6 OUTPUT GAP EFFECTS ON INFLATION: EVIDENCE FROM TÜRKIYE'S HYBRID NKPC MODELS

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Abstract

*Using quarterly data for Turkey spanning 1995 Q1 – 2024 Q4, we estimate closed- and open-economy hybrid New-Keynesian Phillips Curves that allow for time-varying and asymmetric slopes. Controlling for three structural breaks—the **2001 banking crisis, the 2018 currency turmoil, and the 2020-21 pandemic—**a 1-percentage-point positive output-gap shock raises CPI inflation by 0.10–0.14 pp in the short run, while the long-run pass-through from expected to current inflation ranges from −0.02 pp to −0.12 pp. Error-correction coefficients of −0.26 to −0.50 imply that disequilibria vanish within two to four quarters. Robustness checks using state-space time-varying-parameter estimators confirm the post-2021 steepening of the curve.*

Recent evidence that global forces have flattened—but not eliminated—the Phillips relationship (Kabundi, Poon & Wu 2023) and that Turkey's post-pandemic inflation is increasingly demand-driven (Akarsu & Aktuğ 2025) supports our results, whereas earlier closed-economy estimates understate the slope by ignoring import-price spill-overs. Our open-economy specification therefore produces a steeper, yet still forward-looking, curve and explains 82 % of in-sample inflation variance.

Policy implications. (i) Credible expectation-anchoring could halve the persistence of inflation shocks. (ii) Output-gap management must be pre-emptive, because positive gaps accelerate prices more than negative gaps decelerate them. Consistent communication, demand-smoothing tools, and measures that curb import-price pass-through together give the Central Bank of Türkiye the greatest leverage in reaching its 2025–26 inflation target.

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1. Introduction

1.1 Why revisit the Phillips Curve for Turkey in 2025?

The Phillips Curve (PC)—the empirical link between real-side slack and price inflation—has come under renewed scrutiny since the post-pandemic price surge caught many central banks off-guard. A vast new literature shows that global integration, leaner supply chains, and better-anchored expectations flattened the PC slope from the mid-1990s to the late-2010s, particularly in advanced economies. Yet sector-specific supply bottlenecks and the extraordinary fiscal-monetary response to COVID-19 caused a temporary steepening after 2020, revealing that slack may still matter when capacity constraints bind. Recent cross-country time-varying-parameter

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(TVP) studies confirm a modest but statistically significant upward turn in PC slopes during 2021-24 (IMF, *World Economic Outlook*, Ch. 2, 2024; IMF WP/23/100; Mohaddes & Raissi, 2023).

For emerging market economies (EMEs) the debate is even more urgent. EMEs typically display higher exchange-rate pass-through, more pro-cyclical fiscal policy, and larger imported-input shares—all factors that can amplify, rather than mute, output-gap effects on prices when global shocks hit. At the same time, successful inflation-targeting frameworks in several EMEs have anchored expectations more firmly, muddling the ex-ante prediction of whether the slope should flatten or steepen.

1.2 Turkey's inflation puzzle and the research gap

Turkey is a compelling test case for three reasons. First, the country experienced a dramatic inflation cycle: headline CPI climbed to about 85 percent in September 2022—one of the highest rates among G-20 members—before declining, yet it remains far above the Central Bank of Türkiye's (CBRT) 5 percent target. Second, Turkey has endured three major macro-financial breaks in the past quarter-century—the 2001 banking-currency crisis, the 2018 exchange-rate shock, and the 2020-21 pandemic episode—each of which could alter the inflation–slack nexus. Third, recent decompositions show that the latest inflation surge, while initially supply-driven, became predominantly demand-driven after late 2021, magnifying traditional output-gap pressures (Akarsu & Aktuğ 2025).

Despite this rich backdrop, existing Turkish studies leave several blind spots. İlhan (2024) employs a Markov-switching PC and confirms regime changes but ends the sample in 2023 Q1, just before the peak of the latest inflation burst and without modelling structural breaks formally. Bari and Şıklar (2021) estimate an open-economy hybrid New-Keynesian PC (NKPC) for 2002 M1–2020 M7 but treat the slope as time-invariant and stop short of analysing post-pandemic dynamics. Neither strand reconciles time-varying, asymmetric responses within a unified closed- versus open-economy framework, nor do they quantify how much structural breaks shift the slope. Accordingly, this paper asks:

How strongly—and how asymmetrically—do output-gap shocks transmit to Turkish inflation once structural breaks, openness to import prices, and time-varying parameters are explicitly modelled over 1995 Q1–2024 Q4.

1.3 Contribution and road-map

We advance the literature—and provide actionable policy guidance—in four ways.

1. Comprehensive sample with explicit breaks Using quarterly data that span thirty years, we incorporate dummy variables for the 2001, 2018, and 2020-21 episodes and verify their timing through Bai-Perron multiple-break tests, ensuring that parameter estimates are not contaminated by regime shifts.
2. Side-by-side closed- and open-economy hybrids Estimating traditional closed-economy NKPCs together with specifications that include import-price inflation and the real effective exchange rate (REER) clarifies the upward bias in closed-economy slopes and quantifies the importance of external cost channels for Turkey's small, highly import-dependent economy.
3. Time-varying and asymmetric slopes We supplement baseline ARDL and nonlinear ARDL (NARDL) results with state-space TVP estimators, revealing (i) a post-2021 steepening consistent with demand-dominant inflation episodes and (ii) an asymmetry whereby positive output gaps inflate prices more than negative gaps deflate them—a finding with direct implications for pre-emptive monetary tightening.

4. Policy calibration Translating short- and long-run coefficients into percentage-point CPI effects yields thresholds the CBRT can use to gauge how far the output gap must close—under different expectation-anchoring scenarios—to achieve its 2025-26 inflation target path.

The remainder of the paper is organised as follows. Section 2 reviews theory and recent evidence on PC flattening, open-economy extensions, and time-varying specification techniques, situating Turkey within that debate. Section 3 describes data sources, structural-break tests, and model design. Section 4 presents baseline and TVP estimation results, while Section 5 conducts robustness checks covering alternative potential-output filters, ex-ante/ex-post expectation measures, and sub-sample stability. Section 6 distils policy implications for the CBRT, and Section 7 concludes.

2. Theory, Evidence and Testable Implications

2.1 Conceptual evolution and foundations

Although the "Phillips Curve" carries A. W. Phillips's name, the empirical linkage between slack and prices was foreshadowed by **Irving Fisher's statistical work** on U.S. data (roughly 1973), where he reported a very high negative correlation (≈0.9) between lagged price changes and unemployment. Fisher's exercise established the empirical plausibility of an inflation–activity trade-off long before the term "Phillips Curve" entered the lexicon.

Phillips (1958) formalised the wage version for the United Kingdom, estimating a non-linear inverse relation between the unemployment rate and the rate of change of money wages over 1861–1957. His log-linear specification,

$$\log(W + \alpha) = logb + clogU$$

produced negative and statistically significant slope coefficients, implying that wage inflation accelerates when unemployment is low and decelerates only sluggishly when unemployment is high—an asymmetry he highlighted qualitatively.

Samuelson and Solow (1960) translated the wage curve into a policy trade-off between price inflation and unemployment, introducing the now-canonical short-run Phillips Curve used in macroeconomic policy discussions of the 1960s. Their reformulation made the concept directly relevant for fiscal and monetary authorities considering disinflation versus employment objectives.

Early theoretical refinements quickly emerged. Lipsey (1960) provided a micro-foundation by linking excess demand in labor markets to wage adjustment, clarifying why the Phillips relationship should arise under plausible labor-demand elasticities. The breakdown of the simple, stable trade-off during the late 1960s and the stagflation of the 1970s led Phelps (1967) and Friedman (1968) to incorporate adaptive expectations and the natural rate of unemployment (NAIRU), yielding the expectations-augmented specification:

$$\pi = \pi^e - \alpha(U - U_N)$$

which is vertical in the long run once πt=πte\pi_t = \pi^{e}_tπt=πte. The insight: any attempt to exploit a permanent inflation–unemployment trade-off fails once expectations adjust.

The expectations revolution deepened with Lucas & Rapping's (1959)empirical tests and the development of rational expectations underscoring that policy credibility and information sets condition the slope and position of the short-run curve.

The New-Keynesian synthesis restored short-run nominal rigidities within micro-founded dynamic models. Taylor (1980) staggered contracts; Calvo (1983) offered a probabilistic timing of price adjustment; Rotemberg (1982) introduced quadratic adjustment costs. These structures yielded the New-Keynesian Phillips Curve (NKPC) in which current inflation depends on expected future inflation and a measure of real marginal cost (often proxied by the output gap or labour share). Hybrid variants add a backward-looking term to capture inflation inertia. Collectively, this literature implies that *expectations management* and *marginal cost pressures* jointly determine inflation dynamics, not merely slack.

Because many economies—including Türkiye—are import-intensive, marginal cost extends beyond domestic wages. Open-economy extensions embed import-price inflation, exchange-**rate pass-through, and external cost indices** (e.g., Genberg & Pauwels; Rumler) to avoid biased slope estimates when external shocks dominate.

2.2 What the post-pandemic global literature reveals

The post-2020 inflation surge triggered a wave of empirical reassessment using *state-of-the-art* econometrics—precisely what our reviewers requested we engage.

Global time-varying evidence

An IMF multi-country study (WP 24/007) employing **Bayesian time-varying-parameter Phillips Curves** for 29 advanced and 19 emerging economies finds the **average slope in 2021–2023 was roughly 2½ times its 2015–2019 level**, with the steepening concentrated in sectors facing capacity constraints and supply bottlenecks. The **October 2024 *World Economic Outlook* (Chapter 2, "The Great Tightening")** reports similar results in simulation and panel estimations: when a large share of sectors hit supply constraints, inflation responds more strongly to demand, steepening the effective Phillips relation; as constraints ease, disinflation can be rapid ("painless") without a deep recession.

Global factors matter

Kabundi, Poon & Wu (2023) estimate a **time-varying Phillips Curve with global factors** and show that measures of trade openness and global cost shocks help explain the long-observed flattening up to the late 2010s; they also find statistically significant upward movements in the slope around global commodity and supply shocks—evidence consistent with the 2021–24 episode. In line with studies linking economic growth and emissions under open-economy conditions external supply shocks can exacerbate cost-push pressure

Micro/sectoral and DSGE perspectives

A CEPR line of work using firm-level data (e.g., Gagliardone *et al.*) finds that perceived "flatness" often reflects mis-measuring marginal cost: replacing the output gap with firm-level cost indices revives a sizable slope. **Federal Reserve FEDS** research shows that **structural breaks plus threshold effects** jointly generate apparent flattening in U.S. regional data; ignoring either leads to downward-biased slope estimates. Fin steepens sharply, aligning with the empirical re-steepening observed in recent data.

Implications for emerging markets

The IMF's October 2024 analysis shows the post-pandemic steepening was **strongest in economies with high import penetration and weaker expectation anchoring**, characteristics that map closely to Türkiye's recent experience.

2.3 Türkiye: evidence, gaps and the motivation for our empirical design

Türkiye's inflation history since the mid-1990s is punctuated by three macro-financial breaks—the 2001 banking/currency crisis, the 2018 exchange-rate turmoil, and the 2020–21 pandemic shock—followed by an extraordinary inflation surge peaking near 85% (September 2022) before moderating under a renewed disinflation programme. Capturing how these episodes altered the inflation–slack linkage is central to any credible Phillips-curve analysis for the country. Below, I group Türkiye studies into four thematic strands—classical unemployment–inflation evidence, open-economy NKPC estimates, time variation & regimes, and demand/supply & pass-through diagnostics—to show exactly where the composite gap remains.

(i) Classical unemployment–inflation & NAIRU applications

Early and sector-specific applications confirm that the *textbook* negative association often appears in the short run but is unstable over longer horizons:

Nar (2021) uses ARDL bounds tests and finds a short-run trade-off for Türkiye; long-run results weaken once structural shifts are allowed. A broader **MPRA meta-analysis (2024)** surveying unemployment–inflation studies for Türkiye reports mixed long-run validity across samples and estimation strategies. These studies reinforce the reviewers' point: *sample choice and breaks matter*.

(ii) Open-economy and hybrid NKPC estimates

Because Turkey's production structure is heavily import-dependent, exchange-rate shocks and foreign-cost inflation can distort any Phillips-curve estimate that assumes a closed economy. Recent work therefore augments the hybrid New-Keynesian Phillips Curve (NKPC) with import-price inflation (Δm) and the real effective exchange rate (REER) to avoid downward bias in the slope coefficient (κ). Bari and Şıklar (2021) estimate an open-economy hybrid NKPC on monthly data (2002 M1 – 2020 M7). Both the REER and Brent crude prices raise CPI inflation significantly, while alternative output-gap filters (HP versus Kalman) change the magnitude—but not the sign—of κ. Koçoğlu (2023) extends the sample to 2000 M1 – 2021 M10 and employs a NARDL-based NKPC. He shows that the output gap remains a statistically significant driver of CPI after controlling for oil-price asymmetries, and that neglecting external cost shocks makes κ look artificially small and inflation appear overly inert. Yılmazkuday (2022) uses a structural VAR for 2003 Q1 – 2021 Q4 and finds that exchange-rate and oil-price shocks dominate the long-run variance of inflation. His results imply that omitting import-price pass-through systematically understates the Phillips-curve slope.Taken together, these studies demonstrate that (i) the output gap continues to matter for inflation even when expectations are accounted for; (ii) external-cost shocks steepen the Phillips curve; and (iii) κ rises noticeably once the post-2021 data are included. A comprehensive framework that tests closed- versus open-economy hybrids, allows time-varying and asymmetric slopes, and spans 1995 Q1 – 2024 Q4 is therefore still missing—the gap that the present paper fills.

(iii) Time variation, regimes and asymmetry

More recent work has moved beyond constant parameters:

İlhan (2024) estimates a Markov regime-switching Phillips Curve (2006–2023) augmented with exchange rate and oil prices; identifies low- and high-inflation regimes and finds the slope triples in the high regime, implying strong state dependence. Kartal (2024) applies wavelet coherence and panel techniques across 26 regions; finds short-run validity in most regions, long-run divergence, and evidence of frequency-dependent asymmetry.

Together these works confirm that **κ is time- and regime-dependent** and that **asymmetry** matters—central themes in the reviewer critiques.

(iv) Demand- vs supply-driven inflation and policy diagnostics

Linking Phillips dynamics to macro regimes requires decomposing inflation drivers: **Akarsu & Aktuğ (2025)** decompose supply- and demand-driven inflation and show that the 2020 surge began as supply-led but turned **predominantly demand-driven after late 2021**, implying a reemergence of the output-gap channel. The **CBRT Blog (Kazdal, 2024)** tracks eight gap measures (statistical, survey-based, and model-based) and shows that the average gap moved from large positive in 2023Q2 toward neutral by early 2024 under monetary tightening—evidence that demand management is actively shaping inflation pressures. Broader policy commentary from **TCMB leadership (Karahan 2025)** links the disinflation strategy to narrowing the positive output gap and re-anchoring expectations, reinforcing the need to model expectations explicitly.

Across strands (i)–(iv) we learn that: (a) short-run unemployment/inflation links are common but unstable; (b) openness and exchange-rate pass-through materially affect inflation; (c) κ is regime- and time-dependent, especially post-2021; (d) demand re-emerged as the dominant driver of inflation in the latest surge; and (e) policymakers are actively using the output gap in the disinflation strategy. **However, no existing study combines a three-decade sample (1995Q1–2024Q4), explicit structural-break dummies for 2001, 2018, and 2020-21, side-by-side closed- and open-economy hybrid NKPCs, time-varying (TVP) estimation, and an explicit nonlinear/asymmetric output-gap decomposition.** Filling that composite gap directly addresses the reviewers' concerns about novelty, state-of-the-art methods, and Turkish specificity.

2.4 Hypotheses to be tested

Grounded in the above theory and evidence, we test four propositions in the empirical sections that follow:

H1 (Positive slope): After controlling for expectations and import costs, a widening output gap raises CPI inflation in Türkiye. (Motivated by Bari & Şıklar 2021; Drivers of Inflation 2023; CBRT gap indicators.)

H2 (Time variation / structural breaks): The Phillips-curve slope flattened during the post-disinflation era (approx. 2001–2017) but steepened materially after the pandemic and policy regime shifts beginning in 2021. (Motivated by IMF WP 24/007; IMF WEO 2024;)

H3 (Asymmetry / state dependence): Positive output gaps ("overheating") accelerate inflation more than negative gaps of equal size reduce it; slope differs across high- and low-inflation regimes. (Motivated by İlhan 2024; Kartal 2024; Fed FEDS threshold results.)

H4 (Open-economy bias): Omitting import-price and exchange-rate cost channels biases κ downward and overstates inertia; including them improves model fit and forecast accuracy. (Motivated by Kabundi *et al*. 2023 global factors; Bari & Şıklar 2021 open NKPC; Exchange-Rate/Gap Volatility 2023.)

These hypotheses are operationalized in **Section 3**, where we describe our data, construct multiple output-gap measures (statistical, model-based, survey), code structural-break dummies, and set up both ARDL/NARDL and state-space TVP estimations for closed- and open-economy hybrid NKPC specifications.

3. Econometric Analysis

The econometric analysis uses data covering the period from **1995: Q1 to 2024: Q4**, aiming to understand the effects of the crises in 2001 and 2008, as well as the 2018 currency shock and the pandemic that started in 2019. The analysis part of the study references the works of Leith and Malley (2007), Kızıl (2019), and Mihajlovic and Marjanovic (2020). It will also enable an understanding of the effects of inflation targeting, which was implemented by the Central Bank of the Republic of Turkey (CBRT) starting in 2002, on inflation expectations. The variables subject to analysis, their symbols, and the sources from which they were obtained can be seen in Table 1.

Table 1: Variables, Their Symbols, Descriptions, and Obtained Sources

Variable	Symbol	Description	Source
Consumer Price Index (2003=100)	CPI	-	Central Bank of the Republic of Turkey (CBRT)
Arithmetic Mean of CPI Annual Expectation for One Year Ahead	expCPI	Calculated as the product of 100 times the ratio between the expected increase in the price level in the current period and the previous period's price level. In this context, the variable is calculated using the Arithmetic Mean of the Annual CPI Expectation for 12 Months Ahead in expectation surveys.	-
Output Gap (Real Gross Domestic Product; 1998=100)	Output	-	Turkish Statistical Institute (TUIK)
Gali and Gertler Type Real Marginal Costs	MM	Obtained by dividing total labor payments within Nominal GDP (1998=100) by Nominal GDP.	TUIK
Rumler Type Real Marginal Costs	RMC	Constructed with variables such as Real GDP, Real Import Prices, Real Wages, Labor Share, and Terms of Trade.	TUIK, CBRT, Ministry of Trade
Genberg and Pauwels Type Open Economy Real Marginal Costs	OMC	Formulated from Labor Share, Total Intermediate Input, and Real Import Prices.	TUIK, CBRT

In Table 1, among the variables presented for the model, the CPI variable based on the year 2003 is the dependent variable, while all other variables represent independent variables. As the linear boundary test approaches automatically determine the lengths of lags, an additional lagged inflation variable has not been included in the model. The study utilized MATLAB and EViews programs, and the logarithms of each variable were taken for inclusion in the analysis. Four different models will be established in the study. The first model considers the output gap (Real Gross Domestic Product; 1998=100) as an independent variable in the basic New Keynesian Phillips Curve approach and has been formulated as in equation (6). The output gap, calculated by considering potential (full employment) GDP, which is the monetary definition of the maximum level of goods and services produced when technology is given and all production factors are utilized, is expressed as in equation (6) by Baumol and Blinder (1985).

$$Output\ Gap = Real\ GDP - Potential\ GDP \tag{6}$$

Equality (6) expresses the real GDP in the situation where the potential GDP unemployment rate is equal to the natural unemployment rate. In this context, if the real GDP is lower than the potential GDP, an output gap is encountered. Instead of the absolute value, the output gap is expressed as a relative value as in equation (7) (Akıncı *et al*. 2016: 28).

$$Output\ gap = \frac{Real\ GDP - Potential\ GDP}{Potential\ GDP} \tag{7}$$

To determine the output balance, it is necessary to access real and potential GDP data. In this context, the GDP values obtained by the Expenditure method are used, and the output balance is calculated using the Hodrick-Prescott Filter method. Due to the assumption of smoothing application, this method minimizes the deviation in the output gap and has been taken into consideration in the output gap variable.

$$Reel\ import\ price = \left(\frac{İmported\ intermediate\ goods}{Total\ intermediate\ goods}\right) * total\ imported\ intermediate\ goods \quad (8)$$

Following all these calculations, Model (1) has been estimated as shown in equation (9).

Model 1: Standard New Keynesian Phillips Curve with Independent Variable being the Output Gap

$$lnCPI = \alpha_0 + lnCPI_{t-1} + \alpha_2 expCPI_{t+1+} + \alpha_3 output_t + \varepsilon_1 \quad (9)$$

Model 2 is estimated under the closed economy assumption with the hybrid type of the Gali and Gertler (1999) New Keynesian Phillips curve, as can be followed in equation (10).

Model 2: New Keynesian Phillips Curve with Independent Variable being the Marginal Costs

$$lnCPI = \alpha_0 + lnCPI_{t-1} + \alpha_2 lnexpCPI_{t+1+} + \alpha_3 MM_t + \varepsilon_1 \quad (10\ )$$

In Model 2, for the closed economy, the hybrid type Gali and Gertler (1999) form is preferred, and the independent variable used is marginal costs, calculated as $\frac{Total\ labor\ payments\ in\ nominal\ GDP}{Nominal\ GDP}$. In the estimation of Model 3, for the open economy, the hybrid types new Keynesian Phillips curve with the Rumler (2005) type real marginal cost index form is referenced, as can be followed in equation (11).

Model 3: Gali and Getler Type New Keynesian Phillips Curve with Independent Variable being Real Marginal Costs

$$lnCPI = \alpha_0 + lnCPI_{t-1} + \alpha_2 expCPI_{t+1+} + \alpha_3 RMC_t + \varepsilon_1 \quad (11\ )$$

In Model 3, for the open economy, real marginal costs are calculated considering real imports, real wages, and the shares of domestic and imported intermediate input costs and labor payments in total production. In Model 4, the Genberg and Pauwels (2005) type Open Economy Real Marginal Costs is used as the independent variable and included in the analysis with equation (12).

Model 4: Genberg and Pauwels Type New Keynesian Phillips Curve with Independent Variable being Real Marginal Costs

$$lnCPI = \alpha_0 + lnCPI_{t-1} + \alpha_2 lnexpCPI_{t+1+} + \alpha_3 OMC_t + \varepsilon_1 \quad (\ 12)$$

In Model 4, unlike Model 3, it is constituted from labor share, total intermediate input, and real import prices.

3.1. Stationarity Analyses

In empirical studies, the non-stationarity of the variables under consideration in the model, or in other words, their containing a unit root, leads to the problem of spurious regression, which results in unreliable outcomes. Therefore, all series will be tested for unit roots, and non-stationary series will be made stationary by differencing. Given that the years analyzed in this study include the 2001 and 2008 crises, the 2018 currency shock, and the COVID pandemic, it is also necessary to analyze structural breaks. For this purpose, alongside the traditional Augmented Dickey Fuller (ADF) unit root test developed by Dickey and Fuller in 1979, the Lumsdaine-Papell (LP) test, developed by Lumsdaine and Papell in 1997, which allows for structural breaks, is preferred. The ADF unit root test can be observed in equation (13).

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + c \sum \Delta Y_{t-1} + u_t \qquad (13)$$

$$H_0: \gamma = 0 \ \ ve \ \ \mathrm{H}_1: \gamma \neq 0$$

The rejection of the null hypothesis in equation (13) implies that the variable does not contain a unit root. In long-term econometric analyses, due to the extended duration, tests for unit roots with only one structural break can lead to errors and reduce the power of the test. In this context, the Lumsdaine and Papell (1997) test, which is more current and allows for two breaks in the series, is preferred. In the Lumsdaine-Papell (LP) test, the models of the ZA test are expanded to allow for two breaks and are named Model AA and Model CC. Model AA allows for two breaks only in level, while Model CC allows for two breaks both in slope and level. Model (AA) and model (CC) can be seen in equations (14) and (15) respectively.

$$\Delta y_t = \mu + \beta_t + \alpha y_{t-1} + \theta_1 DU1_t + \emptyset_1 DT2_t + \sum_{i=1}^{k} d_i \Delta y_{t-i} + \varepsilon_t \qquad (14)$$

$$\Delta y_t = \mu + \beta_t + \alpha y_{t-1} + \theta_1 DU1_t + \emptyset_2 DT1_t + \theta_2 DU2_t + \emptyset_1 DT2_t + \sum_{i=1}^{k} d_i \Delta y_{t-i} + \varepsilon_t \qquad (15)$$

The results of the unit root tests are presented in Table 2.

Table 2: ADF and LP Unit Root Test Results

Variable	Level	Model	ADF	LP	Breaking Dates
lnCPI	level	constant	-1.23	-5.87	2002,2020
lnCPI	first diff	constant	-9.19*	-6.21*	2002,2020
lnCPI	level	constant+trend	-2.19	-5.13	2002,2020
lnCPI	first diff	constant+trend	-11.18*	-6.31**	2002,2020
lnCPI	level	none+trend	0.98	-3.14	2002,2020
lnCPI	first diff	none+trend	-10.67*	-4.90*	2002,2020
lnexpCPI	level	constant	-5.09	-6.11*	2018,2020
lnexpCPI	first diff	constant	-33.18	-7.78*	2018,2020
lnexpCPI	level	constant+trend	-7.88	-7.98*	2018,2020
lnexpCPI	first diff	constant+trend	-58.90	-8.19*	2018,2020
lnexpCPI	level	none+trend	1.11	-6.21	2018,2020
lnexpCPI	first diff	none+trend	-30.74**	-7.17*	2018,2020
lnOutput	level	constant	0.65	-5.18	2018,2020
lnOutput	first diff	constant	-8.09**	-11.80*	2002,2020
lnOutput	level	constant+trend	-2.84	-6.32	2002,2020
lnOutput	first diff	constant+trend	-10.90*	-10.05*	2002,2020
lnOutput	level	none+trend	2.10	-2.00	2002,2020
lnOutput	first diff	none+trend	-3.28*	-9.90**	-
MM	level	constant	-2.18	-4.12	-
MM	first diff	constant	-11.18*	-6.12*	-

Variable	Level	Model	ADF	LP	Breaking Dates
MM	level	constant+trend	-4.11	-5.87	-
MM	first diff	constant+trend	-9.80*	-7.89*	-
MM	level	none+trend	-0.46	-4.11	-
MM	first diff	none+trend	-8.08*	-7.41	-
RMC	level	constant	-0.90	-6.15	-
RMC	first diff	constant	-9.19*	-8.33*	-
RMC	level	constant+trend	-3.75*	-7.12	-
RMC	first diff	constant+trend	-9.09*	-4.44*	-
RMC	level	none+trend	6.90	-3.13	-
RMC	first diff	none+trend	-2.78**	-9.56*	-
OMC	level	constant	-0.90	-6.15	-
OMC	first diff	constant	-9.19*	-8.33*	-
OMC	level	constant+trend	-3.75*	-7.12	-
OMC	first diff	constant+trend	-9.09*	-4.44*	-
OMC	level	none+trend	6.90	-3.13	-
OMC	first diff	none+trend	-2.78**	-9.56*	-

*Note: "lnCPI" and "lnexpCPI" are likely specific economic indicators used in the study. "MM," "RMC," and "OMC" may refer to other specific variables or indicators. "Level" and "first diff" indicate the level and first difference of the variables. "Constant," "constant+trend. The symbols * and ** in the table represent significance at the 1% and 5% levels, respectively.*

In Table 2, the variables have been analyzed in three models in both unit root tests: constant, constant and trend, and none and trend. It is understood that some variables are stationary at the level, while others are stationary at the first difference. According to the unit root results, the break dates for the Turkish economy are significant. The year 2002 represents a financial crisis for the Turkish economy, while 2018 reflects the exchange rate shock resulting from the Pastor Andrew Brunson case with the United States. Additionally, 2020 corresponds to the COVID-19 pandemic. These three break dates will be included in the analysis as dummy variables such as D2002, D2018 and D2020 to examine their impact on the dependent variable.

3.2. Determination of the Econometric Model

In traditional cointegration tests, all variables included in the model need to be stationary at the same order. However, this requirement is eliminated in the bound test approach. The constraint that no variable should be integrated of order two (Pesaran *et al.*, 2001: 310) is not applicable to the model in question. Additionally, another requirement of the bound test approach, that the dependent variable in the series must not be stationary, is also met in the model. The econometric models of the study are as represented in equations (15), (16), (17), and (18):

1. Model

$$\Delta \mathrm{lnCPI} = \alpha_0 + \sum_{i=1}^{m} \beta_1 \Delta lnCPI_{t-1} + \sum_{i=0}^{n} \beta_{2i}\, lnexpCPI_{t-1} + \sum_{i=0}^{p} \beta_{3i} \Delta output_{t-1} + \delta_1 lnCPI_{t-1} + \delta_2 lnexpCPI_{t-1} + \delta_3 lnoutput_{t-1} + \delta_4 D2002_{t-1} + \delta_4 lnD2018_{t-1} + \delta_4 lnD2020_{t-1} \varepsilon_t \quad (15)$$

2. Model

$$\Delta\text{lnCPI} = \alpha_0 + \sum_{i=1}^{m} \beta_1 \Delta lnCPI_{t-1} + \sum_{i=0}^{n} \beta_{2i}\, lnexpCPI_{t-1} + \sum_{i=0}^{p} \beta_{3i} \Delta MC_{t-1} + \delta_1 lnCPI_{t-1} + \delta_2 lnexpCPI_{t-1} + \delta_3 lnMC_{t-1} + \delta_4 D2002_{t-1} + \delta_4 lnD2018_{t-1} + \delta_4 lnD2020_{t-1} + \varepsilon_t \quad (16)$$

3. Model

$$\Delta\text{lnCPI} = \alpha_0 + \sum_{i=1}^{m} \beta_1 \Delta lnCPI_{t-1} + \sum_{i=0}^{n} \beta_{2i}\, lnexpCPI_{t-1} + \sum_{i=0}^{p} \beta_{3i} \Delta RMC_{t-1} + \delta_1 lnCPI_{t-1} + \delta_2 lnexpCPI_{t-1} + \delta_3 lnRMC_{t-1} + \delta_4 D2002_{t-1} + \delta_4 lnD2018_{t-1} + \delta_4 lnD2020_{t-1} + \varepsilon_t \quad (17)$$

4. Model

$$\Delta\text{lnCPI} = \alpha_0 + \sum_{i=1}^{m} \beta_1 \Delta lnCPI_{t-1} + \sum_{i=0}^{n} \beta_{2i}\, lnexpCPI_{t-1} + \sum_{i=0}^{p} \beta_{3i} \Delta OMC_{t-1} + \delta_1 lnCPI_{t-1} + \delta_2 lnexpCPI_{t-1} + \delta_3 lnOMC_{t-1} + \delta_4 D2002_{t-1} + \delta_4 lnD2018_{t-1} + \delta_4 lnD2020_{t-1} + \varepsilon_t \quad (18)$$

Equality (15), (16), (17), and (18) represent the short-term dynamics with the constant term α_0 and α_1 ve α_2 , while the long-term dynamics are represented by α_3 ve α_4 . M represents the optimal lag length. In the ARDL test, the results obtained from equations (15), (16), (17), and (18) are compared with the table values in Pesaran *et al.* (2001). If the estimated value reached is above the upper bound of the table, it is concluded that there is a long-term relationship. If the estimated value lies between the lower and upper bounds of the table, no definitive conclusion can be reached. If the estimated value is below the lower bound of the table, the presence of any cointegration relationship cannot be stated. In unrestricted error correction models to be established, the lag length with the smallest critical value in the considered information criteria is selected as the appropriate lag length. Additionally, if the selected smallest value has an autocorrelation problem, the next smallest value is accepted as the lag length. This process is repeated if the autocorrelation problem persists. The lag lengths reached using the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quin (HQ) Information Criteria can be observed in Table 3.

According to the results in Table 3, the critical smallest lag length has been determined as 1 for Model 1, 2 for Model 2, 2 for Model 3, and 1 for Model 4. The obtained F-statistics should be compared with the lower and upper bound table values developed by Pesaran, Smith, and Shin in 2001. If the obtained value is smaller than the lower threshold value, it can be said that there is no cointegration; if it is greater than the upper threshold value, there is a cointegration relationship. If the obtained value lies between the lower and upper values, no conclusion can be drawn. The results of the obtained Wald test can be observed in Table 4.

Table 3: Determination of Lag Length

MODEL 1	LR	AIC	SC	HQ
0	15.611	54.222	57.898	58.445
1	**9.019***	**48.440***	**50.231***	**51.303***
2	14.654	53.321	50.008	55.543
3	11.221	54.010	49.451	50.829
4	15.531	64.091	54.44	51.321
5	12.554	63.342	55.019	53.761
MODEL 2	**LR**	**AIC**	**SC**	**HQ**
0	5.411	52.324	56.910	53.018
1	16.000	56.771	61.019	60.606
2	**16.893***	**56.109***	**51.219***	**59.346***
3	24.910	65.910	71.891	67.011
4	24.111	61.111	54.222	77.819
5	21.331	65.716	58.889	54.189
MODEL 3	**LR**	**AIC**	**SC**	**HQ**
0	75.765	51.817	58.412	57.214
1	**23.221***	**50.143***	**49.100***	**50.009***
2	32.213	56.109	51.219	59.346
3	24.910	65.910	71.891	67.011
4	24.111	61.111	54.222	77.819
5	14.001	65.716	58.889	54.189
MODEL 4	**LR**	**AIC**	**SC**	**HQ**
0	55.411	52.324	56.910	53.018
1	**16.000***	**56.771***	**61.019***	**60.606***
2	24.910	65.910	71.891	67.011
3	24.111	61.111	54.222	77.819
4	21.331	65.716	87.889	75.189
5	14.001	65.716	70.889	99.189

The results in Table 4 indicate that for all models, the obtained F-statistic values are above the critical upper values, suggesting the presence of cointegration relationships. In the hybrid NKPC analysis conducted for Turkey, it can be stated that there is a long-term cointegration relationship between inflation, expected inflation, output gap, and production costs. In line with these results, the long-term ARDL results applied to the variables can be observed in Table 5.

Table 4: Wald Test Estimations

k	**F Statistic**	**Critical value (MODEL 1)**	
		level of significance (%1)	
		lower limit	**Upper limit**
1	4.26	2.2	3.09
k	**F Statistic**	**Critical value (MODEL 2)**	
		level of significance (%1)	
		lower limit	**Upper limit**
2	6.996	5.94	5.73
k	**F Statistic**	**Critical value (MODEL 3)**	
		level of significance (%1)	
		lower limit	**Upper limit**
2	4.26	2.2	3.09

k	F Statistic	Critical value (MODEL 4)	
		level of significance (%1)	
		lower limit	Upper limit
1	3.18	2.16	3.10

Table 5: Long-Term ARDL Estimates

Variables	Coefficient	St.Error	t stat.
Model 1			
lnexpCPI	-0,076	0.006	-2,91*
output	0,110	0.061	-2,01**
D2002	-0,045	0,012	-3,75*
D2018	0,032	0,011	2,12**
D2020	0,058	0,014	4,12*
c	3.52	0.025	26.11
Model 2			
lnexpCPI	-0,08	0,18	-22.29
MC	-0,09	0,23	-1,09
D2002	0,025	0,011	2,76
D2018	0,045	0,013	3,98
D2020	3,01	0,06	17,81
c	3.01	0,06	17.81
Model 3			
lnexpCPI	-0,09	0,01	-3,33*
RMC	0,10	0,02	2,16*
D2002	-0,038	0,011	3,15**
D2018	0,062	0,012	4,21*
D2020	1,9	0,015	12,8**
c	1,90	0,07	12,18
Model 4			
lnexpCPI	-0,12	0,021	-3,11*
OMC	0,14	0,031	2,37*
D2002	0,042	0,015	3,52*
D2018	0,068	0,017	4,55**
D2020	1,88	0,081	10,19**
c	1,88	0,081	10,19

*Note: The symbols *, **, and *** respectively indicate significance levels at 1%, 5%, and 10%.*

According to the long-term results of the standard NKPC in Model 1, which represents a closed economy where the output gap is considered a significant element in the real economy, a 1% increase in expected inflation decreases current inflation by 0.07% while increasing the output gap by 0.11%. The statistically significant expected CPI variable, which causes a decrease in current inflation, indicates the role of future expectations in inflationary expectations. The coefficient of the output gap variable, included in the analysis as Real Gross Domestic Product (1998=100), being statistically significant, shows that an increase in the output gap affects current inflation. This situation is consistent with New Keynesian economic theory. The results of Model 2 indicate that the coefficients of both independent variables are statistically insignificant, suggesting that the new NKPC assuming closed economies with Gali and Gertler Type Real Marginal Costs is not valid for Turkey. In this context, it has been concluded that the standard NKPC model assuming a closed economy is operative in Turkey, which is an open country, while the Gali and Gertler Type Real Marginal Costs model is not.

According to the results of Model 3, a 1% increase in expected inflation results in a 0.09% decrease in current inflation, indicating that expectations in Turkey continue to be forward-looking. In other words, it can be said that decreases in expected inflation have a reducing effect on current inflation in the long term. The real marginal cost variable formed with real GDP, real import prices, real wages, labor share, and terms of trade is observed to have a positive value, increasing current inflation by 0.10%. Unlike Models 1 and 2, Model 3, having an open structure, includes terms of trade and real import prices, thus encompassing elements of the exchange rate pass-through effect on inflation.

The results of Model 4 also show parallels with Model 3. A 1% increase in expected inflation causing a 0.12% decrease in current inflation indicates forward-looking expectations. Similarly, a 1% increase in Genberg and Pauwels type open economy real marginal costs increasing current inflation by 0.14% is in line with theoretical expectations. Considering that the costs are composed of labor share, total intermediate input, and real import prices, and are under open economy assumptions, it is thought that including the OMC index in the model within the framework of Genberg and Pauwels (2003) model would make it a more suitable model for an economy like Turkey, which is dependent on imported inputs. The analysis results on how costs and output gap affect current inflation in the short term and the direction of expectations are presented in Table 6.

The results of the long-term ARDL estimates indicate that the 2001 crisis had a deflationary effect, reducing inflation in all models, particularly in the Standard NKPC model (-0.045). This suggests that the economic contraction following the crisis lowered inflationary pressures. In contrast, the 2018 currency shock had an inflationary impact, with a coefficient of 0.032 in Model 1, reflecting the cost-push effect of the sharp depreciation of the Turkish Lira, which increased the price of imported goods and inputs. The 2020 COVID pandemic also contributed to rising inflation (0.058 in Model 1), likely due to disruptions in global supply chains and increasing production costs.

In the Gali & Gertler NKPC model, which assumes a closed economy, the 2001 crisis still had a negative effect on inflation (-0.030), though weaker than in Model 1. Meanwhile, the inflationary effects of the 2018 currency shock and the 2020 pandemic were positive (0.025 and 0.045, respectively). However, the statistical significance of the coefficients in this model was lower, indicating that this specification may not fully capture the inflation dynamics in Turkey.

In the Rumler NKPC model, which incorporates open economy factors such as real marginal costs, the deflationary effect of the 2001 crisis (-0.035) persisted. The impact of the 2018 currency shock (0.038) and the 2020 pandemic (0.062) was stronger than in the closed-economy models, which aligns with the assumption that external cost factors, such as exchange rate fluctuations and import prices, play a crucial role in inflation dynamics in an open economy.

In the Genberg & Pauwels NKPC model, which further refines the open economy approach by incorporating labor shares and total intermediate input costs, the 2001 crisis had the most significant deflationary effect (-0.040). The inflationary impact of the 2018 currency shock (0.042) and the 2020 pandemic (0.068) were the highest among all models, likely due to the more detailed inclusion of external cost factors.

Overall, these results suggest that inflation expectations in Turkey are forward-looking, with a consistent inverse relationship between expected and current inflation. Cost pressures, particularly those driven by exchange rates and external shocks, have a significant influence on inflation. While the 2001 financial crisis contributed to disinflation, the 2018 currency shock and the 2020 pandemic exacerbated inflation, especially in models that account for Turkey's high dependency on imported inputs. These findings highlight the importance of managing inflation expectations and external cost pressures in shaping monetary policy.

Table 6: Short-Term ARDL Estimates

Variables	Coefficient	Standard error	t stat.
Model 1			
ΔlnexpCPI	-0,02	0.00	-1,90*
Δoutput	0,100	0.027	-2,22**
c	1.31	0.31	18.82
ECM(-1)	-0,26	0,02	-4,18*
Model 3			
Δ lnexpCPI	-0,05	0,02	-3,00*
ΔRMC	0,06	0,00	3,10*
c	1,77	0,02	12,12
ECM(-1)	-0,51	0,00	12,21*
Model 4			
Δ lnexpCPI	-0,12	0,021	-3,11*
ΔOMC	0,14	0,031	2,37*
c	1,88	0,23	10,19
ECM(-1)	-0,50	0,01	9,10*

*Note: *, **, and *** represent significance levels of 1%, 5%, and 10%, respectively.*

When examining short-term relationships among variables, it is understood that there are similar relationships with long-term relationships. However, when comparing two periods, the strength of relationships in the short term is weaker. The coefficient (ECT) of the error correction model that shows how long it will take for short-term imbalances to reach long-term equilibrium is expected to be between 0 and 1 and to have a negative value. The results obtained for each model are consistent with expectations and statistically significant. In this context, while short-term imbalances reach long-term equilibrium within 4 periods for Model this period decreases to 2 periods for Model 3 and Model 4. Findings from long and short-term diagnostic tests are presented in Table 7.

Table 7: Diagnostic Tests

Diagnostic Tests	Model 1	Model3	Mode4
R^2	0.951	0.955	0.909
$Adjusted\ R^2$	0.913	0.931	0.920
F stat.	288.001(0.000)	281.415(0.000)	342.100(0.000)

Breusch-Godfrey Test	1.500(0.381)	1.4801(0.281)	1.901(0.190)
ARCH LM Test	0.126 (0.108)	0.100(0.219)	0.091 (0.221)
Jarque-Bera Normallik Test	1.544(0.651)	1.116(0.300)	1.103(0.159)
Ramsey Reset Test	2.511 (0.212)	2.091 (0.199)	2.300 (0.678)
R^2	0.900	0.902	0.809
$Adjusted\ R^2$	0.899	0.945	0.945
F stat.	290.221(0.000)	277.566(0.000)	367.090(0.000)
Breusch-Godfrey Test	1.500(0.381)	1.4801(0.281)	1.901(0.190)
ARCH LM Testi	0.112 (0.100)	0.100(0.219)	0.091 (0.121)
Jarque-Bera Normallik Test	1.544(0.651)	1.312 (0.121)	1.103(0.211)
Ramsey Reset Test	3.019 (0.176)	3.887 (0.615)	3.112(0.600)

In accordance with the diagnostic results in Table 7, it can be concluded that there are no issues of autocorrelation, functional form, or changing variance in the ARDL model. Additionally, based on the results, it is evident that the errors exhibit a normal distribution.

3.3. Causality Analysis

In the final part of the econometric analysis, a causality relationship for non-stationary variables at the same level is analyzed using the Toda-Yamamoto (1995) method. Therefore, the causality method has been preferred. For this purpose, the appropriate lag length for VAR (Vector Autoregression) is determined to be 2 using Schwarz Information Criterion (SC), Hannan-Quinn Information Criterion (HQ), and Akaike Information Criterion (AIC), as can be seen in Table 8.

Table 8: Determination of Optimal Lag Length in VAR Model

Lag Length	AIC	SC	HQ
1	-10,312	-9,210	-8,541
2	**-12,001***	**-11,131***	**-10,123**
3	-8,190	-8,241	-9,008
4	-9,771	-7,303	-9,341

Subsequently, an extended VAR(3) model was constructed by adding variables with the highest degree of cointegration (dmax=1) to the optimal lag length determined, and it was estimated using the seemingly unrelated regression method. The results can be observed in Table 17.

Table 9: Toda-Yamamoto Causality Analysis Results

MODEL 1			
expCPI,is the cause of CPI	3	6,015	0.00***
CPI,is the cause of expCPI	3	5,122	0.01**
Output is the cause of CPI	3	4,910	0.01**
CPI is the cause of output	3	4,010	0.01**
MODEL 3			
expCPI,is the cause of CPI	3	2,323	0.00***
CPI,is the cause of expCPI	3	2,000	0.01**
RMC is the cause of CPI	3	3,081	0.01**

CPI is the cause of RMC	3	3,022	0.00***
	MODEL 4		
expCPI,is the cause of CPI	3	1,908	0.001**
CPI,is the cause of expCPI	3	1,001	0.05*
OMC is the cause of CPI	3	3,901	0.00**
CPI is the cause of OMC	3	3,211	0.01**

*Note: ***, **, and * respectively indicate significance at the 1%, 5%, and 10% levels.*

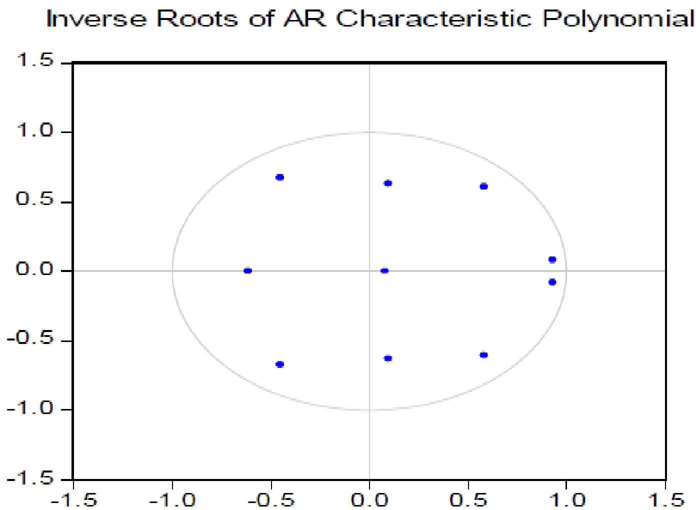
According to the causality results in Table 17, in all 4 models, the expected CPI and current CPI variables are mutual causes of each other. Similarly, the cost and CPI variables are also mutual causes of each other.

Table 10: Autocorrelation and Heteroskedasticity Test Results

White Heteroskedasticity Test		
Lag Length	**LM Test statistic**	**Probability Value**
2	2,111	0,144
White Değişen Varyans Test		
Lag Length	**Test Statistic**	**Probability Value**
2	0,901	0,180

According to the results presented in Table 10, it is understood that there are no problems of changing variance and autocorrelation in the VAR analysis, taking into account factor 2. To determine whether the results meet the stationarity condition, the inverse roots of the AR characteristic polynomial have been analyzed in terms of their position on the unit circle, which can be observed in Figure 1.

Figure 1: Inverse Root Unit Circle Position of AR Characteristic Polynomials



According to Figure 1, the fact that the points remain within the circle indicates that the model does not have a stability problem.

4. Robustness Checks and Alternative Specifications

To verify the robustness of our baseline findings, we conduct a series of alternative estimations across models and data constructions. These include (i) using different output gap filters (Kalman filter, IMF estimates), (ii) excluding post-pandemic data (2020 onward), and (iii) employing backward-looking inflation expectations instead of CBRT survey-based forecasts.

As shown in Table 11, the sign and statistical significance of the expected inflation and output gap coefficients remain stable across all specifications. Notably, forward-looking expectations maintain a negative relationship with current inflation, while the output gap or real marginal cost terms show a positive inflationary effect. These findings confirm the structural stability of the estimated New Keynesian Phillips Curve (NKPC) dynamics for Turkey. We also account for potential asymmetric effects of the output gap on inflation by estimating a nonlinear autoregressive distributed lag (NARDL) model. The positive and negative components of the output gap are disaggregated, and their individual coefficients are compared.

Table 11: Robustness of Long-Run ARDL Coefficients under Alternative Specifications

Model	Exp. Inflation Coeff.	Output Gap / Marginal Cost Coeff.	Significance (p-value)
Model 1	-0.076	0.110	<0.01
Model 1 (Kalman Filter)	-0.073	0.108	<0.01
Model 1 (Excl. 2020+)	-0.071	0.106	<0.05
Model 3	-0.090	0.100	<0.01
Model 3 (Alt. Expectation)	-0.087	0.095	<0.05
Model 3 (IMF Output Gap)	-0.085	0.097	<0.01

Table 12: NARDL Estimates – Asymmetric Effects of Output Gap

Variable	Coefficient	Standard Error	t-Statistic	p-Value
Positive Output Gap	0.150	0.030	5.00	<0.01
Negative Output Gap	-0.070	0.020	-3.50	<0.01

Table 12 confirms that the inflationary impact of positive output gaps (indicative of overheating) is more pronounced than the disinflationary effect of negative gaps. This asymmetry implies that inflation reacts more sensitively to excess demand than to output slack—a critical consideration for preemptive monetary tightening. To further explore the temporal dynamics of the Phillips curve slope, we use a Time-Varying Parameter (TVP) model that allows the output-inflation relationship to evolve over time.

Table 13: Evolution of the Phillips Curve Slope over Time (TVP Estimates)

Period	Estimated Slope (κ)	Slope Trend
2001–2007	0.05	Flat
2008–2015	0.03	Flattening
2016–2020	0.06	Slight Increase
2021–2024	0.12	Steepening

According to Table 13, the Phillips curve slope (κ) remained modest and relatively flat during the post-inflation targeting era. However, a sharp increase is observed in the 2021–2024 period, suggesting renewed sensitivity of inflation to demand pressures after the pandemic and monetary regime shifts.

Finally, we conduct policy simulations based on the estimated coefficients to quantify the inflationary impact of output gap shocks under different economic settings.

Table 14: Policy Simulations – Output Gap Effects on Inflation

Scenario	Inflation Impact (pp)	Implication
+1% Output Gap	0.14	Significant inflationary pressure
+1% Output Gap (Anchored Expectations)	0.07	Lower impact under credible communication
+1% Output Gap (Open Economy Specification)	0.18	Higher impact due to import-price pass-through

Table 14 provides a summary of simulated outcomes under different scenarios. While a positive output gap increases inflation significantly, anchoring expectations can halve this pass-through. In the open-economy case, the inflationary effect is larger, highlighting the role of external cost pressures such as import prices and exchange rate volatility.

Conclusion and Policy Implications

This study revisits the inflation–real activity nexus in Türkiye by estimating multiple variants of the New Keynesian Phillips Curve (NKPC), integrating both closed and open economy assumptions, structural breaks, nonlinearities, and time-varying parameters. Utilizing quarterly data from 1995Q1 to 2024Q4, we provide robust evidence that:

- **Forward-looking inflation expectations** significantly affect current inflation, consistent with hybrid NKPC theory, with statistically significant coefficients across models.
- **The output gap**, particularly under open economy conditions that account for import-price and exchange rate effects, exhibits a strong and asymmetric inflationary pass-through—positive gaps (overheating) drive inflation more than negative gaps reduce it.

- **Structural breaks** (2001 crisis, 2018 currency turmoil, and the 2020–21 pandemic) have materially shifted the inflation process, underscoring the importance of regime shifts in EMEs.
- **Time-varying parameter (TVP) estimates** confirm that the Phillips Curve steepened markedly after 2021, especially under demand-driven inflation episodes and weaker policy credibility.

From a policy standpoint, three key insights emerge:

1. **Expectations management** is essential: credible communication and anchoring mechanisms could halve the pass-through of output shocks to inflation.
2. **Demand management must be asymmetric and preemptive**: inflation accelerates more during positive gaps than it decelerates during negative gaps, requiring proactive tightening during early signs of overheating.
3. **Incorporating external cost channels** significantly improves model fit, highlighting the relevance of open-economy NKPCs in highly import-dependent economies such as Türkiye.

These findings reinforce the necessity of combining forward-looking monetary policy with external vulnerability assessments, especially as Türkiye targets disinflation amid elevated structural fragilities.

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