Global Inflation Before and After the Covid-19 Pandemic: A Panel Data Approach

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Abstract

The main objective of this article is to investigate the global inflation rate behavior before and after the Covid-19 pandemic, for a panel of 42 advanced and emerging market countries. By making use of quarterly data from 2016Q3 to 2022Q3, in a System GMM econometric methodology, we will also investigate the consequences of the beginning of Russia-Ukraine War. The estimated global inflation empirical models indicate that: i) there is indication of anti-inflation persistence before the Covid-19 pandemic and increase in inflation persistence, and statistically significant, after the pandemic; ii) there is evidence of the Fisher Effect, via interest rate dynamics, for all estimated models; iii) there is exchange rate passthrough to inflation only for the post Covid-19/War period, but the deflationary process caused by the exchange rate dynamics has not been enough to contribute to an effective global inflation control after 2020; iv) food and oil prices seem to be specifically important in explaining the recent inflation surge; v) Global supply chain pressures helped to mitigate inflation, before the pandemic, but contributed significantly to the global inflation surge after the outbrea; vi) there is evidence that emerging market economies have been facing lower inflation rates, compared to advanced countries, especially in the post Covid-19/War period.

Keywords: Global Inflation; Coronavirus Pandemic; Russia-Ukraine Conflict; Supply-Chain; System GMM.
JEL Classification: E31, E58, F51, I18

1. Introduction

In 2008-09 the world was struck by a serious financial breakdown, the subprime mortgage crisis, which started in the US and spread throughout advanced and emerging economies. Data from the World Bank show that the Global GDP growth dropped from, respectively, 4.4% and 2.1%, in 2007 and 2008, to -1,3%, in 2009, recovering only in 2010, with a 4.4% average growth rate. In order to fight the financial crisis, interest rates were decreased, and a great amount of monetary expansion was put into place to help financial institutions in danger of failure and, therefore, putting at risk the global economy as a whole.

It took just about one decade for the world economy to be hit by another major event, the Covid-19 pandemic, followed by the Russia/Ukraine conflict. These crises generated some important exogenous shocks, which led to a considerable drop in the world's GDP, an initial deflationary process, followed by a sudden inflation surge, especially due to supply-chain bottlenecks caused by the sudden lockdown. According to IMF (2023), the global GDP growth dropped from 2.8%, in 2019, to -2.8%, in 2020. This economic downturn was more concentrated in advanced economies, from 1.7% (2019) to -4.2% (2020), in comparison with emerging economies, from 3.6% (2019) to -1.8% (2020). As for the 2021/2022 recovery period, the World GDP growth reached 6.3%, in 2021, and 3.4%, in 2022), highlighting the performance related of emerging market countries, 6.9% (2021) and 4.0% (2022), compared to the advanced countries, 5.4% (2021) and 2.7% (2022).

As for inflation rate, the pandemic lockdown led to an initial price decrease, as average global inflation rate reduced from 2.2% (2019) to 1.9 (2020). This process was especially more intense in advanced countries, with inflation decreasing from 1.4% (2019) to 0.7% (2020), whilst emerging economies continued to mark an average inflation rate above 5.0% in 2019 and 2020. The supply-chain bottlenecks and the Russia/Ukraine conflict generated two other important economic shocks which affected inflation all over the planet, with inflation rate averaging 8.3%, in 2022, and almost reaching a double digit (9.85%) in emerging market economies (IMF, 2023).

Despite being recent, a lot has been said and written about these major shocks related to the Covid-19 pandemic, together with the Russia/Ukraine War. As it will be discussed more thoroughly in the next section, the literature has been debating topics such as: substitution effect, change in consumer behavior, impact on unemployment, Phillips Curve alterations, price controls, etc.

This article aims at investigating the effects caused on global inflation by the Covid-19 pandemic and the Russia/Ukraine War. Our aim is not to detail an explanation of the world

inflation throughout the past decades, but only to analyze how prices performed some years before and after the pandemic.

The economic variables defined as potentially determinants of global inflation are country-specific short-term interest rate, real effective exchange rate, output gap, and global variables, such as food prices, oil prices, and a global supply chain pressure index. To this end, this research makes use of System GMM econometric methodology for a panel of 42 advanced and emerging market countries, for the period ranging from 2016Q3 to 2022Q3. The empirical estimations show a significant global inflation persistence (inertia) for the period after the pandemic, as opposed to the anti-persistence detected before the outbreak. There is also a positive effect of the interest rate (Fisher Effect), on global inflation in all models estimated, and an exchange rate passthrough to inflation only for the post Covid-19/War period. However, the deflationary process caused by the exchange rate dynamics has not been enough to contribute to an effective inflation control after 2020. As for food and oil prices, they seem to be specifically important in explaining the recent inflation surge. As for global supply chain pressures, they helped to mitigate inflation, before the pandemic, but contributed significantly to the global inflation surge after the outbreak. Finally, the dummy variable indicates that emerging and less developing economies have been facing lower inflation rates, compared to advanced countries, especially in the post Covid-19/War period.

Besides this introduction, this article has four more sections. Section 2 brings the literature related to the topic analyzed. Section 3 describes the data and econometric approach. Section 4 reports all empirical results, and the final section concludes.

2. Global Inflation and Covid-19 Pandemic: Literature Review

Inflation dynamics around the world has been a source of investigation among researchers and economists for a long time. For instance, in the beginning of the 2000s, Rogoff (2003) documented that global inflation dropped from 30% to 4%, especially due to improved central bank institutions and actions, as well as greater awareness of politicians and economic agents that higher inflation could be the wrong instrument to deal with fiscal problems.

Some years later, Woodford (2007) expressed his concern regarding the ability of monetary authorities to control inflation in a globalized world due to the possibility of i) liquidity premia being more related to global liquidity, than to domestic liquidity supplied by the central bank; ii) real interest rates being more dependent on the investment = saving global balance, than to domestic balance; iii) inflationary pressures being more linked to a “global slack”, than to a country’s output gap.

Ciccarelli & Mojon (2010) analyzed the case of 22 OECD economies, with quarterly data from 1960 to 2008, by estimating the following Augmented Phillips Curve model to forecast global inflation h-step-ahead:

$$\pi_{i,t+h}^{h} = \alpha_{i,0} + \alpha_{i,1}(L)\pi_{i,t} + \alpha_{i,2}(L)\Delta IP_{it} + \alpha_{i,3}(L)\Delta M3_{it} + \alpha_{i,4}(L)\Delta CoP_{t} + \varepsilon_{i,t+h} \quad (1)$$

where: π = inflation (first difference); IP = industrial production (growth rate); M3 = monetary measure (growth rate); CoP = commodity price including energy (growth rate); L = lag operator.

The authors showed a comovement of approximately 70% of the inflation variance in the countries analyzed. This was related to trend components and business cycle fluctuations and made domestic inflation a global phenomenon. They also found that domestic inflation rates usually revert to global inflation due to a strong error correction mechanism and that global inflation is much more than just commodity prices.

Eickmeier & Pijnenburg (2013) made use of a Phillips Curve to analyze global inflation from 1980 to 2007, through data related to 24 OECD countries. They estimated the following augmented Phillips curve equation:

$$\Delta p_{it} = \sum_{j=1}^{4} \beta_{1ij}\, \Delta p_{it-j} + \beta_{2i} y_{it} + \sum_{j=0}^{4} \beta_{3ij}\, \Delta ulc_{it-j} + \sum_{j=0}^{4} \beta_{4ij}\, \Delta imc_{it-j} + \sum_{j=0}^{4} \beta_{5ij}\, \Delta imnc_{it-j} + \varepsilon_{i,t+h} \quad (2)$$

where: Δ = first difference: p_{it} = log CPI of country i (quarter-on-quarter); y_{it}= output gap (HP filtered real GDP); ulc_{it}= log of unit labor costs; Δimc_{it-j} and $\Delta imnc_{it-j}$ = commodity and non-commodity import prices, respectively. The authors found evidence that global inflation is affected by labor costs, import price inflation, international competition, and global interest rate. The pass-through of commodity and non-commodity import price changes to inflation is low but statistically significant.

Parker (2018) constructed a CPI dataset for 223 economies for the period ranging from 1980 to 2012 and showed a decrease in global inflation, mainly in advanced countries, with relative stability until the global financial crisis. Volatility was found in food and energy prices, which usually presented the highest average inflation in the past 30 years. The author also showed that global factors explain about 2/3 of inflation variance in high income economies, but such explanation declines considerably for lower income economies.

Ha et al. (2019a) examined the synchronization case as a source of explanation for global inflation. According to the authors, since 2001, a common global factor has been responsible for explaining 22% of inflation variation across emerging and advanced countries. Such

synchronization could be explained by common shocks, similarities in policy response actions, financial flows, and international trade connections, amongst others.

Ha et al. (2019b) examined the main factors influencing domestic and global inflation rates, for a group of 29 advanced and 26 emerging economies. For the period ranging from 1970 to 2017, they applied a FAVAR econometric methodology with three global variables (inflation, real output growth, and oil prices) and four country-specific variables (CPI inflation, output growth, nominal interest rates, and nominal effective exchange rates). They found that global inflation is largely influenced by global demand and oil price shocks (each of them contributing to 40% of the global inflation variation) and global shocks have been responsible for 25% of the variation in national inflation since the 1970s. However, domestic shocks have accounted for about 75% of domestic inflation variation, in emerging economies, which are more affected by global shocks when they don't follow an inflation targeting regime, with open capital accounts and greater trade openness.

Ha et al. (2023) built a global database to analyze the role of synchronization in explaining inflation around the world and the inflation behavior during global recessions. They found that prices decreased sharply during recessions and continued to decrease even during the recovery period.

Even though the Covid-19 Pandemic and the Russia/Ukraine War have been two recent major events, there is a considerable amount of research on several aspects on consequences of the socks caused by them, particularly the pandemic. For instance, the impact of Covid-19 on unemployment has been examined by Gallant et al. (2020), Lee et al. (2021), Forsythe et al. (2022), Hall & Kudlyak (2022), Carrillo-Tudela et al. (2023), Guo et al. (2023), Lee et al. (2023), Leyva & Urrutia (2023), Pizzinelli & Shibata (2023), among others. Some other authors, such as Xu et al. (2021), Dong et al. (2021), Fujiwara (2022), Meyer et al. (2022), Kim et al. (2022), have focused especially on the consumption changes that the pandemic crisis produced.

Bonam & Smădu (2021) examined the long-run impacts of major pandemics on the European inflation, by using local projection methods and data from 1313 to 2018, covering 19 major pandemics. They showed a significant decrease in trend inflation for more than one decade after the outbreak, which might be different with the Covid-19 pandemic because of i) the quick response of fiscal and monetary authorities to accommodate the negative shocks in their economies, resulting in higher inflation; ii) the arrival of several vaccines, contributing to a quick recovery of the economy; iii) the possibility of some sectors to do their businesses from home or in another alternative way; iv) supply-side pressures and cost-push-shocks.

Caporale et al. (2022) applied a fractional integration process to analyze the European inflation persistence case during the Coronavirus pandemic and the Russia-Ukraine conflict. Their

econometric results showed clear indication of inflation persistence increase in the period, suggesting that the shocks related to the two episodes are temporary, though long-lasting.

Reis (2022) aimed at analyzing four hypotheses for why monetary authorities were unsuccessful in preventing the burst in inflation in 2021–22: i) misjudgment of the characteristics of perturbations; ii) misinterpretation that inflation expectations were anchored and that price surges increases were temporary; iii) belief that, due to credibility conquered in the past, emphasis on real activity recovery would not lead to increase in inflation; iv) central banks tolerance of higher inflation. The author's final arguments were related to suggestions on lowering inflation rates, such as admitting future lower real activity levels, re-anchoring inflation expectations by increasing interest rates, reassuring price stability as the main goal.

Schmitt-Grohé & Uribe (2022) explored the US inflation case, for the period 1900-2021, via estimation of a semi-structural model. Their model predicted a 238 basis points increase of the permanent component of US inflation in the more than 60 years related the postwar data (1955-2021), a period without any sudden inflation growth. When the focus was on the Covid-19 pandemic period (2019-2021), the same prediction showed a 51 basis points increase, i.e., a considerable increase in the permanent component of US inflation in the Covid-19 pandemic period.

Di Giovanni et al. (2022) built a calibrated model to analyze the effects of the Coronavirus outbreak on the European Inflation and comparisons with other economies, for the period 2020-2021. The authors showed that the 2020-21 Euro Area inflation was much more influenced by foreign shocks and global supply chain bottlenecks than by domestic aggregate demand shocks. They also found that inflation and trade were affected by the substitution of consumption from services to goods and that inflation was higher in sectors with labor scarcity. Finally, they found that foreign trade reaction to GDP movements was weaker, compared to the 2008-09 global financial crisis.

Binici et al. (2022) used monthly data for a panel of 30 European countries, from 2002 to 2022, to estimate the following empirical inflation model based on an augmented Phillips in a panel setting:

$$\pi_{c,t} = \beta_1 + \beta_2\pi_{c,t-1} + \beta_3 Y_{c,t}^{Domestic} + \beta_4 Y_t^{World} + \beta_5 neer_{c,t-1} + \beta_6 energy_t + \beta_7 nonenergy_t + \beta_8 GSCP_t + \eta_{c,t} + \varepsilon_{c,t} \quad (3)$$

where: c = country and t = time; π = country's inflation rate; Y = output gap; $neer$ = nominal effective exchange rate; $energy$ = international energy; $nonenergy$ = non-energy commodity prices; $GSCP$ = global supply chain pressure; η = time-invariant country-specific effects.

Their results showed that the European consumer inflation continues to be driven by global factors, such as international energy and non-energy commodity prices and global supply chain pressures, and the exchange rate. But country-specific aspects, such as monetary and fiscal policy coordination, grew in importance, during the coronavirus pandemic period, in explaining high inflation and its persistence in Europe. According to the authors, domestic factors gained importance in explaining inflation dynamics across all countries in the post-pandemic period.

Long et al. (2022) made use of a panel data of 38 countries, from January/2020 to June/2021, to investigate the effects of the Coronavirus outbreak on the world's macroeconomy and whether actions taken by monetary authorities helped mitigate the negative effects of the COVID-19 pandemic. They observed an increase in inflation and unemployment and that the actions taken by central banks were unable to alleviate the macroeconomic consequences of the COVID-19.

Storm (2022) analyzed the main drives related to inflation in times of Covid-19 and War period and argued that such price surge was mainly related to supply-side problems, due to the Covid-19 pandemic, together with some incorrect past and current macroeconomic policy decisions. The author also observed that controlling this type of inflation needs much more than simply raising interest rates, but using other instruments such as, an energy price control strategy, price caps or targeted relief, and some intervention to overcome supply chain bottlenecks.

Harding et al. (2023) proposed a nonlinear Phillips curve able to capture the modest inflation decrease in inflation in the Great Recession period and the inflation increase in the post Covid-19 period. The authors estimated the model for quarterly US data, from 1965Q1 to 2022Q1, considering important variables, such as real per capita GDP, consumption, investment, federal funds rate, among others. Their results showed that high inflation pressures made the monetary authority deal with inflation-GDP trade-off more strongly.

Benigno & Eggertsson (2023a) also worked with a non-linear New Keynesian model to account for the 2020s inflation surge. According to the authors, such increase in inflation and in its persistence was neglected because economic agents assumed a "flat" Phillips Curve and continued to believe that the inflation shock was transitory, even after high inflation rates were in place.

Benigno et al. (2023b) investigated the recent dynamics of inflation and monetary policy stance in the Euro Area. The authors argued that supply shocks were responsible for bottlenecks and an energy crisis in the beginning of 2021. They also argued that contracting aggregate demand, to lower inflation rate, would be costly. Therefore, a policy mix would be more desirable to bring inflation rate back to its target in a medium to long term with a soft landing of the economy.

Gagliardone & Gertler (2023) built a New Keynesian model to examine the recent US inflation case, placing emphasis on oil price increases, due to the Russia/Ukraine war, and on FED's delayed response to increasing inflation in 2021. The authors showed that their model was able to account for the 2020s US inflation surge, and that the combination of oil price shocks and "easy" monetary policy was crucial for such event.

Maurya et al. (2023) used an event study-based approach related to CPI data for 60 economies, for the period ranging from January/2020 to June/2022, to investigate the impact on global inflation of the Russia-Ukraine conflict. Their findings showed that Ukraine's invasion by Russia caused a surge in global inflation, with specific effects determined by geographical proximity and trading relations. activity with the countries in conflict.

Ferrante et al. (2023) analyzed the inflationary effects of sectoral reallocation caused by the COVID-19 pandemic, which shifted the consumption from services to goods. Their model showed that shocks related to demand reallocation explained a large proportion of the U.S. inflation hike after the coronavirus pandemic.

3. Data, Empirical Specification and Econometric Approach

For the period ranging from 2016Q3 to 2022Q3 we analyze data for the following panel of 43 developed and developing countries: Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, UK, USA (see Table A1). Therefore, we follow the strategy of working with a group of countries representing different parts of the world, instead of focusing on one specific region or country-type, which is usually the strategy followed by most of the articles mentioned in the literature revision.

As usual, there is a mixture of country-specific variables and some global variables in our estimations. They are:

- π_{it} = Consumer Inflation Rate (% year). Source: The World Bank.
- r_{it} = Short-term Interest Rate (% year). Source: OECD.
- $reer_{it}$ = Real Effective Exchange Rate (change; increases = appreciation). Source: BIS.
- gdp_{it} = GDP Gap – HP Filtered (U.S. dollars, 2015). Source: OECD.
- $trade_{it}$ = Trade Balance (Exports – Imports) (U.S. dollars, 2015). Source: OECD.
- $food_t$ = Food Prices (% change over previous period). Source: IMF.
- oil_t = Oil Prices (% change over previous period). Source: IMF.

- $GSCPI_t$ = Global Supply Chain Pressure Index (standard deviations from the index's historical average). Source: Benigno et al. (2022), FED New York.

As in Ciccarelli & Mojon (2010), Eickmeier & Pijnenburg (2013), and Binici et al. (2022), we estimate a parsimonious Augmented Phillips Curve model to analyze global inflation in recent years. A general representation of the empirical model can be given by the following equation:

$$\pi_{it} = \beta_0 + \beta_1 \pi_{it-1} + \beta_2 r_{it} + \beta_3 dreer_{it-1} + \beta_4 gdp_{it} + \beta_5 trade_{it} + \beta_6 controls_t + u_{it} \quad (4)$$

The β_1 coefficient, related to the lagged inflation, captures the global inflation inertia (persistence). The interest rate (β_2) coefficient captures the Fisher Effect, meaning that nominal interest rate must increase together with inflation increases to keep real interest rate constant. The lagged exchange rate (β_3) coefficient describes the impact of delayed exchange rate movements on inflation. The purpose behind this approach is that exchange rate movements might affect prices, and therefore inflation, with some delay. The β_4 coefficient is related to each country's economic activity and the β_5 coefficient captures the exposure of global inflation to trade openness. The β_6 coefficient is related to the control variables, which are three important global factors: oil prices, food prices and the GSCPI - Global Supply Chain Pressure Index (Benigno et al, (2022).

The System GMM (two-step) robust estimation will be used as econometric methodology. This methodology is chosen because it considers the time series and the cross-sectional dimensions of the data, and it is also able to deal with non-observable country-specific effects and possible endogeneity problems in the explanatory variables. However, the GMM System empirical methodology poses two important challenges. The first one is the presence of weak instruments and their connection with an asymptotical increase in the coefficients' variance, which might lead to biased coefficients in small samples. Arellano & Bond (1991), Arellano & Bover (1995) and Blundell & Bond (1998) deal with this problem of reducing the potential bias and inaccuracy related to the use of Difference GMM by developing a regression system in differences and levels. The authors say that the lagged levels of the explanatory variables can be used as instruments for the regression in differences, and lagged differences of the explanatory variables can be used as instruments for the regression in levels. They are suitable instruments as it is assumed that the possible correlation between country-specific effects and the levels of the regressors end to disappear when regressors are in differences.

Another empirical challenge is raised by Roodman (2009a, b), who draws attention to the symptoms caused by instrument proliferation in GMM estimations. The author argues that an excessive number of instruments, compared to the sample size, might lead to biased coefficients, invalidating some asymptotic results and specification tests. In order to deal with the instrument

proliferation problem, the system GMM methodology used in this paper applies the "collapse" empirical strategy, which creates an instrument for each variable and lag distance (Vieira et al., 2013).

We will estimate four dynamic panel data inflation models: i) Model 1: Baseline Model, including inflation (dependent variable) and the following control variables: lagged inflation, interest rates, real effective exchange rate (% change) and GDP gap; ii) Model 2: adds food prices to the Baseline Model 1; iii) Model 3: adds oil prices to the Baseline Model 1; iv) Model 4: adds the Global Supply Chain Pressure Index to the Baseline Model 1. We will also include a dummy to differentiate emerging/less developed countries (dummy = 1) advanced economies (dummy = 0). As a benchmark, we will firstly estimate the four models for the whole period and report on Table 2. After that, we will estimate the same four models but breaking the analysis into two periods (Pre-Covid-19: from 2016Q3 to 2019Q3 and Post-Covid-19: from 2020Q2 to 2022Q3). These results will be reported on Table 3.

The descriptive statistics reported on Table 1 show an increase in the average consumer inflation rate, when the periods before and after Covid-19 outbreak are compared. This is in line with the results of Schmitt-Grohé & Uribe (2022) for the US case, who found that the permanent component of US inflation grew in the Covid-19 pandemic period. On the other hand, Bonam & Smădu (2021) reported a different finding but argued that the Covid-19 pandemic could be different as several measures were taken to ease the negative shocks, businesses were performed in several alternative ways, vaccines were quickly made available, and several supply bottlenecks. All these prevented inflation from decreasing heavily, as was usually the case in other pandemics.

As for maximums and minimums, the maximum inflation rates detected before and after the pandemic Covid-19, were in Lithuania (2.98%), and Russia (8.65%), respectively, while the minimum rates were found in Greece, before and after the crisis.

Table 1 also shows that the average global interest rate dropped from 1.67%, before the pandemic, to 1.22%, after the crisis. Despite the high inflation process, this interest rate decrease happened to fight the recession detected by the average GDP Gap, which dived into negative territory. The maximum short-term interest rate (pre and post Covid-19) are found in Brazil, 14.15% and 13.65%, respectively. Both minimum values refer to the Swiss data, -0.84% and -0.78% (Table 1).

Regarding real effective exchange rate dynamics. As in the case of Brazil, for interest rates, both maximum values (pre and post Covid-19) related to the exchange rate are found in Russia, 10.92% and 70.57%, respectively. The minimum value for the post Covid-19/War (-23.7%) is also found in Russia, indicating a high exchange rate volatility in the country. As for the three important

prices for the global economy, it is clear that the descriptive statistics (mean, standard deviation, minimum and maximum) skyrocketed from 2020 on (Table 1).

Table 1: Descriptive Statistics

	Pre Covid-19 (2016Q3-2019Q3)				Post Covid-19 (2020Q2-2022Q3)			
	Mean	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Inflation (% year)	0.47	0.66	-2.09	2.98	0.88	1.04	-2.187	8.65
Interest Rate (% year)	1.67	2.89	-0.84	14.15	1.22	2.47	-0.78	13.65
DREER - Exchange Rate	0.07	2.55	-11.44	10.92	0.03	4.66	-23.7	70.57
GDP Gap	16	57	-304	456	-23	161	-1917	746
Trade Balance	-3452	47338	-241468	228368	-1863	59388	-329634	321760
Food Prices	0.46	3.21	-6.84	7.79	3.38	7.64	-13.30	13.9
Oil Prices	60.52	9.24	46.98	76.08	69.44	24.3	33.77	111.98
Global Supply Chain Pressure Index	0.45	0.99	-1.45	2.11	6.92	2.77	2.63	12.48

Notes: i) Pre Covid: obs = 630; Pos Covid: obs = 462.; ii) REER increases = appreciation
D = indicates first difference
Mean, std. dev., min. and max for the GDP Gap series must be multiplied by 1000.

4. Empirical Results

Even though our main aim is to examine global inflation before and after the Covid-19 pandemic, and consider the Russia/Ukraine conflict, we will start our investigation by analyzing the system GMM panel estimation results for the whole period, ranging from 2016Q3 to 2022Q3. Table 2 shows that the lagged inflation coefficient is not statistically significant in any estimation performed, meaning that, if we disregard the effects related to the Coronavirus pandemic and beginning of the Russia/Ukraine war, there is no indication of inflation inertia (persistence) for the whole period analyzed. The same pattern happens with the trade balance coefficient, which has no statistical significance in all estimated equations.

On the other hand, the interest rate coefficient has a positive and statistically significant impact on global inflation, which is evidence for the Fisher Effect, indicating that nominal interest rates increase together with global inflation increases to keep global real interest rate constant.

Changes in the real exchange rate have a negative sign in the four estimated models. This is an expected outcome once an increase in exchange rate indicates a currency appreciation process, which is normally deflationary, and vice-versa. However, statistical significance is found in only one estimation, when the whole period is analyzed. Finally, there is evidence of an unexpected negative output gap coefficient, though without statistical significance.

The coefficients related to food prices, oil prices and global supply chain pressures are positive and statistically significant, reflecting the importance of global factors in determining global inflation. As for the dummy variable for emerging and less developing countries, the

estimated coefficients are not statistically significant for the estimation related to the entire period analyzed, meaning that there is no difference in the inflation behavior of emerging and advanced economies.

As for diagnostic tests, the autocorrelation results indicate no second order autocorrelation and that the Hansen overidentification tests suggest that the set of instruments are valid for all estimated models (Table 2).

Table 2: Global Inflation Model - System GMM - Whole Period

Variables	Model 1	Model 2	Model 3	Model 4
Inflation$_{t-1}$	0.181 [0.169]	0.219 [0.119]	-0.057 [0.618]	-0.058 [0.647]
Interest Rate	**0.136** **[0.000]**	**0.172** **[0.000]**	**0.102** **[0.000]**	**0.225** **[0.000]**
DExchange Rate$_{t-1}$	-0.025 [0.210]	-0.028 [0.145]	-0.014 [0.428]	-0.015 [0.379]
GDP Gap	2.77E-08 [0.899]	-3.70E-08 [0.858]	**-8.13E-07** **[0.040]**	3.85E-07 [0.197]
Trade Balance	2.37E-06 [0.183]	2.44E-06 [0.151]	2.25E-06 [0.255]	2.51E-06 [0.111]
Food Prices		**0.028** **[0.000]**		
Oil Prices			**0.021** **[0.000]**	
Global Supply Chain Pressures				**0.076** **[0.000]**
Dummy Emerging	-0.609 [0.441]	-0.704 [0.267]	0.014 [0.984]	-0.786 [0.202]
Autocorrelation AR(2) [Prob]	[0.080]	[0.077]	[0.134]	[0.150]
Hansen [Prob]	[1.000]	[1.000]	[1.000]	[1.000]

Notes: P-values in brackets. REER increases = appreciation.
D = indicates first difference
All estimated models use Stata's collapse command to deal with instrument proliferation.

As the main objective of this article is to investigate the global inflation rate behavior before and after the Covid-19 and Russia-Ukraine War for a panel of 42 advanced and emerging market economies, we will now analyze the GMM estimation results for these distinct periods.

The results reported on Table 3 show a lot of differences, when compared to the whole period (Table 2). For the period before the pandemic outbreak, the inflation inertia (persistence) coefficient is statistically significant, with a negative sign, in all four estimated models. This is different from what was reported on Table 2, for the whole period, and it shows indication of anti-persistence before these two major crises (pandemic and war) that hit the whole planet in the beginning of the 2020s.

For the period after the pandemic the inflation inertia coefficient is positive in three out of the 4 models estimated, with statistical significance in two of them. This indicates a strong

possibility of inflation inertia (persistence) growth after the beginning of these two major crises. This persistence increase is in line with Caporale et al. (2022), for the European case, which showed indication of inflation persistence growth in the period. Binici et al. (2022) also reported statistically significant inflation persistence in their post-pandemic longer lags estimation for the European case.

A coefficient that did not change from the previous estimations is the one related to the interest rate (Table 3). In all regressions performed (before and after the crisis), the interest rate has a positive and statistically significant impact on global inflation. Again, this is evidence in favor of the Fisher Effect, meaning that the global nominal interest rate must increase together with global inflation to maintain the global real interest rate constant. However, a nuance worth noting is that the Fisher Effect seems to be much higher in the second period, as it marks an average of 0.254, compared to the average 0.129 from the previous period.

Also, the output gap coefficient came out positive, with statistical significance in 3 of the 4 estimated models in the second period, with the previous period maintaining its lack of statistical significance, just like all trade balance coefficients. This result is in line with Caporale et al. (2022) for the European case, who also found statistically significant output gap in their post-pandemic longer lags estimations.

The exchange rate passthrough is statistically significant (a negative sign) in all regressions, only in the period after the coronavirus outbreak/war. This is the same result reported for the whole period but now with statistical significance. As before, this is an expected outcome once an increase (decrease) in the exchange rate indicates an appreciation (depreciation) process, which is normally deflationary (inflationary). However, this expected negative sign has not been enough to contribute to an effective inflation control after 2020.

Table 3 also brings the results related to the global variables (food prices, oil prices and global supply chain pressures) included in the analysis because they are related to cost push shocks and, therefore, typically more volatile. Basically, the passthrough of food and oil price changes to inflation seems to be specifically important in explaining the recent global inflation surge, as well as the global supply chain pressure index. The specific impact of each of these prices is depicted in the following paragraph.

The oil price variable is the only one which kept its coefficient positive and statistically significant before and after the Covid-19/War crisis, meaning that the influence of this commodity price on global inflation is very important. Table 3 shows that the coefficient is higher in the post-pandemic estimation, meaning that the Coronavirus outbreak and the Russia/Ukraine War led to a considerable oil supply shock. This is in line with Ha et al. (2019b), for the pre pandemic period,

and with Gagliardone & Gertler (2023), who reported that a combination of oil price shocks and dovish monetary policy was decisive for 2020s inflation surge in the USA.

As for the food price coefficient, Table 3 shows that its passthrough to inflation is statistically significant in both periods, but the sign changes from negative to positive from a period to another. This could be an indication of a possible shift in the impact of food prices due to supply chain bottlenecks after the Covid-19/war period.

Table 3: Global Inflation Model (Pre and Pos Covid-19)

	Pre Covid-19 (2016Q3-2019Q3)				**Post Covid-19 (2020Q2-2022Q3)**			
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Inflation$_{t-1}$	**-0.481 [0.000]**	**-0.589 [0.000]**	**-0.477 [0.000]**	**-0.485 [0.000]**	**0.206 [0.088]**	**0.299 [0.051]**	**-0.272 [0.007]**	0.191 [0.103]
Interest Rate	**0.127 [0.000]**	**0.125 [0.001]**	**0.13 [0.001]**	**0.135 [0.000]**	**0.255 [0.000]**	**0.254 [0.000]**	**0.267 [0.000]**	**0.261 [0.000]**
DExchange Rate$_{t-1}$	0.032 [0.134]	0.035 [0.100]	**0.039 [0.069]**	0.025 [0.221]	**-0.083 [0.000]**	**-0.085 [0.000]**	**-0.063 [0.000]**	**-0.077 [0.000]**
GDP Gap	6.89E-07 [0.192]	3.49E-06 [0.351]	3.31E-07 [0.379]	9.04E-07 [0.113]	**1.51E-06 [0.018]**	**1.23E-06 [0.039]**	-6.22E-08 [0.896]	**1.28E-06 [0.035]**
Trade Balance	8.65E-07 [0.704]	1.62E-06 [0.475]	1.31E-06 [0.575]	8.73E-07 [0.705]	-5.44E-06 [0.334]	-5.03E-06 [0.316]	-4.50E-06 [0.540]	-5.15E-06 [0.339]
Food Prices		**-0.048 [0.000]**				**0.012 [0.030]**		
Oil Prices			**0.005 [0.000]**				**0.021 [0.000]**	
Global Supply Chain Pressures				**-0.079 [0.000]**				**0.046 [0.000]**
Dummy Emerging	-0.488 [0.433]	-0.153 [0.789]	-0.261 [0.644]	-0.473 [0.460]	**-2.628 [0.096]**	**-2.59 [0.084]**	-2.589 [0.162]	**-2.598 [0.085]**
Autocorr. [Prob]	[0.577]	[0.110]	[0.612]	[0.594]	[0.130]	[0.111]	[0.347]	[0.150]
Hansen [Prob]	[0.995]	[0.980]	[0.996]	[0.997]	[0.504]	[0.518]	[0.664]	[0.447]

Notes: P-values in brackets. REER increases = appreciation.
D = indicates first difference
All estimated models use Stata's collapse command to deal with instrument proliferation.

The global supply chain pressure index coefficient is also statistically significant in both periods. However, as in the case of food prices, there is a sign change from negative to positive from a period to another. It means that global supply pressures were deflationary before the pandemic but became inflationary after the outbreak, reflecting a shift in the impact of supply costs, due to supply chain bottlenecks, after the Covid-19/war period (Table 3).

These results are in line with Binici et al. (2022), who worked with a local projection method to estimate how inflation responded to global and domestic shocks in the post pandemic period. They found that global factors (global output gap, commodity prices, exchange rate, and global supply chain pressures) could lead to higher inflation rate, with long-lasting effects.

The coefficients related to the dummy variable for emerging and less developing countries kept its negative sign in all estimations performed before and after Covid/War crisis and followed the same pattern as in the estimations related to the whole period. Therefore, there is evidence that emerging and less developing economies have been facing lower inflation rates, compared to advanced countries, especially in the post Covid-19/War period (Table 3).

As previously, the autocorrelation results (probability) indicate no second order autocorrelation for all estimated models and the Hansen (probability) overidentification tests suggests that the set of instruments are valid for all estimated models.

5. Concluding Remarks

This article aimed at examining the global inflation behavior for a panel of 42 advanced and emerging market countries and for the period ranging from 2016Q3 to 2022Q3. An essential feature of the research was to include countries from all regions of the world were included and also to analyze the global inflation before and after the Covid-19 and Russia-Ukraine War. A series of System GMM estimations were performed including country-specific variables, such as lagged inflation, interest rate, real exchange rate, GDP gap, as well as important global prices (oil and food prices) and a global supply chain pressure index, as control variables.

After estimating the models, we were able to draw some general conclusions. The main estimation results showed that anti-inflation persistence was detected before the Covid-19 outbreak, which was reversed to increasing inflation persistence (inertia), and statistically significant, playing an important role after the worst phase of the pandemic. There was also evidence of the Fisher Effect for all estimated models, meaning that the nominal interest rate dynamics was important to keep with certain equilibrium.

Changes in the real effective exchange rate coefficient came out with an expected negative sign only after the Covid-19/War, indicating a significant exchange rate passthrough to inflation only for this period. However, the deflationary process caused by the exchange rate dynamics was not enough to contribute to an effective inflation control after 2020.

As for the global factors, food and oil prices seem to be specifically important in explaining the recent inflation surge. The same applies to global supply chain pressures, which were deflationary before the pandemic but became inflationary after the outbreak, reflecting considerable increases in supply costs after the Covid-19/war period. In addition, it seems that emerging and less developing countries have been facing lower inflation rates after the Covid-19 period, which is a very unusual result.

It is important to emphasize that this is still an ongoing research process trying to contribute to the discussion on the economic impacts of the coronavirus pandemic and the Russia/Ukraine War conflict. It is a continuing process because the total effects of the pandemic, even though it is not considered a pandemic anymore, have yet to be completed. As for the war, it is far from being over, with economic and social consequences hard to be effectively measured. There is no doubt the undergoing global inflation surge has not chosen a specific type of economy, as emerging and advanced countries have been equally suffering from its effects. As time goes by and more data are collected, we will be able to assess more efficiently the real macroeconomic impact of these major events in terms of inflation, economic activity, unemployment level, consumer behavior, and so on.

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Appendix

Table A1: Country List

Code	Country	Code	Country
1	Australia	**22**	Japan
2	Austria	**23**	South Korea
3	Belgium	**24**	Latvia
4	Brazil	**25**	Lithuania
5	Canada	**26**	Luxembourg
6	Chile	**27**	Mexico
7	China	**28**	Netherlands
8	Colombia	**29**	New Zealand
9	Denmark	**30**	Norway
10	Estonia	**31**	Poland
11	Finland	**32**	Portugal
12	France	**33**	Romania
13	Germany	**34**	Russia
14	Greece	**35**	Slovakia
15	Hungary	**36**	Slovenia
16	Iceland	**37**	South Africa
17	India	**38**	Spain
18	Indonesia	**39**	Sweden
19	Ireland	**40**	Switzerland
20	Israel	**41**	United Kingdom
21	Italy	**42**	United States