Department of Economics and Finance

Working Paper No. 2307

EXOGENOUS SHOCKS AND TIME-VARYING PRICE PERSISTENCE IN THE EU27

Guglielmo Maria Caporale, Brunel University London, UK

Luis A. Gil-Alana, University of Navarra, Pamplona, and Universidad Francisco de Vitoria, Madrid, Spain

Amir Imeri, University for Business and Technology, Pristina, Kosovo

February 2022

Abstract

This paper analyses monthly price persistence in the EU27 countries over the period 2010-2022 using a fractional integration framework, where the measure of persistence is the fractional differencing parameter d. In addition to full sample estimates, subsample and recursive ones are obtained to examine time variation. On the whole, the results provide clear evidence that both the exogenous shocks considered have generally increased price persistence in the EU27 (despite their heterogeneity), although the recursive estimates suggest that their impact might have peaked and might now be decreasing. Therefore, any policies adopted to counteract those shocks should be gradually phased out. The exceptions are the Southern European countries, where price persistence appears to have decreased, though in Italy the recursive analysis indicates that it is now rising sharply.

Keywords: Price persistence; fractional integration; Covid-19 pandemic; Russia-Ukraine war; recursive estimation; time variation

JEL Classification: C22; E31

Corresponding author: Professor Guglielmo Maria Caporale, Department of Economics and Finance, Brunel University London, Uxbridge, UB8 3PH, UK. Email: Guglielmo-Maria.Caporale@brunel.ac.uk; https://orcid.org/0000-0002-0144-4135

Luis A. Gil-Alana gratefully acknowledges financial support from the Grant PID2020-113691RB-I00 funded by MCIN/AEI/ 10.13039/501100011033, and from an internal Project from the Universidad Francisco de Vitoria.

1. Introduction

The world economy has recently been hit by two exogenous shocks with global consequences, namely the Covid-19 pandemic and the energy crisis resulting from the Russian invasion of Ukraine. Both of them have had repercussions not only on the real economy, but also on prices, which have risen sharply in countries throughout the globe. An interesting issue is whether or not the effects of those shocks on prices will be long-lived in order to be able to adopt appropriate policy responses. This is the focus of the present study, which provides evidence on the degree of price persistence in each of the 27 European Union member states (EU27) over a sample period including both the Covid-19 pandemic and the Russia-Ukraine war. More specifically, the aim of the analysis is to establish whether there has been any time variation in the degree of persistence as a result of those two shocks. For this purpose, a fractional integration model for monthly log-prices is estimated over the full sample going from January 2010 to December 2022 as well as for two subsamples (the first of which includes only the first shock, whilst the second includes both); in addition, recursive analysis is carried out to shed further light on the possible presence of time variation.

The adopted 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; it produces a direct measure of persistence in the form of the estimated fractional differencing parameter d, and is informative on whether the effects of shocks are transitory or permanent and the nature of the dynamic adjustment process, which is essential for policy makers to know to take appropriate actions. In contrast to most existing studies, our focus is on log-prices rather than the inflation rate, and thus provides evidence on the degree of persistence of a possibly nonstationary series such as prices rather than taking first differences to make it stationary. Studies analysing instead the properties of the inflation rate include Franta et

al. (2010) on the EU new member states, Caporale and Gil-Alana (2011) on a wider set of European economies, Gil-Alana et al. (2016) on the G7 countries, Cuestas et al. (2016) on European countries both within and outside the eurozone, and Fuhrer and Moore (1995) on the US. Also, Marques (2004) found higher persistence in the 60s and 70s in the US but not in Europe; Cogley et al. (2010) reported that in the US

AR(p) one), with higher values corresponding to higher degrees of persistence. However, a serious limitation of this approach is that it imposes an exponential rate of decay on the

persistence are higher in all cases compared to those for the sample ending in January 2022 (see Table 5 for a direct comparison), with Italy (d = 0.50), Spain (0.69), Portugal (0.77) and Greece (0.82) now being the only countries displaying mean-reverting behaviour.

Finally, we estimate the model recursively to analyse time variation in the degree of persistence as measured by d; specifically, we add three observations at a time to the sample ending in December 2019 (which includes 120 observations) to obtain the corresponding estimates up until December 2022, namely for a period which includes both the Covid-19 pandemic and the Russia-Ukraine war. As can be seen, after an initial increase across the board, in the most recent period price persistence appears to have subsided in the vast majority of the EU27, with the exception of the Czech Republic, Hungary, Latvia, Malta and Slovenia, where there has been a slight increase, and most notably Italy, the only case where it has risen sharply after a period of relative stability.

FIGURE 2 ABOUT HERE

4. Conclusions

This paper analyses monthly price persistence in the EU27 countries over the period 2010-2022 using a fractional integration framework which encompasses a wide range of stochastic processes, where the measure of persistence is the estimated value of the fractional differencing parameter d. A related study had previously been carried out by Caporale et al. (2023), but for inflation as opposed to price persistence, and at the aggregate level (for the EU27 and the euro zone countries respectively), while the present contribution focuses on the individual EU member states. The model is initially estimated over the period from January 2010 to December 2019, which produces evidence of heterogeneity across the EU27. The sample is then extended to January 2022, with the

aim of examining the possible effects of the Covid-19 pandemic prior to the outbreak of the Russia-Ukraine war; this exogenous shock appears to have increased price persistence everywhere except in three countries from Southern Europe, namely Italy, Spain and Greece.

Extending the sample period further, i.e. to the end of December 2022 (to include the Russia-Ukraine conflict as well) results in higher estimates of d, with the same countries from Southern Europe as well as an additional one (i.e. Portugal) from the same region being the only ones to exhibit mean reversion. Finally, the recursive estimates suggest that price persistence has subsided in most cases (and increased very slightly in a few ones) in the most recent period, the only outlier being Italy, where a sharp increase appears to have occurred most recently.

On the whole, our analysis provides clear evidence that both the exogenous shocks considered have generally increased price persistence in the EU27 (despite their heterogeneity), although the recursive results suggest that their impact might have peaked and might now be decreasing, which is consistent with the aggregate findings of Caporale et al. (2023) for both the EU27 and the euro zone. Therefore, any policies adopted to counteract those shocks should be gradually phased out. The interesting exceptions are the Southern European countries, where if anything price persistence appears to have decreased as a result of the Covid-19 pandemic and the Russia-Ukraine war, though in Italy the recursive analysis indicates that it is now rising sharply.

A limitation of the present study is its univariate nature, which does not allow us to investigate the possible factors affecting the degree of persistence and thus to provide an explanation for the presence of outliers such Italy. Future work should adopt a multivariate framework to investigate these issues in the context of fractional cointegration, using frameworks such as the fractional CVAR (i.e., FCVAR) model

proposed by Johansen and Nielsen (2010, 2012). Further possible extensions could consider non-linear structures in the deterministic part of the model, such Chebyshev polynomials in time (as in Cuestas and Gil-Alana, 2016), Fourier functions (Gil-Alana and Yaya, 2021) or neural networks (Yaya et al., 2021) within a fractional integration framework.

Gil-Alana, L.A. and Yaya, O. (2021), "Testing fractional unit roots with non-linear smooth break approximations using Fourier functions", *Journal of Applied Statistics*, 48, 13-15, 2542-2559

Gil-Alana, L. A., Yaya, O. S. and Solademi, E. A. (2016), "Testing unit roots, structural breaks and linearity in the inflation rates of the G7 countries with fractional dependence techniques", *Applied Stochastic Models in Business and Industry*, 32, 711-724. https://doi.org/10.1002/asmb.2189

Johansen, S. and Nielsen, M. Ø. (2010), "Likelihood inference for a nonstationary fractional autoregressive model", *Journal of Econometrics*, 158, 51-66.

Johansen, S. and Nielsen, M. Ø. (2012), "Likelihood inference for a fractionally cointegrated vector autoregressive model", *Econometrica*, 80, 2667-2732.

Mayoral, L. (2007), "The Persistence of Inflation in OECD Countries: A Fractionally Integrated Approach", available at SSRN: https://ssrn.com/abstract=1002300 or http://dx.doi.org/10.2139/ssrn.1002300

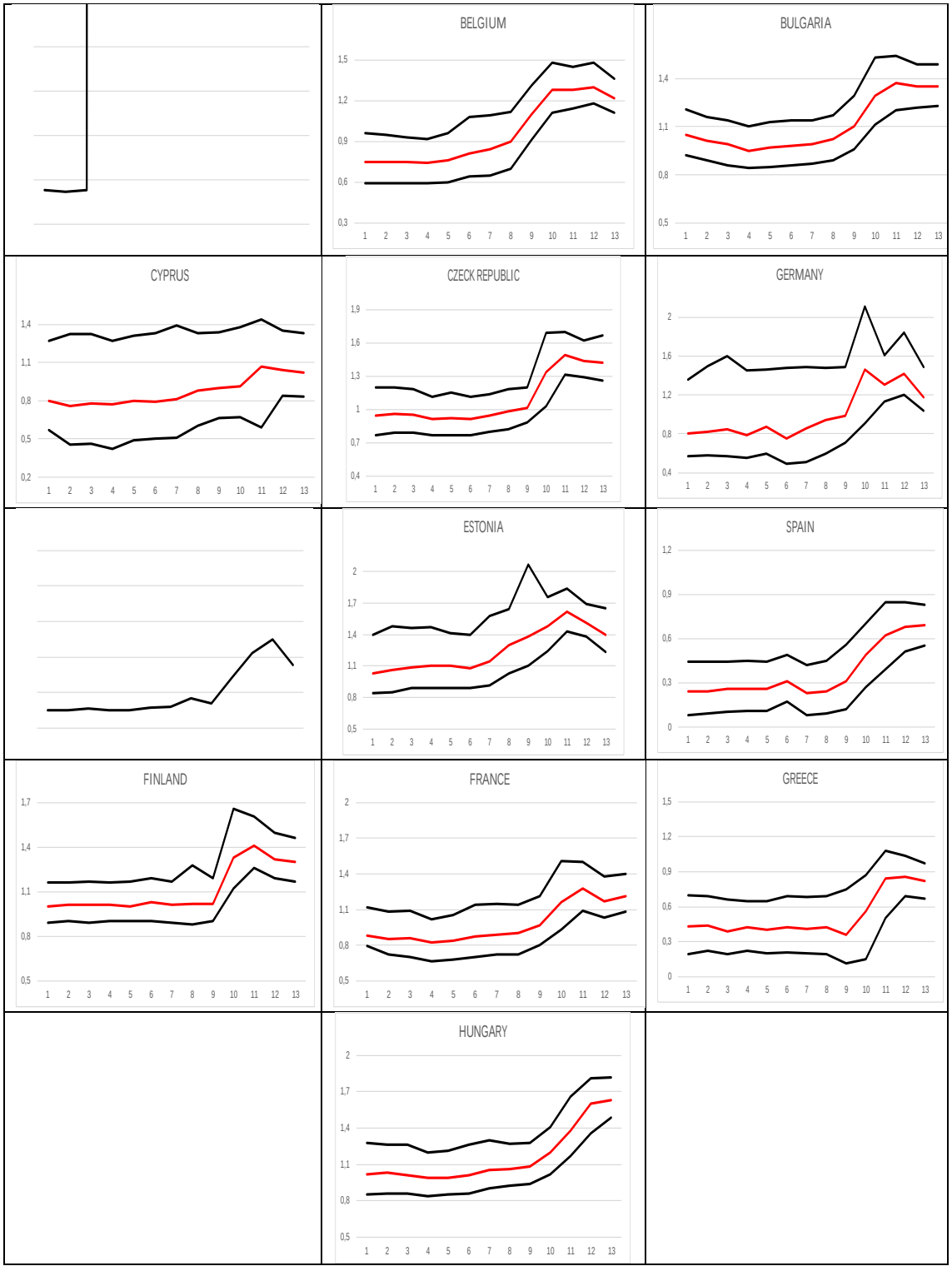
Pitman, E.J.G. Pitman (1948), Mimeographed Lecture Notes on Non-parametric Statistics, Columbia University, New York.

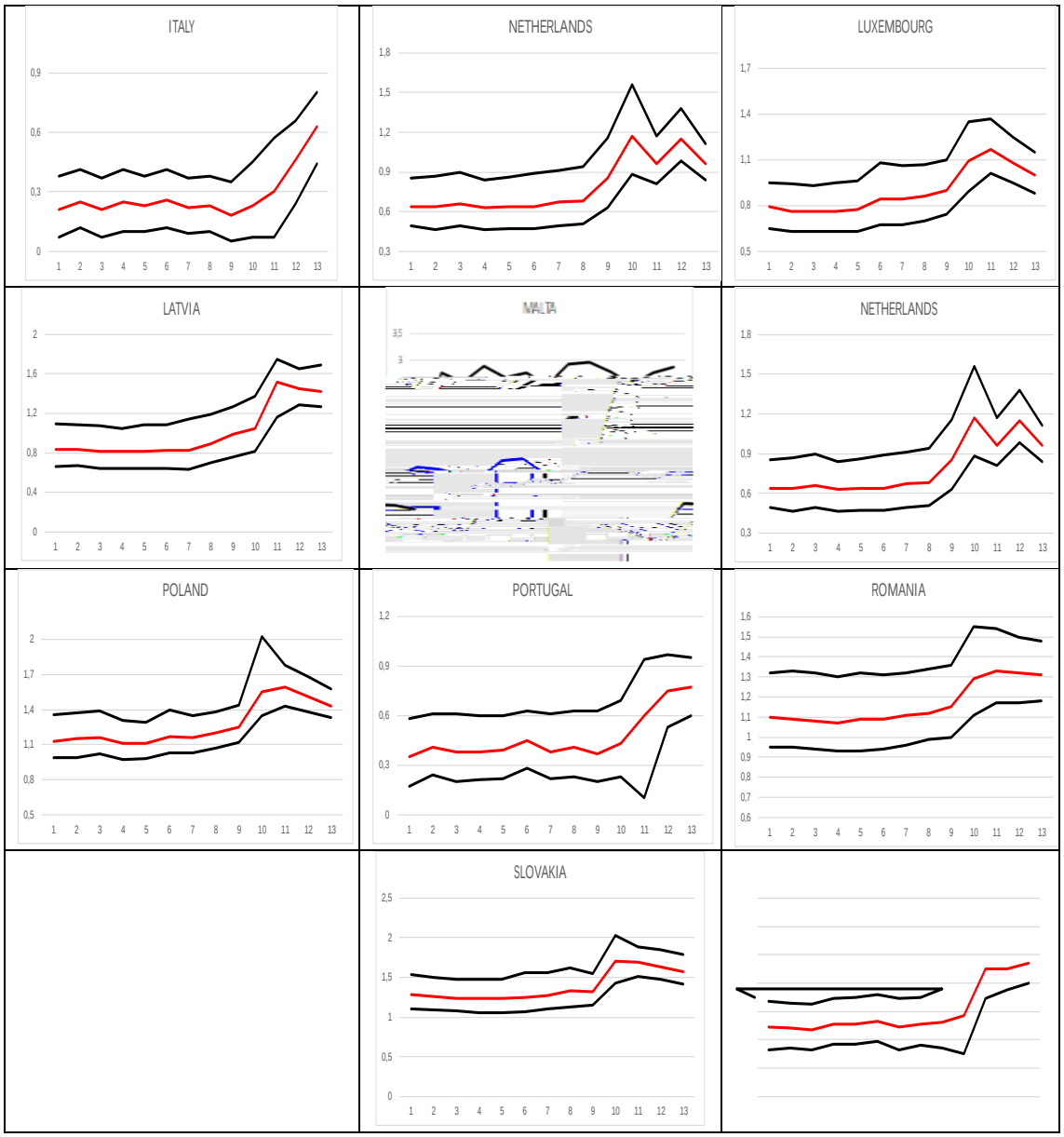
Pivetti, F. and Reis, R. (2007), "The persistence of inflation in the United States",

TABLE 1: Estimates of the differencing parameter. Sample ending in December 2019

Country	No terms	An intercept	An intercept and a linear time trend
AUSTRIA	0.93 (0.73, 1.21)	0.59 (0.53, 0.65)	**0.38 (0.23, 0.57)**
BELGIUM	0.92 (0.73, 1.19)	0.68 (0.61, 0.88)	**0.75 (0.59, 0.96)**
BULGARIA	0.94 (0.77, 1.22)	1.05 (0.91, 1.22)	**1.05 (0.92, 1.21)**

FIGURE 2: Price persistence

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