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Inflation persistence in Europe: the effects of the covid-19 pandemic and of the Russia-Ukraine war

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Abstract

This note analyses the possible effects of the Covid-19 pandemic and of the Russia-Ukraine war on the degree of inflation persistence in both the euro zone and the European Union as a whole (EU27). For this purpose a fractional integration model is estimated, first for the full sample and then using recursive and rolling methods. Although the two latter methods provide evidence of a significant increase in inflation persistence (at least in the case of the EU27, for which in addition to jumps an upward trend is clearly identifiable), the full-sample results imply long-lasting but only temporary effects of the two shocks being examined. These findings suggest that the required policy response to both shocks should also have a temporary nature.

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Section 1. Introduction

Since the beginning of 2020 two exogenous shocks have significantly affected world inflation, namely the Covid-19 pandemic and the Russia-Ukraine war. Pandemics usually give rise to both inflationary and deflationary dynamics; specifically, the disruption in the supply and production chain causes supply-side inflation; in addition, there are deflationary forces reflecting higher idiosyncratic risk; these can be moderated by redistribution policies which, however, can lead to excessive inflation in the longer term (Brunnermeier et al. 2020). The Covid-19 pandemic also led to a sudden increase in inflation uncertainty (Armantier et al. 2021), and to changes in consumer expenditure patterns that introduced a bias in the measurement of inflation, with the official Consumer Price Index (CPI) inflation being lower than actual inflation (Cavallo 2020). In particular, the under-weighting of increasing food prices and the over-weighting of declining transport prices appear to have been the main reasons for underestimating inflation (Reinsdorf 2020).

The Russia-Ukraine war has also affected prices. Any armed conflict has a significant impact on macroeconomic variables but measuring it might not be straightforward. Ruiz Estada (2022) uses a war economic destruction level simulator (WEDL-Simulator) and finds large spillover effects of the Russia-Ukraine war on both inflation and unemployment worldwide. Bodnar et al. (2022) examine euro zone food inflation and report that global energy and food commodity prices had been driving it upwards since the second half of 2021 and that the war has increased it further by hindering the import of energy and food commodities. Finally, Prohorovs (2022) argues that the global trade restrictions that the war has brought about can have long-lived effects on prices.

The present study focuses on a specific aspect of inflation for which the possible effects of both the Covid-19 pandemic and the Russia-Ukraine war have not been previously considered, namely its degree of persistence. More precisely, fractional integration methods are applied to measure inflation persistence in both the euro zone and the European Union as a whole (EU27) using monthly data from September 1997 to August 2022. The model is estimated first for the whole sample, and then using recursive and rolling methods from December 2019 to examine the evolution over time of inflation persistence and thus the possible impact of the recent pandemic and conflict respectively. The chosen framework is more general than the standard one based on the dichotomy between I(0) stationarity and the I(1) non-stationarity since it allows for fractional as well as integer degrees of differentiation; as a result, it encompasses a much wider range of stochastic processes, it sheds light on whether the effects of shocks are transitory or permanent, on whether or not mean reversion occurs, on the speed of the dynamic adjustment process etc., thereby providing useful information to policy makers on the type of policy actions required.

The rest of the paper is structured as follows: Section 2 describes the data, presents the model and the empirical results; Section 3 offers some concluding remarks.

Section 2. Empirical Analysis

For the empirical analysis we use monthly data on the harmonized index of consumer prices (HICP) produced by Eurostat (the statistical office of the European Union) and available on the Bloomberg platform; more precisely, we examine the properties of two series, namely MUICP, which is an aggregate index for the countries in the euro zone, and EICP, which is the corresponding index for the EU27, from September 1997 to August 2022. The data are not seasonally adjusted. Inflation is calculated as the monthly rate of change (M) of consumer prices in year t and month m:

$$M_{m,m-1}^{t} = \left(\frac{I_m^t}{I_{m-1}^t} - 1 \right) . 100$$

To allow for the possible presence of long memory and/or seasonality as well as of deterministic components in the series we consider the following model:

$$x_t = \alpha + \beta t + z_t; \quad (1-L)^d z_t = u_t, \quad u_t = \rho\, u_{t-12} + \varepsilon_t, \qquad (2)$$

where x_t stands for the series of interest; α and β are unknown parameters, specifically the constant and the coefficient on a linear time trend; L is the lag operator, d is a real value, and thus z_t is integrated of order d; u_t is a seasonal AR(1) process which is I(0), and ρ is the seasonal AR coefficient. The estimation is carried out using a Whittle function in the frequency domain. Note that if d = 0 the process exhibits short memory, while d > 0 implies long memory; if d belongs to the range (0, 0.5) the series is covariance stationary and mean-reverting, while if d is in the interval [0.5, 1) the process is nonstationary though still mean-reverting. The series exhibits a unit root when d = 1; in this case (and also if d > 1) shocks have permanent effects.

Table 1: Estimated coefficients in the model given by Eq. (1)

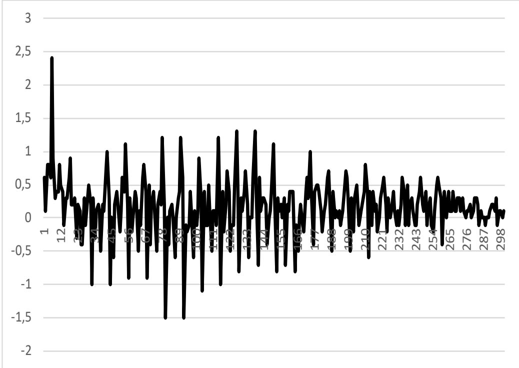
Series	d	Intercept (t-value)	Seasonality (ρ)
Euro zone	0.24 (0.17, 0.32)	0.1956 (2.78)	0.806
EU27 (all 27 EU members)	0.31 (0.23, 0.39)	0.1839 (4.75)	0.790

Note[1]: the numbers in brackets in the column for d correspond to the 95% confidence intervals.

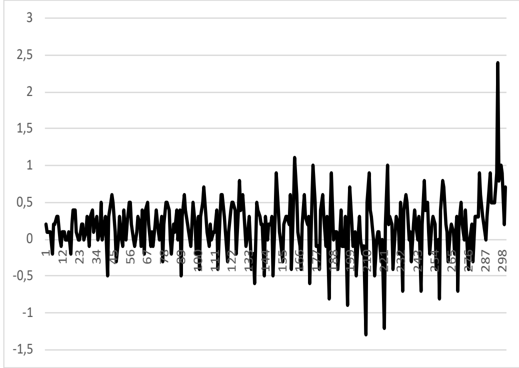
Table 1 reports the estimated coefficients for each of the two series from a model with an intercept only as the time trend was not found to be significant. In both cases, the estimates of d are in the range (0, 0.5), which implies the presence of long memory and long-lived, though transitory, effects of shocks; specifically, the estimated value of d is 0.24 for the euro zone and 0.31 for the EU27, the seasonal component being significant in both cases.

Figure 1: Time series plots

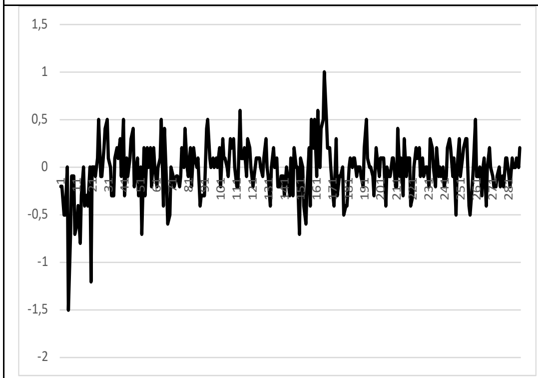
Euro zone



EU27 (all 27 EU members)



$(1 - L^{12})$ Euro zone



$(1 - L^{12})$ EU27 (all 27 EU members)

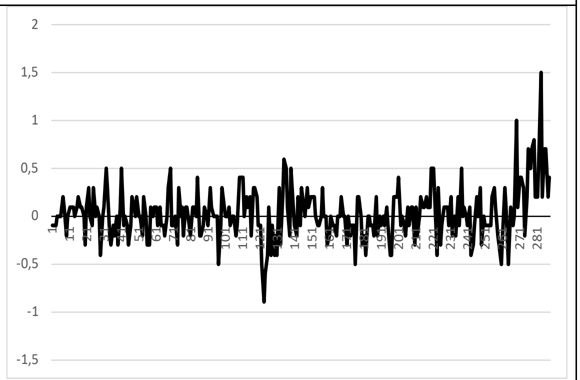
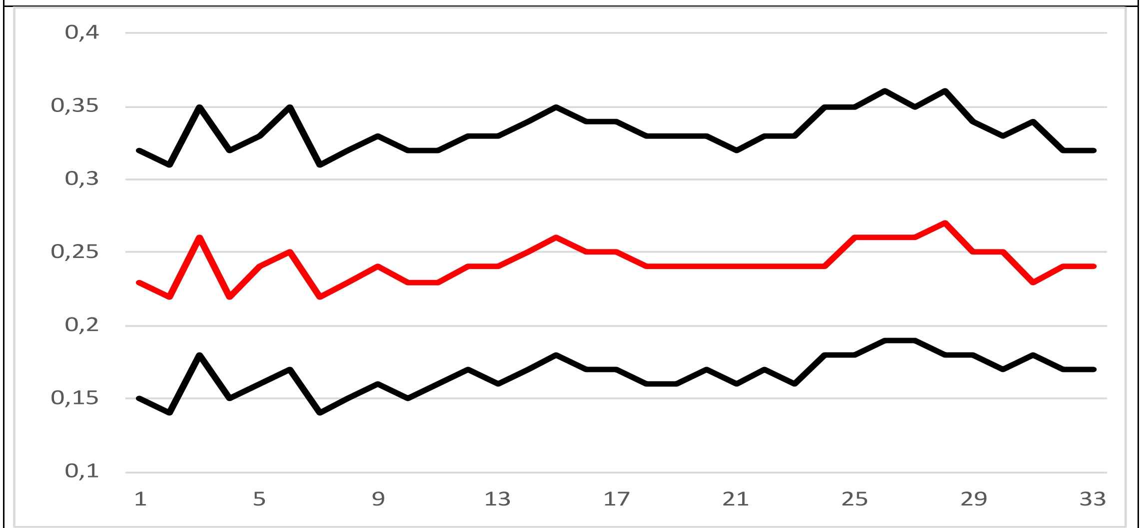
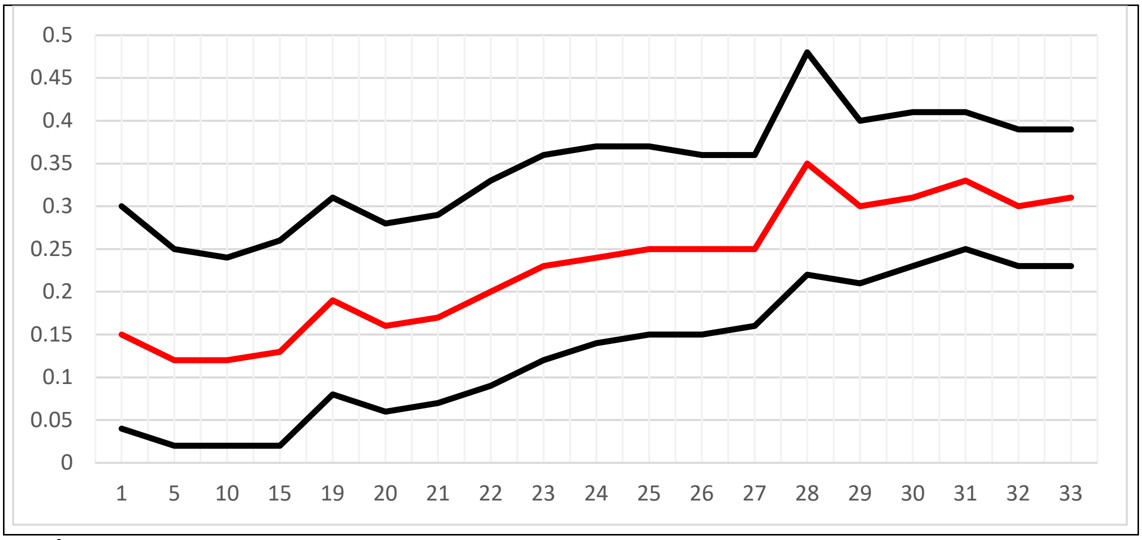


Figure 1: Recursive estimates of d as a measure of inflation persistence

Euro zone



EU27 (all 27 EU members)



Note[2]: The first estimate is d is based on a sample ending in December 2019, then one observation at a time is added recursively to obtain the following estimates. Thus, observation 1 corresponds to the sample ending in January 2020, observation 2 to the one ending in February 2020, etc. The red line corresponds to the estimated values of d whilst the black ones show the 95% confidence intervals.

Table 2: Estimates of d based on the first seasonal differences

Series	White noise	Bloomfield autocorrelation
Euro zone	0.20 (0.13, 0.29)	0.26 (0.13, 0.43)
EU27 (all 27 EU members)	0.27 (0.20, 0.36)	0.26 (0.14, 0.40)

Note[3]: the numbers in brackets in the column for d correspond to the 95% confidence intervals.

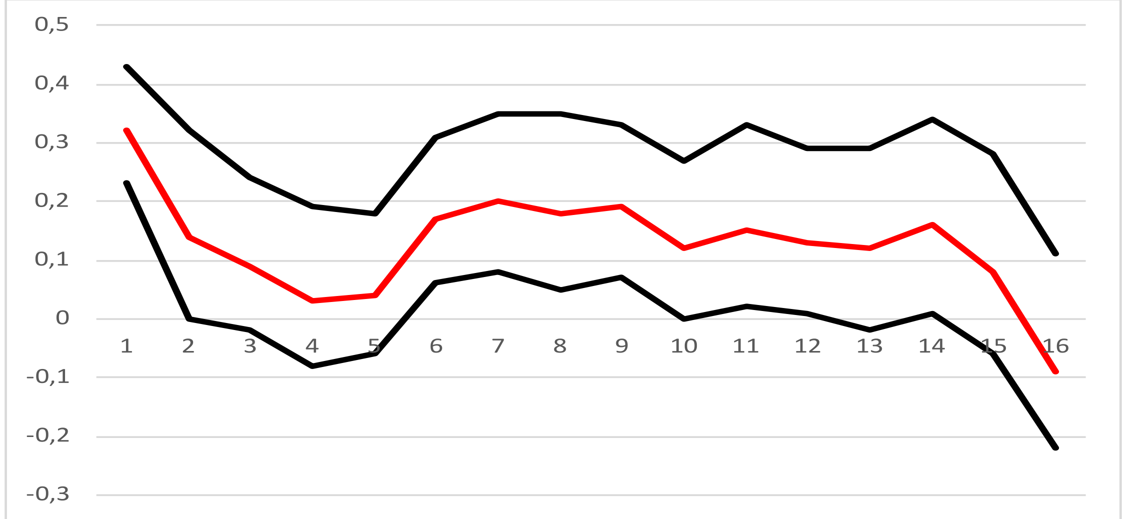
Given the high seasonal AR coefficient for the two series under examination we next conducted various seasonal unit root tests. In particular, we performed three standard procedures: Dickey, Hasza and Fuller (DHF, 1986), Hylleberg, Engle, Granger and Yoo (HEGY, 1990), and Osborn, Chui, Smith and Birchenhall (OCSB, 1988). The results (not reported for reasons of space), generally support the hypothesis of seasonal unit roots, and thus we took monthly first differences of the two series. Time plots of both the original and first differenced series are shown in Figure 1. Table 2 reports instead the estimated values of the differencing parameter d for the differenced series. In this case, the intercept and the time trend coefficients were both found to be statistically insignificant, and the value of d was strictly positive for both series under either assumption about the error term, namely white noise and Bloomfield (1973)-type autocorrelated disturbances respectively. Specifically, the estimated values of d are 0.2 and 0.27 for the Euro-zone and EU27 respectively under the assumption of white noise errors, and 0.26 in both cases with uncorrelated disturbances.

Next, we estimate the parameter d recursively from December 2019 by adding one observation at a time; the aim is to investigate the evolution over time of persistence and if/how it has been affected by the Covid-19 pandemic and the Russia-Ukraine war. Figure 1 displays both the recursive estimates and the 95% confidence intervals. In the case of the euro zone upward jumps in inflation persistence appear to have occurred in February and May 2020, namely in the early stages of the pandemic; persistence then only increases slightly and remains relatively stable till November 2021, before another upward jump in March 2022 (which is around the time of the Russian invasion) and a subsequent slight decrease. As for the behavior of inflation in the EU27, it is noticeable that its persistence increases throughout the sample, first jumping up in June 2020 and then again in March 2022, at the start of the conflict.

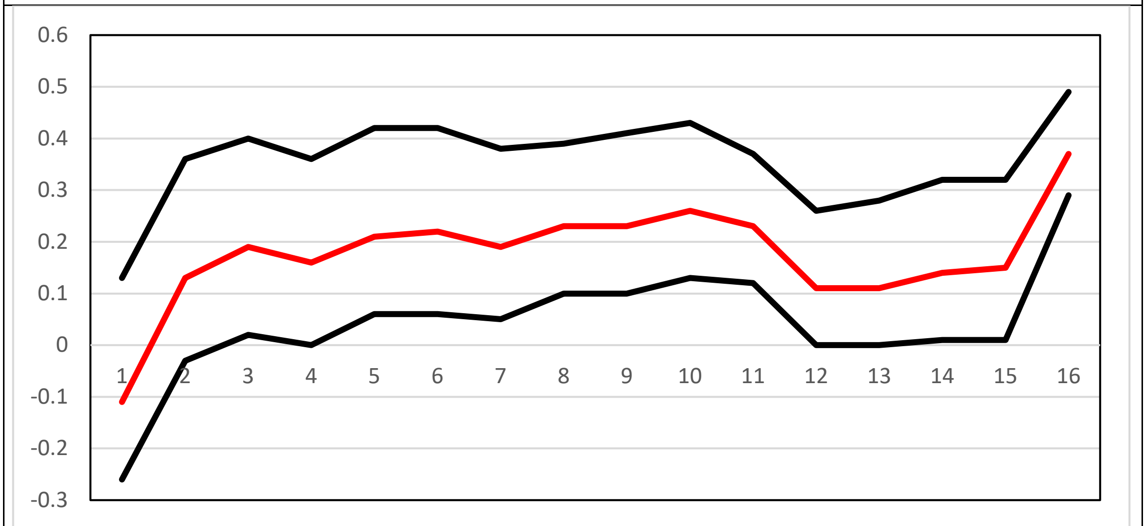
As a robustness check we also obtain rolling-window estimates of d using a window size of 120 observations (i.e., 10 years), shifting the window each time one year ahead, with the last estimate being based on the last 120 observations. We estimate once more the model given by Equation (1); the results for the differencing parameter d, and the seasonal AR coefficient are displayed respectively in Figures 2 and 3. It can be seen that the estimated value of the differencing parameter (Figure 2) trends downwards in the case of the Euro zone, and upwards in the case of the EU27. The same holds for the seasonal AR coefficient (Figure 3).

Figure 2: Rolling windows (10 years) estimates of d and 95% bands

Euro zone

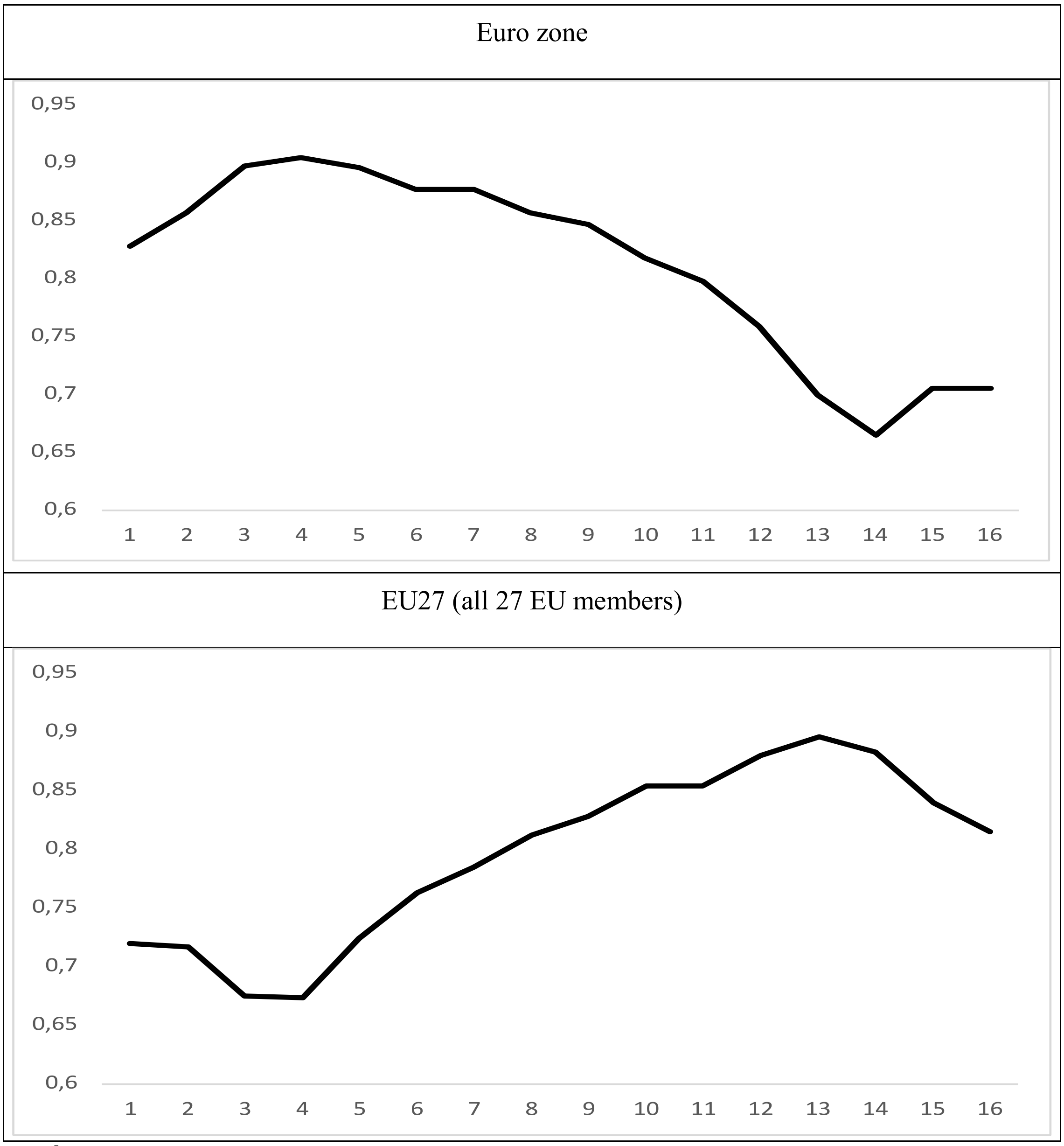


EU27 (all 27 EU members)



Note[4]: The first estimate of d is based on a sample using the first 120 observations (10 years). Then, the following estimates are obtained by successively shifting the sample one year ahead, with the last estimates being based on the last 120 observations (the last 10 years). We also report the 95% confidence bands for the values of d. We also report the 95% confidence intervals.

Figure 3: Estimates of the seasonal AR coefficients using rolling windows (10 years)



Note[5]: The first estimate of d is based on a sample using the first 120 observations (10 years). Then, the following estimates are obtained by successively shifting the sample one year ahead, with the last estimates being based on the last 120 observations (the last 10 years). We also report the 95% confidence bands for the values of d.

Finally, the possible presence of breaks was examined by carrying out the Bai and Perron's (2003) and Gil-Alana's (2008) tests, the latter being specifically designed for the case of fractional integration. The results (not reported) provide no evidence of breaks in either of the two series. Specifications including non-linear deterministic terms (e.g., Cuestas and Gil-Alana 2016, that uses Chebyshev polynomials in time) could be an alternative modelling approach for these series.

Section 3. Conclusions

Exogenous shocks such as pandemics and wars can have a significant impact on economic variables such as inflation, as shown by various previous studies (e.g., Brunnermeier et al. 2020 and Ruiz Estada 2022). This note focuses on one particular issue, namely the possible effects of the Covid-19 pandemic and of the Russia-Ukraine war on the degree of inflation persistence in both the euro zone and the EU27. The adopted empirical framework, which is based on the concept of fractional integration, is very general and it encompasses a variety of stochastic processes; moreover, it is informative about the (transitory or permanent) effects of shocks. The model is estimated in the first instance using the full sample and then recursively to examine the impact of the pandemic and of the ongoing conflict in Ukraine.

Interestingly, although the recursive and rolling-window analysis provides evidence of a significant increase in inflation persistence (at least in the case of the EU27, for which in addition to jumps an upward trend is clearly identifiable), the full-sample results imply long-lasting but only temporary effects of the two shocks being considered. These findings suggest that the policy response to both shocks should also have a temporary nature, and in fact this appears to have been the approach followed by national governments, the measures introduced to deal with the Covid-19 pandemic having already been phased out in most cases, and the response to the energy crisis caused by the current conflict having a clearly defined, finite time horizon.

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