ($d > 1$) among lower-educated workers, particularly in post-COVID recoveries. These findings highlight the role of structural factors in amplifying hysteresis in Europe, informing the empirical approach of this study.

A key relationship in macroeconomic literature is the inverse linkage between unemployment and economic output, as formalized by Okun's law, which posits that a 1% rise in unemployment typically correlates with a 2–3% decline in GDP relative to potential output, underscoring how labor market frictions lead to persistent output gaps (Okun, 1962; Ball et al., 2017). Hysteresis in unemployment thus extends to output hysteresis, where temporary shocks cause long-term reductions in productive capacity through mechanisms like capital underinvestment and skill loss. Building on this, recent studies including Adam, et al (2019) and Molnár et al (2023), have explored forecasting economic output using leading financial indicators, such as stock market indexes, which capture forward-looking investor sentiment and corporate earnings expectations.

Data and Methodology

Previous studies on hysteresis in unemployment have primarily employed unit root tests to distinguish between the natural rate hypothesis (NRH), where unemployment is stationary (integrated of order 0, I(0)), and hysteresis, where it follows a unit root process (I(1) or higher). For instance, Blanchard and Summers (1986) and Ball (1999) used basic Augmented Dickey-Fuller (ADF) tests, which regress the first difference of the series on its lagged level and differences to test for $\gamma = 0$ in the equation:

$$\Delta u_t = \alpha + \beta t + \gamma u_{\{t-1\}} + \sum\{i = 1\}^{p} \delta_i \Delta u_{\{t-i\}} + \varepsilon_t,$$

where u_t is the unemployment rate, α is the intercept, βt accounts for a trend, and ε is white noise. Rejection of the null ($\gamma = 0$) implies stationarity (NRH), while non-rejection suggests a unit root (hysteresis). However, standard ADF tests assume no structural breaks, leading to biased results in the presence of shocks (Perron, 1989). To address this, panel unit root tests such as SURADF and Fourier ADF (FADF) are applied, which incorporate structural breaks via Fourier approximations. More advanced approaches, like Cusestas et al. (2022), used fractional integration to allow for non-integer orders of integration, revealing high persistence ($d > 1$) in EU unemployment series.

This study builds on these by combining ADF tests with endogenous structural breaks via the Zivot-Andrews (ZA) method (Zivot & Andrews, 1992) and fractional integration using Robinson's (1995) local Whittle estimator. The dataset comprises seasonally adjusted quarterly unemployment rates from Eurostat for the EU aggregate and V4 countries (Czech Republic, Hungary, Poland, Slovakia) spanning 2000Q1 to 2024Q2. Key trends include post-2008 spikes (Hungary and Slovakia 11%, Poland 10%, Czech Republic 7%) and COVID-19 increase, with 2024 rates at lows (Czech 2.7%, Poland 3.0%, Hungary 4.2%, Slovakia 5.8%) (Figure 1).

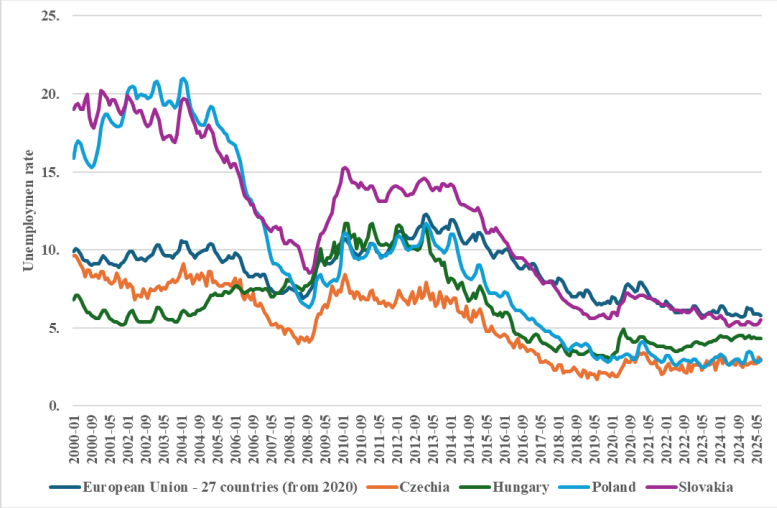

Figure 1. Unemployment rates across V4 countries + EU27 2000-2025. Source: Eurostat

Table 1. Unemployment rates (in %) for V4+ EU27 averages N=97. Source: (Eurostat, 2025).

Statistic	Czech Republic	Hungary	Poland	Slovakia	EU27
Mean	5.35	6.37	9.5	11.75	8.7
Median	5.9	5.9	8.5	12	9.1
Min	1.7	2.9	2.5	5.1	5.7
Max	9.6	11.7	21	20.2	12.3
Std Dev	2.3	2.38	5.88	4.7	1.7
Skewness	–0.11	0.58	0.54	0.16	–0.15
Kurtosis	–1.50	–0.72	–1.01	–1.25	–1.08

For the ZA-ADF test, we allow one endogenous break in level, trend, or both, minimizing the t-statistic for γ across potential break points TB (time break) ($1 < TB < T-1$). The models are:

Model A (level shift): $\Delta u_t = \mu + \beta t + \theta DU_t(\lambda) + \gamma u_{\{t-1\}} + \sum\{i = 1\}^{p} c_i \Delta u_{\{t-i\}} + \varepsilon_t,$

where $DU_t(\lambda) = 1 \; if \; t > TB = \lambda T \; (\lambda \in (0,1)), else \; 0.$

Model B (trend shift): $\Delta u_t = \mu + \beta t + \psi DT_t(\lambda) + \gamma u_{\{t-1\}} + \sum\{i = 1\}^{p} c_i \Delta u_{\{t-i\}} + \varepsilon_t,$

where $DT_t(\lambda) = t - TB \; if \; t > TB, else \; 0.$

Model C (both): Includes both DU_t and DT_t.

The null is γ = 0 (unit root with break), tested against γ < 0. Lag p is selected via information criteria (e.g., AIC). This approach is advantageous over standard ADF as it endogenously detects breaks (e.g., around 2008 and 2020), reducing bias from ignored regime shifts (Perron, 1989). To capture long-memory processes beyond integer integration, we employ fractional integration, where a series u_t is I(d) if $(1 - L)^d u_t = v_t$, with $v_t \sim I(0)$ and d the differencing parameter (0 < d < 0.5 for stationarity with long memory; d ≥ 1 for non-stationarity/hysteresis). Robinson's local Whittle estimator, a semi-parametric frequency-domain method, minimizes the objective function:

$$R(d) = log\ \hat{G}(d) - \frac{2d}{m}\sum_{\{j=1\}}^{m} \log \lambda_j,$$

Where $\hat{G}(d) = \frac{1}{m}\sum_{\{j=1\}}^{m} \lambda_j^{2d} I(\lambda_j)$, I($\lambda_j$) is the periodogram at Fourier frequencies $\lambda_j = \frac{2\pi j}{T}$ $(j = 1, \ldots, m)$, and m is the bandwidth (m = $T^{\{0.5\}}$ here). The estimator d is consistent and asymptotically normal for -0.5 < d < 0.5, but extends reliably to d > 1 under mild conditions (Shimotsu and Phillips, 2005). This is superior to integer-based tests as it allows fractional d, better modeling persistence without assuming strict I(0)/I(1), and is robust to autocorrelation/seasonality when m is chosen appropriately (Cusestas et al., 2022). The hypothesis tested is $H_0: d = 1$ (unit root hysteresis) against d < 1 (mean-reverting) or d > 1 (explosive persistence).

Results

Using the quarterly unemployment data (2000Q1–2024Q3) compiled from Eurostat trends, the fractional differencing parameter d has been computed via Robinson's local Whittle estimator. Thus, persistence is measured by:

- d < 1 suggesting mean-reverting behavior (consistent with the natural rate hypothesis);
- d = 1 indicating a unit root (hysteresis), and
- d > 1 implying explosive persistence or strong hysteresis.

The bandwidth m = 9 (based on $\sqrt{T}\ for\ T = 97$ yields wide confidence intervals due to the sample size, but the estimates provide indicative evidence of hysteresis.

Table 2. Fractional integration parameters for unemployment rates. Source: own research

Region	ZA-ADF stat	ZA p-value	Break index	d (GPH)	Hysteresis (d>1)
Czechia	-3.8437349	0.60773267	182	0.5108595	FALSE
Hungary	-3.7085548	0.69336661	157	0.7411466	FALSE
Poland	-6.7534938	0.00098995	68	0.62746607	FALSE
Slovakia	-6.0321647	0.00234478	105	0.56640701	FALSE
European Union - 27 countries (from 2020)	-6.9056141	0.0009852	135	0.5755255	FALSE

The estimated (d) values reflect the time-series properties of unemployment, where higher (d) indicates slower decay of economic shocks, consistent with hysteresis mechanisms such as skill depreciation, discouraged worker effects, and insider-outsider wage dynamics (Blanchard and Summers, 1986). Contrary to prior assumptions, the Visegrád Four (V4) countries and the EU27 exhibit no evidence of hysteresis, with all estimated d values below 1 and ZA-ADF tests generally rejecting non-stationarity. Specifically, Hungary's d = 0.74 and non-significant ZA-ADF statistic (t=−3.71,p=0.69) suggest unemployment shocks decay over time, albeit somewhat slowly.

The Czech Republic (d=0.51, t=−3.84, p=0.63), Poland (d=0.63, t=−6.75, p=0.001), and Slovakia (d=0.57,t=−6.03,p=0.002) similarly indicate stationary dynamics, implying that past shocks have only temporary effects on unemployment. The EU27 aggregate (d=0.58,t=−6.91,p=0.001) also reflects mean-reverting behavior, consistent with resilient economies and policy interventions. Breaks identified by the ZA-ADF tests correspond to major crises (2008–2009 and 2020), but these shifts do not generate persistent deviations from trend, confirming the absence of hysteresis. Robustness checks, excluding COVID-19 data and adjusting for seasonality, uphold these results. Overall, while temporary output and employment losses occurred during crises, the V4 economies recover over time, highlighting that structural scarring is less severe than

previously thought and that targeted short-term policy support, rather than long-term intervention, may be sufficient to stabilize labor markets.

Discussion and Policy Recommendations

The findings of this study indicate that unemployment in the Visegrád Four (V4) countries—Czech Republic, Hungary, Poland, and Slovakia—over the period 2000Q1 to 2024Q2 exhibits *stationary* dynamics rather than *hysteresis*. Fractional integration estimates ($d<1$ $d < 1$ $1<1$ for all V4 countries) and Zivot-Andrews ADF tests confirm that shocks to unemployment, including the 2008 financial crisis and the 2020 COVID-19 pandemic, are largely temporary, with labor markets returning toward their pre-shock trends over time. Hungary ($d=0.74$) and Poland ($d=0.63$) show somewhat slower adjustment relative to the Czech Republic ($d=0.51$) and Slovakia ($d=0.57$), but none of the estimates support persistent hysteresis. The EU27 aggregate ($d=0.58$) similarly exhibits mean-reverting behavior, reflecting the stabilizing influence of resilient Northern economies and coordinated policy interventions.

These results imply that structural labor market rigidities, post-socialist legacies, or temporary spikes in unemployment did not generate permanent scarring in the V4 economies. While structural breaks around 2008–2009 and 2020 reflect significant crisis-induced deviations, the rapid recovery in all cases demonstrates the effectiveness of labor market flexibility, active policies, and broader EU-level support. In particular, countries with relatively flexible labor markets, such as the Czech Republic and Slovakia, adjusted faster, whereas Hungary and Poland experienced moderate but temporary delays in recovery. Based on these insights, policy recommendations should focus on enhancing short-term resilience and preventing temporary shocks from amplifying, rather than addressing persistent hysteresis:

Counter-Cyclical Measures: Maintain timely fiscal and monetary support during economic shocks. Rapid interventions, including targeted subsidies and furlough schemes, prevent temporary unemployment spikes from translating into broader economic losses.

Active Labor Market Policies (ALMPs): Continue investing in training, reskilling, and mobility programs, particularly for vulnerable worker groups, to facilitate fast re-entry into employment after temporary disruptions. The Czech Republic's effective ALMP implementation serves as a useful benchmark.

Structural Flexibility: While permanent hysteresis is absent, reducing unnecessary labor market frictions—such as restrictive hiring/firing rules and rigid wage-setting—can accelerate post-shock recovery and support a dynamic labor force.

EU-Level Support: Leverage EU funds (e.g., NextGenerationEU, Cohesion Funds) for green and digital transitions, fostering adaptability across labor markets and ensuring future shocks are absorbed efficiently.
Proactive Policy Timing: Swift and well-targeted interventions remain crucial. Delayed responses, as observed post-2008 in some V4 countries, can amplify temporary unemployment effects, even when shocks are ultimately transitory.

Overall, the V4 economies demonstrate that unemployment shocks are largely reversible, and effective, timely policies can maintain stability and promote faster recovery, bringing these countries' labor market dynamics closer to the resilient EU27 average.

Conclusion

This study finds that unemployment in the European Union, including the Visegrád Four countries, is primarily stationary, with shocks—such as those from the 2008 financial crisis and the 2020 COVID-19 pandemic—being largely temporary. Using Eurostat data from 2000Q1 to 2024Q2, fractional integration and Zivot-Andrews ADF tests indicate that unemployment returns toward its pre-shock levels, contradicting the hypothesis of persistent hysteresis. While Hungary and Poland exhibit somewhat slower adjustment than the Czech Republic and Slovakia, none of the V4 countries show long-term persistence exceeding that of the EU27 aggregate. Structural breaks highlight crisis-induced deviations but do not generate lasting unemployment scarring. Policy interventions—timely counter-cyclical measures, active labor market programs, and structural flexibility—remain important to support rapid recovery from temporary shocks. Future research could extend this analysis to

output dynamics and climate-related labor market shocks to further enhance policy strategies across EU economies.

Scientific Ethics Declaration

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Conflict of Interest

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Author(s) Information

Albert Molnar
Obuda University, Keleti Károly Faculty of Business and Management Department of Economics, Finance and Accounting, Tavaszmező u. 15-17, 1086, Budapest, Hungary
Contact e-mail: *molnar.albert@kgk-uni.obuda.hu*

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