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INFLATION AND PANDEMIC IN SPAIN

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Title: Inflation and pandemic in Spain

Abstract:

This paper shows what the main inflation macroeconomics drivers in Spain are. Even if there has been a less than two-digit inflation in the last three decades, it can be emphasized the fact that the inflation rate has raised and declined rapidly in recent years because of its fundamental determinants. Main reasons behind the behaviour of the consumption price index are related to higher prices in the energy sector and a higher government expenditure, particularly after the post-pandemic economy re-opening. Proxy variables such as oil prices free on board in the European Brent market, the 12 months Euribor interest rate of the Economic and Monetary Union, the nominal gross domestic product, the government expenditure of the public administration, and fiscal deficits in terms of the gross domestic product are those variables in which the consumer price index depends on. Changes on interest rates have managed to stabilized inflation rates once again, thereby diminishing the percentage change in the consumer price index.

JEL Codes: E31, E58, L71

Keywords: Inflation rate, Consumer Price Index, Central Banks, Hydrocarbon Fuels

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1 Introduction

What are the main inflation drivers in macroeconomics? How can it be explained the recent increase in the level of prices? Are international energy market's prices related to the Consumer Price Index (CPI) in Spain? Has the pandemic affected the level of the inflation rate?

In macroeconomics, the inflation rate is one of the main variables of the economy. It can be measured as the percentage change on the CPI. It is directly related to the demand and the supply of goods and services purchased or otherwise acquired by households. Its evolution over time could affect both the purchasing power of an individual and the production cost in companies. The analysis of prices behaviour makes it possible to determine which are the fundamental variables that are closely linked to the inflation's evolution over time.

In Spain, the annual variation in percentages of the CPI can be observed in figure 1. During the studied period, a greater variability of inflation is observed until the beginning of the 80s. After the first years of this decade, goods and services prices have been growing in a very stable rate and inflation remained relatively low for almost the last four decades. In fact, annual inflation has been lower than the two digits since May 1985. In June 2022, the inflation rate reached the 10% annual change once again and exceeded it for a short period of time. Notice that there was also negative general inflation at least during three intervals in the last two decades. The CPI percentage change reached below zero levels in 2009, from 2014 to 2016, and especially during the Covid pandemic in 2020.

The CPI is an index used to measure the behaviour of prices over the time paid by consumers for a market basket of consumer's goods and services. According to the Spanish National Institute of Statistics (INE), the CPI can be divided into 12 sectoral, different groups in Spain.

The breakdown of the CPI into sub-groups over the last 20 years can be seen in figure 2 and the appendix. Although the annual percentage variation of the general price index remains relatively stable month to month during this period, some of the sub-groups published by the INE show greater volatility.

In Figure 2, it can be observed the CPI in annual percentage changes for the group 04 on housing, water, electricity, gas and other fuels as well as the overall inflation rate. This subgroup peaks the highest inflation rate in March 2022 when it reaches 33.1%. Notice that the data from group 04 shows not only higher variability than the general index but also a

significant increase in prices during the pandemic. It could be seen as a leading indicator of the inflation rate in Spain during the observed period of time.

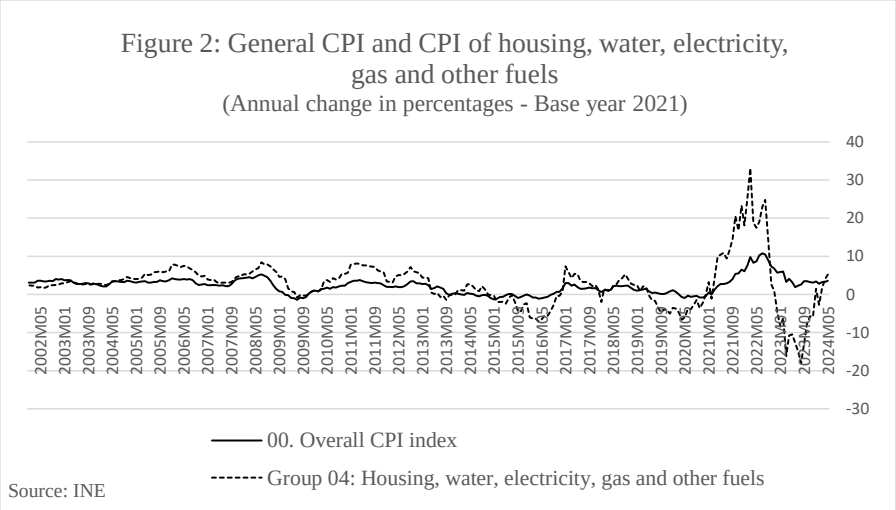
Figure 1: Consumer Price Index
(Annual change in percentages - Base year 2021)

Source: INE

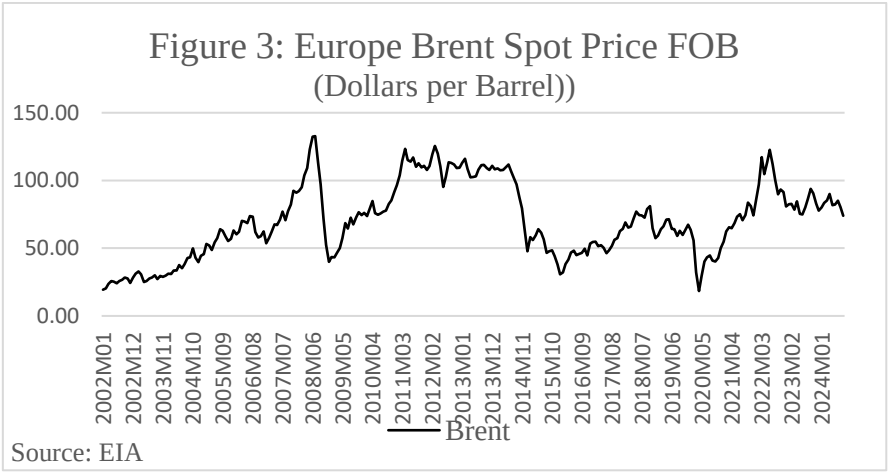
The inflation time series for the remaining groups can be found in the appendix (figures from A1 to A11). In these figures, there were mainly two different groups where the sectoral inflation rate was obviously higher that the overall index during the Covid pandemic as in figure 2. They were the CPI for food and non-alcoholic beverages and the CPI for transport.

In figures A1 and A6 in appendix, the CPI corresponding to the food and non-alcoholic beverages subgroup and the CPI for the transport subgroup both reach a maximum percentage change of 16.6% in February 2023 and 19.2% in June 2022, respectively. These figures also show that there is a significant variability as a consequence of both increasing and decreasing prices in goods and services in economic activities related to food and non-alcoholic beverages and transport sectors. This volatility in prices are similar to those observed in figure 2.

There is plenty economic literature to explain the behaviour of aggregate prices. Keynes (1936) argued that the production level -which is determined by the marginal propensity to consume, the marginal efficiency of capital, and the interest rate- can be increased by increasing the government expenditure in times of economic depression, thereby the more public sector's expenditure, the higher the aggregate demand, and the higher the level of aggregate production.



However, Friedman (1963) explains that the increase in demand and aggregate consumption because of changes on monetary variables -such as money supply or the nominal interest rate- may result, not in a production's increase, but in an increase of the general price level of good and services. Galí (1999) uses a structural econometric analysis in a New Keynesian Phillips curve framework to link inflation not only to the output gap but also to inflation itself (expected and lagged) and the marginal cost.



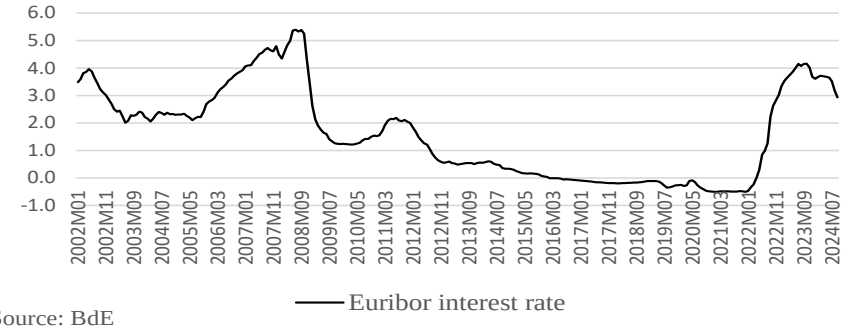
The CPI appears to be related to production costs as a consequence of decreasing and increasing energy prices on the supply side. Figure 3 shows oil prices free on board (FOB) in the Brent European market according to the U.S. Energy Information Administration (EIA).

There are three periods of time where the price was higher than 100 dollars per barrel in figure 3, the first one goes from March 2008 to August 2008, the second one is related to

period that starts in February 2011 and ends in August 2014 (excluding month June 2012), and the last one starts in March 2022 until August 2022. Notice that Russia invaded Ukraine in February 2022.

Taking into account data from the European Money Market Institute (EMMI), the Central Bank of Spain (BdE) publishes the Euribor in a monthly basis (the interest rate at which a selection of European banks lend one another). Figure 4 shows such an interest rate for 12 months related to the money market in the Economic and Monetary Union. Besides the fact that there was a negative interest rate between February 2016 and March 2022, it is important to observe that there are three peaks in the data corresponding to May 2002, July 2008, and October 2023.

Figure 4: Euríbor interest rate.
EMU Money market. 12 months.
(Percentage)



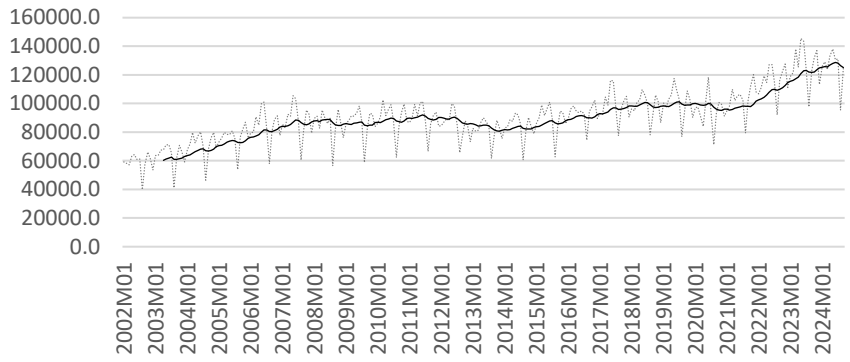
Source: BdE

Ascari et al (2023) distinguishes three chronological phases to explain inflation in recent years in the Euro Area. According to the authors, there were three phases during the Covid pandemic. The covid shock (both first and second quarters in 2020) as phase I, the reopening of the economy (from third quarter 2020 to third quarter 2021) as phase II, and the post reopening (from the fourth quarter 2021 onwards) as phase III. Specifically, the behaviour of output and inflation appears consistent with (i) aggregate demand experiencing a negative shock in phase I followed by a sequence of positive shocks in phase II and III, and (ii) aggregate supply experiencing a negative shock in phase I followed by a positive shock in phase II and another negative shock in phase III.

According to the INE, the Gross Domestic Product (GDP) exhibited an unprecedented decline during the phase I in Spain. This reduction was equivalent to 22.8% from 326,698 millions of euros at current prices from the fourth quarter of 2019 to 252,148 millions of euros

at current prices in the second quarter of 2020. Using an index built by INE to measure the industrial production in Spain, it has been transformed the quarterly GDP to a monthly basis in order to plot the data shows in figure 5. In this chart, it can be observed that the aforementioned GDP's negative change during the phase I is different from the -0.34% CPI annual decrease in June 2020. It suggests that there was not inflationary effects of a decreasing supply during this period of time.

Figure 5: Gross Domestic Product at current prices (Millions of Euros)



Source: Author's own calculations

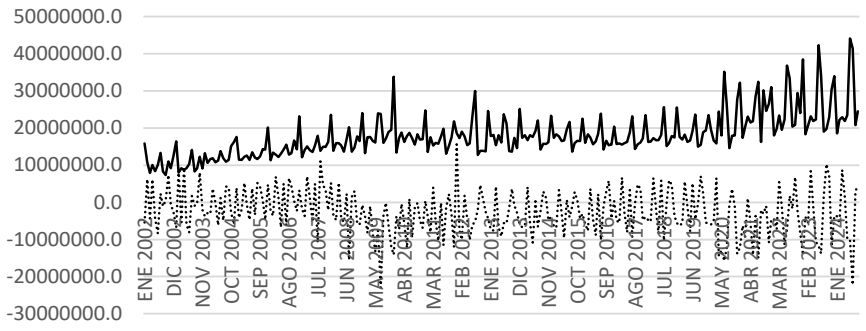
Moreover, the GDP grew at 8.21% y-to-y in the third quarter of 2021 when the CPI showed an annual change of 4.01% in September 2021. The economic activity has been growing in average 2.21% q-to-q since the beginning of phase III. The inflation rate reached a peak of 10.77% in July 2022 and decreased until it gets an average of around 3.2% during the first half of 2024. Therefore, there was a positive and increasing inflation during the reopening of the economy in phase II and a positive and even two-digit inflation after the post reopening of the economy in phase III.

Figure 6 shows the government expenditure (black line) as well as the fiscal deficit (segmented line). These time series are published in the Public Administration Statistics of the BdE in thousands of euros based in data from the Spanish Ministry of Economics and Finance (IGAE) in a monthly basis from January 2004 onwards. Observations for the first two years of the sample has been calculated using the government cash flow month by month. The level of government spending has been growing consecutively since the beginning of the selected period of time and its volatility is always higher, particularly after June 2020. Notice that the

fiscal surplus reached its maximum level of 15,626,000 thousands euros in December 2011 and the highest fiscal deficit corresponds to July 2009 when it was equal to -23,013,000 thousands euros.

This research's main goal is to present an econometric model with main determinants of the consumption price index behaviour to show that recent changes on inflation depends positively not only on energy prices but also on the government expenditure and negatively on the interest rate. The methodology is based on cointegration techniques in the long run when the OLS method with error correction mechanisms is applied to find the short term relationship.

Figure 6: Public expenditure and fiscal deficit
(Thousands of Euros)



Source: Author's own calculations

2 The model

The econometric model for inflation and its main determinants is based on two main approaches. The first approach applies a cointegration process (Johansen, 1988 and 1991) to find a long-term relationship between the macroeconomic variables (Engle and Granger, 1987) under the assumption of unrestricted intercept and restricted trend as in Pesaran, Shin and Smith (2000). The second approach uses the methodology of ordinary least squares (OLS) with error correction mechanism (ECM) to find the short-term relationship employing a "from general to specific" procedure as specified by Campos et al. (2005) and Hendry (2024).

In addition, unit root tests are carried out based on the augmented Dickey-Fuller test (Dickey and Fuller, 1979 and 1981) considering the optimal number of lags calculated through the Schwarz information criterion and the critical values established by MacKinnon at 1, 5 and 10% (MacKinnon, 2010).

The proxy variables for aggregate prices and its determinants are the following (for both the long and the short term):

1) CPI: The Consumer Price Index as general, aggregate, consumer prices. It is an index from the Spanish National Institute of Statistics (INE).
2) Brent: The Europe Brent Spot Price FOB (dollars per barrel) as energy prices from the U.S. Energy Information Administration (EIA).
3) Euribor: A 12 month interest rate in percentages as a monetary variable from the European Money Market Institute (EMMI). This data is published by the Central Bank of Spain (BdE) in a monthly basis.
4) GDP: The gross domestic product (millions euros at current prices) as an economic activity variable from the INE. Using an index built by INE to measure the industrial production, this time series has been transformed from quarterly to monthly data.
5) G: The government expenditure (thousands euros) from the Public Administration Statistics of the BdE based in data from the Spanish Ministry of Economics and Finance (IGAE).
6) Deficit: The fiscal deficit from the Public Administration Statistics of the BdE based in data from the Spanish Ministry of Economics and Finance (IGAE) divided by the GDP. The first two years of the sample has been calculated using the government cash flow month by month.

3 Empirical evidence

The software EViews 12 (Startz, 1994) is used to study the stationarity of the variables in the model. The standard augmented Dickey-Fuller test evaluates unit roots. The null hypothesis corresponds to one unit root (I(1)).

Table 1: Unit Root Test
(Augmented Dickey-Fuller)

Variable	Order of integration
CPI	I(2)
Brent	I(1)
Euribor	I(1)
GDP	I(1)
G	I(1)
Deficit	I(1)

Source: Author's own calculations

The Schwarz information criterion is taken into account to choose the optimal number of lags with a maximum number of 15 lags. The intercept is included in the test equation.

The critical values from MacKinnon (2010) are considered to estimate the probabilities associated to the *t* statistics. Table 1 shows the results. It can be observed that all variables are integrated of order 1 I(1) apart from the CPI. The CPI is integrated of order 2.

Converting CPI to I(1), the multivariate cointegrating autoregressive vectors (VAR) are found using the software Microfit 5.5 (Pesaran and Pesaran, 2009) under the assumption of unrestricted intercept and restricted trend as calculated in Pesaran, Shin and Smith (2000).

Table 2: Cointegration with unrestricted intercepts and restricted trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

272 observations from 2002M2 to 2024M9. Order of VAR = 1.

List of variables included in the cointegrating vector:

CPI BRENT EURIBOR GDP G DEFICIT Trend

List of eigenvalues in descending order:

.65244 .57192 .53741 .40219 .059593 .0052092

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	287.4344	43.6100	40.7600
r<= 1	r = 2	230.7727	37.8600	35.0400
r<= 2	r = 3	209.6870	31.7900	29.1300
r<= 3	r = 4	139.9379	25.4200	23.1000
r<= 4	r = 5	16.7122	19.2200	17.1800
r<= 5	r = 6	1.4206	12.3900	10.5500

****

Source: Author's own calculations.

In tables 2 and 3, the results of the cointegration test run with variables lagged only once can be observed. Taking into account the fact that the *r* statistic is greater than the critical values calculated as an asymptotically non-standard distribution according to the Johansen methodology (Johansen, 1988 and 1991) in the case of at least 3 vectors (when r <= 3), the null hypothesis of 3 cointegrated long run relationships are not rejected (see table 2).

The long-term relationship between the CPI and its fundamental determinants can be seen in Table 3.

Table 3: Cointegrated Vectors in Johansen Estimation

Cointegration with unrestricted intercepts and restricted trends in the VAR

272 observations from 2002M2 to 2024M9. Order of VAR = 1.

List of variables included in the cointegrating vector:

CPI BRENT EURIBOR GDP G DEFICIT Trend

	Vector 1	Vector 2	Vector 3
CPI	-.0069817	-.065875	-.077337
	(-1.0000)	(-1.0000)	(-1.0000)
BRENT	.4254E-4	.3122E-3	-.7517E-4
	(.0060929)	(.0047396)	(-.9720E-3)
EURIBOR	.012361	-.0029891	-.015159
	(1.7705)	(-.045406)	(-.19601)
GDP	-.1434E-7	.1881E-5	.3572E-5
	(-.2054E-5)	(.2856E-4)	(.4619E-4)
G	-.1118E-7	-.7850E-8	.5324E-8
	(-.1601E-5)	(-.1191E-6)	(.6885E-7)
DEFICIT	-.0087951	.0058860	.2027E-3
	(-1.2597)	(.089375)	(.0026210)
Trend	.5720E-3	.1029E-3	-.0010607
	(.081923)	(.0015604)	(-.013715)

Source: Author's own calculations. Valores Normalized values in Brackets.

This table shows 3 vectors with the corresponding cointegrating parameters values that have been found. Apart from the parameter in the variable G, all coefficients in vector 2 exhibit correct signs according to the theory. The positive relationship between CPI and G will be found in the short term model introducing variables with a higher number of lags.

After calculating the ECM with vector 2, the coefficients of the variables for the short-term model are estimated with the OLS method using the robust econometric procedure "from the general to the specific" as in Campos et al. (2005) and Hendry (2024). The software EViews 12 (Startz, 1994) is used once again to run the model with all variables integrated in order 0. Table 4 shows the results. Considering the probabilities associated to the *t* statistic, it can be observed that all variables are statistically significant at 10% (apart from the intercept and the ECM).

The CPI has been introduced lagged in the econometric model to proof both the inertia and persistence on inflation. Notice that D stands for first differences, D2 are second differences, values in parentheses indicate level of lags, and the coefficient of the ECM has a negative sign. All variables exhibit correct signs according to the theory. Increasing inflation

are related to increasing energy prices, a decreasing interest rate, a higher government expenditure, and a higher deficit. The relationship between the CPI and the GDP appears to be positive short term. The model fits the data by more than 70% ($R^2 = 0.73$).

Table 4: Ordinary Least Squares (OLS) regression model

Dependent Variable: D2CPI
Method: Least Squares
Date: 11/11/24 Time: 19:25
Sample (adjusted): 2003M01 2024M09
Included observations: 261 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006400	0.030898	-0.207149	0.8361
D2CPI(-1)	-0.407911	0.046145	-8.839701	0.0000
D2CPI(-3)	-0.155297	0.050038	-3.103569	0.0021
D2CPI(-4)	-0.291315	0.050976	-5.714739	0.0000
D2CPI(-6)	0.239530	0.047531	5.039423	0.0000
DBRENT	0.034198	0.003983	8.585165	0.0000
DBRENT(-4)	0.009052	0.004326	2.092464	0.0374
DEURIBOR(-2)	-0.405072	0.232646	-1.741149	0.0829
DEURIBOR(-3)	-0.703238	0.285331	-2.464641	0.0144
DEURIBOR(-4)	1.026161	0.232612	4.411477	0.0000
DGDP(-1)	1.49E-05	2.82E-06	5.279625	0.0000
DGDP(-5)	1.46E-05	2.86E-06	5.094005	0.0000
DGDP(-6)	5.23E-06	2.71E-06	1.932731	0.0544
DGDP(-11)	1.40E-05	3.24E-06	4.331321	0.0000
DG	1.34E-08	5.52E-09	2.421961	0.0162
DG(-3)	1.16E-08	5.30E-09	2.184351	0.0299
DG(-8)	-1.18E-08	5.81E-09	-2.027517	0.0437
DDEFICIT	0.015927	0.003826	4.162518	0.0000
DDEFICIT(-7)	0.005457	0.003153	1.730434	0.0848
ECM	-0.597808	0.603902	-0.989909	0.3232

R-squared	0.726645	Mean dependent var	-0.003594
Adjusted R-squared	0.705094	S.D. dependent var	0.738742
S.E. of regression	0.401175	Akaike info criterion	1.084697
Sum squared resid	38.78693	Schwarz criterion	1.357840
Log likelihood	-121.5529	Hannan-Quinn criter.	1.194491
F-statistic	33.71777	Durbin-Watson stat	2.290416
Prob(F-statistic)	0.000000		

Source: Author's own calculations.

4 Conclusions

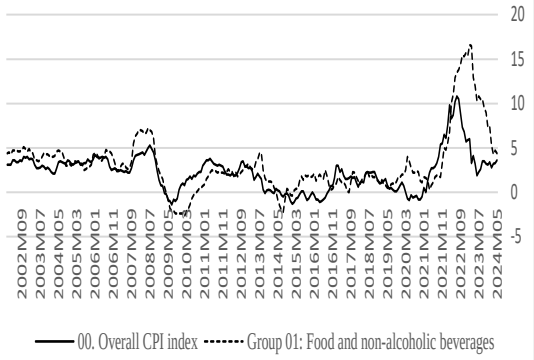
The main interest in this research has been to explain with certainty the behaviour of the inflation in Spain not only in the short term but also in the long run. The energy sector, an efficient monetary policy, level of aggregate production, expansive fiscal policy and several years of deficit are some of the fundamental determinants of inflation, particularly during the pandemic. In fact, the main reasons behind the consumption price index increase after the post-pandemic economy re-opening are related to higher prices in the energy sector.

Proxies like oil prices in the European Brent market, the Euribor interest rate, the domestic gross domestic product, the domestic government expenditure, and the fiscal deficit from the national public administration are those variables in which the consumer price index depends on.

Further research could be done in order to find if the interaction between the demand and the supply of good and services has structural changes' effect on inflation.

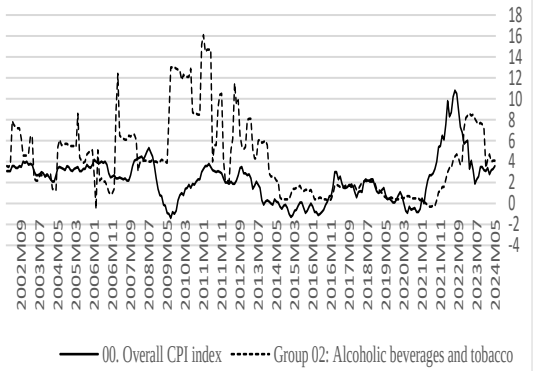
5 Appendix

Figure A1: General CPI and CPI of food and non-alcoholic beverages
(Annual change in percentages - Base year 2021)



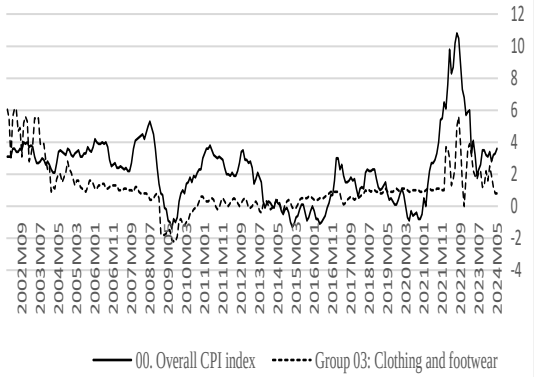
Source: INE

Figure A2: General CPI and CPI of alcoholic beverages and tobacco
(Annual change in percentages - Base year 2021)



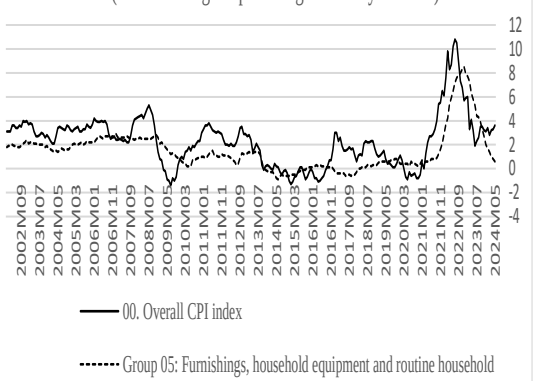
Source: INE

Figure A3: General CPI and CPI of clothing and footwear
(Annual change in percentages - Base year 2021)



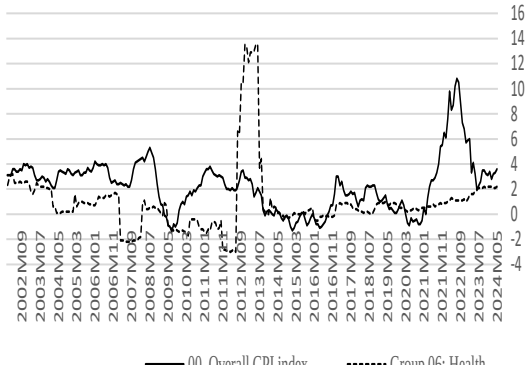
Source: INE

Figure A4: General CPI and CPI of furnishings, household equipment and routine household maintenance
(Annual change in percentages - Base year 2021)



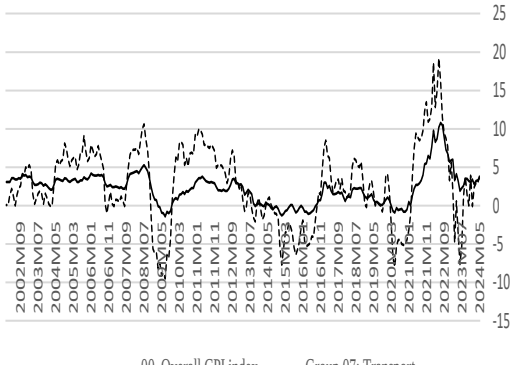
Source: INE

Figure A5:
General CPI and CPI of health
(Annual change in percentages - Base year 2021)



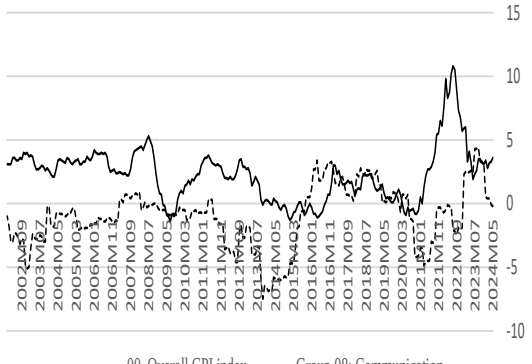
Source: INE

Figure A6: General CPI and CPI of Transport
(Annual change in percentages - Base year 2021)



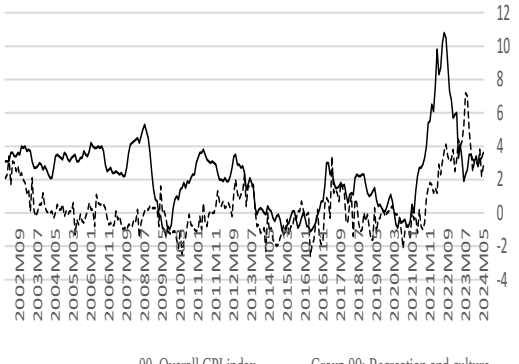
Source: INE

Figure A7: General CPI and CPI of Communication
(Annual change in percentages - Base year 2021)



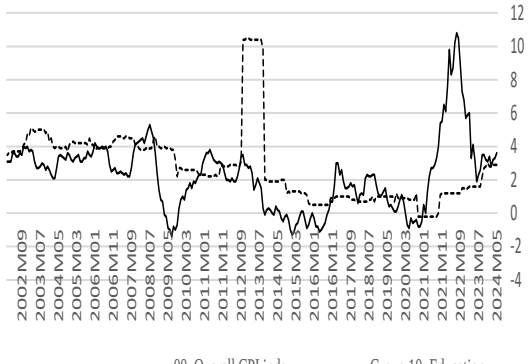
Source: INE

Figure A8: General CPI and CPI of Recreation and Culture
(Annual change in percentages - Base year 2021)



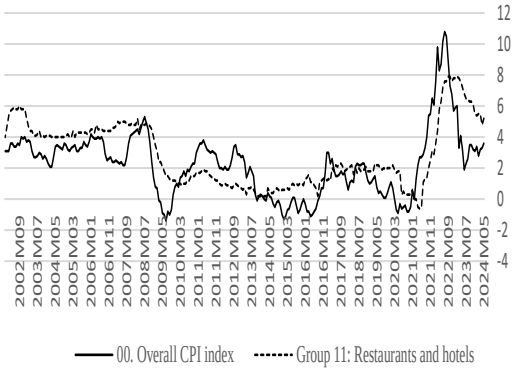
Source: INE

Figure A9: General CPI and CPI of Education
(Annual change in percentages - Base year 2021)

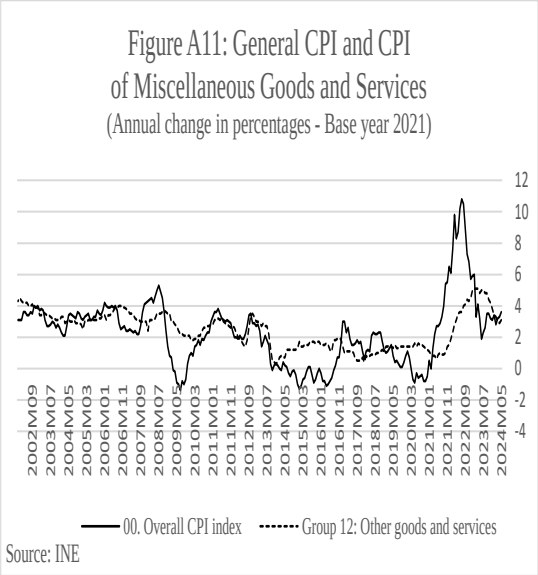


Source: INE

Figure A10: General CPI and CPI of Restaurants and Hotels
(Annual change in percentages - Base year 2021)



Source: INE



References:

Ascari, G., & Sbordone, A. M. (2014). The Macroeconomics of Trend Inflation. *Journal of Economic Literature, 52*(3), 679–739.

Ascari, G., Bonomolo, P., Hoeberichts, M., & Trezzi, R. (2023). The Euro Area Great Inflation Surge. *De Nederlandsche Bank Analysis Series*, 1-21.

Campos, J., Ericsson, N., y Hendry, D. (2005). General-to-specific modelling: an overview and selected bibliography, *International Finance Discussion Papers*, 838, Board of Governors of the Federal Reserve System (U.S.).

Dickey, D., & Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a unit root, *Journal of the American Statistical Association, 74*(366), 427-431.

Dickey, D., & Fuller, W. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica, 49*(4), 1057-1072.

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica, 55*(2), 251-276.

Friedman, M. (1963). Inflation: Causes and Consequences. *Asia Publishing House for the Council for Economic Education* in Collected Works of Milton Friedman Project, n. 2016c21.1266.

Galí, J., & Gertler, M. (1999). Inflation dynamics: A structural econometric analysis. *Journal of Monetary Economics 44*, 195-222.

Hendry D., (2024). A Brief History of General-to-specific Modelling, *Oxford Bulletin of economics and statistics, 86*(1), 0305-9049. doi: 10.1111/obes.12578

Johansen, S. (1988). Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control, 12*, 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models, *Econometrica, 59*(6), 1551-1580.

Keynes, J. M. (1936). The General Theory of Employment, Interest, and Money. *International Relations and Security Network* in ISN ETH Zurich, pp. 190.

Lagarde, C., & De Guindos, L. (2022). Monetary policy statement in "Combined monetary policy decisions and statement". *European Central Bank, Press conference*, 8 September 2022.

MacKinnon, J. (2010). Critical Values for Cointegration Tests, *Queen's Economics Department Working Paper,* No. 1227.

Pesaran, B., & Pesaran, M. H. (2009). Time Series Econometrics using Microfit 5.0: A User's Manual, *Oxford University Press*.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*, 265-312.

Pesaran, M. H., Shin, Y., & Smith, R. (2000). Structural analysis of vector error correction models with exogenous I(1) variables, *Journal of Econometrics, 97*, 293-343.

Shang, J., & Hamori, S. (2024). The response of oil-importing and oil-exporting countries' macroeconomic aggregates to crude oil price shocks: some international evidence. *Eurasian Economic Review, 14*, 933–980.

Startz, R. (1994). EViews Illustrated, *IHS Global Inc*, pp. 442.