

## RESILIENCE OF CONSUMER PRICES LEVEL TO INTERNATIONAL TRADE SHOCKS IN EUROPEAN UNION

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**Abstract.** Inflation in most of the countries of the European Union has recently increased significantly. One of the main reasons for this is higher imports and, especially, energy prices. It is very important to investigate the specific characteristics of this process in different countries to better understand the reasons why countries are different in sensitivity to international shocks. This knowledge helps to improve inflation control. The results of a statistical analysis of 1269 balanced panel observations have revealed differences in inflationary reactions in European countries and possible reasons for these differences. These shocks were most significant in Lithuania, Estonia, Latvia, and Hungary.

**Keywords:** Harmonised Index of Consumer Prices (HICP), European Union, inflation, import, international trade, panel data analysis.

**JEL Classification:** E31, F47, M21.

### Introduction

The global economic environment has changed radically compared to two or more years earlier. Now most countries are influenced by different economic shocks, not only pandemic disruptions, World economic cycle downturn, energy crisis, war in Ukraine, climate crisis, inflation, and so on. “This is the year of the polycrisis, where risks are more interdependent and reciprocally damaging than ever” (World Economic Forum, 2023).

How are all these developments influencing the cost of living? What mechanisms are transferring these polycrisis shocks to living conditions, and how can we measure this influence? These questions are very often asked by populations, governments, statisticians, researchers, planners, companies, and researchers, and there are numerous published analyses on these questions. But anyway, many aspects of these problems still are not clear enough, different literature sources provide different answers, reliant on the points of view to what economic forces are the most important and what is the best way to measure the changes in population wellbeing.

In this article, we will discuss these main aspects. First, we should answer the question: how do we measure the impact of shocks in the international environment on the living conditions of the population? The second question is what transmission mechanism of these shocks to the living conditions of the population we can analyse? And the third question is how to quantitatively measure the scope of this transmission?

### 1. Literature review

For the evaluation of the influence of price dynamics on the changes of consumption level in the European Union, in the euro area, is officially accepted the Harmonised Index of Consumer Prices (HICP) is officially accepted. “It is ‘harmonised’ because all the countries in the European Union follow the same methodology. This ensures that the data for one country can be compared with the data for another.” (European Central Bank, 2023). However, there are different opinions in the literature on how to measure changes in consumptions in special situations. An increase in food price affects not only by limiting the

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amount of food that poor people can allow for themselves to buy, but also the structure of the diet may be affected by shifting to consumption of lower quality foods (Akin et al., 2019).

Researchers from the World Bank have noticed such biases in the Consumer Price Index (CPI): “commodity substitution bias, outlet substitution bias, quality change bias and bias from the introduction of new goods”, also “concerns about the representativeness of CPI weights for the poor” (Dabalen et al., 2020).

One of the most important transmission media for the “Polycrisis” of the influence of the world on the European countries are international trade relations. Juan Blyde has analysed import exposure and welfare effects from the expenditure channel (Blyde, 2021). Financial condition indices (FCI) were chosen for the analysis of the influence of the foreign environment on the country by other authors (Ganchev & Paskaleva, 2020).

On the question of how to evaluate these interactions quantitatively? The answers are also numerous. Researchers from the Board of Governors of the Federal Reserve System Colin J. Hottman and Ryan Monarch (2020) “constructed household-specific import price indexes based on a two-tier Constant Elasticity of Substitution framework, where at the upper tier, non-homotheticity is generated from sector-specific taste shifters at the household level, and Lower tier varieties are purchased according to a sector-specific elasticity of substitution” (Hottman & Monarch, 2020).

Other researchers used the threshold generalised autoregressive conditional heteroskedasticity (TGARCH) model and panel data analysis (Chiew & Sek, 2019).

Preliminary literature analysis suggests such successive research questions for the discussion: a) suitability of the Harmonised Index of Consumer Prices for the evaluation of consumption patterns; b) the role of international trade in the changes of the HICP; c) models for the evaluation of the impact of the international origin shocks on the index of consumer prices in the country.

### **1.1. Suitability of the Harmonised Index of Consumer Prices for the evaluation of consumption patterns**

Researchers are widely acknowledged for the importance of evaluation how the population is assessing the influence on them by different external shocks. Bildirici and Badur (2019) analysed the effects of oil and gasoline prices on the confidence of the population and the return of the energy companies for Turkey and the US by using the Markov switching vector auto regressive method and the Markov switching-granger causality methods. Such research was aimed at a rather narrow scope of targets from the oil industry.

Blundell et al. (2020) analysed COVID-19 influence on the consumer prices index and found that sometimes the basket of the CPI may not be adequate for the evaluation of actual spending, because the structure of the

basket may not adequately represent the latest changes in the consumption structure.

Some authors have researched the impact of oil spot prices on consumer prices by the consumer price index and the means of the consumption price index, and on producer prices as indicated by the producer price index and the means of production price index and a monetary policy (Chen et al., 2020). Such an attitude may be rational when investigating the impact of a limited number of imported commodities on one country's indexes.

De Mendonca and Garcia (2023) have proved that both the international oil price pass-through and the central bank credibility are relevant in explaining the price diffusion. They have also shown that the effects of oil price passing through and credibility of banks on price diffusion are long-lasting. They also found an asymmetry in the effect of fluctuations of oil price.

Diewert and Fox (2022) analysed the implications of the pandemic and associated lockdowns on a disappearing products problem in the construction of price indexes. During the pandemic, many goods and services became unavailable and the expenditure patterns for the still available products changed dramatically. These authors suggested that statistical offices must concentrate on getting more up-to-date expenditure weights for the post-lockdown period so that inflation during the lockdown period can be more accurately measured.

Our remark is that the other shocks also must be taken into account in the weights of the commodities in the consumer price indices, such as the war in Ukraine, and the consequences of these shocks on the international markets.

Koursaros et al. (2023); analysis revealed that “the decrease in the cost of living following a recession comes both from price decreases and the combination of more frequent sales and more active bargain hunting by consumers, a price index that simply focuses on prices and neglects high frequency sales and their weight in the consumer's basket appears to be less responsive to shocks”.

Other authors also used consumer price index for the evaluation of the impact on the population (Coulibaly, 2021; Guo et al., 2022; Jimenez-Rodriguez & Morales-Zumaquero, 2022; Kwark & Lim, 2020; Matsumura, 2022; Okolo & Udabah, 2019; Sasaki et al., 2022; Sek, 2019; Ten Raa, 2020; Tiwari et al., 2019).

According to the European central bank declaration, the European harmonised index of consumer prices is refined from many drawbacks mentioned by these authors (European Central Bank, 2023) and is suitable for the analysis of consumption shocks in Europe.

### **1.2. The role of international trade in the changes of the HICP**

There are different ways to evaluate international trade as the factor that influences the internal environment of the country. Some authors for forecasting of technological potential and the future possibilities of countries use

the Economic Complexity Index constructed on the basis of comparison of export and import information (Cakir et al., 2021).

Altunoz (2022). Analysed the nonlinear and asymmetric pass-through effect of crude oil prices onto the inflation.

Bildirici and Badur (2019) estimated the effects of oil and gasoline prices on the inflation dynamics and on energy companies in Turkey.

Blyde (2021) analysed import exposure and welfare effects of expenditure and found that the increase in Chinese import competition has influenced inflation in Mexico.

Some authors analysed different biases of the Harmonised Index of Consumer Prices and other consumer price indexes when evaluating the impact of different external factors (Herzberg et al., 2022; Jia et al., 2022; Kilic & Cankaya, 2020; Korley & Giouvris, 2022; Olanipekun et al., 2019; Phoong et al., 2019; Said & Giouvris, 2019; Sarkaya Icelliglu, 2019; Schlossarek et al., 2019; Shang & Hamori, 2021; Siami-Namini et al., 2020; Sun et al., 2022; Ueda, 2020; Von Auer & Shumskikh, 2022; Wang, 2022).

We selected import dynamics as a factor for the analysis of the impact of the foreign environment on the consumption of population.

### 1.3. Models for the evaluation of the impact of the international origin shocks on the index of consumer prices in the country

Yamaka et al. (2023) uses panel data analysis of 31 provinces in China to reveal spatial spillover effects of internet development on foreign trade in China. Other researchers also use panel data analysis for the determination of the causal relationship between beef prices and the consumer price index in Turkey (Akin et al., 2019). Other authors analysed the impact of oil prices on the consumer price index by applying ARDL (autoregressive distributed lag) and NARDL (nonlinear ARDL) models (Altunoz, 2022). Such a method is well suited for the analysis of time series in economics because it allows evaluating interrelation between two or more variables with nonlinear dependences in situations where variables are nonlinearly growing or declining over time.

Ozgun et al. (2021) used Factor Augmented Vector Autoregressive (FAVAR) methodology for the evaluation of the fuel price pass-through in Turkey.

Okolo and Udabah (2019) analysed the influence of crude oil price and exchange rate volatilities, on the cost of living in Nigeria applying the structural equation modelling with the three-stage Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model.

Kpodar and Liu (2022) used the local projection approach which basically consists of generating multistep predictions using direct forecasting models that are reestimated for each forecast horizon.

Hovhannisyanyan and Shanoyan (2020) used a panel demand model for the evaluation of the unobserved population and regional heterogeneity estimated by regional

panel data for the evaluation of price changes and two policy initiatives in China.

In our case, the aim of the paper is to reveal the differences between EU countries in reactions to external shocks, so the panel method is the best. This method allows one to evaluate the cross-section effects, which are very important for our research because they reflect the differences in reaction of the institutions of the European Union countries to external forces influencing the price level in the analysed countries.

## 2. Methodology

Based on theoretical analysis and the literature review, we selected the panel data analysis method to reveal differences in reaction to the external shocks of different European countries.

Panel data estimations are in many cases, especially in analysing such huge macroeconomic object as the European Union countries approached as the one system, much better than time series or cross-sectional analyses because the panel data analysis allows one to increase the simultaneously processed quantity of observations and also decreases the econometric problems arising from individual time series analysis.

## 3. The results and discussion

For the analysis, 1269 total panel (balanced) monthly observations were selected for the period from 01/01/2019 to 11/01/2022, total 47 periods for 27 countries (cross sections), from the Eurostat database (2023).

The dependent variable is HICP in the country and the independent variable imports to each country.

The estimation output of the equation is presented in Table 1. It shows rather good fit of the model: The R-squared is 0.923581 and the adjusted R-squared is 0.918913. The Durbin-Watson statistics show the existence of autocorrelation in the residuals of a regression, which is common in the panel data of countries, with the fixed cross-sections and with fixed periods. The computation procedure fixes these cross-section effects with dummy variables. This ensures rather high t-Statistics for the independent variable IMPORTSLOG and for the coefficient c. For our model the existence of the autocorrelation is not a problem, because the all-analysed countries were influenced by the similar fluctuations of imports prices, and for our research aim the cross-section effects (Table 2 and Figure 1) are more important than the coefficients of the linear regression coefficients.

From Table 2 we can see, that the most acute positive shocks for the HICP growth were in countries: CY (Cyprus), EE (Estonia), LT (Lithuania) and LV (Latvia). The most negative coefficients of the cross-section effects were observed in DE (Germany), FR (France), and MT (Malta). This may be explained by the greatest efforts against the fluctuations in import prices in these countries.

Table 1. The results of the estimation of the equation (source: estimations by the authors)

Dependent Variable: HICP_LOG				
Method: Panel Least Squares				
Date: 02/15/23 Time: 14:16				
Sample: 2019M01 2022M11				
Periods included: 47				
Cross-sections included: 27				
Total panel (balanced) observations: 1269				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.007882	0.065549	61.14318	0.0000
IMPORTSLOG	0.081475	0.007713	10.56314	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
Period fixed (dummy variables)				
R-squared	0.923581	Mean-dependent var.	4.700261	
Adjusted R-sq	0.918913	S.D. dependent var.	0.070391	
S.E. of regression	0.020044	Akaike info criterion	-4.925197	
Sum squared res	0.480121	Schwarz criterion	-4.625116	
Log likelihood	3199.038	Hannan-Quinn criterion	-4.812471	
F-statistic	197.8416	Durbin-Watson st	0.218963	
Prob (F-statistic)	0.000000			

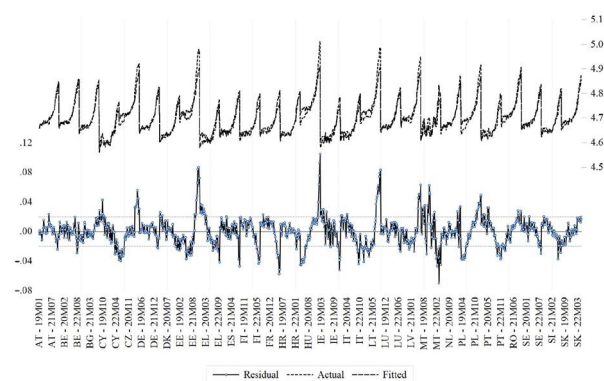


Figure 1. The residuals, actual and fitted of the equation  $HICP\_LOG=C + IMPORTSLOG$  panel data analysis of the European Union countries (source: Eurostat data, estimations by the authors)

The estimation of the fixed effects is presented in Table 3. Here we can see that the strongest influence of import prices growth was observed in the period from January 2022 to August 2022, and had a growing tendency.

The estimation of the equation Coefficient Confidence Intervals is presented in Table 4.

From the results in Table 4 we can observe that for the most often used 95% confidence level the confidence interval for the coefficient C (calculated value: 4.007882) is from 3.879278 to 4.136486. Respectively, coefficient for the independent variable IMPORTSLOG (calculated

Table 2. The estimation of the equation Cross-sectional effects (source: estimations by the authors)

No	COUNTRY	Effect	No	COUNTRY	Effect
1	AT	-0.053370	15	IE	-0.016005
2	BE	-0.100898	16	IT	-0.158360
3	BG	0.081166	17	LT	0.136109
4	CY	0.129337	18	LU	0.089881
5	CZ	-0.011629	19	LV	0.150284
6	DE	-0.211649	20	MT	0.209579
7	DK	-0.048898	21	NL	-0.111405
8	EE	0.179510	22	PL	-0.059879
9	EL	-0.006828	23	PT	-0.039699
10	ES	-0.117862	24	RO	0.032452
11	FI	-0.016708	25	SE	-0.037276
12	FR	-0.173825	26	SI	0.048059
13	HR	0.052210	27	SK	0.009368
14	HU	0.046336			

Table 3. The estimation of the equation Period fixed effects (source: estimations by the authors)

No	DATE	Effect	No	DATE	Effect
1	2019M01	-0.048054	25	2021M01	-0.019263
2	2019M02	-0.044427	26	2021M02	-0.022608
3	2019M03	-0.044793	27	2021M03	-0.029744
4	2019M04	-0.033798	28	2021M04	-0.016940
5	2019M05	-0.034415	29	2021M05	-0.013411
6	2019M06	-0.027454	30	2021M06	-0.015125
7	2019M07	-0.033855	31	2021M07	-0.010478
8	2019M08	-0.019455	32	2021M08	0.003789
9	2019M09	-0.031469	33	2021M09	-0.004045
10	2019M10	-0.035301	34	2021M10	0.003188
11	2019M11	-0.033675	35	2021M11	0.002172
12	2019M12	-0.025125	36	2021M12	0.010063
13	2020M01	-0.029778	37	2022M01	0.021437
14	2020M02	-0.030176	38	2022M02	0.028152
15	2020M03	-0.025632	39	2022M03	0.033180
16	2020M04	0.001431	40	2022M04	0.057267
17	2020M05	-0.005591	41	2022M05	0.063121
18	2020M06	-0.017428	42	2022M06	0.076656
19	2020M07	-0.021712	43	2022M07	0.086435
20	2020M08	-0.010958	44	2022M08	0.095072
21	2020M09	-0.026229	45	2022M09	0.097406
22	2020M10	-0.027559	46	2022M10	0.108639
23	2020M11	-0.032692	47	2022M11	0.108914
24	2020M12	-0.025736			

value: 0.081475) has 95% confidence interval from 0.066342 to 0.096608.

The estimation of the equation Residual Cross-Section Dependence Test is presented in Table 5. It shows the existence of the cross-sectional dependence (correlation)

Table 4. The estimation of the equation coefficient confidence intervals (source: estimations by the authors)

Coefficient Confidence Intervals							
Date: 02/27/23 Time: 15:45							
Sample: 2019M01 2022M11							
Included observations: 1269							
Variable	Coefficient	90% CI		95% CI		99% CI	
		Low	High	Low	High	Low	High
C	4.007882	3.899980	4.115784	3.879278	4.136486	3.838769	4.176995
IMPORTSLOG	0.081475	0.068778	0.094172	0.066342	0.096608	0.061576	0.101375

Table 5. The estimation of the equation Residual Cross-Section Dependence Test (source: estimations by the authors)

Residual Cross-Section Dependence Test			
Null hypothesis: No cross-sectional dependence (correlation) in residuals			
Equation: EQ01_LOGHICP_LOGIMP			
Periods included: 47			
Cross-sections included: 27			
Total panel observations: 1269			
Cross-section effects were removed during estimation			
Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	6267.284	351	0.0000
Pesaran scaled LM	223.2957		0.0000
Bias-corrected scaled LM	223.0023		0.0000
Pesaran CD	-1.242878		0.2139

in residuals that can be explained by the same source of the external shocks on the HICP from the world market prices of imports to European countries.

The results in Table 5 show that the Null hypothesis: “No cross-sectional dependence (correlation) in residuals exists” is rejected. This result was expected, because all the European Union countries were affected by the same external factors influencing the price level in the international trade. For our research this correlation is not essential, because our focus was on the Cross-section effects estimation which reveals the specific reactions of the inflation index to changes in the conditions of international trade.

## Conclusions

These results have revealed that not all countries have suffered the increase in prices in the same way. The Baltic countries and Malta got the biggest shock.

The most efficient efforts to compensate the effects of negative shocks from import prices were observed in Germany, France, and Italy.

The panel data analysis method allowed us to reveal differences in reactions to the external shocks in different European countries. Such an analysis may be useful for governments of European countries for the fine tuning of their economic policy.

Future research may be done after the new monthly data will be available for the analysed countries, which may reveal changes in the economic policy of these countries. Another possibility is to include more independent variables for the evaluation of additional factors that influence the dynamics of HICP as an inflation index in the countries of the European Union.

## Disclosure statement

The authors have no competing financial, professional, or personal interests from other parties.

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