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Heterogeneity in Food Price Inflation Convergence Across the EU: Evidence From Club Dynamics and Structural Breaks

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ABSTRACT

This study examines food price inflation rate convergence among EU27 Member States from 2005 to 2024, focusing on structural breaks, external shocks, and regional disparities. Using panel unit root tests and club convergence analysis, the findings reveal no overall convergence but identify multiple convergence clubs. Structural breaks linked to major global crises exacerbate inflation disparities. Temporary inflation alignment occurs during shocks, but long-term convergence remains constrained by economic and policy differences. The study highlights the need for tailored fiscal and agricultural policies to enhance market cohesion. These insights contribute to understanding food price dynamics and guiding policymakers toward stability.

JEL Classification: E31, C33, F15, F45, O52

1 | Introduction

Thirty years after the launch of the EU Single Market, Europe's grocery bills still trace the continent's political-economy fault lines rather than a fully integrated market. Eurostat 2024 purchasing-power-parity survey reveals an almost 50-percentage-point spread in the price index for food and nonalcoholic beverages: Luxembourg sits 25% above the EU average, while Romania is 24% below it. Denmark, operating under the same CAP rules as its Nordic neighbour, prices a standard basket 20% above the mean, whereas Sweden hovers at roughly EU-parity. These enduring gaps challenge the expectation that the Single Market, the Common Agricultural Policy (CAP) and, for nineteen Member States, the euro would compress price levels—and, by extension, harmonise the trajectories of food-price inflation—raising fundamental questions about how market forces, policy choices and supply-chain structures interact across the EU.

Evidence of persistent border effects is not new. Chen (2004) identified sizeable price discontinuities inside the customs union, and subsequent research shows that they have survived successive shocks—from the global financial crisis and the euro-area debt turmoil to the pandemic and the recent energy-price spike (Brož and Kočenda, 2018; Peersman, 2022). What

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remains under-explored is how and why the degree of convergence shifts over time and across countries, and what this implies for the political economy of EU food and competition policies.

Three gaps motivate this study. First, macro-level analyses of inflation convergence (Altansukh et al. 2017; Liu and Lee 2021) rarely open the black box of food supply chains, where menu costs, search frictions, buyer power and regulatory heterogeneity can mute arbitrage. Second, the rich threshold-arbitrage literature—formalised in nonlinear price-transmission models (Blake and Fomby 1997; Goodwin and Piggott 2001; Barrett and Li 2002)—has seldom been applied systematically to EU retail food markets. Third, emerging evidence of club convergence suggests that countries co-move in groups rather than as a single bloc, yet we lack a comprehensive mapping of how these clubs form, dissolve and reconfigure through crises.

We address these lacunae with a two-pronged contribution: (i) an empirical anatomy of monthly Harmonised Index of Consumer Prices (HICP) food inflation for the EU-27 plus the United Kingdom, 2005–2024, and (ii) a dynamic perspective that tracks how convergence clubs evolve across four policy-relevant sub-periods. Methodologically, we combine panel unit-root tests that allow for multiple structural breaks, the Phillips and Sul (2007) log-t procedure to detect convergence clubs, and Dynamic Common Correlated Effects–Mean Group estimation to gauge adjustment speeds. Five clubs emerge over the full sample, but the number and membership of clubs vary markedly—from three during the postcrisis consolidation years (2009–2013) to six during the high-inflation 2020–2024 episode. These patterns point to shifting arbitrage costs and underline the importance of supply-chain bottlenecks, asymmetric pass-through and policy heterogeneity.

The findings speak directly to ongoing debates on the resilience and fairness of EU food systems. They show that legal integration is a necessary but insufficient condition for price convergence; logistics infrastructure, market structure and national-level policies continue to matter. For agribusiness firms, understanding club dynamics is essential for pricing and procurement strategies. For EU policy-makers, the persistence—and time variability—of clubs flags unfinished business in competition enforcement, VAT harmonisation and cross-border retail regulation.

The remainder of this paper is structured as follows: Section 2 reviews the existing literature on inflation convergence, highlighting gaps in food price inflation research. Section 3 outlines the data sources and methodology, detailing the econometric techniques used. Section 4 presents the empirical results, including structural break analysis and club convergence findings. Section 5 discusses policy implications, and Section 6 concludes with key takeaways and avenues for future research.

2 | Inflation Convergence: Insights from the Recent Literature

Since the launch of the Single Market and the Common Agricultural Policy (CAP), the European Union has progressively lowered border frictions in agri-food trade and harmonised key product and competition standards. Theory of price integration therefore predicts a tendency toward a law-of-one-price outcome—not for every good at every moment, but for average price dynamics over time (Garcia-Hiernaux and Guerrero 2021; Brož and Kočenda 2018). Three intertwined mechanisms sustain this tendency. (i) Common shocks and coordinated policies. Euro-area monetary policy, CAP market-stabilisation measures and EU-wide food-safety regulation transmit broadly similar cost signals to all Member States, damping idiosyncratic inflation and pulling national price trends together (Lopez and Papell 2012; Karanasos et al. 2016). (ii) Deepening supply-chain integration. Cross-border mergers among retailers and processors, the dominance of a handful of purchasing alliances, and the growing importance of supermarket private-label sourcing have made procurement strategies increasingly European rather than national; as procurement prices converge, retail price trajectories should follow suit (Fan et al. 2023; Peersman 2022). (iii) Labour mobility and income convergence. Free movement of labour and cohesion funds raise productivity and disposable income in less-developed regions, gradually aligning demand patterns and mark-ups across the Union (Altansukh et al. 2017; Liu and Lee 2021).

Convergence, however, is far from automatic. Heterogeneous VAT rates, divergent wage dynamics, unequal bargaining power along the food chain and national differences in logistics still create persistent wedges (Yilmazkuday 2022; Stylianou 2022). The policy question is therefore empirical: under which circumstances—and for which groups of countries—does the centripetal force of integration dominate the centrifugal pull of local conditions?

Addressing this question requires more than a single convergence test. The Phillips and Sul (2007) algorithm is useful precisely because it identifies endogenously formed convergence clubs—groups of countries that share a common path even when the panel as a whole does not. Such clubs are expected along three overlapping dimensions. Institutional affinity: euro-adopters share the same nominal anchor and face European Central Bank oversight, while CAP spending remains skewed toward historical production baselines that differ systematically between the 'old' EU-15 and newer Member States (Maurer 2022). Geographical proximity and logistics costs: Baltic and Nordic states are linked through ferry corridors and integrated wholesale markets, whereas Iberian countries share climate-driven harvest patterns; these spatial factors can synchronise supply shocks and retail margins within regions (Fan et al. 2023). Market structure and retailer concentration: countries where a few discount chains dominate (e.g. Germany, the Netherlands) experience stronger buyer power and faster cost pass-through than fragmented markets (e.g. Cyprus, Greece). In such an environment, failing to find overall convergence but detecting club convergence is not a statistical oddity—it is what the literature predicts for an economic union that remains institutionally incomplete and structurally diverse (Brož and Kočenda 2018).

A frequent source of confusion in the inflation-convergence debate is the conflation of border prices for wheat or dairy commodities with the retail prices faced by consumers. Retail prices embed processing and packaging costs (sensitive to national carbon-pricing schemes), marketing and retail margins (linked to domestic competition law and buyer power), transport and storage costs (driven by geography and fuel taxation) and indirect taxes and regulatory fees (Peersman 2022). These layers weaken the pass-through from commodity markets to the shop shelf, allowing for prolonged national inflation differentials even under fully integrated commodity markets. Recognising this distinction is crucial: if retail margins adjust sluggishly, convergence in consumer-level food inflation will be slower and more clustered than convergence in farm-gate prices (Fan et al. 2023).

Building on this conceptual foundation, we derive four propositions that guide the empirical work. P1 (Baseline convergence): if EU-wide policies dominate, national food-price inflation rates should be mean-reverting toward a common long-run trend (Lopez and Papell 2012). P2 (Club formation): where national frictions persist, subsets of countries with similar institutions or market structures will converge internally but diverge from other subsets (Brož and Kočenda 2018). P3 (Shock synchronisation): external shocks—such as the 2022 fertiliser-price surge or the Russia–Ukraine conflict—should temporarily pull inflation rates together, with faster re-divergence in clubs where retail pass-through is sluggish (Sohag et al. 2023). P4 (Retail–commodity wedge): deviations between commodity and retail inflation will be widest in countries with low retail concentration and high logistics costs, delaying convergence (Yilmazkuday 2022).

Together these propositions transform the econometric sequence deployed in Section 3—from panel unit-root tests through structural-break analysis to Phillips–Sul club detection—into a coherent test of economic hypotheses rather than a purely statistical exercise. They also offer clear policy hooks: if P2 and P4 hold, Brussels may need differentiated rather than uniform interventions to secure food-price stability.

3 | Methodology and Data

This study employs a rigorous econometric framework to assess food price inflation convergence across EU Member States from 2005 to 2024. To address the complexity of food price dynamics, we implement a combination of panel unit root tests, structural break analysis, and club convergence methods. This multifaceted approach allows us to capture heterogeneity in convergence patterns, identify structural shifts, and determine whether subgroups of countries exhibit distinct inflation trajectories.

To evaluate the presence of food price inflation convergence, we first apply panel unit root tests that account for cross-sectional dependence and heterogeneity. Specifically, the Demetrescu and Hanck (2012) test, the Herwartz and Siedenburg (2008) wild bootstrap test, and the Herwartz et al. (2018) heteroskedasticity-robust test were applied. These tests increase the reliability of the unit root testing process by addressing common econometric issues in panel data settings. In addition, we performed panel unit root tests that allow for structural breaks using the methodology developed by Karavias and Tzavalis (2014). These tests allow for one or two structural breaks in the deterministic components of the series and can be used in both fixed-T and large-T settings, where T is the number of time series observations in the sample.

Second, Identifying structural shifts is essential in assessing food price inflation dynamics. We assessed potential structural breaks in our panel data using the methodology developed by Ditzen et al. (2021). This test is specifically designed for panel data models and allows for the detection of multiple structural breaks both across individual units and over time. By incorporating this test into our analysis, we can identify and adjust for sudden shifts in food price inflation that may have occurred due to significant events such as policy changes, economic crises, or external shocks. Accounting for these structural breaks enhances the robustness of our convergence assessment by ensuring that our results are not biased by unaccounted structural changes in the data-generating process.

Third, given the heterogeneous nature of EU economies, we employ the Phillips and Sul (2007) club convergence methodology to assess whether subgroups of countries follow distinct convergence paths. This approach employs the log t-regression test, which assesses convergence by examining the time-varying behaviour of individual series relative to a group average over time.

The first step involves calculating the relative transition parameter, which measures the relative position of each unit (e.g., country) with respect to the group's average at each point in time. This parameter is defined as:

$$h_{it} = \frac{y_{it}}{\frac{1}{N}\sum_{i=1}^{N} y_{it}} \tag{1}$$

where y_{it} represents the variable of interest (e.g., food price inflation) for country i at time t, and N is the number of countries in the sample. The transition parameter h_{it} allows for the assessment of relative dynamics, focusing on the tendency of individual units to converge towards a common path.

The log *t*-test is then employed to assess whether all units converge to a common steady-state path. The test involves estimating the following regression:

$$\log\left(\frac{H_1}{H_t}\right) - 2\log\log(t) = \alpha + \beta\log(t) + \varepsilon_t \tag{2}$$

where $H_t = \frac{1}{N}\sum_{i=1}^{N}(h_{it}-1)^2$. The key parameter of interest is $\hat{\beta}$: if $\hat{\beta} \geq 0$, we fail to reject the null hypothesis of convergence, implying that the series converges. A significantly negative $\hat{\beta}$ indicates divergence.

If overall convergence is rejected, Phillips and Sul's method proceeds with a clustering algorithm to identify convergence clubs. The algorithm iteratively forms groups (clubs) by maximizing the homogeneity within each club, applying the log *t*-test within subgroups. This step allows for the identification of distinct clusters that converge to different steady states, capturing heterogeneity in convergence behaviour across units.

We use the DCCE-MG estimator to measure speed of convergence and half-life of inflation persistence within each convergence club. The DCCE-MG extends the standard Common Correlated Effects (CCE) estimator to include lagged dependent variables, while controlling for unobserved global shocks via cross-sectional averages of the dependent and explanatory variables. This framework accommodates country-specific heterogeneity in parameters and dynamics, providing a more accurate depiction of how each subgroup responds to inflation shocks.

After estimating the coefficient λ on the lagged inflation term, we computed the speed of convergence as $\beta = -\ln(1-\lambda)$. This parameter measures how quickly an inflation shock dissipates. The half-life of convergence, which indicates the time required for half of a shock to fade, was calculated as: $\ln(0.5)/\ln(1-\lambda)$. Applying the DCCE-MG estimator to each convergence club—identified through the Phillips and Sul (2007) algorithm—allows us to quantify how quickly club members' food inflation rates revert to a steady-state level. This step is especially relevant in a policy context, as it highlights which clubs adjust quickly to shocks and which may require deeper structural reforms or targeted interventions to foster price stability. By identifying convergence clubs, we provide a complex understanding of inflation heterogeneity, allowing policymakers to tailor strategies for specific economic clusters rather than implementing uniform EU-wide policies.

Monthly data are collected from Eurostat for the period January 2005 to August 2024. We used food inflation indices, in particular the food component of the Harmonised Index of Consumer Prices (HICP), where the base year is 2015 = 100%. The analyses were carried out using STATA 18 software.

Figure 1 displays the heterogeneity of food price inflation dynamics within the EU. While external shocks like financial crises and pandemics have broadly influenced inflation rates, national factors such as economic structure, policy responses, and market resilience play critical roles in shaping these inflation trajectories. These findings indicate that tailored, country-specific policy measures may be necessary to effectively manage food price inflation across the EU, given the diverse responses to global and local economic pressures.

Because our analysis treats each country's food-price series in isolation (even when grouped into clubs), it does not permit us to assess how observable country- or club-level characteristics (e.g. agricultural structure, trade openness, policy regimes) affect either the probability of membership in a given convergence club or the speed with which members revert to their steady-state path. Incorporating these factors would require a multivariate panel-regression or a hierarchical modelling approach, which we leave for future research.

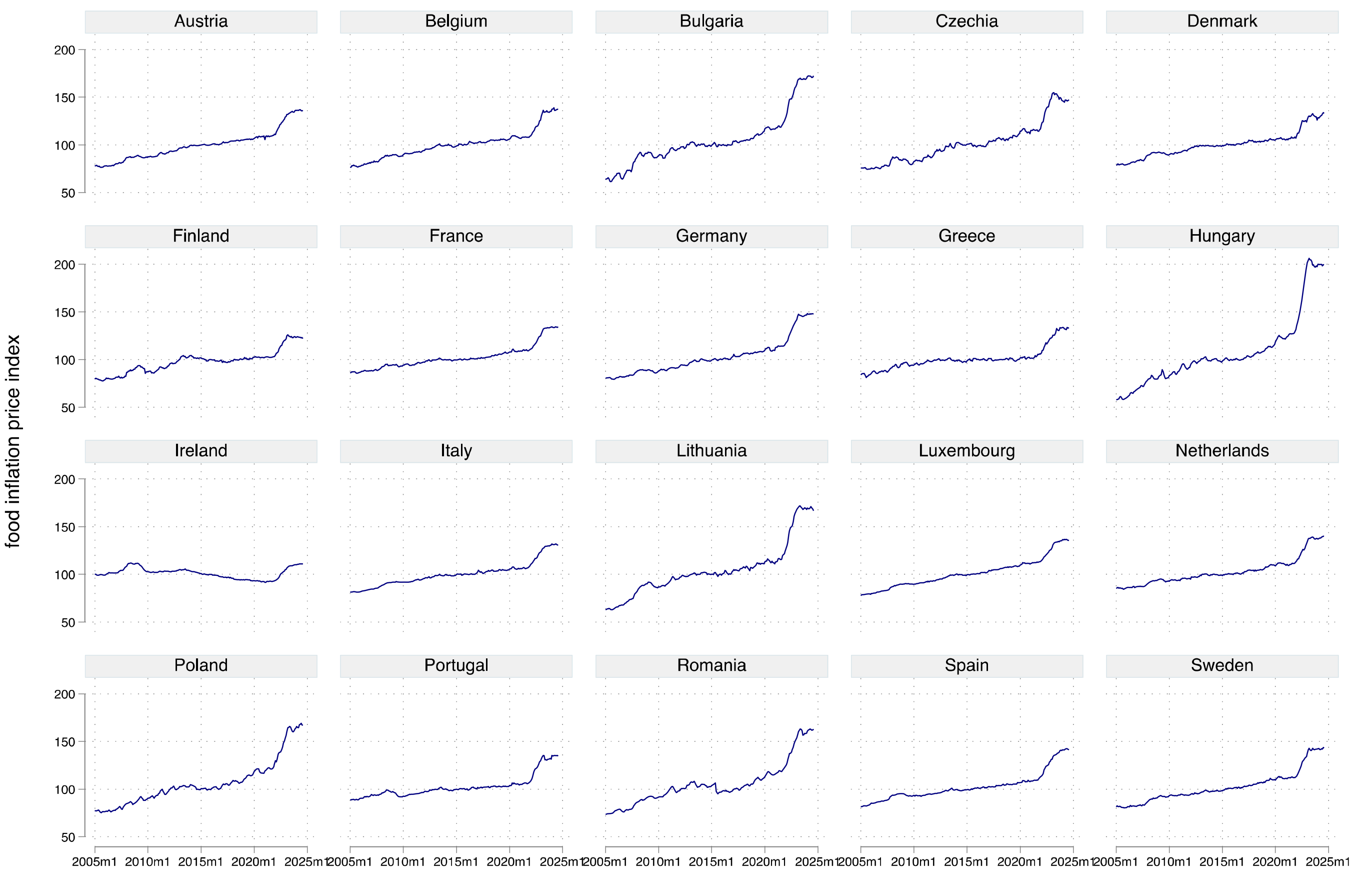

FIGURE 1 | Food inflation price index by country.

4 | Results

4.1 | Overall Convergence

We conducted panel unit root tests with and without structural breaks to assess whether food price inflation rates among EU Member States have converged over time. Table 1 presents the results without considering structural breaks, revealing that p-values exceeded conventional significance levels across all tests. This suggests that we cannot reject the null hypothesis of a unit root, indicating a lack of overall convergence in food price inflation rates. These results highlight persistent disparities in food price inflation across the EU, suggesting that national economic and policy differences outweigh the integrating effects of a single market.

Table 2 reports panel unit root test results incorporating structural breaks. While structural break adjustments improved model specification, the findings remained consistent: we found no evidence of overall food price inflation convergence among EU countries. This highlights the role of country-specific economic structures and policy responses in shaping food price dynamics. Given these results, we proceeded with club convergence analysis to identify potential subgroups exhibiting distinct convergence patterns.

These findings reinforce the necessity of employing the club convergence approach to uncover potential subgroups of countries exhibiting inflation rate convergence behaviour. The lack of overall inflation convergence highlighted by both the standard and structural break-adjusted panel unit root tests indicates that the EU Member States may be converging in smaller clusters rather than as a whole. By identifying these convergence clubs, we can capture the heterogeneous convergence dynamics that aggregate tests might overlook, providing a more subtle understanding of food price convergence within the EU.

4.2 | Club-Convergence

Using the Phillips and Sul (2007) methodology, we first tested for overall convergence and rejected the null hypothesis, confirming that food inflation rates across the EU did not follow a single common trajectory. Next, we applied the clustering algorithm to identify subgroups (convergence clubs) exhibiting similar inflation trends. Initial results identified six clubs, which were refined through sequential merging tests to five final convergence clubs (Table 3 and Figure 2).

TABLE 1 | Results of panel unit root tests.

	Level without trend		Level with trend	
Name	**Statistic**	***p*-value**	**Statistic**	***p*-value**
hs	−1.2778	0.1007	3.0553	0.9989
dh	−0.9363	0.1745	3.5514	0.9998
hmw			14.9647	1.0000

Note: hs: Herwartz and Siedenburg test (2008), dh: Demetrescu and Hanck test (2012), hmw: Herwartz et al. (2018).

Club 1 (Bulgaria, Czechia, Estonia, Germany, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Sweden) showed weak convergence, likely due to a mix of advanced and transitioning economies. Club 1 comprises a mix of economies at varying stages of development. It includes more advanced economies such as Germany and Sweden, as well as catching-up economies like Bulgaria and Romania. Geographically, most of these countries are located in Central and Eastern Europe, sharing similar economic structures and agricultural traditions. Due to its economic weight and substantial trade activity, Germany stands out within this club. Its export-import dynamics facilitate the transmission of food price movements to other club members, helping stabilize prices and enhance resilience to external shocks. For less developed economies within the club, higher Common Agricultural Policy (CAP) subsidies further contribute to price stability and promote convergence.

Club 2 (Croatia, Netherlands, Slovenia, Spain) exhibited moderate convergence, possibly linked to shared economic structures and agricultural markets. Club 2 primarily consists of Mediterranean countries with strong agricultural sectors, serving as net exporters in fruit and vegetable trade. Food industry specialization manifests differently across these countries: the Netherlands stands out with advanced agricultural technologies, Spain is a major exporter of agricultural products, while Slovenia and Croatia play significant roles in regional food market integration. A common characteristic linking these countries is their well-developed logistical infrastructure, facilitating efficient supply chains and contributing to food price stability.

Club 3 (Belgium, Hungary) displayed divergence, reflecting different fiscal policies and market structures. Club 3 appears initially as the most unusual pairing, given that Belgium and Hungary have few obvious similarities. This is likely due to strong localized and country-specific factors influencing food prices. Examining retail market characteristics, Hungary exhibits lower competition levels and higher concentration in food retail markets, whereas Belgium benefits from more stable and established regulatory frameworks. Both countries are significantly exposed to global food price shocks; however, their speed and mechanisms of adjustment differ markedly.

Club 4 (Austria, Denmark, France, Greece, Italy, Luxembourg, Portugal, United Kingdom) showed signs of convergence, potentially influenced by higher levels of market integration. Club 4 countries share a high degree of economic integration, including several of the most developed EU member states. Most of these countries belong to the monetary union, which inherently promotes price stability by eliminating exchange rate risk. Additionally, these countries have well-developed retail sectors complemented by robust competition regulations, further supporting stable and converging food prices across the group.

Club 5 (Cyprus, Finland, Ireland) demonstrated divergence, likely due to distinct economic structures and trade dependencies. Club 5 consists of geographically dispersed countries, each positioned at the EU's periphery. This geographic factor significantly impacts transportation costs, increasing both food prices and price volatility. Finland and Cyprus are net importers of food, heightening

TABLE 2 | Results of panel unit root tests with structural breaks.

	Statistic	Asymptotic critical value	p-value
no trend	0.0005	−1.6449	0.5002
trend	0.0010	−1.6449	0.5004
no trend csd het	-0.0168	−1.6449	0.4933
csd het trend	-0.0107	−1.6449	0.4957

Note: csd: cross-sectional dependence, het: heteroscedasticity.

TABLE 3 | Log t regression results for convergence clubs.

Club(s)	Members	Coefficient	t-statistic
All Countries	EU27 countries and United Kingdom	−1.6638	−11.3301
Initial Clubs			
Club 1	Bulgaria, Estonia, Latvia, Lithuania, Malta, Poland, Romania	0.418	2.583
Club 2	Czechia, Germany, Slovakia, Sweden	0.069	0.238
Club 3	Croatia, Netherlands, Slovenia, Spain	0.308	0.912
Club 4	Belgium, Hungary	−3.977	−1.325
Club 5	Austria, Denmark, France, Greece, Italy, Luxembourg, Portugal, United Kingdom	0.178	1.567
Club 6	Cyprus, Finland, Ireland	−0.355	−1.502
Merged Clubs			
Club 1 + 2	Members of Clubs 1 and 2	−0.118	−0.578
Club 2 + 3	Members of Clubs 2 and 3	−0.638	−16.414
Club 3 + 4	Members of Clubs 3 and 4	−2.419	−7.783
Club 4 + 5	Members of Clubs 4 and 5	−2.064	-10.025
Club 5 + 6	Members of Clubs 5 and 6	−0.838	−4.148
Final Clubs			
Club 1	Bulgaria, Czechia, Estonia, Germany, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Sweden	−0.118	−0.578
Club 2	Croatia, Netherlands, Slovenia, Spain	0.308	0.912
Club 3	Belgium, Hungary	−3.977	−1.325
Club 4	Austria, Denmark, France, Greece, Italy, Luxembourg, Portugal, United Kingdom	0.178	1.567
Club 5	Cyprus, Finland, Ireland	−0.355	−1.502

their exposure to global market fluctuations. In contrast to Finland and Cyprus, Ireland has a highly export-oriented agricultural sector; however, being an island nation, it simultaneously remains heavily dependent on imports, thereby amplifying its sensitivity to international price movements.

These results reveal nuanced convergence patterns within specific groups of countries. The absence of overall convergence highlights the heterogeneity in economic structures, market dynamics, and policy environments affecting food prices across the region. While some clusters of countries exhibit convergence behaviour, others demonstrate divergence, emphasizing the complex interplay of regional factors influencing food inflation rates in the EU27 and the United Kingdom. Understanding these dynamics is crucial for formulating effective agricultural and monetary policies aimed at stabilizing food prices and promoting economic cohesion within the EU.

To supplement the Phillips and Sul (2007) results, we estimated the speed of convergence and half-life of inflation persistence across the final clubs using the Dynamic Common Correlated Effects Mean Group (DCCE-MG) estimator. This approach provides insights into how quickly—and to what extent—food price inflation shocks dissipate within and across each club.

The analysis investigates the speed of convergence and half-life of inflation persistence across the identified convergence clubs using the DCCE-MG estimator. The findings highlight significant heterogeneity in the convergence process across the final clubs.

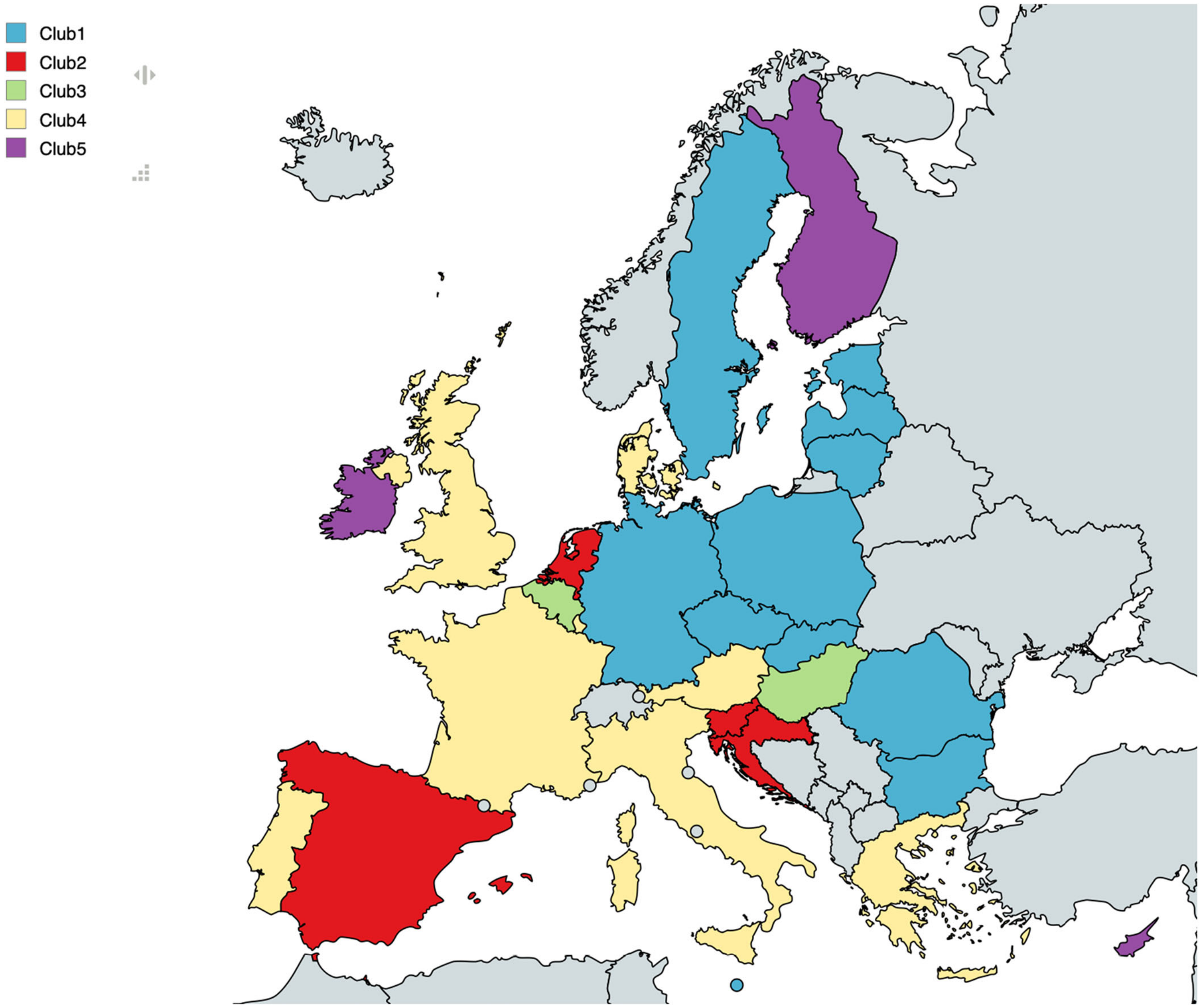

FIGURE 2 | Log t Regression results final clubs of convergence clubs.

For the entire sample, the estimated adjusted speed of convergence is 0.3628 (on a monthly frequency basis), indicating a moderate rate at which inflation persistence dissipates over time. This suggests that shocks to inflation tend to persist but gradually diminish across the entire dataset.

Table 4 summarizes the DCCE-MG estimates for each final club. The speed of convergence (β) and half-life estimates reveal notable variation across clubs: Club 1 exhibits a relatively high speed of convergence (3.865), with a short half-life (0.179 months). Despite its mix of advanced and transitioning economies, members in this club show the capacity for rapid dissipation of inflationary shocks. Club 2 presents a lagged inflation coefficient above unity (1.0197), making the speed of convergence and half-life undefined. This implies potentially explosive behaviour or strong persistence of inflationary shocks, warranting further investigation. Club 3 also shows a coefficient above unity (1.0445), suggesting similarly nonstationary or explosive behaviour in inflation persistence. Club 4 has a speed of convergence of 3.276 and a half-life of 0.212 months, implying moderate mean-reverting inflation. Club 5 displays the highest speed of convergence (4.115) and the shortest half-life (0.168 months), indicating the most rapid reversion to mean among the stable clubs.

TABLE 4 | DCCE-MG estimates for convergence clubs.

Club	Lagged inflation coefficient	Speed of convergence (β_club)	Half-Life (months)
Club 1	0.9790	3.865	0.179
Club 2	1.0197	Undefined	Undefined
Club 3	1.0445	Undefined	Undefined
Club 4	0.9622	3.276	0.212
Club 5	0.9837	4.115	0.168

4.3 | Characteristics of Clubs

Building upon the identification of convergence clubs in the previous section, we more deeply investigate the characteristics and dynamics of these groups to understand the underlying factors influencing food inflation convergence within the EU27 countries and the United Kingdom.

Figure 3 presents the relative transition curves of food price inflation across the identified convergence clubs. The curves illustrate distinct trajectories, reflecting underlying economic structures, policy interventions, and market conditions within each club. Club 1, comprising a mix of transitioning and advanced economies, displays a relatively stable convergence pattern over time. This suggests that despite structural differences, shared market frameworks and EU-wide policies may facilitate gradual inflation alignment. Conversely, Club 3 shows pronounced fluctuations, indicating that external shocks such as commodity price volatility or differential policy responses disrupt inflation convergence.

Figure 4 compares the food price inflation indices across convergence clubs, offering insights into the stability and volatility of inflation trends. Clubs 1 and 4 exhibit relatively smooth inflationary patterns, reflecting stronger policy coordination, robust supply chains, and greater market integration. In contrast, Clubs 3 and 5 display significant volatility, suggesting that these groups face more substantial economic uncertainty and exposure to exogenous shocks. Notably, the post-2020 period reveals inflation spikes across all clubs, underscoring the disruptive effects of the COVID-19 pandemic and global supply chain crises on food price stability. These findings highlight the need for targeted policy interventions to mitigate inflationary pressures, particularly within high-volatility groups.

Figure 5 examines cross-sectional variance in food price inflation indices, providing a measure of internal cohesion within convergence clubs. Clubs 1 and 4 exhibit lower variance, suggesting greater economic alignment and synchronization of price dynamics. This stability is likely facilitated by a combination of common agricultural policies, market structures, and monetary coordination. In contrast, Clubs 3 and 5 show persistently high variance, indicating that inflation trends within these groups remain heterogeneous. This variation suggests that while some countries within these clubs benefit from inflation convergence, others diverge due to country-specific economic conditions, policy responses, or supply chain constraints. The increased variance in the post-COVID period further emphasizes the challenges of maintaining inflation stability in the face of global disruptions.

4.4 | Robustness Tests

We identified structural breaks using the Ditzen et al. (2021) method to further investigate the dynamics influencing food price inflation. Table 5 presents structural breaks identified in food price inflation trends across EU Member States. The results confirm the presence of five significant breakpoints, aligning with major global economic events such as the global financial crisis, the European debt crisis, and the COVID-19 pandemic. These structural breaks indicate that food price inflation trends are highly sensitive to external shocks, disrupting potential convergence patterns and reinforcing divergence across countries. Notably, inflation spikes following these events were unevenly distributed, with countries experiencing different recovery trajectories depending on their economic structures and policy responses. These findings underscore the need for targeted policy interventions that enhance market resilience against external shocks.

Table 6 extends this analysis by examining unit root test results across different economic subperiods. When trends were excluded from the analysis, the results suggest that inflation

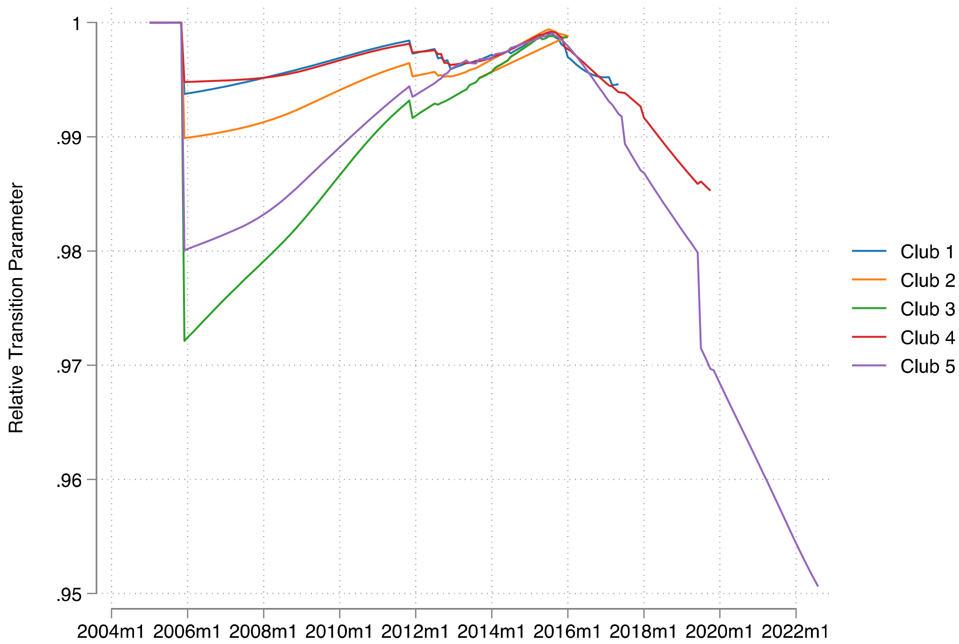

FIGURE 3 | Relative transition curves.

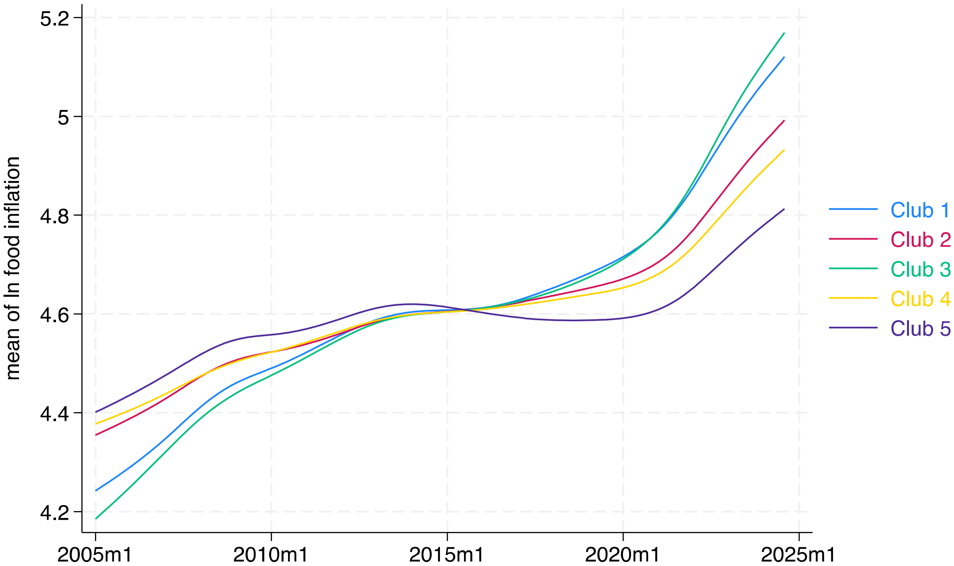

FIGURE 4 | Food price inflation indices for convergence clubs.

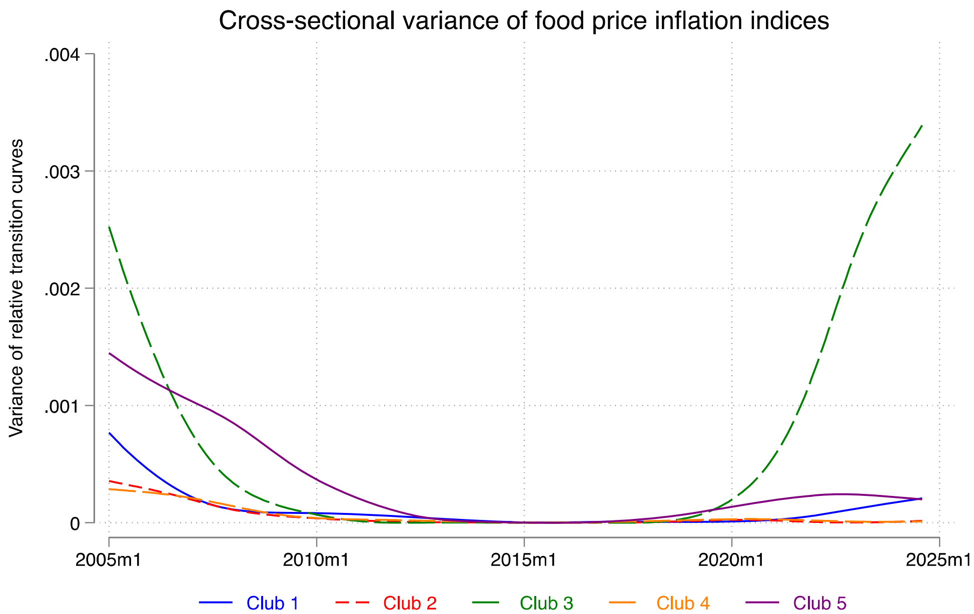

FIGURE 5 | Cross-sectional variance of food price inflation indices according to convergence clubs.

TABLE 5 | Structural breaks test results.

Hypothesis tested	Test statistic	Critical values (1%, 5%, 10%)	Decision
H_0: No breaks versus H_1: 5 breaks	sup W(τ)W(\tau)W(τ) = 5348.43	4.91, 3.91, 3.47	Reject H_0
H_0: 4 breaks versus H_1: 5 breaks	F(s + 1|s)F(s + 1\mid s)F(s + 1|s) = 792.36	15.76, 12.25, 10.58	Reject H_0

Note: Estimated break points are November 2007, December 2010, November 2013, October 2018, and September 2021.

disparities were largely stationary in the short run, particularly in stable periods like the Precrisis and recovery phases. This implies that external shocks did not immediately disrupt underlying inflation dynamics, allowing for temporary convergence. However, when trends were included, the tests revealed stronger divergence in crisis periods such as the financial crisis, the debt crisis, and post-COVID, suggesting that inflation trajectories were increasingly shaped by long-term economic transformations rather than short-term market adjustments. This indicates that food price inflation dynamics require not only immediate policy responses to short-term disruptions but also longer-term structural reforms that address underlying inflationary pressures and economic disparities across EU Member States.

TABLE 6 | Results of panel unit root tests by subperiods (p values).

	Without trends		With trends		
	hs	dh	hs	dh	hmw
Precrisis	0.0002	0.0001	0.8820	0.9099	0.9501
Financial crisis	0.0001	0.0001	0.7369	0.6196	0.7963
Debt crisis	0.0061	0.0045	0.6493	0.8071	0.6136
Recovery	0.0113	0.0388	0.9718	0.9963	0.9953
Pre-Covid	0.0022	0.0044	0.8147	0.8044	0.9616
Post-Covid	0.0012	0.0025	0.8675	0.8990	0.9489

Note: hs: Herwartz and Siedenburg test (2008), dh: Demetrescu and Hanck test (2012), hmw: Herwartz et al. (2018).

To explore how food price inflation convergence evolved over time, we conducted a subperiod analysis (Table 7) covering key economic phases: Precrisis (2005–2007), financial crisis (2008–2010), debt crisis (2010–2013), recovery (2014–2018), pre-COVID (2019–2020), and post-COVID (2021–2024).

During the precrisis period, food price inflation showed weak signs of convergence, suggesting that economic stability and trade liberalization efforts within the EU facilitated a gradual alignment of food prices. However, this trend was disrupted during the financial crisis, where inflation divergence became apparent due to the uneven economic impact across Member States. Countries with more resilient economies managed to stabilize inflation, while others experienced severe inflationary shocks due to currency depreciation, financial instability, and weakened consumer demand.

The European debt crisis saw a mixed pattern, with marginal convergence emerging as some countries implemented austerity measures and structural reforms. However, inflation remained highly sensitive to national fiscal policies, leading to fragmented convergence dynamics. The recovery period (2014–2018) brought further differentiation among Member States, with some countries benefiting from economic stabilization and improved market integration, while others struggled with persistent inflationary pressures due to structural inefficiencies and reliance on external food imports.

The pre-COVID period (2019–2020) exhibited continued fragmentation, with country-specific inflation trajectories becoming more pronounced. Structural factors such as differences in food supply chain resilience, agricultural productivity, and market access contributed to this heterogeneity. The post-COVID period (2021–2024) reinforced these divergences, with inflation spikes observed across all convergence clubs. The sharp inflationary pressures in this period can be attributed to supply chain disruptions, rising input costs, and economic recovery efforts that varied significantly among Member States.

Overall, the analysis of economic phases highlights the complexity of food price inflation convergence in the EU. While periods of economic stability foster temporary alignment, external shocks and structural disparities drive persistent divergence. These findings emphasize the need for adaptive policy measures that address both short-term inflation volatility and long-term structural imbalances in the food market.

5 | Conclusions

Our analysis set out to test a fundamental promise of European integration: that the Single Market, the CAP and the euro would eventually deliver a common trajectory for retail food-price inflation. By applying break-robust panel tests, Phillips–Sul club detection and DCCE-MG estimation to two decades of monthly HICP-food data, we have shown that this promise remains only partially fulfilled. Inflation does not coalesce around a single path; instead, it splinters into five distinct convergence clubs whose composition shifts whenever shocks alter logistics costs, market power or policy settings.

The persistence and time-variability of these clubs suggest that the cost of arbitrage is neither uniform across Member States nor constant over time. Periods of relative calm allow some borders to blur, while crises—whether financial, viral or geopolitical—thicken them again. The result is a patchwork of price-inflation blocs that wax and wane with the wider macro context, mirroring the uneven geography of transport bottlenecks, retail concentration and indirect-tax regimes.

These findings broaden the literature in two ways. First, they provide the first EU-wide, time-resolved map of club convergence in food-price inflation, thereby linking aggregate inflation patterns to the underlying structure of European food supply chains. Second, they underscore the political-economy insight that formal market integration is a necessary but insufficient condition for economic convergence; the frictions that survive integration—whether rooted in infrastructure, regulation or market structure—continue to shape outcomes long after treaties are signed.

For consumers, the continued existence of multiple clubs means that purchasing power diverges across borders in ways that cannot be explained solely by differences in income. For agribusiness firms, club boundaries mark where a uniform pricing strategy is feasible and where local conditions still warrant price differentiation. And for EU policy-makers, our results point to a concrete agenda: to invest in cross-border logistics, harmonise VAT and packaging rules, and keep a watchful eye on retail concentration if the economic reality is to match the legal architecture of the Single Market.

The study has its limits. National averages mask within-country heterogeneity; our econometric approach traces co-movement

TABLE 7 | Final clubs by subperiod.

Precrisis 2005–2007		**Coeff.**	***t*-statistic**
Club1	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom	0.199	3.452
Club2*	Ireland, Malta, Portugal	3.452	−29.96
Financial Crisis 2008–2010			
Club1	Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom	−0.064	−1.288
Club2*	Czechia	—	—
Debt Crisis 2010–2013			
Club1	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom	0.077	1.474
Recovery 2014–2018			
Club1	Estonia, Latvia	1.11	1.001
Club2	Czechia, Germany, Hungary, Lithuania, Malta, Poland, Sweden	−0.172	−1.214
Club3	Belgium, Netherlands, Slovakia	−0.914	−0.608
Club4	Austria, Spain	−1.031	−0.885
Club5	France, Italy	1.248	1.733
Club6	Croatia, Romania	−0.832	−0.944
Club7	Cyprus, United Kingdom	0.721	0.7
Club8	Finland, Greece	−1.451	−1.402
Club9*	Bulgaria, Denmark, Ireland, Luxembourg, Portugal, Slovenia	−4.635	−8.208
Pre-Covid (2019–2020)			
Club1	Estonia, Romania	0.328	0.282
Club2	Czechia, Latvia, Lithuania	0.194	2.839
Club3	Malta, Slovakia	1.142	0.578
Club4	Germany, Luxembourg, Sweden	0.009	0.037
Club5	Netherlands, Slovenia	0.615	0.517
Club6	Austria, Spain	2.023	1.498
Club7	Croatia, Denmark, Italy, Portugal	0.034	0.646
Club8	Cyprus, Finland, Greece, United Kingdom	0.202	3.176
Club9*	Belgium, Bulgaria, France, Hungary, Ireland, Poland	−1.461	−544.374
Post-Covid 2021–2024			
Club1	Bulgaria, Estonia, Lithuania, Slovakia	0.237	3.968
Club2	Latvia, Poland	0.392	0.799
Club3	Croatia, Czechia, Germany, Malta, Spain, Sweden	−0.036	−0.545
Club4	Austria, Belgium, France, Greece, Luxembourg, Netherlands, Portugal, United Kingdom	−0.037	−1.264
Club5	Denmark, Italy	3.398	3.317
Club6	Cyprus, Finland	0.685	0.688
Club7*	Hungary, Ireland, Romania, Slovenia	−1.104	−88.285

Note: * denotes not-convergent clubs.

but not causality; and the sample ends in December 2024, excluding the policy reforms and shocks that surely lie ahead. Future work can close these gaps by exploiting store-level scanner data, estimating structural models that decompose adjustment costs, and examining how emerging threats such as climate-induced yield shocks propagate through the inflation clubs we have identified.

Taken together, the evidence paints a picture of European food markets as a mosaic rather than a monolith—islands of convergence separated by stubborn, if shifting, frictions. Bridging those islands will require targeted policy and strategic investment, but the payoff—greater price stability, fairer consumer outcomes and a more resilient food system—goes to the heart of the European project.

Ethics Statement

The authors have nothing to report.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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