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RESEARCH ARTICLE

UNEMPLOYMENT HYSTERESIS IN ASIAN COUNTRIES: FINDINGS BASED ON FLEXIBLE FOURIER FORM AND STRUCTURAL BREAK UNIT ROOT TESTS

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ABSTRACT

The present paper investigates unemployment hysteresis in 47 Asian countries using annual data from 1991 to 2019. A novel unit root framework, capable of modelling nonlinearity in the form of smooth break is applied due to the small sample sizes of the unemployment data. The results show evidence of hysteresis in most of the Asian countries except in Brunei, Malaysia, Qatar and Turkey. Labour markets in those countries with unemployment hysteresis therefore need to be proactive in their policies to address unemployment shocks, particularly those wealthy Asian nations among them.

KEYWORDS

Unemployment hysteresis; Unit root; Fourier function; Structural break; Asia

1. INTRODUCTION

The macroeconomic theory postulated that the unemployment rate would revert to the natural rate after a recession (Phelps, 1967; 1968; Friedman, 1968). Blanchard and Summers therefore proposed a modified unemployment theory that assumed the unit root process of the unemployment rate and that recession has a lasting impact on the unemployment rate (Blanchard and Summers, 1996). Three contradicting hypotheses explain the behaviour of the unemployment rate. (i), the natural rate hypothesis of the non-accelerating inflation rate of the unemployment rate (NAIRU) that assumes that unemployment rate fluctuates around the equilibrium level, thus the rate is a stationary time process (Phelps, 1967; Friedman, 1968). (ii), the structural slump hypothesis assumes fluctuation of unemployment rates around the equilibrium level and shifts occasionally as a result of structural changes (Phelps, 1994). (iii), the hysteresis hypothesis, in which unemployment rate assumes path-dependent structure such that it has a weak tendency to return to its equilibrium level, that is a nonstationary process (Blanchard and Summers, 1986). Accepting the hypothesis of unemployment hysteresis implies rejecting the natural rate hypothesis.

According to Furuoka, the natural rate hypothesis assumes that the unemployment equilibrium level is driven by labour market institutions and is not influenced by the actual unemployment (Furuoka, 2012). Unexpected movements in labour demand and supply affect the equilibrium level and change the actual unemployment path, leading to the equilibrium level of unemployment or the NAIRU. In other words, cyclical fluctuations influence unemployment in the short run in which in the absence of government intervention, the unemployment rate will eventually revert to the NAIRU in the long run (Smyth, 2003). Studying unemployment hysteresis and NAIRU is important in the context of Asian countries due to policy relevance of the properties of the rates: (i), the hysteresis of unemployment indicates the long-lasting stabilizing effects of level of the labour market and macroeconomic policies on unemployment rates. NAIRU suggests that the unemployment rate converges to the natural rate in the long run and policymaker has a lesser role to play. (ii), mean reversion in unemployment rate implies the predictability of future values of the unemployment rate, while NAIRU suggests such predictability and hysteresis does not. (iii), the trade-off between inflation and unemployment as the Phillips curve has shown a negative relationship between the two economic variables. (iv), the independence of aggregate demand policies and governments low inflation targeting (Batini et al., 2006). Based on (iii) and (iv), unemployment hysteresis would call for permanent and persistent anti-inflation policies, while NAIRU suggests temporary policy effect on employment, that is the trade-off between inflation and unemployment is less costly.

Asian financial crisis of 1997-1998 affected unemployment rates in Asia, in which many countries are yet to recover from the shock. The labour markets in some countries are flexible enough to withstand the negative impact of shocks on unemployment. Based on the unemployment rate datasets, published by the Worldbank (reported in Section 2), among middle-income economies, for example, China, Indonesia, Japan, Korea, Malaysia, Qatar and Singapore were able to sail through the shocks since their unemployment rates quickly stabilized after the crisis. Since 1999 till 2019, the unemployment rate has increased more than 50 percent in Armenia, Bhutan, Brunei and Turkey, while this has improved about 50 percent in Afghanistan, Azerbaijan, Cambodia, Israel, Kazakhstan, Laos Qatar, Sri Lanka, Thailand, Turkmenistan and Uzbekistan.

Low unemployment rates in some countries can disguise substantial poverty in the country since a high percentage of the labour force that needed job might have lost interest in searching for a job, particularly if the country allows for unemployment benefits. The unemployed workers, therefore, tend to remain jobless for a long period if the unemployed benefits are sufficient for them, this can cause unemployment hysteresis since the unemployment dynamics in such a country has been affected. Lack of such benefits would ginger the labour force category to find a new job, thus, a higher-than-normal unemployment rate would revert to its mean level (Furuoka, 2014). High unemployment rates can occur in countries with a high level of economic growth and low poverty rates since workers tend to search for suitable and lucrative jobs which may not easily come. Another cause for hysteresis in economically developed countries is the out-turn of graduates in their colleges and universities. For example, China produced 8.3 million graduates in 2019, with this population, more than entire Hong Kong. Also, a large number of graduates that have schooled in the west are seen returning due to the tightening of policies in

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the US and Europe.

The present paper re-investigates the hysteresis hypothesis in unemployment in 47 Asian countries for the period 1991-2019. The aim of the study is in three-fold: (i), the validity of unemployment hysteresis is investigated in Asian countries within a specific study period. (ii), empirical works on unemployment hysteresis in developing countries of Asia are scarce, rather authors such as Furuoka (2014, 2017) have selected a couple of countries of interests. (iii), we applied alternative unit root tests that are robust to a small sample of the annual unemployment rate, that is the Fourier-based unit root tests which outperform other classical unit root tests in a small sample (Becker et al., 2006; Enders and Lee, 2012a,b). The approach is novel and is hardly applied in testing unemployment hysteresis. The rest of the paper is structured as follows: section 2 presents the data and the preliminary data results. Section 3 presents the core statistical methods and the findings while section 4 concludes the paper.

2. Data and Preliminary Results

Annual time series of unemployment rates are considered in this work. These are the percentage total of the labour force in Asian countries, obtained from the database of the World Bank – the World Development Indicators (WDI) (https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS). Forty-seven (47) countries are considered and each unemployment series spanned between 1991 and 2019. The summary report of the entire dataset is given in Table 1, indicating starting and ending unemployment rates in 1991 and 2019, as well as the minimum and maximum rates in the sampled period across those Asian countries. In 1991, high unemployment rates, reaching two digits are found in Iran, Iraq, Israel, Jordan and Sri Lanka with 11.1, 10.3, 13.4, 19.5 and 14.7 percent, respectively, while Iran and Jordan still experienced double-digit unemployment rate till the end of 2019 while others improved to one-digit rates. Armenia, Georgia, Iran, Jordan, Tajikistan, Turkey and Yemen with 17.7, 14.2, 12.0, 14.9, 11.1, 11.9 and 12.8 percent, respectively. Minimum rates for all countries range from 0.1 percent as in Qatar to 11.9 percent as in Jordan, while the maximum rate ranged from 1.2 percent as in Bahrain to 19.7 percent as in Jordan. By looking at the range in the fifth column of the reporting table, that is, the difference between the maximum rate and minimum rate in each country, we observed range values above 10% in the case of Armenia, Azerbaijan, Cyprus, Georgia, Israel, Kazakhstan, Kyrgyzstan, Sri Lanka, Tajikistan, Turkmenistan and Uzbekistan with 17.4, 10.9, 14.1, 15.6, 10.2, 12.6, 11.6, 10.8, 14.6, 11.3 and 11.4 percent, respectively.

In the analysis of hysteresis, we start with the first generational unit root tests with augmentation and bandwidth lags are set to 1. In Table 2, the results of ADF, DF-GLS, PP and KPSS tests are presented. The ADF test only rejected hysteresis hypothesis of unemployment in four countries, that is, in Azerbaijan, Kazakhstan, Kuwait and Tajikistan, while the PP test could not reject the null of unemployment hysteresis in any of the countries. The DF-GLS test rejected the null hypothesis in Bahrain, Cyprus, Iran, Korea, Malaysia, Qatar and Turkey. These three unit root tests have inconsistently rejected hysteresis hypothesis, that is, the unit root null at 5% level of significance. By looking at the KPSS test, with the null of series having no unit root against the alternative that the series has unit root, we quite observe rejection of null hypothesis of no unit root in the majority as detected by the first three ADF, DF-GLS and PP tests. Thus, the hysteresis of unemployment is detected when the test significantly rejected the null hypothesis, implying the rejection of hysteresis of unemployment in cases of Armenia, Bahrain, Cyprus, Iran, Korea, Kuwait, Malaysia, Mongolia, Thailand and Turkey. The KPSS test, therefore, rejected the hysteresis hypothesis in all the countries detected by the DF-GLS test, that is in Bahrain, Cyprus, Iran, Korea, Malaysia, Qatar and Turkey.

Table 1: Data Summary

Country	1991 rate	2019 rate	Min. rate	Max. rate	Range
Afghanistan	3.0	1.5	1.5	3.7	2.2
Armenia	1.6	17.7	1.6	19.0	17.4
Azerbaijan	0.9	5.4	0.9	11.8	10.9
Bahrain	1.0	1.0	0.8	1.2	0.4
Bangladesh	2.2	4.3	2.2	5.0	2.8
Bhutan	1.3	2.2	1.2	4.0	2.8
Brunei	4.7	9.2	4.7	9.3	4.6
Cambodia	2.3	1.0	1.0	2.6	1.6
China	2.4	4.4	2.4	4.7	2.3
Cyprus	2.0	7.9	2.0	16.1	14.1
Georgia	2.7	14.2	2.7	18.3	15.6
Hong Kong	1.8	2.8	1.8	7.9	6.1
India	2.4	2.6	2.3	3.2	0.9
Indonesia	2.5	4.4	2.5	8.1	5.6
Iran	11.1	12.0	9.1	13.5	4.4
Iraq	10.3	7.9	7.9	10.3	2.4
Israel	13.4	3.9	3.9	14.1	10.2
Japan	2.1	2.4	2.1	5.4	3.3
Jordan	19.5	14.9	11.9	19.7	7.8
Kazakhstan	0.9	5.4	0.9	13.5	12.6
Korea	2.4	3.7	2.0	7.0	5
Kuwait	0.7	2.2	0.7	2.9	2.2
Kyrgyzstan	1.0	7.4	1.0	12.6	11.6
Laos	2.2	0.6	0.6	2.6	2
Lebanon	8.2	6.2	6.1	9.0	2.9
Malaysia	3.6	3.4	2.5	4.1	1.6
Maldives	0.7	6.4	0.7	6.4	5.7
Mongolia	5.5	6.3	3.9	7.6	3.7
Myanmar	1.0	1.6	0.8	1.6	0.8
Nepal	1.6	1.2	1.2	1.9	0.7
Oman	4.6	3.1	3.1	5.1	2
Pakistan	0.6	3.0	0.4	3.6	3.2
Philippine	3.2	2.4	2.4	4.1	1.7
Qatar	1.3	0.1	0.1	1.7	1.6
Saudi Arabia	7.0	5.9	4.3	7.2	2.9
Singapore	2.2	3.6	2.2	5.9	3.7
Sri Lanka	14.7	4.3	3.9	14.7	10.8
Syria	6.8	8.2	6.8	11.7	4.9
Tajikistan	1.9	11.1	1.9	16.5	14.6
Thailand	2.6	0.7	0.5	3.4	2.9
Timor-Leste	3.3	3.0	3.0	4.3	1.3
Turkey	8.2	11.9	6.5	12.6	6.1
Turkmenistan	1.4	3.9	1.4	12.7	11.3
UAE	1.6	2.6	1.6	3.1	1.5
Uzbekistan	1.9	5.5	1.9	13.3	11.4
Vietnam	2.0	1.9	1.0	2.9	1.9
Yemen	8.0	12.8	8.0	14.0	6

Note, rates are given in percentages.

Table 2: Results of DF-GLS, ADF, PP and KPSS tests

Country	ADF	PP	DF-GLS	KPSS
Afghanistan	-3.3417	-3.4039	-1.8831	0.2487***
Armenia	-3.1912	-2.3859	-2.9445	0.1105
Azerbaijan	-4.5334***	-3.4928	-2.6169	0.2521***
Bahrain	-3.1219	-2.2055	-3.2156***	0.0896
Bangladesh	-2.1838	-2.6907	-2.3192	0.2309***
Bhutan	-0.7158	-1.0548	-1.0172	0.2659***
Brunei	-1.5558	-0.8114	-1.8704	0.2965***
Cambodia	-2.1298	-1.9523	-2.1095	0.1822***
China	-1.4372	-0.8639	-1.6282	0.3327***
Cyprus	-3.4485	-1.5654	-3.6048***	0.1257
Georgia	-1.7143	-2.2144	-1.4429	0.2382***
Hong Kong	-1.9542	-1.7888	-1.8772	0.2976
India	-2.8907	-2.0501	-2.8002	0.1520***
Indonesia	-1.8164	-1.4108	-1.4468	0.3550***
Iran	-3.4394	-3.1864	-3.5197***	0.0617
Iraq	-2.6430	-2.9528	-2.8893	0.1738***
Israel	-2.1241	-1.6477	-2.1993	0.2287***
Japan	-1.7087	-1.0927	-1.6883	0.3298***
Jordan	-2.7209	-1.7689	-2.4120	0.2057***
Kazakhstan	-4.0864***	-2.5773	-2.7067	0.2015***
Korea	-3.4096	-2.8487	-3.4271***	0.1096
Kuwait	-2.5968***	-2.1633	-2.5679	0.1170
Kyrgyzstan	-3.1674	-2.4386	-2.0575	0.2928***
Laos	-2.0290	-1.6644	-2.1202	0.2006***
Lebanon	-3.1350	-2.4126	-2.9113	0.1852***
Malaysia	-3.3554	-2.7644	-3.4358***	0.0689
Maldives	-2.5736	-2.5931	-1.9172	0.2625***
Mongolia	-2.1393	-2.3027	-2.1805	0.1412
Myanmar	-2.0602	-0.9035	-2.2948	0.1809***
Nepal	-2.5240	-2.0829	-2.2052	0.2056***
Oman	-2.4662	-2.1537	-2.2367	0.2575***
Pakistan	-1.2872	-1.7092	-1.2892	0.2983***
Philippine	-0.9972	-1.1003	-1.2601	0.3094***
Qatar	-3.5791	-2.6020	-3.2593***	0.1710***
Saudi Arabia	-3.3060	-1.8290	-2.7704	0.1938***
Singapore	-2.1800	-2.6553	-2.1238	0.2682***
Sri Lanka	-1.2805	-1.0559	-1.4319	0.2797***
Syria	-2.1400	-2.2264	-2.1378	0.2313***
Tajikistan	-5.8301***	-3.2859	-2.3677	0.2445***
Thailand	-2.4069	-2.8794	-2.5499	0.1224
Timor-Leste	-2.5532	-2.0825	-2.2125	0.2020***
Turkey	-3.4236	-2.7051	-3.5359***	0.0707
Turkmenistan	-4.1569***	-2.2704	-3.0245	0.2289***
UAE	-2.1276	-1.8533	-2.0940	0.2644***
Uzbekistan	-3.1322	-2.7955	-2.0214	0.2045***
Vietnam	-1.9152	-2.3137	-1.9223	0.1511***
Yemen	-1.6095	-0.9007	-1.9556	0.2203***

Note, values were computed for trended test regression only and critical values used for DF-GLS test are given in Elliott-Rothenberg-Stock as -3.1900 while critical values for ADF and PP tests are given in given in MacKinnon as -3.5875 and -3.5806, respectively (Elliott-Rothenberg-Stock, 1996; MacKinnon, 1996). Critical values for the KPSS test are found in as 0.1460 (Kwiatkowski et al., 1994). The lag structure of test models is constrained to 1 in the DF-GLS, ADF and KPSS tests, while the bandwidth is also constrained to 1 in the case of PP test, due to small sample size. while critical values for ADF and PP tests are given in given in MacKinnon as -3.5875 and -3.5806, respectively (Elliott-Rothenberg-Stock, 1996; MacKinnon, 1996). Critical values for the KPSS test are found in as 0.1460 (Kwiatkowski et al., 1994). The lag structure of test models is constrained to 1 in the DF-GLS, ADF and KPSS tests, while the bandwidth is also constrained to 1 in the case of PP test, due to small sample size.

3. Flexible Fourier Unit Root Tests and Findings

The unit root tests considered in this section of the paper were developed to correct the shortcomings of the standard unit root tests. The FADF, FADF-SB and FKPSS tests possess improved powers in the small sample over other DF-like unit root tests and the possess strong nonlinear abilities to smoothly model breaks compared to Kapetanios, Snell and Shin unit root test (Kapetanios et al., 2003). The FADF-SB test uses the regression model:

$$(1-L)y_t = \mu + \beta t + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \delta DU_t + \theta D(T_B) + \rho y_{t-1} + \sum_{i=1}^{p} c_i (1-L) y_{t-i} + \varepsilon_t, \quad (1)$$

where y_t is the unemployment rate observed at time t where L is the backward shift operator such that $Ly_t = y_{t-1}$, μ and β are constant and trend parameters, respectively; γ_1 and γ_2 are the parameters measuring the amplitude and displacement of the sinusoidal component of the Fourier function; *k* is the frequency of the function, π = 3.142 and *T* is the number of observations in the unemployment rates. The parameter, c_i (i = 1, ..., p) are parameters in the augmentation component $(1-L)y_{t-k}$, which controls the whitening of the residuals, ε_t in the test regression. The parameter δ is the slope coefficient for the structural break dummy, $DU_t = 1$ if $t > T_B$ and $DU_t = 0$ otherwise, T_B is the breakpoint where the structural break occurs, θ is the slope coefficient for the one-time break dummy, $D(T_B)_t = 1$ if $t = T_B$ and $D(T_B)_t = 0$ otherwise. In this estimation method, two dummy variables, namely a structural break dummy and one-time break dummy, are used to capture the undefined structural break.

To test the unit root hypothesis, the *t*-statistic is used to test the null $\rho = 0$ for unit root against the alternative of no unit root with $\rho < 0$. Thus, the acceptance of the null hypothesis implies the evidence in support of hysteresis in the unemployment rate.

The FADF test is based on the following equation:

$$(1-L)y_t = \mu + \beta t + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \rho y_{t-1} + \sum_{i=1}^{p} c_i (1-L) y_{t-i} + \varepsilon_t, \quad (2)$$

which do not consider the structural break component in its specification. Thus, the FADF test captures only the smooth break, while the FADF-SB

captures both smooth and instantaneous breaks. The test model in (1), that is the FADF-SB becomes the ADF-SB test regression of Zivot and Andrews when the nonlinear Fourier form is absent (Zivot and Andrews, 1992). The result model is,

$$(1-L)y_t = \mu + \beta t + \delta DU_t + \theta D(T_B) + \rho y_{t-1} + \sum_{i=1}^{p} c_i (1-L) y_{t-i} + \varepsilon_t, \quad (3)$$

The FKPSS test of tests the null hypothesis of no unit root against unit root in the time series (Becker et al., 2006). The test statistic is,

$$\text{KPSS} = T^{-2} \sum \hat{S}_t^2 / \hat{\sigma}_T^2(q) \quad (4)$$

where $\hat{S}_t = \sum_{t=1}^{T} \hat{\varepsilon}_t$ and ε_t are residuals from the Fourier function with the trend,

$$\varepsilon_t = (1-L)y_t - \mu - \beta t - \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) - \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) - \sum_{i=1}^{p} c_i (1-L) y_{t-i}$$

and long-run variance formula $\sigma_T^2(q)$ given by Lo (1991) is computed as $\sigma_T^2(q) = c_0 + \sum_{j=1}^{q} w_j(q) c_j$ with the conditions that c_j are the j^{th} –order sample autocovariance of y_t and $w_j(q)$ are the Bartlett window weights given by $w_j(q) = 1 - j/(q+1)$ for $q < T$.

By looking at the results obtained from those tests, as presented in Table 3, the FADF test only rejected hysteresis hypothesis of unemployment in Brunei, Hong Kong, Malaysia, Qatar and Turkey, while the FKPSS test rejected the null of no hysteresis in unemployment of all the 47 countries. With the ADF-SB test, the null of hysteresis of unemployment was rejected in most of the cases except in Bhutan, Georgia, Japan, Kuwait, Maldives, Mongolia, Nepal, Saudi Arabia, Sri Lanka, Timor-Leste, UAE, Vietnam and Yemen while FADF-SB detected unemployment hysteresis in Bangladesh, Georgia, Indonesia, Israel, Kazakhstan, Kyrgyzstan, Philippine, Sri Lanka, Uzbekistan and Yemen.

Table 4 summarizes the findings obtained by those unit root tests. All the eight unit root tests gave inconclusive decision about the hysteresis hypothesis of unemployment in those Asian countries, except in Brunei, Malaysia, Qatar and Turkey where they jointly rejected hysteresis hypothesis in these four countries. Thus, natural rate hypothesis of the NAIRU where unemployment rates fluctuate around the equilibrium level operates in these four countries, while in the remaining 43 countries, long-lasting stabilizing effects of level of the labour market is required with other macroeconomic policies to control unemployment rates.

Table 3: Findings from FADF, FKPSS, ADF-SB and FADF-SB tests

Country	FADF		FKPSS		ADF-SB			FADF-SB			
	t-stat	k	t-stat	k	t-stat	λ_{TB}	T_B	t-stat	k	λ_{TB}	T_B
Afghanistan	-4.4018	1	0.0395***	1	-4.6206***	55.2	2006	-7.6282***	1	58.6	2007
Armenia	-3.7191	2	0.1229***	2	-4.8251***	58.6	2007	-8.6764***	1	58.6	2007
Azerbaijan	-2.1195	1	0.0938***	1	-7.0527***	41.4	2002	-6.6846***	2	37.9	2001
Bahrain	-3.5921	2	0.0811***	2	-5.8453***	62.1	2008	-5.6291***	1	62.1	2008
Bangladesh	-3.6376	1	0.0462***	1	-3.9919***	34.5	2000	-4.4522	1	37.9	2001
Bhutan	-2.0343	1	0.0638***	1	-2.5465	72.4	2011	-5.0673***	1	72.4	2011
Brunei	-4.6681***	1	0.0448***	1	-5.3372***	82.8	2014	-5.3020***	2	82.8	2014
Cambodia	-2.7538	1	0.0814***	1	-8.6414***	34.5	2000	-10.1752***	2	34.5	2000
China	-4.0280	1	0.0398***	1	-5.5881***	34.5	2000	-5.3150***	2	34.5	2000
Cyprus	-3.3354	2	0.1696***	2	-5.9521***	72.4	2011	-5.9332***	2	72.4	2011
Georgia	-1.5658	2	0.0855***	1	-3.0090	79.3	2013	-4.4027	2	24.1	1997
Hong Kong	-4.2803***	1	0.0495***	1	-4.510.9***	24.1	1997	-7.2893***	1	55.2	2006
India	-3.5736	2	0.1641***	2	-5.1177***	51.7	2005	-5.5568***	1	51.7	2005
Indonesia	-2.4241	1	0.0667***	1	-4.5796***	62.1	2008	-4.2457	2	62.1	2008
Iran	-3.5185	1	0.0420***	1	-4.2396***	75.9	2012	-4.6670***	2	75.9	2012
Iraq	-3.8917	2	0.0566***	1	-3.8629***	55.2	2006	-4.4056***	2	69.0	2010
Israel	-4.0317	1	0.0728***	1	-4.4400***	34.5	2000	-4.4912	1	37.9	2001
Japan	-2.9489	1	0.0721***	1	-3.2956	24.1	1997	-5.4680***	1	62.1	2008
Jordan	-2.3143	2	0.3007***	2	-4.0001***	82.8	2014	-4.7192***	1	13.8	1994
Kazakhstan	-2.8088	1	0.0852***	1	-4.0398***	44.8	2003	-3.6357	1	34.5	2000
Korea	-4.1075	1	0.0397***	1	-6.5233***	27.6	1998	-14.7275***	1	24.1	1997
Kuwait	-3.4551	1	0.0462***	1	-3.2762	89.7	2016	-4.9484***	1	75.9	2012
Kyrgyzstan	-3.3060	1	0.0667***	1	-6.6314***	41.4	2002	-4.4440	2	37.9	2001
Laos	-3.3206	1	0.0593***	1	-3.4506	41.4	2002	-4.9508***	1	51.7	2005
Lebanon	-3.7930	1	0.0476***	1	-9.8470***	58.6	2007	-11.8746***	2	58.6	2007
Malaysia	-4.3283***	2	0.0407***	2	-3.9362***	34.5	2000	-6.3426***	1	17.2	1995
Maldives	-2.6058	2	0.0664***	1	-3.6597	62.1	2008	-5.0374***	2	62.1	2008
Mongolia	-3.1409	2	0.1647***	2	-3.4358	58.6	2007	-5.2355***	1	86.2	2015
Myanmar	-4.1656	1	0.0603***	1	-6.6728***	86.2	2015	-7.7148***	2	86.2	2015
Nepal	-2.8249	2	0.0663***	1	-3.2359	27.6	1998	-4.5052***	2	79.3	2013
Oman	-3.9644	1	0.0672***	1	-4.6015***	82.8	2014	-8.3288***	1	62.1	2008
Pakistan	-1.9600	1	0.0609***	1	-5.6663***	75.9	2012	-4.9859***	2	75.9	2012
Philippine	-3.2754	1	0.0735***	1	-4.0522***	82.8	2014	-4.2072	1	82.8	2014
Qatar	-5.8891***	1	0.0450***	1	-6.2907***	51.7	2005	-7.8128***	2	17.2	1995
Saudi Arabia	-2.7240	2	0.0833***	1	-3.5259	17.2	1995	-4.7830***	2	62.1	2008
Singapore	-4.1348	1	0.0424***	1	-4.1486***	37.9	2001	-5.6850***	1	37.9	2001
Sri Lanka	-1.1194	2	0.0827***	1	-2.2671	75.9	2012	-4.6518	1	37.9	2001
Syria	-3.1573	1	0.0479***	1	-5.1830***	31.0	1999	-5.8584***	2	34.5	2000
Tajikistan	-1.9472	1	0.0958***	1	-6.1655***	44.8	2003	-6.6620***	2	51.7	2005
Thailand	-3.2554	1	0.1005***	2	-5.5178***	24.1	1997	-13.8140***	1	24.1	1997
Timor-Leste	-3.2244	2	0.0656***	1	-3.7699	44.8	2003	-4.2246***	2	79.3	2013
Turkey	-4.9874***	2	0.0358***	2	-4.7681***	34.5	2000	-5.7429***	2	34.5	2000
Turkmenistan	-2.4696	1	0.0885***	1	-4.2689***	44.8	2003	-5.0838***	1	13.8	1994
UAE	-2.9860	1	0.0593***	1	-3.2464	69.0	2010	-4.9117***	1	89.7	2016
Uzbekistan	-0.8850	1	0.0979***	1	-4.3318***	41.4	2002	-4.2463	2	93.1	2017
Vietnam	-3.1402	1	0.0527***	1	-3.4125	62.1	2008	-4.8337***	1	65.5	2009
Yemen	-0.8739	2	0.3307***	2	-2.7298	24.1	1997	-2.8665	1	86.2	2015

Note: FADF statistic values with corresponding selected Fourier frequency in the second column of the table. In the third column, there are ADF-SB statistic values, break fractions, λ_{TB} and break dates, T_B, while in the fourth column, there are FADF-SB statistic values, Fourier frequency, break fractions and break dates.

*** indicates statistical significance at 5% level. For critical values of these tests, see Furuoka (2017).

Table 4: Summary of Empirical Findings

Country	ADF	PP	DF-GLS	KPSS	FADF	FKPSS	ADF-SB	FADF-SB
Afghanistan	UH	UH	UH	UH	UH	UH	NUH	NUH
Armenia	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Azerbaijan	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Bahrain	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Bangladesh	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Bhutan	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Brunei	NUH	NUH	NUH	NUH	NUH	NUH	NUH	NUH
Cambodia	UH	UH	UH	UH	UH	UH	NUH	NUH
China	UH	UH	UH	UH	UH	UH	NUH	NUH
Cyprus	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Georgia	NUH	NUH	NUH	NUH	NUH	NUH	UH	UH
Hong Kong	UH	UH	UH	NUH	NUH	NUH	NUH	NUH
India	UH	UH	UH	UH	UH	UH	NUH	NUH
Indonesia	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Iran	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Iraq	UH	UH	UH	UH	UH	UH	NUH	NUH
Israel	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Japan	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Jordan	UH	UH	UH	UH	UH	UH	NUH	NUH
Kazakhstan	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Korea	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Kuwait	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Kyrgyzstan	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Laos	UH	UH	UH	UH	UH	UH	UH	NUH
Lebanon	UH	UH	UH	UH	UH	UH	NUH	NUH
Malaysia	NUH	NUH	NUH	NUH	NUH	NUH	NUH	NUH
Maldives	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Mongolia	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Myanmar	UH	UH	UH	UH	UH	UH	NUH	NUH
Nepal	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Oman	UH	UH	UH	UH	UH	UH	NUH	NUH
Pakistan	UH	UH	UH	UH	UH	UH	NUH	NUH
Philippine	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Qatar	NUH	NUH	NUH	NUH	NUH	NUH	NUH	NUH
Saudi Arabia	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Singapore	UH	UH	UH	UH	UH	UH	UH	NUH
Sri Lanka	NUH	NUH	NUH	NUH	NUH	NUH	UH	UH
Syria	UH	UH	UH	UH	UH	UH	NUH	NUH
Tajikistan	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Thailand	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
Timor-Leste	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Turkey	NUH	NUH	NUH	NUH	NUH	NUH	NUH	NUH
Turkmenistan	NUH	NUH	NUH	NUH	UH	UH	NUH	NUH
UAE	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Uzbekistan	NUH	NUH	NUH	NUH	NUH	NUH	NUH	UH
Vietnam	NUH	NUH	NUH	NUH	NUH	NUH	UH	NUH
Yemen	NUH	NUH	NUH	NUH	NUH	NUH	UH	UH

Notes: UH mean the detection of unemployment hysteresis by the unit root test while NUH means no unemployment hysteresis detected.

4. Conclusion

The study investigates unemployment hysteresis in 47 Asian countries using data from 1991 to 2019. The findings separated the time series dynamics of unemployment rate in Asia into a case where long-lasting stabilizing effects of level of the labour market and macroeconomic policies on the unemployment rate is required, that is the hysteresis of unemployment, and a case of the natural rate hypothesis of the NAIRU where unemployment rates fluctuate around the equilibrium level. With the fact that unemployment rates might have undergone structural shifts such as Asian crisis of 1997-1998 and the global crisis of 2007-2008 which could have induced nonlinearities of different forms, the classical unit root tests, therefore, lack power in this regard to satisfactorily determine the stationarity properties of unemployment rates in Asia. By using a unit root testing framework contained in Furuoka, based on flexible Fourier function to capture smooth breaks, (i.e. the FADF, FKPSS and FADF-SB tests), with other classical unit root tests, the findings detected hysteresis in unemployment in 43 Asian countries including China, Singapore and Korea, while hysteresis of unemployment is sternly rejected in Brunei, Malaysia, Qatar and Turkey. In those countries where unemployment hysteresis are detected, labour markets in these countries need to be proactive in their policies to address unemployment shocks, particularly when two Asians giants and Asian tigers are among

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