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Dynamics of Inflation and Unemployment: Applying Threshold Models to Assess Critical Points in the Economy in Indonesia

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ABSTRACT

This study examines the nonlinear relationship between inflation and unemployment in Indonesia using a panel threshold regression model. Utilizing data from 34 provinces over the period 2016–2023, the analysis identifies a single significant inflation threshold at 1.9 percent. Below this threshold, inflation significantly increases the open unemployment rate, whereas inflation above 1.9 percent reduces unemployment. The results remain robust when the sample is divided into pre-COVID (2016–2019) and post-COVID (2020–2023) periods, although the relevant thresholds rise to 2.68 percent and 3.11 percent after the pandemic. Higher per-capita income, regional economic output, and educational attainment significantly lower unemployment, while higher minimum wages, poverty levels, and democracy scores are associated with higher unemployment. These findings support the short-run Phillips Curve in a regime-dependent framework and highlight the importance of maintaining moderate inflation above the identified thresholds, accompanied by policies that strengthen human capital and income growth. The study contributes to the literature by providing the first provincial-level threshold estimates of the inflation–unemployment nexus in Indonesia and by incorporating institutional and human-capital controls.

Keywords: inflation threshold; unemployment; Phillips Curve; panel threshold model; Indonesia; COVID-19

ABSTRAK

Penelitian ini mengkaji hubungan non-linear antara inflasi dan pengangguran di Indonesia dengan menggunakan model regresi threshold panel. Menggunakan data dari 34 provinsi selama periode 2016–2023, analisis mengidentifikasi satu threshold inflasi yang signifikan pada tingkat 1,9 persen. Di bawah threshold tersebut, inflasi secara signifikan meningkatkan tingkat pengangguran terbuka, sedangkan inflasi di atas 1,9 persen menurunkan pengangguran. Hasil tetap robust ketika sampel dipisahkan menjadi periode pra-COVID (2016–2019) dan pasca-COVID (2020–2023), meskipun threshold yang relevan meningkat menjadi 2,68 persen dan 3,11 persen setelah pandemi. Pendapatan per kapita, output ekonomi regional, dan pencapaian pendidikan yang lebih tinggi secara signifikan menurunkan pengangguran, sementara upah minimum, tingkat kemiskinan, dan skor demokrasi yang lebih tinggi berhubungan dengan pengangguran yang lebih tinggi. Temuan ini mendukung Kurva Phillips jangka pendek dalam kerangka yang bergantung pada rezim dan menekankan pentingnya menjaga inflasi moderat di atas threshold yang teridentifikasi, disertai kebijakan yang memperkuat modal manusia dan pertumbuhan pendapatan. Penelitian ini memberikan kontribusi terhadap literatur dengan menyediakan estimasi threshold tingkat provinsi yang pertama kali mengenai hubungan inflasi–pengangguran di Indonesia serta dengan memasukkan kontrol institusional dan modal manusia.

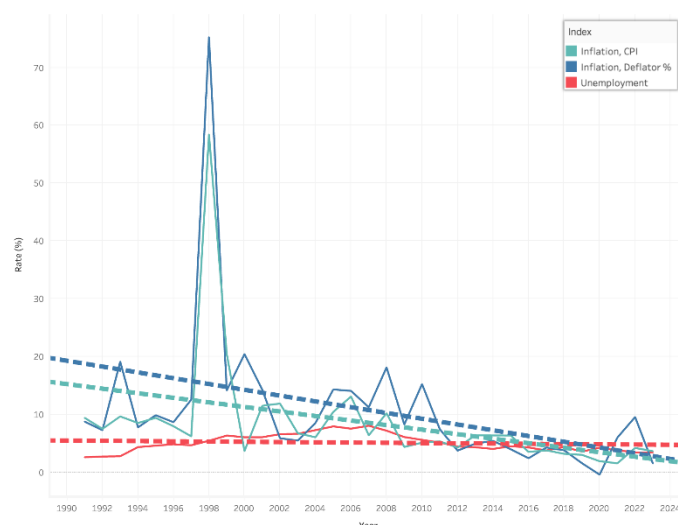
Kata kunci: threshold inflasi; pengangguran; Kurva Phillips; model threshold panel; Indonesia; COVID-19

INTRODUCTION

The relationship between inflation and unemployment has long been a central concern in macroeconomic theory and policy. The Phillips Curve, first formalized by Phillips (1958), posits a short-run inverse trade-off: lower unemployment tends to be associated with higher wage and price inflation, while higher unemployment is linked to lower inflation. Subsequent developments—

particularly the expectations-augmented Phillips Curve (Friedman, 1968; Phelps, 1967) and New Keynesian formulations—have refined this relationship by incorporating inflation expectations, labor-market rigidities, and the natural rate of unemployment (or NAIRU). In the short run, rising labor demand can push wages and prices upward; in the long run, however, the trade-off may weaken or disappear as expectations adjust.

Empirical evidence for the Phillips Curve is mixed and context-dependent. Studies have documented significant short- and long-run inverse relationships in developing economies such as Ethiopia (Niken et al., 2023), while the relationship appears weaker in smaller Eurozone economies that joined after 2004, remaining more robust in larger member states (Combes & Lesuisse, 2022). In Indonesia, aggregate data from 2000–2023 illustrate periods of inverse co-movement: inflation rose to 9.57 percent in 2022 as unemployment fell to 3.46 percent, whereas the COVID-19 shock produced near-zero or negative inflation alongside a sharp rise in unemployment (World Bank data).



Source: World Bank

Figure 1
Movement of Inflation and Unemployment in Indonesia, 2000–2023

Yet recent research highlights growing complexity. During the Great Recession and the COVID-19 pandemic, inflation did not decline as sharply as traditional models predicted, and the link between long-term unemployment and inflation proved weaker than expected (Guirguis et al., 2022; Meloni et al., 2022; Crump et al., 2024; Iwasaki et al., 2021). These findings suggest that the inflation–unemployment nexus is nonlinear and subject to structural breaks, economic shocks, and policy regimes.

Linear regression approaches are therefore inadequate for capturing potential threshold effects in the inflation–unemployment relationship. Hansen’s (1996, 2000) threshold regression framework provides a rigorous method for identifying regime-dependent coefficients, allowing the impact of inflation on unemployment to differ below and above an estimated threshold value. While several studies have applied threshold models to inflation and economic growth in Indonesia and the broader ASEAN region—finding critical values around 5–8 percent beyond which inflation becomes detrimental (Kusumatriana et al., 2022; Su Dinh, 2015; Baharumshah et al., 2016)—research specifically examining inflation thresholds for unemployment remains scarce. Moreover, existing Indonesian studies rarely incorporate institutional quality and human-capital variables that are theoretically and empirically relevant for labor-market outcomes.

Government institutions influence unemployment through the effectiveness of labor-market policies, fiscal management, and regulatory quality (Cui, 2017; Castro et al., 2025). Higher educational attainment expands individuals’ employability and facilitates the implementation of public policies (Yoana et al., 2024; Siburian, 2023; Angelou et al., 2024). Omitting these factors risks omitted-variable bias and limits the policy relevance of threshold estimates.

Against this background, the present study identifies the inflation threshold that minimizes the open unemployment rate across 34 Indonesian provinces over the period 2016–2023. Employing Hansen’s panel threshold model, we estimate regime-dependent effects of inflation while controlling for per-capita income, gross regional domestic product, minimum wages, poverty, democracy, and educational attainment. We further examine whether the threshold and its associated coefficients differ between the pre-COVID (2016–2019) and post-COVID (2020–2023) periods. The analysis contributes to the literature in three ways. First, it provides the first provincial-level threshold estimate of the inflation–unemployment relationship in Indonesia. Second, it incorporates institutional and human-capital controls that have been largely overlooked in prior threshold studies. Third, it assesses the stability of the relationship across the COVID-19 shock, offering timely insights for monetary and labor-market policy.

METHOD

This study employs balanced panel data covering 34 Indonesian provinces for the period 2016–2023, yielding 272 observations. All variables are obtained from the Indonesian Central Bureau of Statistics (BPS), except the inflation rate. Provincial inflation is constructed as the average of city-level consumer price indices (82 cities for 2016–2019 and 90 cities for 2020–2023). Following the 2022 administrative expansion of Papua and West Papua, city-level inflation data belonging to the newly created provinces are reassigned to their parent provinces to maintain consistency of the panel structure.

The dependent variable is the open unemployment rate (UNE). The key independent variable is the inflation rate (INF). Control variables include the natural logarithm of per-capita income (IPC), the natural logarithm of gross regional domestic product (GDP), the natural logarithm of the provincial minimum wage (MNW), the natural logarithm of the number of poor people (POP), the natural logarithm of the democracy index (DMC), and average years of schooling (EDU). These controls capture income, economic size, labor-cost, poverty, institutional quality, and human-capital effects on unemployment.

The baseline linear specification is written as:

$$UNE_{it} = \alpha_t + \beta_1 IPC_{it} + \beta_2 GDP_{it} + \beta_3 MNW_{it} + \beta_4 POP_{it} + \beta_5 INF_{it} + \beta_6 DMC_{it} + \beta_7 EDU_{it} + \mu_i + e_{it}$$

where: (i) indexes provinces, (t) indexes years, (α_t) denotes time fixed effects, (μ_i) denotes province fixed effects, and e_{it} is the idiosyncratic error term. To allow for possible nonlinear effects of inflation, we estimate a fixed-effects panel threshold model following Hansen (1996, 2000):

$$UNE_{it} = \mu_i + \beta'_1 X_{it} I(INF_{it} \leq \lambda) + \beta'_2 X_{it} I(INF_{it} > \lambda) + e_{it}$$

where: X_{it} is the vector of all regressors (including inflation itself if treated as regime-dependent), I is the indicator function, and λ is the unknown threshold parameter to be estimated. The model partitions the sample into two regimes according to whether inflation is below or above the estimated threshold. Sequential testing is performed to determine the number of thresholds (single, double, or triple). Inference on the threshold parameter relies on the bootstrap procedure proposed by Hansen (1996).

In addition, the sample is split into the pre-COVID period (2016–2019) and the post-COVID period (2020–2023) to examine whether the estimated threshold and the associated slope coefficients differ across the two sub-periods. All estimations are conducted with province fixed effects. Standard errors are clustered at the province level. The threshold model is estimated using the sequential least-squares approach with 300 bootstrap replications and a 15 percent trimming percentage to ensure sufficient observations in each regime.

RESULTS

Descriptive Statistics and Correlation Analysis

Table 1 presents the descriptive statistics for the eight main variables across 34 Indonesian provinces during 2016–2023 (272 observations). Per-capita income (IPC) has a mean of 10.8867 (SD = 0.5704), indicating relatively uniform distribution. Gross regional domestic product (GDP) averages 12.3605 (SD = 1.1469). The minimum wage (MNW) averages 14.6900 (SD = 0.2442), while the

number of poor people (POP) averages 6.0207 (SD = 1.0802). Inflation (INF) has a mean of 3.0801 (SD = 1.4476), ranging from -0.03% (deflation) to 7.73%. The open unemployment rate (UNE) averages 5.0891% (SD = 1.7785). The democracy index (DMC) and average years of schooling (EDU) average 16.6757 and 13.0778, respectively.

Table 1
Descriptive Statistics (34 Provinces, 2016–2023)

Variable	Obs.	Mean	Std. Dev.	Min	Max
IPC	272	10.8867	0.5704	9.6862	12.6842
GDP	272	12.3605	1.1469	10.2802	15.0519
MNW	272	14.6900	0.2442	14.1064	15.4051
POP	272	6.0207	1.0802	3.8508	8.4422
INF	272	3.0801	1.4476	-0.0300	7.7300
UNE	272	5.0891	1.7785	1.4000	10.9500
DMC	272	16.6757	1.1652	14.5743	19.4894
EDU	272	13.0778	0.6263	11.7064	15.1196

Source: Processed data

Table 2 shows the pairwise correlation matrix. IPC is positively correlated with GDP ($r = 0.4642$) and MNW ($r = 0.5829$), but negatively correlated with POP ($r = -0.2425$). GDP is strongly positively correlated with POP ($r = 0.6639$). UNE exhibits positive correlations with IPC (0.3058), GDP (0.4129), MNW (0.1824), POP (0.1529), DMC (0.1519), and EDU (0.1689), and a weak negative correlation with INF (-0.0542).

Table 2
Correlation Matrix

	UNE	IPC	GDP	MNW	POP	INF	DMC	EDU
UNE	1.000							
IPC	0.306	1.000						
GDP	0.413	0.464	1.000					
MNW	0.182	0.583	0.005	1.000				
POP	0.153	-0.243	0.664	-0.406	1.000			
INF	-0.054	0.065	0.031	-0.010	-0.022	1.000		
DMC	0.152	-0.096	0.181	-0.189	0.136	0.087	1.000	
EDU	0.169	0.203	0.046	0.129	-0.240	0.104	0.169	1.000

Source: Processed data

Threshold Effect Tests

Table 3 reports the sequential tests for threshold effects following Hansen (1996, 2000). The single-threshold test yields an F-statistic of 29.43 ($p = 0.0067$), significant at the 1% level. The double-threshold ($F = 3.92$, $p = 0.8033$) and triple-threshold ($F = 3.58$, $p = 0.8967$) tests are insignificant. Therefore, the single-threshold model is preferred.

Table 3
Tests for Threshold Effects

Test	F-statistic	p-value	Critical values (10%, 5%, 1%)
Single threshold	29.43***	0.0067	18.31, 21.26, 28.26
Double threshold	3.92	0.8033	13.49, 16.73, 23.35
Triple threshold	3.58	0.8967	12.61, 16.13, 24.30

Notes: *** $p < 0.01$.

Source: Processed data

Main Threshold Regression Results

Table 4 presents the fixed-effects panel threshold estimates with inflation as the threshold variable. The estimated threshold is 1.9%. Below this threshold, inflation has a positive and significant effect on unemployment (coefficient = 0.4325, $p < 0.01$). Above 1.9%, the effect becomes

negative and significant (coefficient = -0.0505 , $p < 0.05$). Among the regime-independent controls, IPC (-1.9186 , $p < 0.01$) and EDU (-1.1955 , $p < 0.10$) significantly reduce unemployment, while MNW (2.6082 , $p < 0.01$), POP (1.8577 , $p < 0.05$), and DMC (0.5211 , $p < 0.05$) significantly increase it. The model explains 85.17% of the variation in unemployment ($R^2 = 0.8517$).

Table 4
Threshold Regression Results (Dependent Variable: UNE)

Variable	Coefficient	Std. Error
Regime-independent regressors		
IPC	-1.9186^{***}	0.6542
GDP	-0.0352^*	0.5084
MNW	2.6082^{***}	0.6702
POP	1.8577^{**}	0.8629
DMC	0.5211^{**}	0.4394
EDU	-1.1955^*	0.6102
Threshold variable		
Inflation ≤ 1.9	0.4325^{***}	0.1096
Inflation > 1.9	-0.0505^{**}	0.0373
Constant	-16.4096	6.9389
R^2	0.8517	
Observations	270	
Prob > F	0.0000	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Province fixed effects included.

Source: Processed data

Pre- and Post-COVID Analysis

Table 5 reports the threshold estimates when the sample is split into pre-COVID (2016–2019) and post-COVID (2020–2023) periods. Two significant thresholds are identified: 2.68% and 3.11%. Table 6 shows the regime-dependent coefficients. Before COVID-19, low inflation ($\leq 2.68\%$) has a positive coefficient (0.1175 , $p < 0.05$), moderate inflation a smaller positive effect (0.0419 , $p < 0.01$), and high inflation a weakly negative effect (-0.0100 , $p < 0.10$). After COVID-19, the positive effect of low inflation strengthens (0.2206 , $p < 0.05$), while the negative effect of high inflation becomes larger in magnitude (-0.085 , $p < 0.05$).

Table 5
Threshold Estimates (Full Sample Split)

Threshold	Estimate	95% Confidence Interval
π_1	2.68^{**}	[2.08, 3.44]
π_2	3.11^{***}	[2.85, 3.45]

Notes: ** $p < 0.05$, *** $p < 0.01$.

Source: Processed data

Table 6
Regime-Dependent Coefficients Before and After COVID-19

Regime	Before COVID	After COVID
Inflation ≤ 2.68	0.1175^{**}	0.2206^*
$2.68 < \text{Inflation} \leq 3.11$	0.0419^{***}	0.0283^*
Inflation > 3.11	-0.0100^*	-0.085^{**}

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Processed data

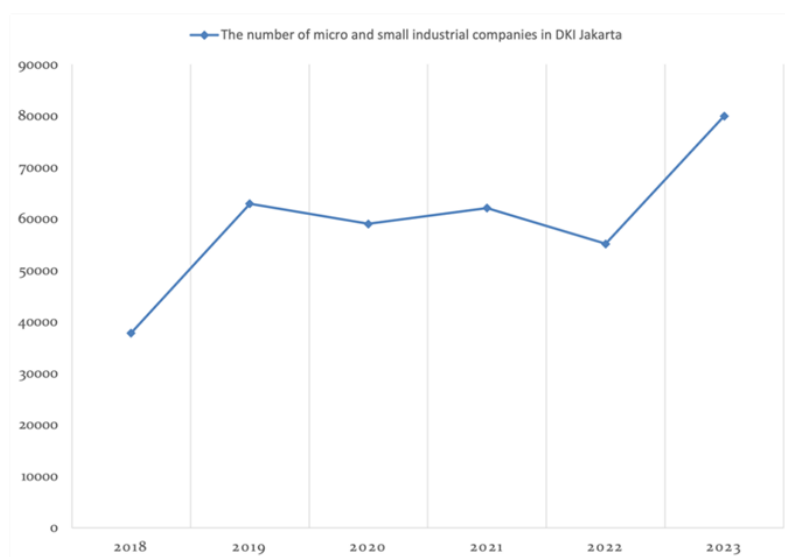
Table 7 classifies the 34 provinces by inflation regime before and after the pandemic. Before COVID-19, several provinces (e.g., West Sumatra, East Java, Papua) were in the low-inflation regime. After the pandemic, only DKI Jakarta remained in the low-inflation regime ($\leq 2.68\%$), while the majority of provinces shifted to the high-inflation regime ($> 3.11\%$).

Table 7
Provincial Classification by Inflation Regime

Period	$\leq 2.68\%$	2.68–3.11%	$> 3.11\%$
Before COVID (2016–2019)	West Sumatra, East Java, North Sulawesi, Southeast Sulawesi, East Nusa Tenggara, Papua, North Maluku, Gorontalo, West Sulawesi	Aceh, Riau, Jambi, South Sumatra, Lampung, Central Java, Yogyakarta, South Kalimantan, East Kalimantan, South Sulawesi, Bali, West Nusa Tenggara, North Kalimantan, Riau Islands	North Sumatra, Bengkulu, DKI Jakarta, West Java, West Kalimantan, Central Kalimantan, Central Sulawesi, Maluku, Banten, Bangka Belitung, West Papua
After COVID (2020–2023)	DKI Jakarta	South Sumatra, Bengkulu, West Java, East Kalimantan, West Nusa Tenggara, East Nusa Tenggara, North Maluku, Gorontalo, Riau Islands, West Papua	Aceh, North Sumatra, West Sumatra, Riau, Jambi, Lampung, Central Java, Yogyakarta, East Java, West Kalimantan, Central Kalimantan, South Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi, Bali, Maluku, Papua, Banten, Bangka Belitung, West Sulawesi, North Kalimantan

Source: Processed data

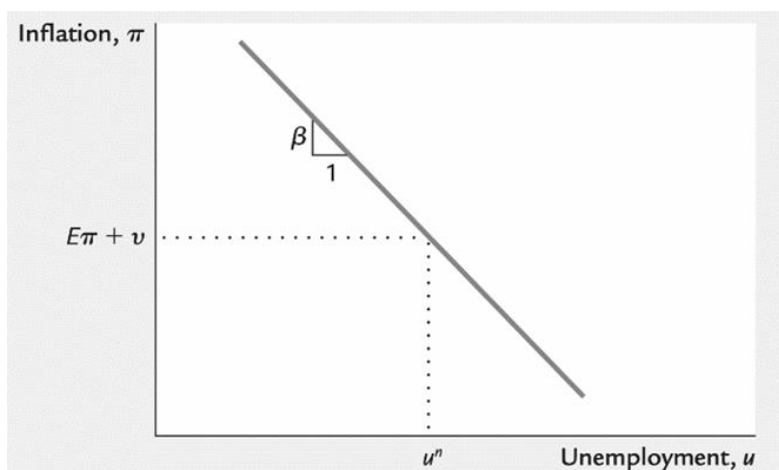
Figure 2 illustrates the decline in the number of micro and small industrial companies in DKI Jakarta in 2020, coinciding with the peak of COVID-19 cases in the province.



Source: BPS DKI Jakarta

Figure 2
Number of Micro and Small Industrial Companies in DKI Jakarta, 2018–2023

The single threshold of 1.9% indicates a regime shift consistent with a nonlinear Phillips Curve (Phillips, 1958; Friedman, 1968; Phelps, 1967). Below 1.9%, rising inflation increases unemployment, reflecting insufficient demand to stimulate hiring. Above 1.9%, inflation reduces unemployment, supporting the short-run trade-off (Radhyanti et al., 2023; Meloni et al., 2022; Hauriza et al, 2021).



Source: Processed data

Figure 3
Phillips Curve Trade-off Between Inflation and Unemployment

The strengthening of regime effects after COVID-19 highlights the increased sensitivity of the labor market to inflation regimes during recovery (Ruiz Estrada, 2021; Friawan & Yasid, 2021; Guirguis et al., 2022). The persistence of low inflation only in DKI Jakarta post-2020 is consistent with the severe demand shock in the province with the highest case load. Higher per-capita income and education significantly reduce unemployment, in line with human-capital theory (Christianto et al., 2022; Yoana et al., 2024; Yasar & Elgin, 2024). Conversely, higher minimum wages and poverty increase unemployment, consistent with labor-demand constraints (Neumark & Shirley, 2022; Manihuruk et al., 2024; Faturohim et al., 2023). The positive coefficient on the democracy index may reflect institutional complexities specific to the Indonesian context (Hutasoit et al., 2024; Cui, 2017).

Overall, maintaining inflation moderately above the identified thresholds, while strengthening education and real incomes and carefully calibrating minimum-wage policy, can help reduce unemployment and support economic stability (Hansen, 2000; Abas, 2019; Iwasaki et al., 2021).

CONCLUSION

This study investigates the nonlinear relationship between inflation and open unemployment across 34 Indonesian provinces from 2016 to 2023 using a panel threshold regression model. The results identify a single significant inflation threshold at 1.9 percent. Below this threshold, inflation significantly increases unemployment, whereas inflation above 1.9 percent reduces the unemployment rate. These findings are consistent with the short-run Phillips Curve in a regime-dependent framework.

When the sample is divided into the pre-COVID (2016–2019) and post-COVID (2020–2023) periods, the relevant thresholds rise to 2.68 percent and 3.11 percent. In the post-COVID period, the positive effect of low inflation on unemployment strengthens, while the negative effect of high inflation becomes more pronounced. Only DKI Jakarta remained in the low-inflation regime after 2020, reflecting the heterogeneous provincial impact of the pandemic.

Among the control variables, higher per-capita income, larger regional economic output, and longer average years of schooling significantly reduce unemployment. In contrast, higher minimum wages, a larger number of poor people, and a higher democracy index are associated with higher unemployment rates. These results underscore the importance of complementary policies that promote income growth, expand educational attainment, and carefully manage minimum-wage adjustments.

From a policy perspective, maintaining inflation moderately above the identified thresholds—while strengthening human capital and institutional quality—can help lower unemployment and support macroeconomic stability. Future research could extend the analysis by incorporating more recent data, examining inflation expectations, or exploring additional labor-market rigidities at the provincial level.

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