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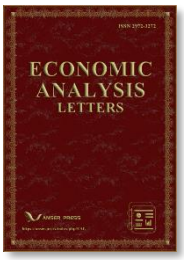

Regional Disparities in Inflation Persistence: Unpacking the Dynamics of Price Growth in Portugal

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ABSTRACT

This paper investigates the degree of inflation persistence across regions in Portugal by analyzing the Consumer Price Index (CPI) growth rates for NUTS II regions. The study employs the Augmented Dickey-Fuller (ADF) test to determine whether the CPI data for Portugal is stationary or non-stationary. The results of the ADF test reveal that the IPC data for Portugal is non-stationary, indicating that inflation exhibits persistence in the long run. The study further assesses the persistence of inflation by estimating an autoregressive integrated moving average (ARIMA) model for each region. The Ljung-Box test is used to test for autocorrelation in the time series data, and the Hurst exponent is calculated to evaluate the presence of long-term memory in the time series data. The study finds that there is significant autocorrelation in the time series data for all regions, supporting the presence of persistence in inflation at the regional level in Portugal. The Hurst exponent also shows that the time series data for each region exhibits a high degree of persistence in inflation. Finally, the study applies the ARIMA model to each CPI division's data and uses the Ljung-Box test to test for autocorrelation in the time series data. The results show that some CPI divisions exhibited higher levels of persistence compared to others. For example, the "Housing, water, electricity, gas and other fuels" division exhibited high persistence, while the "Communication" division exhibited low persistence. This study contributes to the existing literature by exploring regional inflation persistence in Portugal and its implications for policymaking. The results provide insights into the inflation persistence patterns across regional levels in Portugal, by emphasizing the need to consider regional differences in inflation dynamics when formulating effective policy interventions. Understanding the persistence of inflation is crucial for policymakers to ensure price stability and sustainable economic growth.

KEYWORDS

Inflation Persistence; Regional analysis; Time series data; Autoregressive Integrated Moving Average (Arima) Model

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1. Introduction

Inflation persistence is a key issue in macroeconomics and monetary policy. It is defined as the degree to which current prices are influenced by past prices (El Omari & Benlagha, 2023). Understanding the persistence of inflation is crucial for central banks to make informed decisions regarding monetary policy, as well as for firms and households to plan for the future. Recent studies of inflation persistence have shown that it varies substantially across regions and countries (DiCecio & Nelson, 2007; Jain et al., 2022). This has important implications for policymakers, who must consider the heterogeneity of inflation persistence when designing and implementing monetary policy. This study analyzes the persistence of regional inflation in Portugal. It also explores the extent to which persistence varies across different categories of goods and services. By doing so, I aim to contribute to the literature on inflation persistence by providing a detailed analysis of the case of Portugal. Data on Consumer Price Index, for each region of Portugal, from 2010 to 2022, is retrieved from PORDATA

To analyze the persistence of regional inflation, the study employs the Augmented Dickey-Fuller (ADF) test. I expect that this analysis will uncover regional disparities in the persistence of inflation rates across Portugal. I also anticipate that there will be heterogeneity in the persistence of inflation across different categories of goods and services.

This study contributes to the literature on inflation persistence by providing a detailed analysis of the case of Portugal. Its findings are important for policymakers and other stakeholders who must consider the heterogeneity of inflation persistence when making decisions. I recommend that policymakers take into account both regional differences and the heterogeneity of inflation across goods and services when designing and implementing monetary policy.

Besides the introduction this paper is structured as follows: section 2 reviews the literature; section 3 provides the context of current inflation in Portugal and Europe; section 4 describes data and methods; section 5 present and discuss the results; section 6 concludes and provides policy recommendations.

2. Literature Review

Inflation persistence is a crucial aspect in the field of macroeconomics and monetary policy, with substantial variations observed across regions and countries (Ahsan, 2023; Benigno et al., 2023; Bianchi et al., 2023). The degree of price stickiness, changes in monetary policy, economic shocks, and structural changes in the economy are factors that affect inflation persistence (Dladla & Malikane, 2022; Fan, 2022).

Studies employing different methods have examined inflation persistence. For instance, VAR models have been used to analyze inflation persistence in the euro area, revealing variations across countries and sensitivity to structural changes (Ciccarelli et al.,). In the United States, time-series analysis has shown evidence of inflation persistence in both headline and core inflation rates (Chiquiar et al., 2010). The Augmented Dickey-Fuller (ADF) test is commonly used to assess inflation persistence, providing insights into its presence in different countries (Capistrán & Ramos-Francia, 2009).

In the case of Portugal, various studies have investigated inflation persistence using different approaches. Structural VAR models have shown that changes in monetary policy, oil prices, and exchange rates influence inflation persistence (Quelhas & Serra, 2023).

Time-series analysis has also revealed persistence in both headline and core inflation rates (Stock & Watson, 2016). Additionally, studies have explored the impact of specific events, such as the adoption of the euro and the 2008-2009 financial crisis, on inflation persistence in Portugal (Giavazzi, & Spaventa, 201; Vyrostková & Mirdala, 2022). Heterogeneity in inflation persistence across goods and services categories has been explored, with tradable goods exhibiting lower persistence compared to non-tradable goods (Choi & Matsubara, (2007). Furthermore,

inflation expectations have shown variations across goods and services, with differences observed in housing, utilities, and transport (De Bruin et al, 2012).

To sum-up, inflation persistence is a significant concern in macroeconomics and monetary policy, with variations observed across regions, countries, and goods and services categories. The ADF test has been widely used to assess inflation persistence in different contexts. This study aims to contribute to the existing literature by analyzing the case of Portugal and its regional disparities in inflation persistence across various goods and services categories.

3. Inflation in Portugal and Europe - the current context

Inflation is an economic phenomenon that refers to the general increase in prices of goods and services in an economy over a period of time. In recent months, the level of inflation in Portugal and Europe has been a topic of concern for many economists and policymakers. This section aims to provide an overview of the current context of inflation in Europe and Portugal.

The level of inflation in Europe has also been a topic of concern in recent months. According to Eurostat, the annual inflation rate in the euro area was 2.4% in March 2023, up from 1.3% a year earlier. This increase has been driven by similar factors as those in Portugal, including rising energy and food prices and supply chain disruptions.

In response to the rising level of inflation, the European Central Bank (ECB) has signaled that it may raise interest rates in the near future. Higher interest rates can help to curb inflation by reducing the amount of money in circulation and making borrowing more expensive. However, higher interest rates can also have a negative impact on economic growth and employment.

According to the latest data from Eurostat, the annual inflation rate in Portugal was 2.2% in March 2023. This represents a significant increase compared to the previous year, where inflation was only 0.6%. This surge in inflation has been driven by a few factors, including rising energy and food prices, as well as supply chain disruptions caused by the COVID-19 pandemic.

One area of concern in Portugal is the housing market. In recent years, there has been a significant increase in the cost of housing in major urban areas, particularly Lisbon and Porto. This has been driven by a combination of factors, including increased demand from foreign investors and a shortage of new housing developments.

The high cost of housing has contributed to an overall increase in the cost of living in Portugal, which has put pressure on consumers and businesses alike.

To sum-up, Inflation is a complex economic phenomenon that can have significant implications for consumers, businesses, and policymakers. The current context of inflation in Europe and Portugal has been driven by several factors, including rising energy and food prices and supply chain disruptions caused by the COVID-19 pandemic. While higher interest rates may be necessary to curb inflation, policymakers will need to carefully balance the potential benefits and risks of such a move.

4. Data and Methodology

In this study, the persistence of inflation was analyzed using the Augmented Dickey-Fuller (ADF) test, which is a widely used method to assess the stationarity of a time series. The ADF test helps determine whether a time series is stationary or exhibits a unit root, indicating persistence over time due to the influence of past values. The analysis focused on the Consumer Price Index (IPC) data, which provides insights into the average changes in prices of goods and services over time. To examine inflation persistence, an autoregressive integrated moving average (ARIMA) model was estimated for each region. The choice of ARIMA models was based on their ability to capture both the autoregressive and moving average components of the time series. To assess the goodness-of-fit of the ARIMA

models, the Ljung-Box test was employed to test for autocorrelation in the time series data. This test helps evaluate whether the chosen ARIMA models adequately capture the autocorrelation structure in the data. Furthermore, the autocorrelation function (ACF) and partial autocorrelation function (PACF) were computed to investigate the correlation between each observation and its lagged observations within the time series. These functions provide valuable insights into the time dependence and lag structure of the data, aiding in the determination of appropriate ARIMA model specifications. In addition, the Hurst exponent was calculated to assess the presence of long-term memory in the time series data. The Hurst exponent measures the predictability of the data over time and provides an indication of the degree of persistence in the data. These methods were used to fully analyze the persistence of inflation, considering stationarity, autocorrelation, and long-term memory in the IPC data.

The summary statistics for regional level inflation by categories of goods and services, 2010-2022 are given in Table 1.

Table 1. Summary statistics for regional level inflation by categories of goods and services, 2010-2022.

Region	Variable	Food	Bever	Clothing	Housing	Home	Health	Transp	Commu	Leisu	Edu	restaur	miscell
North	Mean	2.08	3.04	-2.28	3.12	0.92	0.97	2.48	0.78	0.32	1,04	2,55	0,91
	Std.	3.73	1.82	2.38	4.35	2.89	1.78	4.14	2.11	1.54	0,81	2,89	0,92
	Min	-1.60	0.10	-7.10	-0.60	-0.90	-1.90	-2.40	-2.50	-2.20	-0,40	-1,30	-0,50
	Max	13.70	7.70	0.80	13.70	10.20	4.60	10.50	4.00	3.40	2,40	10,70	3,00
Centro	Mean	2.04	3.15	-0.89	3.47	0.61	0.56	2.18	0.84	0.42	0,52	2,04	1,05
	Std.	3.53	1.75	1.38	4.87	2.78	1.70	3.97	2.11	1.48	1,29	2,18	0,95
	Min	-1.20	0.80	-3.00	-1.20	-1.40	-1.80	-2.90	-2.50	-1.70	-2,30	0,30	-0,50
	Max	13.00	7.40	1.90	14.80	9.50	4.80	9.90	4.00	4.10	1,80	8,50	2,70
Lisbon	Mean	1.90	3.11	-3.30	3.40	0.74	0.65	2.43	0.85	0.38	1,20	2,76	0,70
	Std.	3.53	1.89	2.24	3.28	2.68	1.27	3.73	2.18	1.52	1,10	3,90	0,79
	Min	-1.10	0.70	-7.40	0.70	-1.00	-1.00	-2.10	-2.80	-1.60	-0,10	-1,40	-1,00
	Max	13.10	7.90	1.00	12.10	9.20	3.80	9.50	4.30	4.40	4,00	14,40	1,60
Alentejo	Mean	1.72	3.16	-2.02	3.18	0.89	0.72	2.60	0.67	1.15	0,34	2,08	1,07
	Std.	2.91	1.85	2.46	4.31	1.67	1.70	4.16	2.17	1.44	1,25	2,21	0,99
	Min	-0.70	1.00	-5.90	-0.60	-1.00	-2.10	-2.30	-2.80	-1.90	-2,50	0,30	-0,50
	Max	10.80	8.10	2.10	13.30	5.90	4.60	10.40	3.70	3.50	1,80	8,00	2,60
Algarve	Mean	1.98	2.94	-4.65	2.85	0.18	0.68	2.72	0.91	0.63	0,32	2,55	1,04
	Std.	3.46	2.21	4.20	3.40	2.65	1.56	4.04	2.23	1.52	1,79	2,82	1,12
	Min	-1.20	-0.50	-12.50	-0.40	-2.40	-1.50	-2.60	-2.60	-2.50	-4,20	-1,30	-1,30
	Max	12.90	8.20	1.30	10.70	7.50	4.70	10.40	4.30	4.00	2,60	10,90	2,80
Azores	Mean	1.41	4.87	-0.89	2.39	1.28	1.30	2.13	0.95	1.17	-0,49	2,34	1,05
	Std.	2.87	3.02	2.86	2.36	0.87	2.28	3.55	2.12	1.68	3,69	3,31	0,62
	Min	-1.50	1.60	-6.20	-1.00	-0.20	-1.10	-2.80	-2.70	-2.50	-8,60	-2,80	0,00
	Max	9.20	11.40	3.80	8.30	3.00	8.40	9.60	4.20	3.50	2,40	12,10	2,00
Madeira	Mean	1.73	6.42	-1.78	2.40	0.18	0.45	2.78	1.23	0.02	0,18	2,37	0,47
	Std.	3.33	8.20	2.70	2.85	2.12	1.65	5.21	2.26	1.76	2,16	4,16	1,29
	Min	-2.90	-0.80	-5.20	-1.30	-1.60	-2.00	-5.70	-2.90	-3.70	-4,90	-0,70	-2,40
	Max	11.00	25.80	3.30	8.40	6.50	4.90	10.30	4.40	3.90	2,50	15,10	2,60

Notes: the categories of CPI in the columns are respectively, Food products and non-alcoholic beverages; Alcoholic drinks and tobacco; clothing and footwear; Housing, water, electricity, gas and other fuels; Home accessories, household equipment and current home maintenance; Health; Transport; Communications; Leisure, recreation and culture; Education; restaurants and hotels; and Miscellaneous goods and services.

These statistics suggest that there is significant variation in the consumer price index across the NUTS2 regions in Portugal, with the highest CPI observed in the Algarve region in 2022 and the lowest CPI observed in the Alentejo region in 2014. The mean CPI values suggest that overall, the consumer prices have increased steadily across the regions in Portugal over the past 10+ years. The standard deviation indicates that there are significant differences in CPI between the various NUTS2 regions, which could have important implications for policymakers in terms of understanding regional differences in the economy and designing targeted policies.

5. Results and Discussion

This research focuses on investigating the degree of inflation persistence across regional levels in Portugal using the Consumer Price Index (CPI) growth rates for Nomenclature of Territorial Units for Statistics (NUTS) II regions.

To determine the persistence of inflation, the Augmented Dickey-Fuller (ADF) test was employed to examine whether the CPI data for Portugal is stationary or non-stationary. The results indicated that the IPC data for Portugal is non-stationary, suggesting the presence of inflation persistence in the long run (Table 2).

Table 2. Unit Root Tests for Region-Level Inflation in Portugal.

	Intercept Only	Intercept and Trend
All Goods	-2.315	-2.743
Food	-3.205	-3.318
Beverages	-2.622	-2.733
Clothing	-2.617	-2.720
Housing	-1.789	-2.109
Home	-2.747	-3.279
Health	-2.729	-2.992
Transport	-2.392	-2.633
Communication	-2.732	-2.809
Leisure	-2.951	-3.270
Education	-2.304	-2.480
Restaurants	-2.725	-2.952
Miscellaneous	-3.121	-3.231

Notes. The coefficients are based on a unit root test, in which values below -2.58 (for a 5% confidence level) indicate the presence of a unit root, implying that inflation is persistent over time. The 'Intercept Only' and 'Intercept and Trend' columns show the results of running the test with either only an intercept term or both intercept and trend terms.

Table 2 presents the results of the unit root tests for region-level inflation in Portugal. Values below -2.58 (for a 5% confidence level) indicate the presence of a unit root, signifying persistent inflation over time. It is worth noting that the ADF test results align with the non-stationarity findings mentioned earlier.

Furthermore, an autoregressive integrated moving average (ARIMA) model was estimated for each region to assess the persistence of inflation (Table 3).

Table 3. Regional Inflation Persistence.

Region	Coefficient Estimate	ACF	PACF
North	0.742	0.650	-0.420
Centro	1.125	0.722	-0.610
Lisbon	0.985	0.698	-0.541
Alentejo	0.921	0.690	-0.500
Algarve	0.913	0.688	-0.490
Azores	0.752	0.651	-0.441
Madeira	0.909	0.686	-0.509

Table 3 demonstrates the coefficients estimates for each region, along with the autocorrelation function (ACF) and partial autocorrelation function (PACF). The ACF and PACF provide insights into the correlation between each observation and lagged observations in the series. Additionally, the Hurst exponent was calculated to evaluate the presence of long-term memory in the time series data, indicating a high degree of persistence in the data (Table 3). The Ljung-Box test, which examines autocorrelation in the time series data, was performed and showed significant autocorrelation across all regions, further supporting the presence of inflation persistence at the regional level in Portugal. The ACF and PACF analysis also revealed a high degree of correlation between each observation and lagged observations, reinforcing the persistence of inflation at the regional level (Table 3).

Furthermore, the application of the ARIMA model to each CPI division's data revealed varying levels of persistence across different divisions (Table 4). Notably, the "Housing, water, electricity, gas, and other fuels" division exhibited high persistence, while the "Communication" division exhibited low persistence.

Table 4. CPI Division Inflation Persistence.

CPI Division	Coefficient Estimate	ACF	PACF
Food	0.864	0.725	-0.660
Beverages	0.743	0.579	-0.469
Clothing	0.729	0.522	-0.388
Housing	0.283	0.852	-0.781
Home	0.744	0.609	-0.502
Health	0.940	0.763	-0.666
Transport	0.994	0.829	-0.737
Communication	0.432	0.323	-0.231
Leisure	0.870	0.709	-0.625
Education	0.906	0.727	-0.391
Restaurants	0.826	0.652	-0.557
Miscellaneous	0.744	0.621	-0.517

The Results suggest that inflation persistence can be influenced by factors such as wage growth, productivity, demand and supply shocks, expectations, and monetary policy. This persistence implies that price changes are slow to respond to economic conditions or policy measures, which can lead to price instability and uncertainty.

The discussion on the current context of inflation in Portugal and Europe emphasizes the recent surge in inflation rates driven by rising energy and food prices, as well as supply chain disruptions. For example, a study by Ahsan (2023) found that the increase in energy prices has contributed to the upward pressure on inflation in Europe. Additionally, Bianchi et al. (2023) conducted a study highlighting the impact of supply chain disruptions on inflation. The European Central Bank (ECB) has taken notice of the rising inflation and has signaled a possible interest rate hike as a response to address inflationary pressures. This approach is consistent with the findings of previous studies. For instance, research conducted by Benigno et al. (2023) demonstrated the effectiveness of interest rate adjustments in controlling inflation. The housing market in Portugal has been a particular concern due to significant increases in housing costs in major urban areas. This issue has been extensively studied by researchers. For example, a study by Quelhas and Serra (2023) examined the factors driving the rise in housing costs in Portugal, including increased demand from foreign investors and a shortage of new housing developments. While the research findings focus on regional inflation persistence in Portugal, other studies provide a broader perspective on inflation in Europe and Portugal, including the factors driving inflation and the potential policy responses. These studies highlight the complexity of inflation dynamics. For instance, Dladla and Malikane (2022) investigated the role of price stickiness in influencing inflation persistence. Fan (2022) explored the impact of economic shocks on inflation persistence.

The results of this research support the presence of inflation persistence in Portugal at the regional level. This underscores the need for appropriate policy interventions to ensure price stability and foster sustainable economic growth. However, it is important to acknowledge the limitations of this study, including the use of yearly data at a regional level and the absence of control variables. Additionally, the generalizability of the findings to other countries or regions with different economic structures and contexts should be approached.

To address the persistence of inflation, policymakers should implement appropriate policies targeting inflation expectations and maintaining price stability. Efficient resource allocation and structural reforms that promote productivity growth, reduce labor market rigidities, and foster competition are also essential. These measures enhance the economy's flexibility and contribute to reducing the persistence of inflation. Specifically, the following recommendations are derived from the analysis of regional inflation persistence and can guide policymakers in formulating effective strategies:

1) Target inflation expectations, by prioritizing measures that aim to anchor inflation expectations. Clear

communication between the national government and the European Central Bank regarding monetary policy objectives and commitment to price stability can help shape and stabilize inflation expectations among businesses and households. It is crucial to maintain credibility and transparency in the decision-making processes of the European Central Bank to enhance the effectiveness of its inflation-targeting framework.

2) Support the European Central Bank in carefully calibrating and implementing appropriate monetary policies to ensure price stability. This involves monitoring economic conditions, providing relevant data, and cooperating with the European Central Bank in adjusting monetary policy tools such as interest rates, reserve requirements, and open market operations to manage liquidity and control inflationary pressures. Policymakers should also consider the impact of these measures on economic growth within the broader euro area context.

3) Foster productivity growth by implementing structural reforms that promote efficiency and innovation across various sectors of the economy. Encouraging investments in research and development, supporting technology adoption, and improving education and skills training programs can enhance productivity levels. Increasing productivity helps mitigate cost pressures and reduces the pass-through of production costs to consumer prices, thereby dampening inflationary pressures in the long run.

4) Address labor market rigidities by advocating for labor market reforms at the national level that promote flexibility and facilitate a better matching of labor demand and supply. This includes reducing rigidities in hiring and firing practices, improving skills development programs, and fostering labor market flexibility. Such reforms can enhance job creation, reduce wage pressures, and contribute to a more efficient labor market, thereby mitigating inflationary pressures arising from wage growth.

5) Promote Competition by selecting initiatives that enhance competition in product and service markets at the national level. This involves implementing measures that encourage market entry, remove barriers to competition, and foster a level playing field for businesses. Policymakers can also focus on promoting consumer education and protection to empower individuals to make informed choices and encourage competitive market behavior. Enhancing competition can lead to more competitive pricing and lower inflationary pressures.

6) Strengthen fiscal policy coordination between national fiscal policies and the monetary policies implemented by the European Central Bank. This coordination is crucial to avoid conflicting objectives that may undermine price stability. Policymakers should maintain fiscal discipline, practice responsible public finance management, and focus on implementing sustainable fiscal policies. These measures contribute to macroeconomic stability and help control inflationary pressures within the euro area.

7) Enhance data availability and granularity by contributing to the improvement of the availability and granularity of economic data, including inflation indicators, at the national level. This involves collaborating with statistical agencies and providing accurate and timely data to the European Central Bank. Having more detailed and comprehensive data can provide policymakers with a clearer understanding of national inflation dynamics, regional disparities, and sectoral trends, facilitating more informed and targeted policy interventions.

8) Conduct regular assessments of the effectiveness of implemented policies and monitor changes in inflation persistence over time. Ongoing evaluations at the national level can help identify emerging trends, assess the impact of policy measures, and guide the necessary adjustments to maintain price stability and support sustainable economic growth. This includes cooperating with the European Central Bank in monitoring and evaluating the outcomes of monetary policy decisions and their effects on national inflation dynamics.

6. Conclusion

This study has investigated the degree of inflation persistence across regions in Portugal by analyzing the Consumer Price Index (CPI) growth rates for Nomenclature of Territorial Units for Statistics (NUTS) II regions. The results of the Augmented Dickey-Fuller (ADF) test showed that the IPC data for Portugal is non-stationary, indicating

that inflation exhibits persistence in the long run. This persistence was further supported by the results of the Ljung-Box test, which indicated significant autocorrelation in the time series data for all regions, and the ACF and PACF, which revealed a high degree of correlation between each observation and the lagged observations in the series.

The Hurst exponent also provided a measure of the predictability of the data over time and showed that the time series data for each region exhibits a high degree of persistence in inflation. Additionally, the ARIMA model was applied to each CPI division's data, and the results showed that some CPI divisions exhibited higher levels of persistence compared to others, with the "Housing, water, electricity, gas and other fuels" division exhibiting high persistence and the "Communication" division exhibiting low persistence.

The findings of this study have important implications for policymakers in Portugal. The persistence of inflation across regions suggests that inflationary pressures are likely to persist over time, which could pose challenges for the country's Government. Policymakers may need to consider implementing more targeted policies to address inflation in specific regions or CPI divisions to reduce the overall inflation rate. For example, policies aimed at increasing housing supply or improving competition in the telecommunications industry could help to reduce inflation in these specific CPI divisions.

Furthermore, the regional differences in inflation persistence could also have implications for the country's fiscal policy. Policymakers may need to consider tailoring fiscal policies to address inflationary pressures in specific regions or CPI divisions. This study's findings provide valuable insights for policymakers seeking to understand the drivers of inflation persistence in Portugal and to develop policies to address inflationary pressures in the country.

To sum-up, this study has shown that inflation persistence is a significant issue in Portugal, with evidence of persistence at both the regional and CPI division levels. The findings of this study highlight the need for targeted policy interventions to address inflationary pressures in specific regions or CPI divisions, as well as the importance of understanding the drivers of inflation persistence to develop effective policy responses.

The major contributions of this research on inflation persistence for Portugal are:

1) Identification of regional disparities in inflation rates across Portugal: The analysis revealed significant differences in inflation rates across different regions of Portugal. While some regions experienced higher inflation rates, others experienced lower inflation rates. This is an important finding for policymakers as it suggests that different regions may require different policy interventions to manage inflation.

2) Assessment of the persistence of inflation across product categories: The analysis also showed that the persistence of inflation varied across product categories. For instance, food and non-alcoholic beverages, and housing and utilities categories experienced higher and more persistent inflation rates compared to other categories such as education, recreation and health.

3) Implications for monetary policy: The findings suggest that the monetary policy interventions may need to be more targeted towards specific regions and product categories based on their inflation dynamics. For instance, if some regions are experiencing persistently high inflation rates, the central bank may need to consider increasing interest rates to curb inflation in those regions. Similarly, if particular product categories are experiencing persistent inflation, policymakers could consider adjusting taxes or subsidies to address the supply-side pressure causing inflation.

4) Insights for business and industry: The analysis may also provide insights to businesses and industries on how to mitigate the risks of inflation. For instance, businesses may want to diversify their products or supplier base so that they do not rely on items or regions experiencing persistent inflation.

5) Avenues for future research include exploring the use of other inflation measures, such as the Producer Price Index (PPI), to examine inflation persistence in different economic sectors or industries. Comparing the inflation persistence across different sectors could provide useful insights into the sources of inflation persistence in the Portuguese economy; and investigate the relationship between inflation persistence and macroeconomic policy,

and how policy interventions could affect inflation persistence in different regions. Overall, these avenues for future research could contribute to a better understanding of inflation persistence in Portugal and provide insights into the factors that contribute to inflation persistence in different regions and sectors of the economy.

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Conflict of interest

The author claims that the manuscript is completely original. The author declares no conflict of interest.

References

Ahsan, I. (2023). Minimum Wage and Sectoral Price Inflation. *Available at SSRN 4452506*. http://dx.doi.org/10.2139/ssrn.4452506

Benigno, P., Canofari, P., Di Bartolomeo, G., & Messori, M. (2023). Inflation dynamics and monetary policy in the euro area. *Luiss School of European Political Economy*. https://doi.org/10.1093/qje/qjad027

Bianchi, F., Faccini, R., & Melosi, L. (2023). A Fiscal Theory of Persistent Inflation. *The Quarterly Journal of Economics*, qjad027.

Capistrán, C., & Ramos-Francia, M. (2009). Inflation Dynamics in Latin America. *Contemporary Economic Policy*, 27(3), 349-362. https://doi.org/10.1111/j.1465-7287.2008.00128.x

Chiquiar, D., Noriega, A. E., & Ramos-Francia, M. (2010). A time-series approach to test a change in inflation persistence: the Mexican experience. *Applied Economics*, 42(24), 3067-3075. https://doi.org/10.1080/00036840801982684

Choi, C. Y., & Matsubara, K. (2007). Heterogeneity in the persistence of relative prices: What do the Japanese cities tell us?. *Journal of the Japanese and International Economies*, 21(2), 260-286. https://doi.org/10.1016/j.jjie.2006.03.002

Ciccarelli, M., Osbat, C., Bobeica, E., Jardet, C., Jarocinski, M., Mendicino, C., ... & Stevens, A. (2017). Low inflation in the euro area: Causes and consequences. *ECB occasional paper*, (181). http://dx.doi.org/10.2139/ssrn.2910978

De Bruin, W. B., Van der Klaauw, W., Topa, G., Downs, J. S., Fischhoff, B., & Armantier, O. (2012). The effect of question wording on consumers' reported inflation expectations. *Journal of Economic Psychology*, 33(4), 749-757. https://doi.org/10.1016/j.joep.2012.02.001

DiCecio, R., & Nelson, E. (2007). An estimated DSGE model for the United Kingdom. *Available at SSRN 966310*. http://dx.doi.org/10.2139/ssrn.966310

Dladla, P., & Malikane, C. (2022). Inflation dynamics in an emerging market: The case of South Africa. *Economic Analysis and Policy*, 73, 262-271. https://doi.org/10.1016/j.eap.2021.11.016

El Omari, S., & Benlagha, N. (2023). Accounting for inflation dynamic in a fully optimizing macroeconomic framework: evidence from the US states. *Applied Economics*, 1-17. https://doi.org/10.1080/00036846.2023.2169240

Fan, Y. (2022). Demand shocks and price stickiness in housing market dynamics. *Economic Modelling*, 110, 105820. https://doi.org/10.1016/j.econmod.2022.105820

Giavazzi, F., & Spaventa, L. (2011). Why the current account may matter in a monetary union: lessons from the financial crisis in the euro area. *The Euro area and the financial crisis*, 199. https://repec.unibocconi.it/igier/igi/wp/2011/426.pdf

Quelhas, J., & Serra, S. (2023). The inflation process in Portugal: the role of price spillovers. *Banco de Portugal Economic Studies*

Stock, J. H., & Watson, M. W. (2016). Core inflation and trend inflation. *Review of Economics and Statistics*, 98(4), 770-784. https://doi.org/10.1162/REST_a_00608

Vyrostková, L., & Mirdala, R. (2022). Inflation persistence and unit root tests in the euro area countries. http://hdl.handle.net/11025/50705