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Drivers of Inflation in the Caucasus and Central Asia

Maria Atamanchuk, Alejandro Hajdenberg, Dalia Kadissi, Giulio Lisi, and Nasir Rao

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ABSTRACT: In parallel with global developments, inflation in the Central Asia and Caucasus (CCA) has exhibited large swings in recent years. This paper investigates inflation dynamics in the CCA and its main drivers and derives conclusions that can inform policymaking. The analysis is based on three empirical approaches. Inflation drivers and its dynamics are investigated through the estimation of a Phillips curve augmented with foreign factors and a panel vector autoregression. The paper also assesses the role of monetary policy in steering inflation outcomes by estimating a local projection model. The paper finds that external factors play a major role in determining CCA inflation dynamics, although domestic factors (e.g., demand conditions, expectations) also contribute. Monetary policy is found to have a statistically significant effect on inflation, including by moderating the impact of external drivers. The findings point to the need to continue strengthening policy frameworks to steer expectations and improve the effectiveness of monetary policy, while establishing adequate social safety nets to cushion the impact from global shocks.

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WORKING PAPERS

Drivers of Inflation in the Caucasus and Central Asia

Prepared by Maria Atamanchuk, Alejandro Hajdenberg, Dalia Kadissi, Giulio Lisi, and Nasir Rao[1]

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1. Introduction

In parallel with global developments, inflation in most of the countries in the Central Asia and Caucasus region (CCA) surged in 2022 to levels not seen in decades before starting to subside in 2023. The upswing can be traced to the dislocations caused by the COVID-19 pandemic (including disruptions in supply chains, large fiscal stimulus and accommodative monetary policies, and pent-up consumer demand) amplified by the impact of Russia's invasion of Ukraine on energy and food prices. A reversal of these factors contributed to the subsequent global disinflation. For the CCA region as a whole, inflation almost doubled to 13 percent in 2022 from around 7 percent in 2020—significantly above the global average of 8.7 percent in 2022—before dropping to 9.8 percent in 2023 and continuing to trend down in 2024. Although the trend in CCA inflation has been consistent with global developments, domestic policies are likely to have played a role as well.

The goal of this paper is to investigate inflation dynamics in the CCA and its main drivers and derive conclusions that can inform policymaking. To our knowledge, this is the first study of inflation determinants focusing on the CCA region. In particular, we seek to shed light on the roles of key foreign factors, domestic economic conditions and inflation expectations in driving local price dynamics. We also assess the impact of monetary policy actions on the inflation process. Understanding these issues should contribute to the design of appropriate macroeconomic policy responses when faced with renewed shocks, aiming to preserve stability and protect vulnerable segments of the population from prices surges.

The empirical analysis consists of three approaches:

- We start by estimating *a Phillips curve* (PC) where the standard determinants (lagged inflation, inflation expectations and a measure of economic slack) are augmented with foreign factors (nominal effective exchange rates, global oil and food prices, and foreign inflation) to assess the role played by external and domestic factors on inflation dynamics.[2]
- Next, we use a panel vector autoregression (pVAR) to assess the dynamics of inflation with respect to a similar set of variables as in the PC analysis. Relative to the latter, the pVAR allows us to analyze the timing and persistence of the various drivers of the inflation process, as well as to quantify their contribution to medium-term changes in the price level. As an extension to our pVAR framework, we also evaluate the link from wages to inflation, including how wage dynamics interact with external factors.
- Finally, we study the role of monetary policy in steering inflation outcomes using the local projections approach pioneered by Jordà (2005). Following Brandao-Marques et al. (2020), we explore the transmission of policy rates to inflation and how this interacts with the behavior of other inflation drivers, namely the nominal effective exchange rate (NEER), foreign inflation, and global food prices.

In line with findings for other regions (e.g., Bems et al. 2018; Kamber et al 2020; IMF 2022) our results identify a role of both domestic and external factors in driving domestic prices. The model estimates find a greater contribution to inflation dynamics from external factors, but domestic factors are found to also contribute to price dynamics even if more modestly. Estimates point to significant and large effects from foreign inflation as

[2] Work on the role of external factors on inflation include Auer et al., (2017), Ball (2006), Baba et al. (2023), Bems et al. (2022), Borio and Filardo (2007), Borio (2017), Calza (2008), Forbes (2019), and Minasyan et al. (2023) among others.

well as global food prices on domestic price indices. This is consistent with the fact that the countries in the CCA are all small open economies with large dependence on imports. On the other hand, the smaller contribution from domestic factors could be also due to the difficulty in measuring these factors. Obtaining good measures of economic slack and inflation expectations is generally difficult and this is particularly true for countries in the CCA given limitations in the data. The findings also point to significant persistence of inflation processes in the CCA as well as pass-through from exchange rate fluctuations. The findings with respect to the role of global oil prices are mixed. While the PC analysis point to no significant impact on domestic prices, the pVAR suggests there is a small lagged effect. These findings could be due to the important role that administered prices, subsidies, and long-term contracts play in several countries in the region.

On the role of monetary policy in managing inflation pressures, we find that that changes in the policy stance affect domestic inflation dynamics. Namely, an increase in the policy rate is associated with a statistically significant decline in inflation four- to six quarters after the policy decision. The effectiveness of monetary policy in containing inflation is found to be stronger when accompanied by a nominal effective exchange rate appreciation. Finally, pass-through from external factors to domestic prices is found to be substantially smaller when a rise in food prices or foreign inflation is met by a policy tightening.

Overall, the paper's findings underscore that policies are significant in managing inflation outcomes in the region. Despite the relatively larger role played by external factors compared to domestic ones, monetary policy is important, especially when exchange rates are allowed to adjust. Likewise, fiscal and wage policies also play important roles. By contrast, administrative measures may be counterproductive, and should be avoided.

The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 describes the stylized facts of inflation dynamics and its main drivers in the region. Section 4 presents the empirical analysis to analyze formally the drivers of inflation, starting with the estimation of augmented PC models; then considering a pVAR setting, and finally implementing the local projections approach to evaluate the role of monetary policy. Section 5 concludes and provides policy recommendations.

2. Literature

The surge in inflation and its persistence in different parts of the world following the COVID-19 pandemic and subsequent moderation has led to renewed interest in understanding the drivers of inflation, its distributional impact, and ultimately, the appropriate policy response. To our knowledge, this paper is the first study on this subject focusing specifically on the CCA region. In terms of regional coverage, the IMF (2022c) looks at the role of external drivers, supply chain disruptions and domestic policies driving price dynamics in the Middle East and Central Asia region. Several studies, for example, IMF (2022c), Baba et al. (2023), Binici et al. (2022), and Minasyan et al. (2023) looked at recent inflation developments in Europe.

Our paper relates to several strands of the literature on the drivers of inflation. An extensive volume of work has focused on the growing influence of foreign factors on domestic inflation dynamics resulting from greater global interconnectedness. Studies along these lines include Auer et al. (2017), Borio and Filardo (2007), Ball (2006), Bems et al. (2022), Calza (2008), and Forbes (2020), among others. There are numerous studies on the link between wages and inflation. Recent examples include Alvarez et al. (2022) and Boranova et al. (2019).

In terms of empirical approaches studying inflation drivers, estimation of the PC, augmented with global factors, has been widespread. This literature traces back to the studies of Galí and Gertler (1999), Galí et al. (2001), and Galí et al. (2003). More recent contributions include Auer et al. (2017), Kamber et al. (2020), IMF (2022c), Binici et al (2022) and Baba et al (2023).

Inflation dynamics have also been often studied with vector autoregression analysis. This methodology seeks to circumvent the problem of endogeneity that is present in the single equation PC approach. Recently, structural VARs have become a frequent tool to address the identification of the impact of different shocks. Works along these lines include IMF (2021), Finck and Tilman (2022), and Minasyan et al. (2023). Panel VARs have been used less frequently on this subject. This methodology, reviewed in Canova and Cicarelli (2013) was utilized by Dees and Güntner (2014) to look at inflation disaggregated by production sectors in four countries of the Euro area and by Boranova et al. (2019) to study the relationship between wage growth and inflation in Europe.

The estimation of impulse responses by local projections, pioneered by Jordà (2005) has become increasingly popular in empirical macroeconomic analysis. This method produces similar output as a VAR but has several appealing features when assessing the impact of policies, which also motivated us to pursue this route. In particular, it requires imposing fewer constraints on the dynamic interaction of the variables in the model, it allows easy interaction of the policy of interest with other structural characteristics or economic variables and can easily accommodate non-linearities. Among others, Brandao-Marques et al. (2020) used local projections to assess monetary policy transmission, Binici et al. (2022) analyzed the role of global and domestic factors in post-pandemic inflation in Europe, and Baba and Lee (2022) focused on the pass-through of oil prices to inflation.

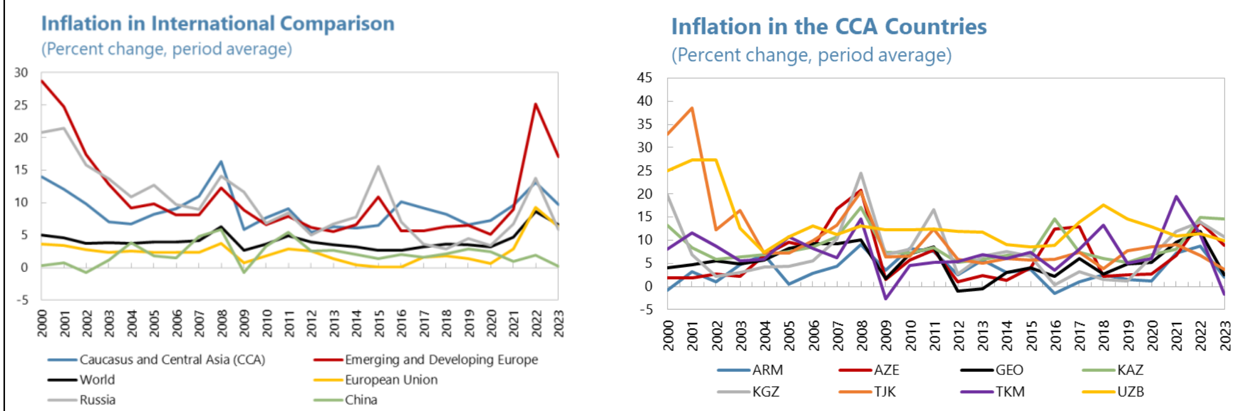
The role of monetary policy and policy transmission channels in determining inflation has also been subject to extensive research. In an early study, Romer and Romer (1989) employ a narrative approach to conclude that the clarity and consistency of the monetary policy regime plays a key role in a properly functioning transmission mechanism. Poghosyan et al. (2023) examines monetary policy regimes in the CCA, elaborating on their main strengths and shortcomings. In a study closest to ours, IMF (2023a) finds that the strength of monetary policy transmission in the Middle East and Central Asia region varies widely based on numerous factors, including the exchange rate regime, financial development, coordination with fiscal policy, and the strength of the monetary policy framework. In another closely related paper, Brandao-Marques et al. (2020) first identify monetary policy shocks using the Taylor rule, then estimate the strength of monetary policy transmission using local projections. Eklou (2023) also used the local projection framework to assess monetary policy transmission, finding that the exchange rate channel is particularly important in emerging markets.

The literature on monetary policy regimes continues to highlight the importance of credible and independent central banks for achieving macroeconomic stability. Central bank independence, alongside robust policy frameworks, plays a significant role in reducing inflation and fostering economic growth by anchoring expectations and enhancing economic resilience (Dincer et al., 2014, and IMF, 2024). Although this paper does not specifically research this question, the recent paper by Poghosyan et al. (2023) provides a comprehensive examination of the CCA region's monetary policy landscape, highlighting key challenges in policy design and implementation, as well as identifying critical areas for improvement, such as structural weaknesses in monetary policy transmission due to weak bank competition, high dollarization, and small and illiquid capital markets.

3. Stylized facts and recent developments

The CCA region has had several episodes of high inflation. The severe dislocations resulting from the collapse of the Soviet Union led the region to experience hyperinflation in the early 1990s. As the newly established countries started the transition to market economies, macroeconomic stability was gradually re-established. In some cases, inflation returned to single digits by the end of the decade (Armenia, Azerbaijan, Georgia, Kazakhstan), while in the rest it took several years longer (Uzbekistan has had inflation in the low single digits for most of its recent history, Figure 1). Inflation accelerated again in the period preceding the Global Financial Crisis. The slump in oil prices started in 2014 and the ensuing currency depreciations, pushed inflation up again in the region's oil exporting countries, while contributing to price moderation in oil importers.

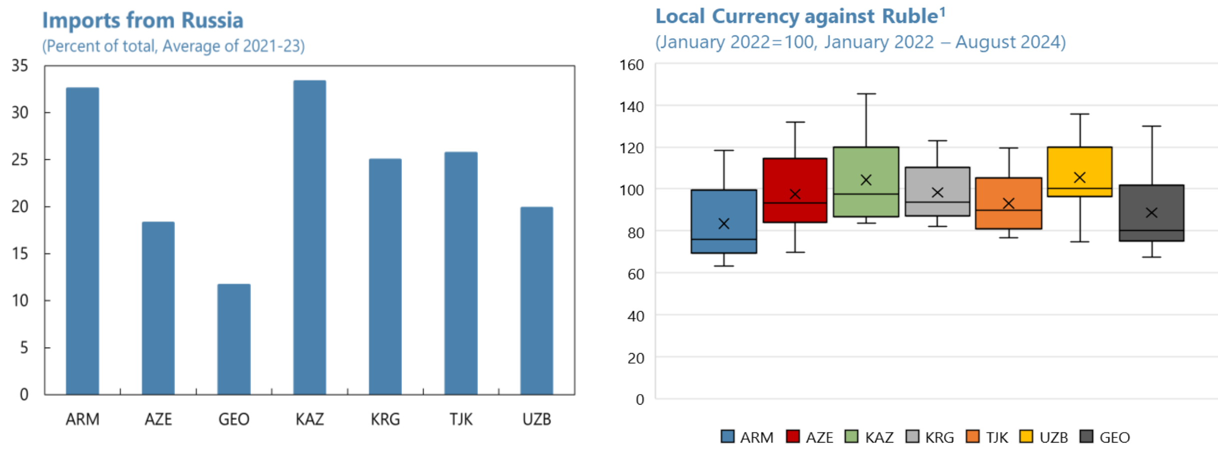
Figure 1. Inflation in the CCA over the longer run



Sources: Haver Analytics; and International Monetary Fund, *World Economic Outlook*.

In parallel with global developments, inflation in the CCA started accelerating in 2020 boosted by a series of shocks (Figure 3). The COVID-19 pandemic in 2020 caused unprecedented disruptions to global supply chains and triggered supply shortages in various industries. Governments responded with large fiscal and monetary stimulus across the globe to support the economy and protect lives. The strong post-pandemic recovery was accompanied by surging energy and food prices. The trend in global commodity prices was later reinforced by the breakout of the war in Ukraine in February of 2022. The volatility of the Russian ruble also played an important role given the region's reliance on imports from Russia. The ruble has undergone three phases since the commencement of the war: initially depreciating in response to the shock, followed by a sharp appreciation, and more recently experiencing depreciation to levels below those observed before the onset of the conflict.

Figure 2. CCA Countries and Russia

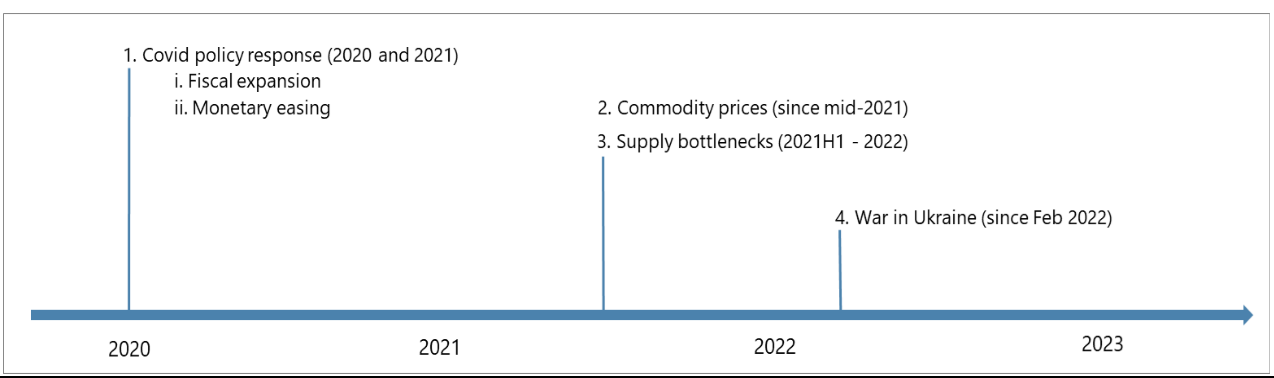


Sources: Haver Analytics; and IMF staff calculations.

1/ Chart shows the range of local currencies' exchange rate against the Ruble, within the indicated period. Tajikistan, Armenia, and Kyrgyz Republic have sizeable remittances from Russia, which affects their exchange rates against ruble.

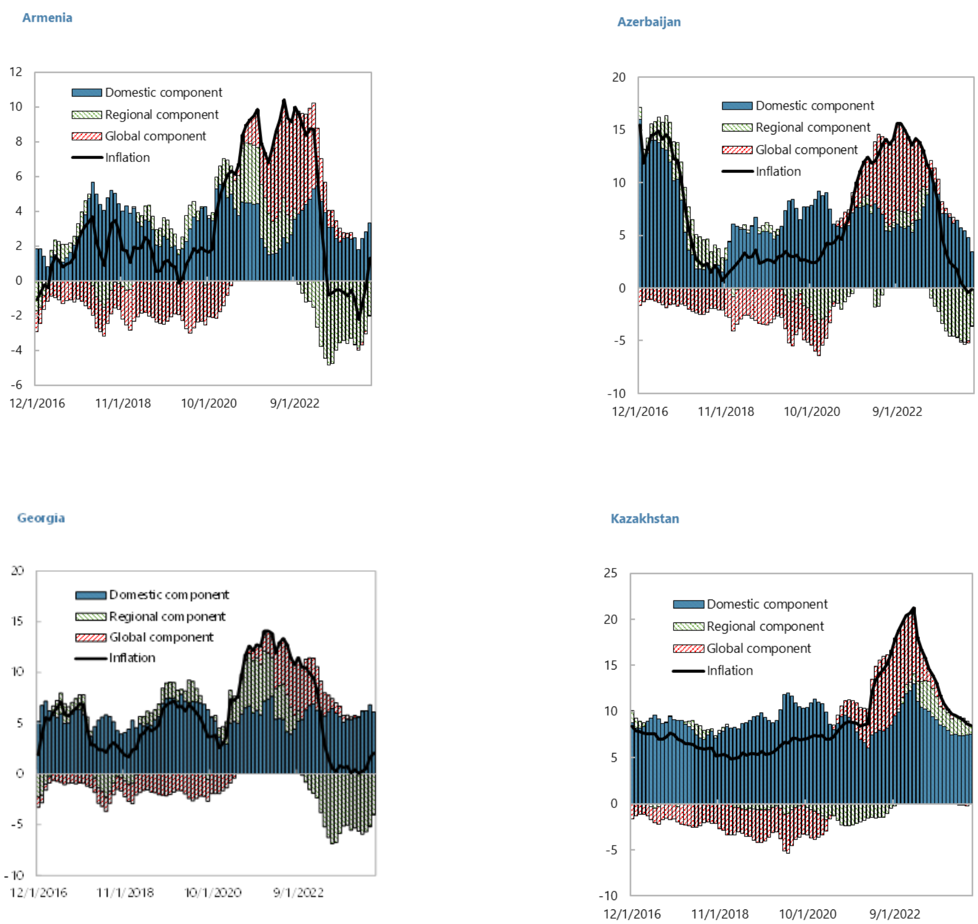
Since 2023, inflation pressures have subsided across the majority of CCA countries. The dissipation of base effects, the decline in commodity prices (i.e., food oil and gas), and tighter monetary policies contributed to the overall reduction in inflation. Strong exchange rate appreciation was a significant factor also played a crucial role in tempering inflationary trends in several CCA countries. Notably, domestic currencies in Armenia, Georgia, and Tajikistan experienced strong appreciations spurred by substantial capital inflows from Russia (Figure 2). The more favorable inflation outlook allowed countries to start loosening monetary policy (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, and Tajikistan).

Figure 3. Inflationary Shocks Affecting the CCA in 2020-23



External factors have generally played a crucial role in shaping inflation in the CCA. Notably, the escalation of food and energy prices in the post-Covid period was one of the key drivers of headline inflation, which subsequently spilled over to core inflation[3]. The charts in Figure 4 present a decomposition of inflation between domestic, foreign, and regional components based on principal component analysis (PCA).[4] The exercise underscores the importance of the global component as an inflation driver in the region. Up to 2020, it had mostly contributed to moderate inflation. By contrast, it became a major contributor to the inflation surge in the post-Covid period, except in the cases of Tajikistan and Uzbekistan which show more idiosyncratic behavior. The war in Ukraine appears to have impacted the regional component, with the impact differing for oil importers and exporters. In Armenia, Georgia and Tajikistan, the regional component has contributed to the disinflation process, while in Azerbaijan and Kazakhstan the regional component has been on the rise, offsetting a smaller contribution from the global component. The domestic component has been generally more stable. In Uzbekistan and Tajikistan inflation appears mostly driven by domestic factors, while in Armenia domestic factors have played an important role (albeit smaller than foreign factors) in both the upward and downward trends.

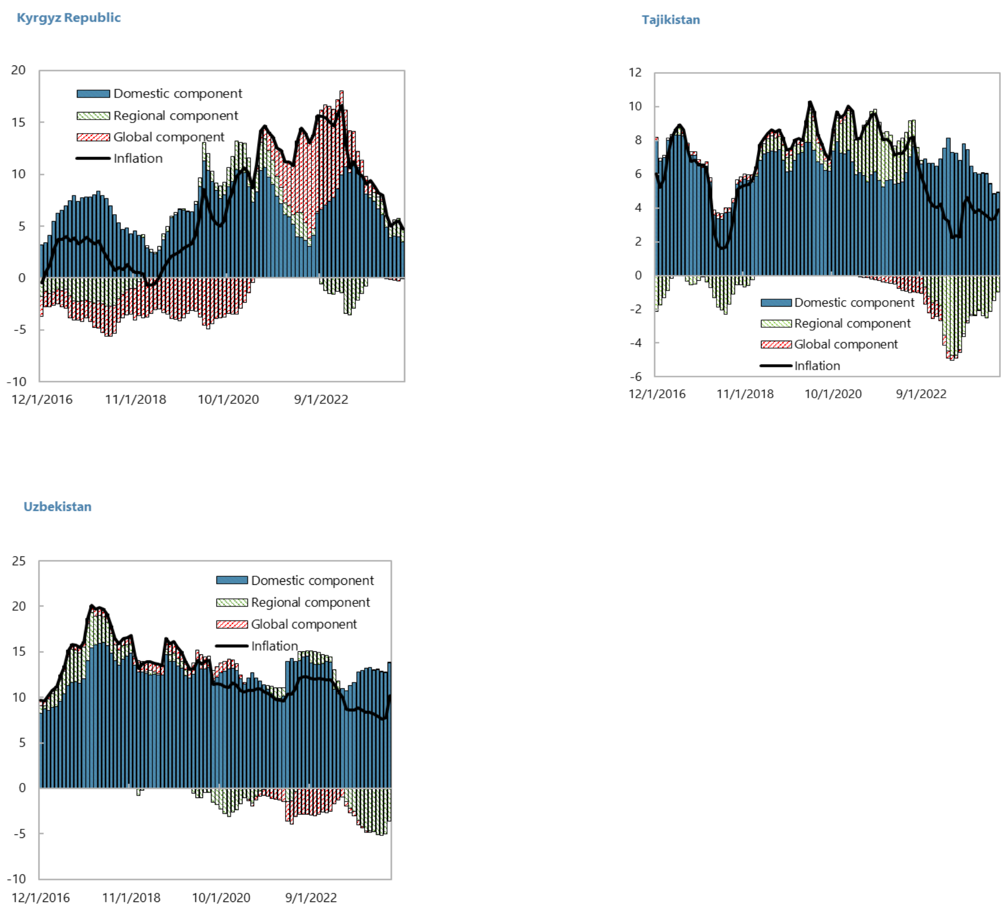
Figure 4. Domestic and External Components of Inflation in the CCA



3 Core inflation is defined by the national authorities, and the definition may differ from country to country.

4 This decomposition follows the methodology of Krusper (2012) and is described in Annex II.

Figure 5. Domestic and External Components of Inflation in the CCA (Concluded)



Sources: Haver Analytics; and IMF staff calculations.

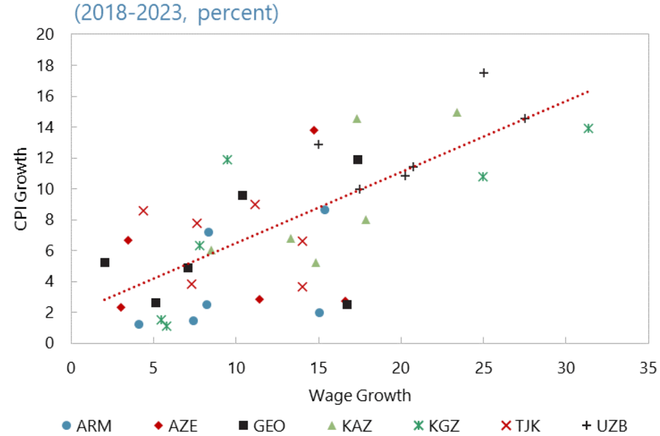
Exchange rate pass-through remains an important determinant of inflation in CCA countries due to their high dependence on imports and, in most cases, substantial levels of dollarization. For the CCA, the average pass-through to inflation of a depreciation of the local currency vis-a-vis the US dollar has been typically estimated at around 10 percent on impact and about 25 percent after 12 months (see for example Poghosyan, 2020). The pass-through has been found to be broadly similar in fixed versus floating exchange rate regimes. For comparison, this average pass-through is higher than those estimated for the Commonwealth of Independent State (CIS) countries (Comunale and Simola, 2018) as well as for emerging economies in Central and Eastern Europe (Caselli and Roitman, 2016).

Global commodity prices also play a significant role in domestic inflation across the CCA. As noted above, most countries in the region have high dependence on imports, which exposes them to fluctuations in global commodity prices. For example, in 2022, the Commodity Price Index increased by around a third leading to the observed peak in inflation, the subsequent retraction of commodity prices contributed to the disinflation process that followed. Commodity prices naturally affect prices of food and energy products. Indeed, a breakdown of CPI inflation along its main components suggests that food has been the main contributor to CCA's inflation dynamics over the past three years (Figure 7). Energy prices were the second largest contributor to inflation until early 2022, when other domestic factors, such as services, gained strength.

Wage growth and inflation have exhibited a positive correlation in most CCA countries. The positive association between nominal wage growth and inflation in most CCA over the last few years can be seen in Figure 5. Since early 2022, nominal wages have grown strongly throughout while inflation decelerated leading to significant gains in real wages. While this could reflect improved productivity, it could also lead to a buildup of inflationary pressures.

Figure 6. CPI Growth vs. Wage Growth

(2018-2023, percent)



Sources: Haver Analytics, International Monetary Fund, *World Economic Outlook*; and IMF staff calculations.

Inflation levels were also influenced by the domestic policy stance. To address the effects of the pandemic, on average, countries in the CCA adopted fiscal measures equivalent to about 4.7 percent[5] of 2020 GDP, ranging from 1.2 percent of GDP in Armenia to over 9 percent of GDP in Kazakhstan. Protracted accommodative monetary policies in some CCA countries also contributed to inflation. For example, policy rates were reduced in 2020 in Kazakhstan, Armenia and Uzbekistan to support activity and kept low even as inflation gathered pace. Loose policies also translated into fast rates of growth of the money supply, adding to the inflationary pressures. Policies were eventually tightened, contributing to the observed disinflationary process and, in turn, allowing gradual normalization in as inflation declined towards its objective.

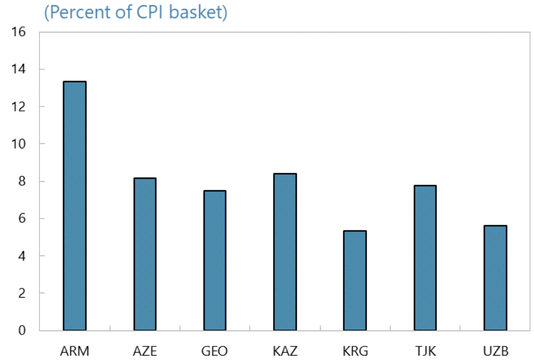
Some CCA countries resorted to administrative measures to contain the surge of inflation. While administered prices comprise a relatively small share of consumer price indices, they played a significant role in some cases in moderating the surge in inflation, also by preventing the pass-through to other goods (Figure 6). However, this was at the expense of introducing price distortions and expanding subsidies (which are seldom reflected in the fiscal accounts). All countries have some regulated utility tariffs in place covering electricity, natural gas, heating, and water and sewage. Some countries have also regulated prices for certain fuels (Azerbaijan, Kazakhstan, Uzbekistan) and domestic transportation (Azerbaijan, Georgia).[6] In some countries, although prices of certain products are regulated, domestic prices were adjusted to reflect international price variations (Armenia, Georgia). Contracts to purchase gas at fixed prices helped limit the volatility of domestic prices in Armenia, Kyrgyz Republic and Uzbekistan. Other measures introduced by countries in the region included exports restrictions (Kazakhstan), price controls (Tajikistan), and reduced tax rates (Azerbaijan, Kyrgyz Republic) of socially sensitive goods.

[5] Calculated as arithmetic average.

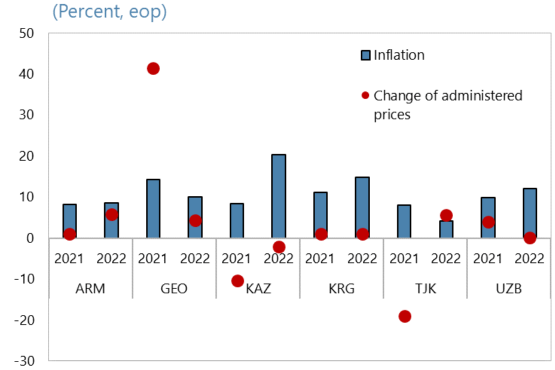
[6] Gasoline prices are deregulated in Armenia, Georgia, Kyrgyz Republic, and Uzbekistan. In Kazakhstan only the price of AI-95 fuel is not regulated.

Figure 7. Administered Prices and Inflation

Administered prices (2023)[1/]
(Percent of CPI basket)



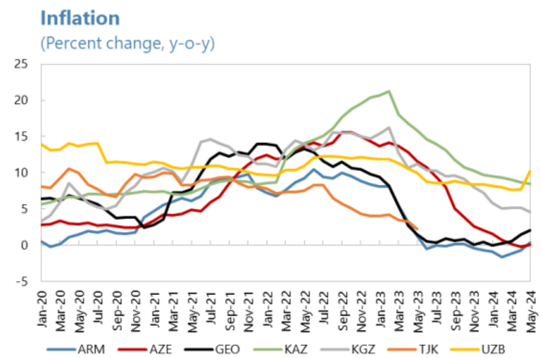
Inflation and Administered Prices
(Percent, eop)



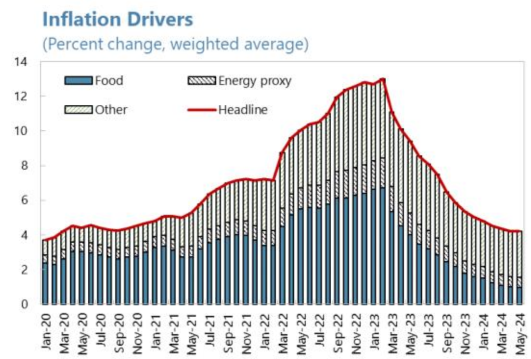
Sources: National authorities; and IMF staff calculations.
1/ Data for Azerbaijan is for 2021 and for Kyrgyz Republic for 2016.

Figure 8. Inflation Developments in the CCA during 2020-23

Inflation in the CCA region surged in 2022 and started receding in 2023.

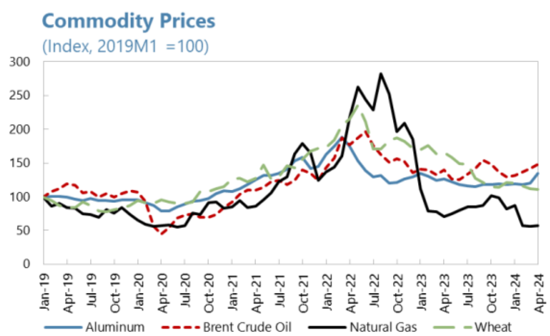


Food prices played a major role in inflation dynamics…

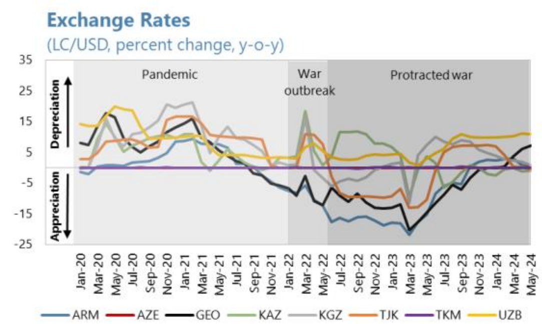


Note: the CCA sample of countries excludes Turkmenistan and Uzbekistan.

…in line with global commodity price developments.

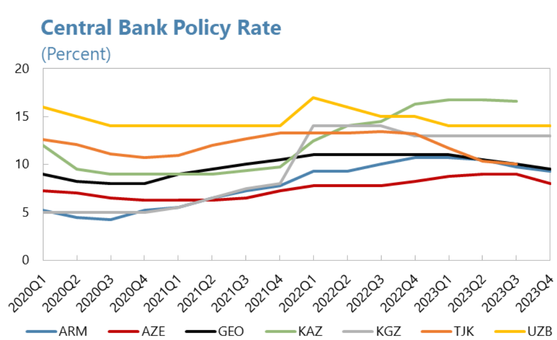


Exchange rates generally depreciated during the pandemic but subsequently appreciated.

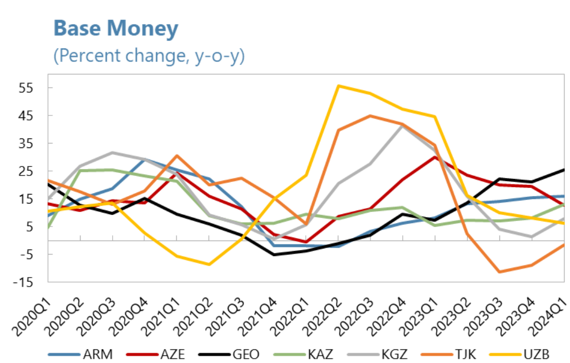


Note: AZE and TKM have pegged exchange rates.

Central banks initially kept loose monetary policies, subsequently tightened and then started normalizing.



Strong expansions of the monetary base in some countries accompanied the inflation surge, then going to more moderate levels.



Sources: CEIC Data, Haver, International Monetary Fund, *Global Assumptions,* International Monetary Fund, *International Financial Statistics;* and IMF staff calculations.

4. Data

The empirical analysis covers all countries of the CCA region except Turkmenistan, for which adequate data is not available. The sample consists of quarterly data for the period 2001:Q1 through 2022:Q4. The variables are described below with additional details in Annex I.

The dependent variables in the various models below are the headline and core consumer price inflation. The latter generally excludes volatile components, such as food and energy, with specific details for each country provided in the data annex. In line with the literature, besides lagged inflation, regressors in the PC analysis are the output gap and inflation expectations. In addition, the analysis is augmented with a set of variables to capture the influence of the external environment, namely changes in the NEER, global food prices, global oil prices, foreign CPI, and the foreign output gap. As detailed in Annex I, variables are transformed into year-on-year growth rates to mitigate non-stationarity issues and seasonal effects. A robustness check also relies on seasonally adjusted quarterly growth rates. The pVAR analysis also looks at the relationship between wages and inflation.

The output gap and inflation expectations are unobservable variables that need to be estimated. Therefore, the usual caveats about the uncertainty surrounding these estimates apply. Our measure of the output gap is the percent difference between actual annualized output and trend output computed with a Hodrick-Prescott filter with a smoothing parameter of 1600. Inflation expectations used in studies covering advanced economies and emerging markets are usually from surveys of households and market participants, however in the case of the CCA survey information is not available. In the baseline specification, we build on IMF (2022c), and obtain expectations as the three-year ahead forecast of CPI inflation from the IMF's World Economic Outlook. For each country, we construct lagged series of WEO inflation forecasts three years ahead to obtain a broad proxy of inflation expectations.[7] As a robustness check (explained below), we construct a second measure building on Hamilton (2016), and Jordà et al. (2022), regressing one-year ahead inflation against lags of the CPI (more precisely, quarter-on-quarter annualized change in headline inflation).

Data availability and distribution vary considerably across countries and variables. The number of available observations ranges from a total of 623 for Armenia, to only 285 for Uzbekistan across seven series (see Annex I). Standard deviations point to substantial volatility in the data. In the sample, the standard deviation of year-on-year changes in the CPI and the NEER is about 6 and 11 percent, respectively, as opposed to roughly 2 percent for trading partners' inflation and some of the proxies for inflation expectations. Given high variability in the data distributions, below we include estimates obtained after standardizing the main variables (to have zero mean and a unit standard deviation) to facilitate interpretability of the results.

[7] The three-years horizon is consistent with Bems et al. (2018). Our alternative measure of expectations focuses instead on one-year ahead forecasts as in Kamber et al. (2020).

5. Empirical analysis

5.1. INFLATION DRIVERS: AN AUGMENTED PHILLIPS CURVE FOR THE CCA

Baseline specifications

In this section we estimate a standard version of the Phillips curve and a version augmented with explanatory variables to capture the impact of foreign developments on CCA countries:

$$\pi_{i,t} = \beta_1 \pi_{i,t-1} + \beta_2 {\pi^e}_{i,t} + \beta_3 {Y^{(g)}}_{i,t} + \beta_4 e_{i,t} + \gamma_i + \varepsilon_{i,t} \qquad (1)$$

$$\pi_{i,t} = \beta_1 \pi_{i,t-1} + \beta_2 {\pi^e}_{i,t} + \beta_3 {Y^{(g)}}_{i,t} + \beta_4 e_{i,t} + \boldsymbol{Z}^f \varphi'_{t-1} + \gamma_i + \varepsilon_{i,t} \qquad (2)$$

where $\pi_{i,t}$ denotes year-on-year headline or core inflation for country i in quarter *t*; ${\pi^e}_{i,t}$ denotes expected inflation; ${Y^{(g)}}_{i,t}$ is the output gap, $e_{i,t}$ is the annual change in the nominal effective exchange rate; φ'_{t-1} is a vector of external factors consisting of oil prices, food prices and foreign inflation, which enter the equation with a one-quarter lag; γ_i represents a set of country fixed effects; and $\varepsilon_{i,t}$ is the error term.

The estimation covers the period 2001:Q1-2022:Q4. The model is first estimated by least squares with standard errors clustered by countries for the seven countries of the CCA (excluding Turkmenistan). We also conduct the analysis after standardizing the variables to have zero mean and unit standard deviations which allows us to compare the relative contribution of different factors. Finally, while the main analysis relies on the above fixed effect regressions, as explained below we also estimate models (1) and (2) for each individual country. In this case, confidence intervals for the estimates are constructed with a bootstrapping procedure to account for the limited number of observations for some of the countries.

Equations (1) and (2) provide an intuitive framework to study broad correlates of inflation in the CCA region. However, they are subject to some methodological limitations. First, measurement problems, especially for inflation expectations or the output gap, may lead to biased estimates. A second issue is that some of the variables may be correlated, and therefore, their effects may be imprecisely measured. This could be the case especially for global variables. To address these limitations, in the robustness section we present results obtained with an alternative proxy for expectations, and by estimating models that seek to extract autonomous movements in oil prices.

Estimation results

Table 1 presents estimation results for the panel of CCA countries. The results are presented with both headline and core inflation as the dependent variable. The table shows the results for the standard PC and the one augmented with foreign variables. The table also displays results where the variables have been standardized to be expressed in the same units, such that, as noted above, the value of the coefficients provides a measure of the relative strength of the association between the regressors and inflation.

The results suggest inflation in the CCA is significantly persistent and strongly influenced by external factors. The main findings are as follows:

- Inflation is consistently persistent. the coefficient for lagged inflation is large and significant (about 0.7-0.8). When repeating the exercise with seasonally adjusted quarterly inflation rates, the coefficient on lagged inflation falls to between 0.21 and 0.45 across the different specifications, pointing to still considerable inertia.[8] This is in line with previous studies which generally find inflation to be a persistent phenomenon.[9]

- In the standard specification, there is a positive association between inflation and inflation expectations, with a coefficient of approximately 0.15, while the negative coefficient on the NEER confirms that a currency depreciation drives inflation upwards (and vice versa). Results for the output gap are more mixed. The sign is positive across specifications, indicating that stronger domestic demand is correlated with inflation although the coefficients tend to be small, at between 0.02 and 0.08. The estimates are not significant in the case of core inflation.
- The augmented specification highlights the significant contribution of external factors. In particular, there is a significant positive association between global food prices, foreign inflation, and headline domestic inflation. A one percent increase in international food prices or foreign inflation is, on average, associated with approximately a 0.1 percent growth in domestic CPI. The link between food prices and core inflation is weaker, given the exclusion of food prices from consumption indices but still significant, possibly pointing to second-round effects. By contrast, results do not show a significant association between oil prices and inflation. This could reflect the important role that administered prices, subsidies, and long-term contracts play in several countries in the region. When foreign factors are added to the regression, the output gap is no longer statistically significant, possibly due to correlation between domestic demand conditions (proxied by the output gap) and foreign factors.

[8] Results available upon request. Other findings are robust across models that use annual and quarterly inflation.

[9] For example, Bems et al. (2018), IMF (2023b), and Kamber et al. (2020) estimate coefficients between 0.5 and 0.7 for European countries.

Table 1. Phillips Curve Estimation, Augmented by External Factors

	Headline CPI				Core CPI			
	Normal		Standardized		Normal		Standardized	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag of headline/core inflation	0.779***	0.678***	0.802***	0.689***	0.826***	0.729***	0.809***	0.709***
	(0.047)	(0.023)	(0.029)	(0.028)	(0.024)	(0.042)	(0.033)	(0.049)
Inflation expectations (3 years ahead)	0.168**	0.148***	0.110***	0.088***	0.130***	0.099***	0.133***	0.112***
	(0.067)	(0.045)	(0.018)	(0.006)	(0.034)	(0.022)	(0.026)	(0.030)
Output gap	0.084***	0.022	0.065***	0.017	0.088	0.045	0.059	0.024
	(0.028)	(0.030)	(0.023)	(0.017)	(0.054)	(0.038)	(0.040)	(0.031)
Nominal effective exchange rate	−0.069***	−0.088***	−0.140***	−0.179***	−0.078***	−0.102***	−0.156***	−0.209***
	(0.019)	(0.015)	(0.046)	(0.046)	(0.020)	(0.019)	(0.037)	(0.038)
Lag of oil prices		−0.003		−0.011		0.005		0.037
		(0.005)		(0.030)		(0.004)		(0.041)
Lag of food prices		0.093***		0.234***		0.040*		0.112
		(0.019)		(0.042)		(0.023)		(0.069)
Lag of foreign inflation		0.128**		0.043		0.234**		0.143**
		(0.052)		(0.033)		(0.103)		(0.061)
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	527	527	527	527	370	370	370	370
Adjusted R^2	0.822	0.862	0.761	0.806	0.835	0.862	0.753	0.792

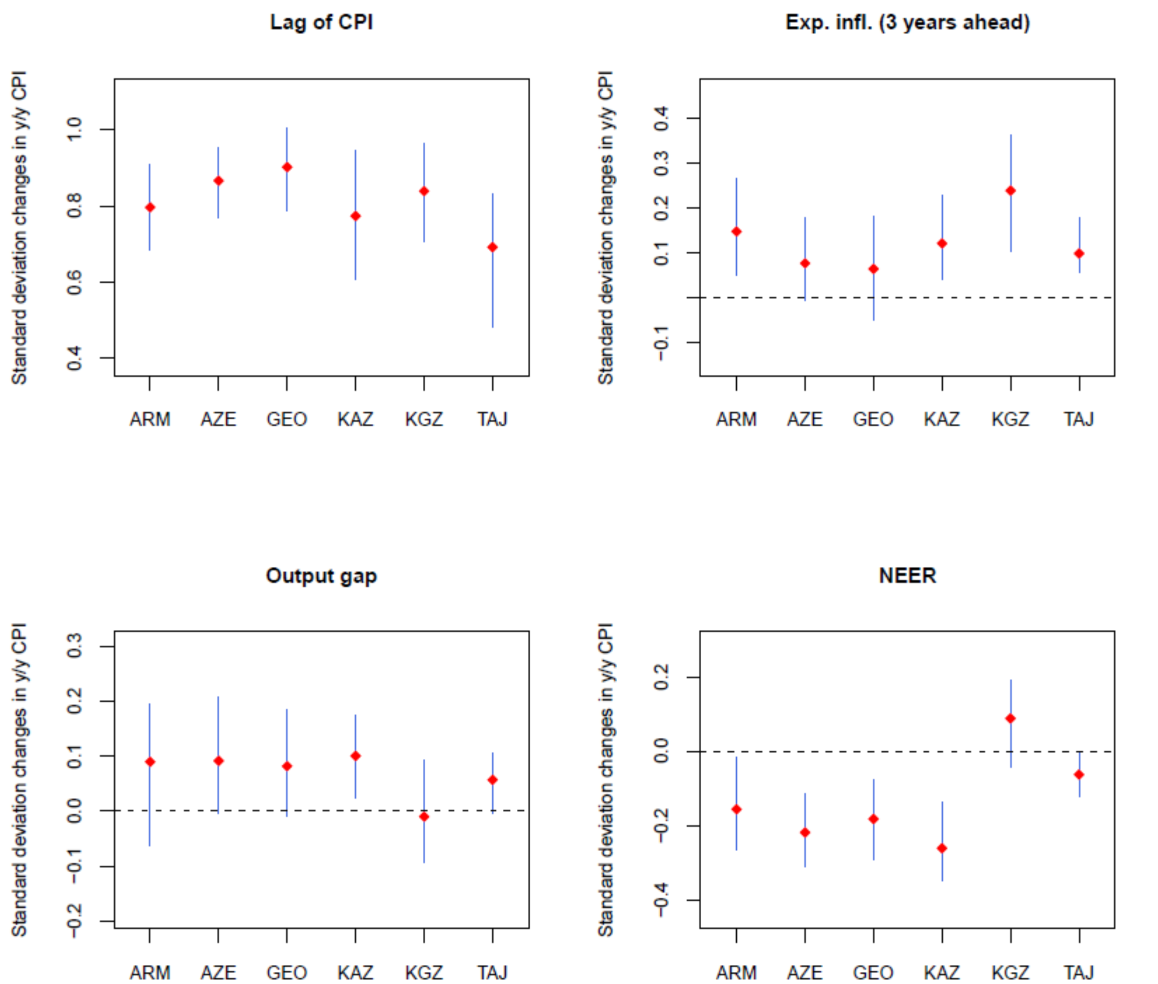
Variables, with the exception of the output gap, are expressed in y-o-y percent changes. Output gap: difference between s.a. real GDP and its Hodrick-Prescott filter ($\lambda = 1600$). Expected inflation: 3-year ahead historical forecast from the April and October vintages of the World Economic Outlook. Foreign inflation: Average of y-o-y CPI in Russia, EU27, and China. Error terms are clustered by country and shown in parantheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Country by country estimates are broadly in line with the aggregate results. They are presented in Figures 8 and 9, which summarize the estimation with standardized variables of equations (1) and (2) above. Due to the limited number of observations per country, confidence intervals are constructed using a bootstrap procedure.[10] The following observations emerge. The strong persistence of inflation is present in every country, although slightly less in Tajikistan. The relationship between inflation and inflation expectations is more heterogeneous; it is relatively stronger for the Kyrgyz Republic, Kazakhstan, and Armenia, and weaker for Tajikistan, Azerbaijan, and Georgia. The relationship with the output gap is more uniform, except for the Kyrgyz Republic, where the association is weaker and not statistically significant (the coefficient is also not statistically significant for Armenia). The NEER is strongly associated with inflation, except for the Kyrgyz Republic, for which the association is not significant. Food prices have a strong impact on inflation throughout the region, but less so in Tajikistan. Foreign inflation is a significant driver of headline inflation only in Kazakhstan and Azerbaijan.[11] Finally, in line with the aggregate results, oil prices are not statistically significant.

[10] Given limited numbers of observations results for Uzbekistan are excluded.

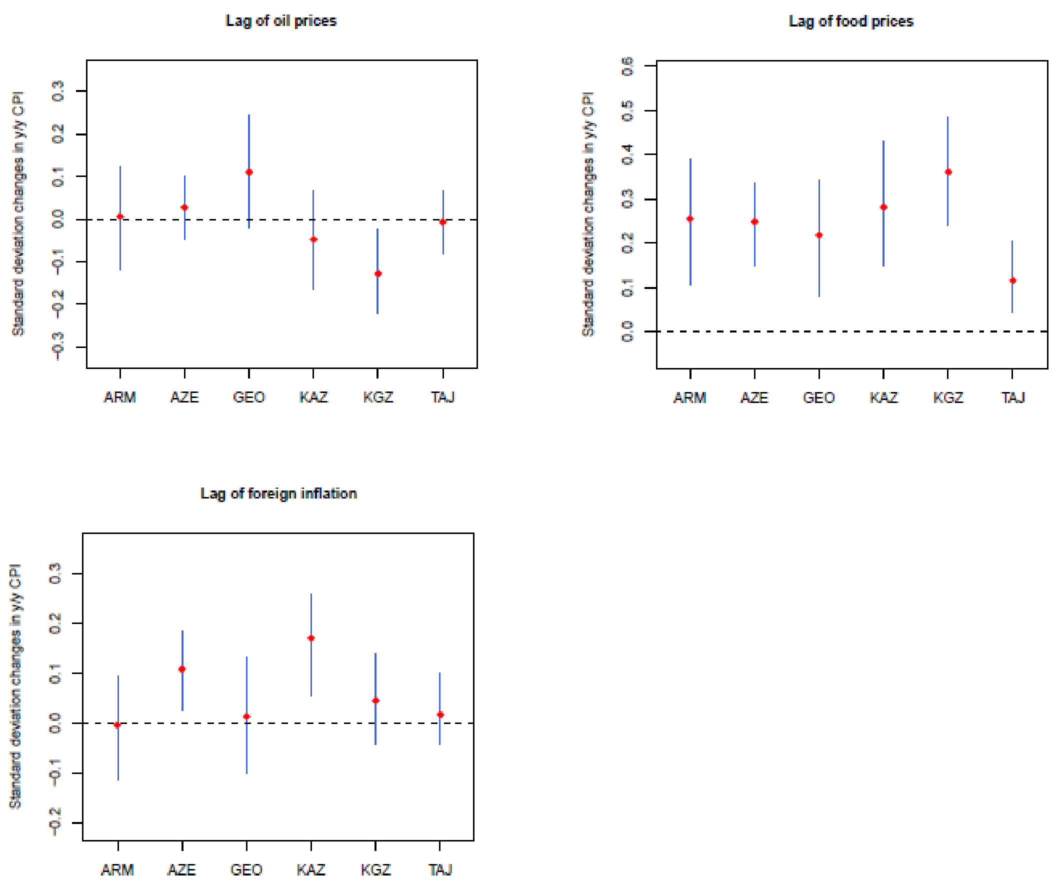
[11] This is consistent with the results in Table 1, showing that the relation between foreign CPI and domestic headline inflation is not statistically significant. Nonetheless, as suggested in Table 1, foreign CPI appears strongly associated with domestic core inflation.

Figure 9. Country-level Phillips Curve Estimates, Baseline Model



Source: Authors' calculations. The figure shows standardized regression coefficients from equation (1), estimated separately for each country. The vertical bars correspond to 95% bootstrap confidence intervals, obtained with 1,000 draws.

Figure 10. Country-level Phillips Curve Estimates, Augmented Model



Source: Authors' calculations. The figure shows standardized regression coefficients from equation (2), estimated separately for each country. The vertical bars correspond to 95% bootstrap confidence intervals, obtained with 1,000 draws.

5.2. INFLATION DYNAMICS: A PANEL VAR APPROACH

In this section we focus on the dynamic effects of the factors driving inflation in the CCA. The estimation of the Phillips curve allowed us to characterize some of the drivers of inflation and their relative influence. We now turn to a vector autoregression approach to study the transmission of shocks to these variables over time. We also look at their relative contribution to inflation dynamics by estimating the associated forecast error variance decomposition (FEVD). One well-known advantage of the VAR is that it helps to overcome the likely endogeneity between the variables in the model. In addition, the VAR allows to study relevant correlations/imputed effects over time, and to assess the feedback between variables. In the current context, another important advantage in the current context, as explained by Del Negro et al. (2020), is that the VAR does not need to include a measure of inflation expectations, assuming that the variables that are included reflect the set of information used by the economic agents to form those expectations.[12].

We estimate a pVAR for the countries of the CCA along the lines of Canova and Ciccarelli (2013). The panel framework allows us to exploit common shocks throughout the region and helps to expand the sample size and, hence, improve the accuracy of the estimates. The estimated model takes the following form:

$$Y_{i,t} = A_{\ i}(L)\, Y_{i,t-1} + \ u_i + \varepsilon_{i,t} \tag{3}$$

where $\mathrm{Y}_{i.t}$ is a vector of endogenous dependent variables, L is the lag operator, and $\mathrm{u_i}, \varepsilon_{\mathrm{i,t}}$, are country intercepts and error terms, respectively. In line with equation (1), we initially include headline inflation, the NEER, and the output gap as dependent variables. We then augment the framework to consider, one at a time, oil prices, food prices, and foreign inflation. In the first set of models, we order the variables assuming the NEER is the most exogenous variable in the system, followed by the domestic output gap, and inflation; in the latter, it is assumed that foreign variables are exogenous to domestic factors, while keeping the ordering of the remaining variables unchanged.[13] The models are estimated for the same period as above with quarterly data using the Generalized Method of Moments (GMM).[14] The number of lags is selected using Akaike and Bayesian information criteria (Ivanov and Kilian 2005), and confidence intervals are based on simulated standard errors derived from the pVAR implementation package for Stata of Abrigo and Love (2015).

Estimates from the pVAR are consistent with the PC analysis above. Results confirm the substantial persistence of inflation. They also point to a quick pass-through of foreign inflation, global food prices, and exchange rate fluctuations. The estimates for a shock to oil prices are somewhat surprising, as they show a negative effect immediately, although the effect becomes positive after a couple of quarters. The role of domestic demand conditions is found to be modest, with changes in the output gap having a small effect on inflation, possibly reflecting the difficulties in accurately estimating the output gap.

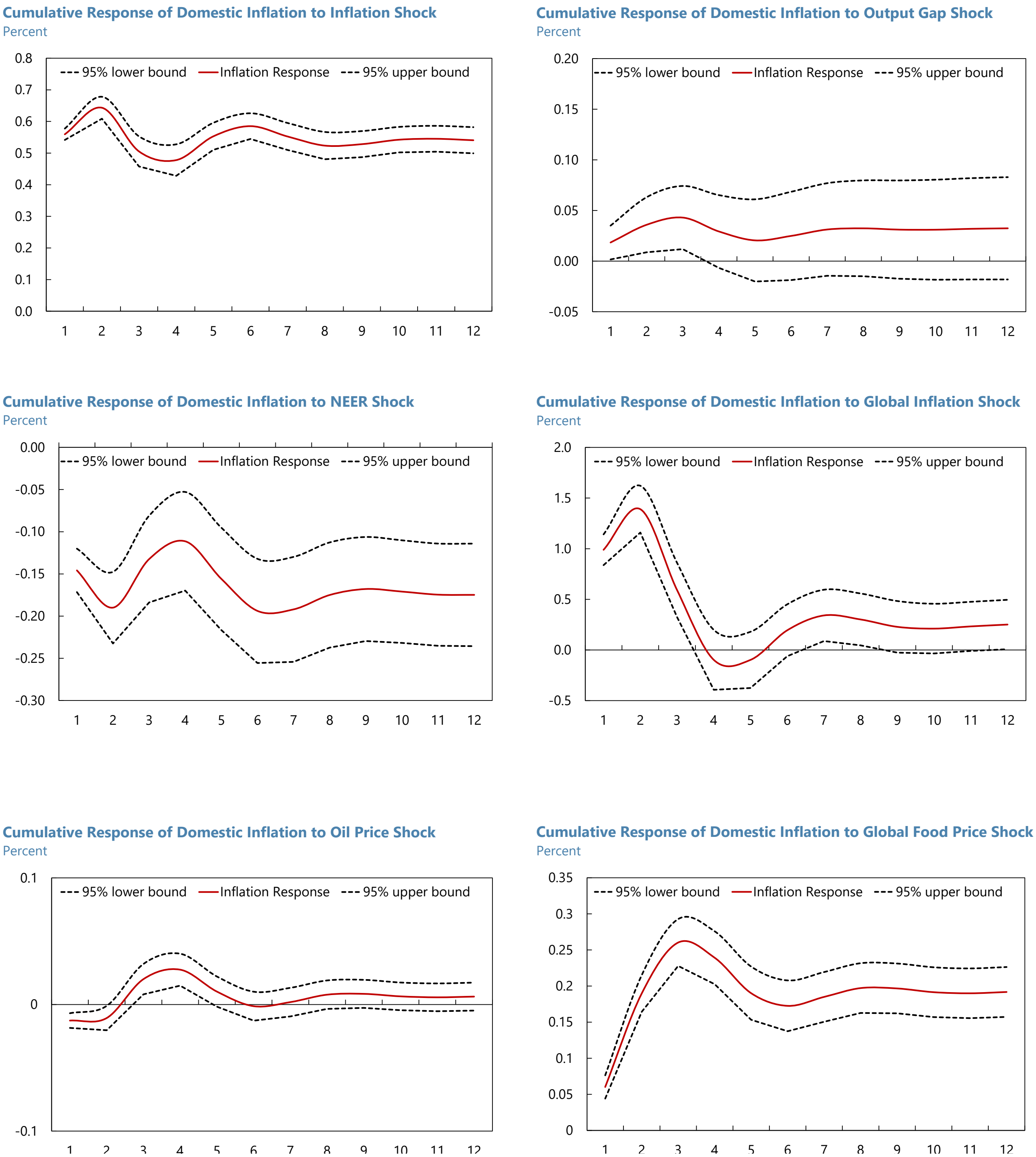
Results for the initial specification are summarized by the cumulative impulse response functions displayed in Figure 10, obtained with quarter-on-quarter changes. A one percent increase in foreign inflation can cause a 1.7 percent rise in domestic inflation within the first two quarters. While the foreign inflation shock starts to taper after the third quarter, global food shocks are more persistent. A one percent increase in global food prices can bring an additional 0.23 percent in domestic inflation in the first four quarters from the shock. The results also suggest significant pass-through of exchange rates with a one percent depreciation in the exchange rate adding 0.20 percent to domestic inflation within the first six quarters of the shock. In line with the baseline results (table 1), the association with the domestic output gap while significant tends to be smaller and have lower statistical significance. The results also confirm that the direct effect of oil prices on domestic inflation may be counterintuitive and limited, at least for some countries, while food and imported inflation contribute to a larger extent.

[12] See also Adams and Barrett (2022) and Doh and Smith (2022) for a discussion of inflation expectations in a VAR framework.

[13] The ordering follows the literature, e.g., Ca' Zorzi, Hahn, and Sánchez (2007). Changing the order of the variables yields qualitatively similar results.

[14] Following Holtz-Eakin and Newey and Rosen (1988), so to account for biases in OLS estimates arising from the use of lagged dependent variables in the presence of unit fixed effects (e.g., Nickell 1981, Arellano and Bond 1991).

Figure 11. Impulse Response Functions, pVAR Models of Inflation Correlates, Baseline Specification

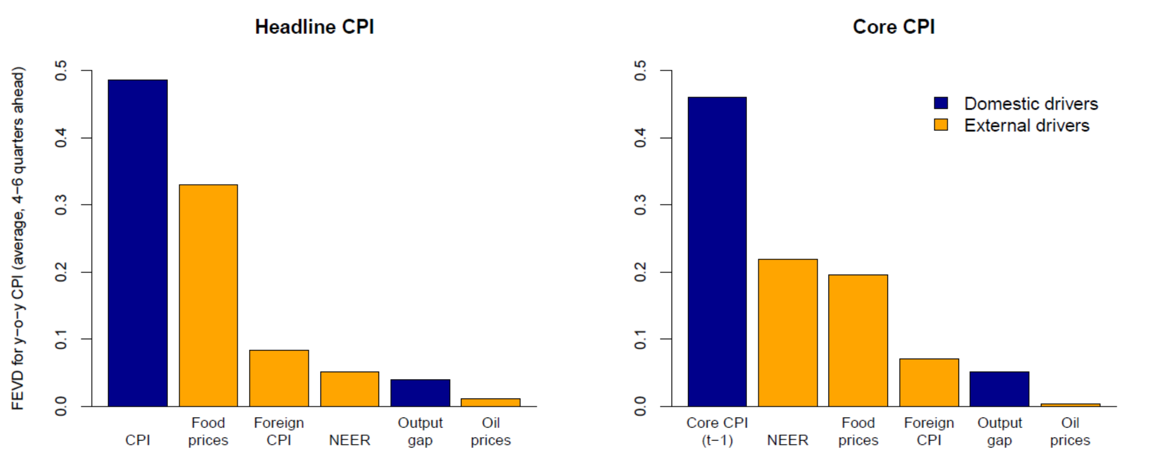


Source: Authors' calculations. The figure shows orthogonalized impulse response functions from pVAR estimates of equation (1), estimated using GMM (Abrigo and Love 2015). The shaded area gives the 90% simulated confidence intervals.

To gauge the contributions of individual variables to the inflation process, we analyze forecast error variance decompositions (FEVD), obtained by estimating pVAR models including both headline and core CPI, using standardized coefficients. The aim of this exercise is to break down contributions from domestic and exogenous factors several quarters after an initial shock.[15] We focus on the average error decompositions four to six quarters ahead, obtained including the full set of variables reported in figure 11, and repeating the analysis separately for core and headline inflation.

Results reported in Figure 11 confirm substantial persistence of domestic inflation and underscore the importance of additional factors. For both headline and core inflation, a shock to CPI accounts for approximately 50 percent of the error variance four to six quarters ahead, confirming the relative persistence of inflation in the region. Food prices in turn cumulatively account for approximately 35 percent of the forecast error variance of headline inflation, while their contribution to error decomposition of core inflation is lower at approximately 0.2 percent. After food prices, foreign CPI appears to have the largest contribution in explaining variations in future headline CPI. The share of error variance explained by the NEER, in turn, is considerably higher in the case of core CPI. Finally, in line with previous results, the estimated FEVD for oil prices and the output gap is considerably lower.

Figure 12. Forecast Error Variance Decomposition for pVAR Estimates, Including External Factors



Source: Authors' calculations. The figure shows the average FEVD of headline/core inflation four to six quarters ahead, obtained from GMM estimates of pVAR models of equation (2), using standardized variables. Results are expressed on a 0-1 scale (y-axis).

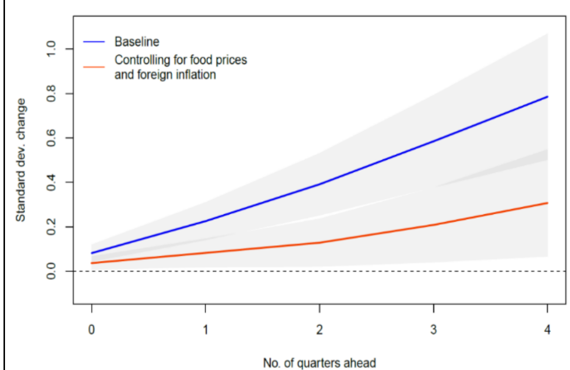
[15] For FEVD estimates reported in the charts, we order variables assuming that oil prices, food prices, and foreign inflation are the most exogenous variables (in this order), followed by the NEER, the output gap, and inflation. Different orderings, where for example, trading partners' inflation is treated as exogenous to oil and food prices, yield largely similar results.

Wage growth and inflation dynamics

In this section, we extend the pVAR analysis to investigate the role of wages on inflation dynamics. For this, we incorporate nominal wage growth in two separate models. In the first specification, we add annualized changes to nominal wages in a model that also includes the NEER, domestic inflation, and the output gap. In a second step, we also consider food prices and foreign inflation in the analysis to investigate how wage growth interacts with global factors. We assume food prices to be the most exogenous variable in the system, followed by foreign inflation, the NEER, domestic inflation, wages, and the output gap. Different orderings (e.g., assuming inflation and wages immediately respond to the output gap, but not the other way around) yield similar results. The cumulative IRFs obtained with standardized variables are presented in Figure 12.

When global factors are excluded (blue line in Figure 12) a one percent increase in wage growth is cumulatively associated on average with up to 0.4 percent increase in inflation three to four quarters after the shock. However, the impact becomes weaker once global food prices and partners' inflation are included in the analysis (orange line in the plot), increasing somewhat after two quarters. The smaller response of inflation to wage growth obtained after controlling for foreign prices may suggests that wages in part reflect external prices, possibly highlighting second-round effects from food prices and foreign inflation to wages. We further investigate this point below.

Figure 13. Estimated Response of Inflation to a Change in Wage Growth



Source: Authors' calculations. The figure shows four-quarter ahead cumulative and orthogonalized impulse response functions from pVAR systems, estimated using GMM and standardized variables. Shaded areas correspond to 90% confidence intervals.

5.3. ROBUSTNESS CHECKS

The analysis has been conducted with data for the period 2001-2020. However, in recent years, several CCA countries have progressively modernized their monetary frameworks and this may have altered the dynamics of the inflation process. Hence, we re-estimate the Philips curve models with data starting in January 2015. Results in Table 2 are broadly in line with the baseline estimates, with a somewhat stronger impact from foreign inflation.

Table 2. Phillips Curve Estimation, Augmented by External Factors, Alternative Sample Period (2015-2022)

	Headline CPI				Core CPI			
	Normal		Standardized		Normal		Standardized	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag of headline/core inflation	0.863***	0.749***	0.863***	0.762***	0.842***	0.684***	0.821***	0.651***
	(0.026)	(0.045)	(0.045)	(0.069)	(0.056)	(0.068)	(0.058)	(0.078)
Inflation expectations (3 years ahead)	0.279***	0.149*	0.145*	0.059	0.215**	0.106	0.109*	0.023
	(0.090)	(0.083)	(0.074)	(0.062)	(0.095)	(0.117)	(0.062)	(0.061)
Output gap	0.067**	0.033	0.050**	0.023	0.034	−0.006	0.008	−0.032
	(0.029)	(0.024)	(0.023)	(0.035)	(0.032)	(0.019)	(0.015)	(0.025)
Nominal effective exchange rate	−0.041**	−0.075***	−0.118**	−0.201***	−0.035	−0.081**	−0.097*	−0.200***
	(0.017)	(0.023)	(0.048)	(0.054)	(0.030)	(0.033)	(0.053)	(0.058)
Lag of oil prices		0.005*		0.074***		0.008**		0.077**
		(0.003)		(0.028)		(0.003)		(0.031)
Lag of foreign inflation		0.241*		0.124*		0.544***		0.291***
		(0.135)		(0.074)		(0.154)		(0.069)
Lag of food prices		0.049***		0.114*		0.011		0.046
		(0.019)		(0.066)		(0.009)		(0.042)
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	208	208	208	208	186	186	186	186
Adjusted R^2	0.875	0.897	0.780	0.819	0.822	0.860	0.743	0.807

Variables, with the exception of the output gap, are expressed in y-o-y percent changes. Output gap: difference between s.a. real GDP and its Hodrick-Prescott filter ($\lambda = 1600$). Expected inflation: 3-year ahead historical forecast from the April and October vintages of the World Economic Outlook. Foreign inflation: Average of y-o-y CPI in Russia, EU27, and China. Error terms are clustered by country and shown in parantheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Secondly, we re-estimated models (1) and (2) using a different proxy for inflation expectations. Following Hamilton et al. (2016) and Jordà et al. (2022), expectations are derived from a regression of one-year ahead inflation against four lags of quarter-on-quarter inflation[16]. Results are reported in Table 3. In the case of headline CPI, the coefficients for inflation expectations are substantially larger when untransformed variables are used in the regression (columns 1-2), given the limited variation in the alternative measure of expectations relative to the dependent variable.[17] Otherwise, the estimates are largely consistent with the baseline results.[18]

[16] Expectations are computed as the fitted values of the following model:

$$\pi^4_{nt} = \alpha + \emptyset\pi_{nt} + \emptyset\pi_{nt-1} + \emptyset\pi_{nt-2} + \emptyset\pi_{nt-3} + \emptyset\pi_{nt-4} + \varepsilon_t$$

where π^4_{nt} is the annual inflation four-quarters ahead for country n and $\pi_{n,t}$ corresponds to the quarter-on-quarter annualized change in the CPI.

[17] The standard deviation of this alternative measure of inflation is around 2 percent, as opposed to over 6 percent for realized year-on-year inflation. When standardized variables are used in the regression (columns 3-4), the size of the coefficients is considerably smaller at around 0.4.

[18] As an extra check, we constructed inflation expectations as an index combining the two methods reported in the text. Similar results (available upon request) were obtained.

Table 3. Phillips Curve Estimation, Augmented by External Factors: Alternative Proxy for Inflation Expectations

	Headline CPI				Core CPI			
	Normal		Standardized		Normal		Standardized	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag of headline/core inflation	0.713***	0.669***	0.711***	0.674***	0.769***	0.723***	0.758***	0.709***
	(0.077)	(0.065)	(0.059)	(0.047)	(0.067)	(0.054)	(0.046)	(0.048)
Inflation expectations	1.214***	1.040***	0.373***	0.338***	0.669*	0.543*	0.235***	0.204***
	(0.118)	(0.131)	(0.062)	(0.064)	(0.352)	(0.309)	(0.051)	(0.039)
Output gap	0.064**	0.031	0.042***	0.021**	0.067*	0.046	0.048	0.032
	(0.030)	(0.020)	(0.013)	(0.010)	(0.038)	(0.039)	(0.035)	(0.035)
Nominal effective exchange rate	−0.050***	−0.062***	−0.104***	−0.122***	−0.082***	−0.097***	−0.164***	−0.193***
	(0.019)	(0.023)	(0.029)	(0.036)	(0.009)	(0.007)	(0.039)	(0.043)
Lag of oil prices		0.001		0.019		0.005		0.041
		(0.003)		(0.018)		(0.005)		(0.051)
Lag of food prices		0.054***		0.099***		0.018		0.032
		(0.012)		(0.029)		(0.019)		(0.059)
Lag of foreign inflation		0.021		−0.007		0.145		0.098
		(0.051)		(0.029)		(0.115)		(0.071)
Observations	506	506	506	506	352	352	352	352
Adjusted R^2	0.893	0.905	0.886	0.895	0.871	0.878	0.808	0.817
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	506	506	506	506	352	352	352	352
Adjusted R^2	0.896	0.910	0.889	0.898	0.872	0.880	0.807	0.819

Variables, with the exception of the output gap, are expressed in y-o-y percent changes. Output gap: difference between s.a. real GDP and its Hodrick-Prescott filter ($\lambda = 1600$). Expected inflation calculated building on Jordá et al. (2022). Foreign inflation: average of y-o-y CPI in Russia, EU27, and China. Error terms are clustered by country and shown in parantheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Finally, we investigate the robustness of our findings to different statistical modeling assumptions and estimators. As noted above, fixed effects models in the presence of lagged variables imply a bias on least squares estimators (Nickell 1981; Arellano and Bond 1991). To address this issue, we follow Forbes (2020) and Kamber et al. (2020) to re-estimate models (1) and (2) using random effects for units, as well as by repeating the analysis with system GMM, already used for the VAR analysis above. Results for the additional tests are reported in columns (5)-(8) of Table 4. We find a slightly greater association between past and current inflation when using constrained and median regression (columns [1] to [4]), as well as larger coefficients for foreign inflation using random effects and GMM estimators. However, the sign and size of key coefficients, as well as estimates for other variables, are in line with those presented in Table 1.

Table 4. Phillips Curve Estimation, Augmented by External Factors, Alternative Estimators

	Headline CPI			
	Random		GMM	
	(1)	(2)	(3)	(4)
Lag of headline inflation	0.771***	0.679***	0.767***	0.621***
	(0.043)	(0.025)	(0.046)	(0.017)
Inflation expectations (3 years ahead)	0.156***	0.150***	0.150	0.158**
	(0.055)	(0.037)	(0.093)	(0.065)
Output gap	0.080***	0.017	0.143***	0.009
	(0.023)	(0.025)	(0.038)	(0.026)
Nominal effective exchange rate	−0.064***	−0.086***	−0.086***	−0.100***
	(0.016)	(0.013)	(0.017)	(0.015)
Lag of oil prices		−0.003		−0.004
		(0.004)		(0.004)
Lag of food prices		0.094***		0.095***
		(0.018)		(0.018)
Lag of foreign inflation		0.118**		0.278***
		(0.048)		(0.050)
Country FE			✓	✓
Country RE	✓	✓		
Observations	527	527	527	527
Adjusted R^2	0.822	0.863		
Sargan test (chi-sq.)			266	266

Reported standard errors for random effect and GMM models are derived from heteroskedasticity- and autocorrelation-robust variance-covariance matrices. Significance levels: *p<0.1; **p<0.05; ***p<0.01. Variables, with the exception of the output gap, are expressed in y-o-y percent changes. Output gap: difference between s.a. real GDP and its Hodrick-Prescott filter ($\lambda = 1600$). Expected inflation: 3-year ahead historical forecast from the April and October vintages of the World Economic Outlook. Foreign inflation: Average of y-o-y CPI in Russia, EU27, and China.

5.4. THE ROLE OF MONETARY POLICY

Empirical framework

In this section we evaluate the transmission from policy interest rates to inflation. We conduct three separate exercises. First, we look at the unconditional response of inflation to monetary policy shocks. Next, we assess the response considering movements in the exchange rate. Last, we evaluate the response considering changes in external conditions, namely variations in global food prices and foreign inflation.

Assessing the impact of monetary policy shocks on price dynamics requires having a measure of the exogenous variation in the policy variable. Building on Brandao-Marques et al. (2020), we associate changes in the monetary policy to changes in the policy rate set by the central bank, identifying monetary policy shocks for each country in our sample using a Taylor-rule model.[19] Since all the countries in the CCA are small open economies where the exchange rate plays an important role in driving inflation dynamics and are part of the central banks' policy-decision considerations, we incorporate changes in the NEER in the model. For each country, we use quarterly data to estimate the following equation:[20]

$$\Delta i_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 {\pi^e}_t + \beta_3 {Y^{(g)}}_t + \beta_4 e_t + \beta_5 \Delta\, i_{t-4} + \varepsilon_t \qquad (4)$$

where i_t is the year change of the policy rate in quarter t, and the explanatory variables are the lagged year-on-year inflation, ${\pi^e}_t$ is inflation expectations based on WEO forecast used in Table 1; the $Y^{(g)}$ is the output gap; e_t is the year-on-year change in the NEER. The monetary policy shock is then captured by $\widehat{\varepsilon_t}$; this represents the fraction of the interest rate that is unexplained by observed data, taken as a proxy for information that is contemporaneously available to the economic agents.

We next estimate the response of inflation to monetary policy shocks using local projections (Jordà 2005). The local projections method allows us to directly estimate the response of inflation to the policy shock without having to specify the unknown true multivariate dynamic data-generating process and is therefore more robust to misspecification than VAR. The framework also lets us easily incorporate interactions for the transmission of policy shocks with various country characteristics, as we do below.

We assess the impact of policy surprises on inflation with the following specification:

$$\pi_{i,t+h} = \beta_1 \pi_{i,t-1} + \beta_2 \widehat{\varepsilon_{i,t}} + \boldsymbol{Z_t}^f \varphi' + \gamma_i + u_{i,t} \qquad (5)$$

Where $\widehat{\varepsilon_{i,t}}$ is the estimated and standardized country-specific policy shock; $\boldsymbol{Z}^f$ is the set of global controls consisting of lags on food prices and foreign inflation; γ_i are a set of country fixed effects. The coefficient of interest is β, which measures the response of inflation to a 1 percent change in the policy rate shock. The impulse response function is generated by estimating equation (4) for each horizon (h), with h varying from 1 to 6 quarters. The shock is assumed to have no contemporaneous impact on inflation. The estimation is done by least squares with standard errors clustered by country.

We next test if changes in the external environment affect the transmission of monetary policy. We focus specifically on (i) changes in the nominal effective exchange rate and (ii) variations in food prices and foreign inflation. Our earlier results indicate that the variations in the NEER tend to be strongly (and negatively) correlated with domestic inflation. To assess whether changes in the exchange rate affect the policy transmission mechanism, in equation (6) we add a term interacting the policy rate shock with the NEER (Brandao-Marques et al. 2020; IMF 2023a). We also test whether the policy transmission is affected by foreign developments, as captured by global food prices or foreign inflation. The presumption is that the authorities adjust monetary policy to limit second round effects from external shocks (Taylor, Carriere-Swallow, Ha and

[19] This approach has the advantage of allowing us to compare monetary policy decisions across different economies. For some of the CCA countries, other policy variables (such as monetary aggregates) or short-term interest rates may have been more relevant for the conduct of monetary policy, especially at the beginning of our sample. As such, the analysis presented in this section should be interpreted carefully.

[20] Alternative specifications varying the number of lags or using the interest rate level (instead of the change) yield largely similar results.

Stocker). Again, we interact the policy shock with the relevant external variable. The augmented specification is as follows:

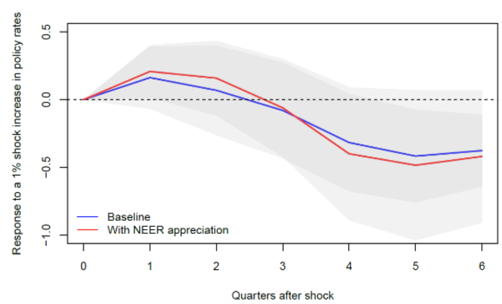
$$\pi_{i,t+h} = \beta_1 \pi_{i,t-1} + \beta_2 \widehat{\varepsilon_{i,t}} + \beta_3 k_t + \theta(\widehat{\varepsilon_{i,t}} \times k_{i,t}) + \boldsymbol{Z}^f \varphi' + \gamma_i + u_{i,t} \quad (6)$$

where k_t corresponds, sequentially, to the contemporaneous movement in the NEER, food prices or foreign CPI. The coefficient of interest is θ. It is interpreted as the effect of a monetary policy shock, conditional on a change in the variable of interest.

Estimation Results

Results suggest that monetary policy tightening has a significant effect on inflation, especially through movements in the nominal exchange rate. As shown in Figure 13, a 1 percent increase in the policy rate is associated with approximately 0.3-0.4 percentage point reduction in inflation, five to six quarters after the shock, with the effect being statistically significant after five quarters. In addition, the point estimates suggest the impact of interest rate changes is somewhat stronger when policy tightening is associated with a nominal appreciation, in line with the findings from the PC and VAR analyses.

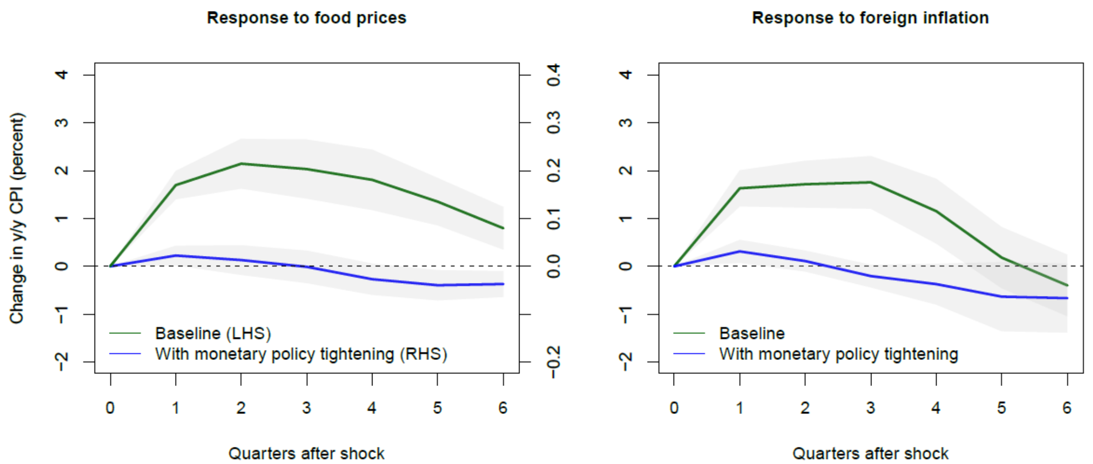
Figure 14. Estimated Response of Inflation to Monetary Policy Tightening



Source: Authors' calculations. Showing impulse response functions of inflation to a shock increase in policy rates, estimated from models (3) and (4). The vertical bars correspond to 90% confidence intervals, obtained with clustered standard errors.

Monetary policy limits the pass-through from foreign factors to inflation. Response functions for a 1 percent increase in food or foreign CPI, reported in figure 14, show a significant increase in inflation several quarters after the shock (green line), both for food prices and foreign inflation (consistent with the VAR analysis). However, the effects are considerably smaller when coinciding with a tightening of monetary policy (blue line). For food prices, for example, the pass-through to domestic inflation is estimated at around 0.02 percent in the first four quarters after a shock, on average, compared to 0.2 percent in case of no policy tightening. In the case of foreign inflation, the estimated pass-through is close to zero when the shock is accompanied by an increase in interest rates. In both instances, the effect of foreign prices are not statistically significant starting from two quarters after the shock, when policymakers opt for a tightening (blue lines in Figure 14). This is consistent with existing contributions arguing that prudent monetary policy has an important role in anchoring expectations, limiting second-round effects of foreign price pressures to expectations and broad-based increases in domestic prices (Blanco, Ottonello, and Ranosova 2022; Reis 2022).

Figure 15. Estimated Response of Inflation to Shocks in Food Prices and Foreign Inflation



Source: Authors' calculations. Showing impulse response functions of inflation to a shock increase in food prices (left-hand chart) and foreign CPI (right-hand chart), estimated starting from model (5). The vertical bars correspond to 90% confidence intervals, obtained with clustered standard errors.

6. Summary and policy recommendations

The paper explores inflation developments in the CCA region, with a particular focus on recent years. The period under consideration was marked by extraordinary challenges, including the global Covid-19 pandemic and Russia's invasion of Ukraine. The aftermath of the pandemic saw a surge in inflation across the region influenced by global factors as well as domestic policy decisions, with inflation starting to subside in 2023. We assess the role global and domestic factors have played in shaping inflation dynamics in the region.

Our analysis characterizes the main drivers of inflation in the CCA through various empirical methodologies. The analysis is conducted through the estimation of an augmented PC, a pVAR, and a Local Projections model. Inflation in the region is found to be substantially persistent and consistently influenced by both foreign and domestic factors. Estimates from the PC find that inflation expectations and domestic demand conditions (proxied by the output gap) play a modest but statistically significant role. The findings also point to substantial pass-through to inflation from fluctuations in the exchange rate. When the models are augmented with foreign variables, the estimates highlight the strong influence of inflation in the rest of the world as well as global food prices. Global oil prices show a weaker association with domestic inflation, likely reflecting widespread regulation of energy prices and long-term contracts across the region.

The finding that global factors play a major role in driving domestic inflation dynamics is consistent with previous findings in the literature. For example, Forbes (2019) concluded that they were the predominant factor in several emerging markets. The role of external factors implies that central banks have a more limited influence over local price dynamics. However, our results also show that domestic factors still matter, implying that local authorities retain an important role in maintaining price stability.

Indeed, our estimates also found that monetary policy can play an important role in controlling inflation in the region. The estimated impulse response functions from a local projections model suggest that monetary policy in the CCA region operate with a lag of about 4-6 quarters and is most effective when accompanied by an appreciation of the exchange rate, underscoring the importance of exchange rate flexibility in improving the effectiveness of monetary policy in countering inflation pressures. Additionally, the study suggests that monetary policy responses can limit the impact of global factors such as food and energy price shocks on domestic inflation.

As concluding thoughts, the paper offers the following policy recommendations:

- Efforts to strengthen monetary policy frameworks should continue for authorities in the CCA region to more effectively manage inflation pressures. Resolving structural weaknesses, such as high dollarization and underdeveloped financial markets, will help strengthen monetary policy transmission mechanism (for details refer to Poghosyan et al., 2023). Stronger commitment to price stability is associated with weaker persistence and lower exchange rate pass-through, and better anchored inflation expectations (cf. Mishkin and Hebbels 2007; Brandao-Marques, Gelos et al. 2020). Pursuing prudent macroeconomic policies will help to further reduce dollarization within the CCA, which despite the decline in recent years remains elevated. (Cakir et al., 2022).

- Administrative policies to control inflation (e.g., price controls and trade restrictions), which are fiscally costly, ineffective, and counterproductive in the longer term should be avoided. Governments should allow prices to adjust as price signals are critical to promote the allocation of resources as needed, to promote energy conservation and encourage private investment (IMF, 2022a).

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ANNEX I. DATA SOURCES

Variable (In y-o-y percent change)	Source	Coverage	Observations	Mean	Standard Deviation	Notes
Headline Inflation	IMF WEO, Haver, MCDHFI.dmxe	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB *	548	7.28	6.04	
Core Inflation	IMF WEO, MCDHFI.dmxe	ARM, AZE, GEO, KAZ, KGZ, TJK	382	4.98	4.99	Inputs from country desks; generally excludes food and energy
Output Gap (level)	IMF WEO, Haver, MCDHFI.dmxe, Authors' calculations	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB *	557	0.03	4.30	Calculated as percent difference between annualized actual output and trend output using HP filter
Nominal Effective Exchange Rate	IMF INS (STA)	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB	616	-2.06	11.36	
Food Prices	UN FAO Food Price Index	Global	616	4.27	13.54	
Brent Crude Oil Prices	Bloomberg	Global	616	11.54	34.55	
Foreign Inflation	IMF WEO, Authors' calculations	CHN, RUS, EU	616	4.71	1.97	Constructed as the average CPI of CHN, RUS, & EU
Wages	Haver	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB *	476	15.67	11.49	Annualized quarterly growth rate of nominal average wages in each country
Inflation Expectations (t+3)	IMF WEO vintages (1999-2019), Authors' calculations	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB	616	6.70	11.74	t +3 inflation forecasts from period t WEO are used as proxy for inflation expectations
Policy Rate	IMF MFS (STA)	ARM, AZE, GEO, KAZ, KGZ, TJK, UZB *	482	8.50	4.47	

* Limited coverage for UZB.
Note: Turkmenistan was excluded from the empirical analysis due to data limitations.
Note: All variables are gathered in quarterly frequency and, with the exception of output gap, are expressed as year-on-year percent change to mitigate seasonality and non-stationarity issues.

Country	Observations
Armenia	623
Azerbaijan	567
Georgia	510
Kazakhstan	569
Kyrgyz Republic	578
Tajikistan	545
Uzbekistan	285

Note: Turkmenistan was excluded from the empirical analysis due to data limitations.

ANNEX II. INFLATION DECOMPOSITION BY PRINCIPAL COMPONENT ANALYSIS

The decomposition presented in the text follows Krusper (2012) which carried out a similar exercise for Hungary and EU countries and which, in turn, is based on Stock and Watson (2002). Changes in inflation levels are decomposed between its domestic, global, and regional drivers. This is a statistical method that captures correlations between time series and therefore does not provide an explanation for the transmission of inflation, but nevertheless it provides a useful description of inflation dynamics. We estimate the following equation:

$$\pi_{ijt} = \lambda_{ij} f_t + \mu_{ij} g_{jt} + e_{ijt}$$

where π_{ijt} is the standardized annual change of the consumer price index (i.e., subtracting the mean and dividing by the standard deviation) in country i and region j, f_t is the global factor, g_{jt} is the regional factor in region j, and e_{ijt} is the country-specific component. The parameters λ_{ij} and μ_{ij} may differ across countries.

The estimation distinguishes between a global factor, a regional factor, and the purely domestic component of inflation. The sample consists of the G20 economies and countries in the Caucasus and Central Asia (CCA) region, with monthly data since January 2017 until May 2024. The analysis focuses on headline inflation. The region is defined as the CCA and Russia, the remaining countries constitute the global economy. The estimation entails three steps. First, principal components are obtained for inflation of the whole sample of countries. Second, principal components are obtained again from the residuals of the first step (i.e., excluding the global component) for the CCA countries and Russia. Finally, inflation in each country is regressed on the estimated global and regional components and the residual from this regression gives us the country-specific component.

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