

Non-Tradeable Sticky Price Inflation: Developing Better Concepts for Monetary Policy Analysis

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By Angela Papikyan, Hayk Avetisyan, and Douglas Laxton¹

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Abstract

This paper develops alternative price indices for Armenia that better fit the analytical framework developed within international macroeconomics and the notion of “sticky prices” as defined by Dornbusch (1976) in his seminal work on open economy macroeconomics. We explore in detail the conceptual basis for non-tradeable sticky price indices (NTSPI) and provide a methodology for constructing NTSPI, as well as discuss the historical narrative of NTSPI in Armenia. Finally, we explore opportunities to incorporate the NTSPI within monetary policy frameworks that seek to achieve price stability and include a loss function and endogenous credibility.

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I. Conceptual Introduction to Sticky Price Inflation

How should we decompose the CPI to better help monetary policymakers make better decisions and communicate policy more effectively? This is the task we have set for ourselves in this paper where we present a decomposition of the CPI that we believe helps the execution and communication of analysis within modern monetary policy transmission mechanisms.

We search for a decomposition of inflation that aligns with the two most prominent aspects of the transmission mechanism: the expected short-term interest rate path and exchange rate implications. Special attention is given to the latter when considering the best decomposition for different price measures. This approach is informed by the work of Rudiger Dornbusch, particularly his influential paper 'Expectations and Exchange Rate Dynamics', commonly known as the 'overshooting sticky-price Dornbusch model'. The concepts of 'sticky-prices' and their 'flexible-price' counterparts are integral to our practical implementation and analysis within New Open Economy Macroeconomics (NOEM).

Furthermore, the work of Maurice Obstfeld and Kenneth Rogoff and their development of NOEM, especially by incorporating better microfoundations, are instrumental to our approach. These advancements have real-world applications, such as the Global Economy Model developed by the IMF's research department which drew inspiration from Obstfeld and Rogoff's path-breaking research. We recognize the distinction between academic research models and those models that are more directly applicable to policy analysis. Our work, while drawing upon these important insights, selectively employs models based on dynamic optimization theory, depending on the specific questions and issues we are addressing.

Traditional 'sticky' price measures like core, median, or trimmed mean are often approached statistically, focusing on eliminating volatile items without deeply considering the economic rationale behind categorizing items into different buckets for analytical clarity. NOEM provides a conceptual framework for differentiating these price buckets: prices sensitive to exchange rate fluctuations (flexible) and those less sensitive (sticky), which are crucial for evaluating the effectiveness of short-term interest rates over time. In the Dornbusch overshooting sticky-price model, fast-moving asset markets contrast with the more sluggish segments of the goods market, producing exchange rate overshooting dynamics. Internationally traded goods, directly impacted by the exchange rate, are categorized as flexible prices, while non-traded items, such as most services, fall under sticky prices.

The exchange rate, though influenced by monetary policy, is not a direct target of central banks. It is the outcome of various economic factors, including policy rate decisions and market expectations. Distinguishing between traded goods prices, affected by the exchange rate, and non-traded goods prices is crucial. For instance, sticky prices is important because they respond more slowly to market changes than flexible prices, offering unique insights into inflation dynamics and expectations." Meanwhile, flexible prices are influenced by unique, or idiosyncratic, shocks, and can adjust quickly to market conditions and offer early warnings about inflationary trends. If monetary policy fails to adequately respond to these signals, particularly under conditions of generalized excess demand affecting these markets, there is a risk that this inflationary pressure will spread into stickier segments of the economy, like wages and non-traded sticky prices. If these pressures take hold, then

a much more aggressive policy adjustment might be required, resulting in unnecessary harm for the real economy.

The core of the problem lies in the nature of price indices, which aggregate the prices from a variety of unique markets whereby excess demand pressures are indicated not by isolated market behavior but when many of these markets collectively experience a state of excess demand. Recognizing and responding to these signals accurately is key to ensuring that monetary policy remains effective in stabilizing prices without unnecessarily reacting to transient or market-specific fluctuations.

This issue of correctly interpreting market signals and responding with appropriate monetary policy was particularly evident in 2021. Many believe that the challenges faced that year stemmed from a failure to address generalized excess demand pressures in a timely manner. Admittedly, opinions are still divided on this matter. While some argue that it is still possible to achieve a 'soft landing'—a scenario where inflation is controlled without causing a significant increase in unemployment—others are skeptical. This ongoing debate highlights the delicate balance central banks must maintain in their policy decisions, ensuring they react adequately to economic signals without overcorrecting and causing undue hardship to the real economy. This balance is vital to manage inflation effectively while maintaining overall economic stability, a challenge that continues to define the evolving landscape of central banking.

This paper is structured as follows. Section II explores in more detail the conceptual basis for NTSPI. Section III provides the methodology for estimating NTSPI, using the example of Armenia, a small open economy. Section IV explores opportunities to incorporate the NTSPI within monetary policy frameworks that seek to achieve price stability and include a loss function. Section V offers concluding remarks.

II. Moving Forward: Non-Traded Sticky Price Inflation

Central banks typically employ various measures of core prices, each targeting specific aspects of the consumer basket, offering different insights for policymakers in analyzing price trends. The use of different inflation measures is considered an integral component of a broader policymaking and analytical framework. The purpose of this paper is not to simply supply yet another alternative measure of underlying inflation, nor is it to argue that such a “perfect” inflation measure exists that can provide a panacea to policymakers in times of uncertainty. Rather, the motivation for developing a measure for Non-Traded Sticky Price Inflation stems from the specific challenges facing small open economies, such as Armenia, particularly in times of great volatility and uncertainty.

While a systematic and comprehensive examination of multiple measures contributes to understanding different scenarios, the primary objective of policymakers should remain centered on early warning signals where inflation expectations could become de-anchored. Hence, the proposed measure should clearly reflect the underlying long-term driving forces of inflation that allow the central bank to monitor and quickly adjust policy to achieve macroeconomic and price stabilization.

II.A. Supply Shocks

Traded goods prices can be affected by a wide range of external factors such as fluctuations in exchange rates, changes in global supply and demand, and disruptions to global supply chains. Much of the source of these price movements can be caused by factors that are either temporary in nature or that are outside the purview of monetary policy, and thus should not receive a policy response from monetary authorities on a period-by-period basis. This type of situation was clearly on display during the Covid-19 pandemic, when pandemic-related disruptions (including changes in trade policies or restrictions on transportation, shifts in consumer behavior, supply chain disruptions, labor shortages and so on) created significant bottlenecks in production and supply chains. These bottlenecks had direct impacts on prices of traded goods, generating significant short-term increases in prices. For example, furniture prices (as a durable traded good) have largely been affected by a variety of factors such as supply chain disruptions, increased demand for home furnishings due to stay-at-home orders, and changes in consumer spending habits. During this period prices of furniture in the United States were highly susceptible to these supply shocks, increasing by 24% between April 2020 and April 2022. Because this price shift was caused by a series of transitory supply shocks rather than fundamental changes to long-term supply/demand dynamics for furniture, once the bottlenecks began to gradually ease, furniture prices were among the first to decline, and while still well above pre-pandemic levels, continue to decline at a gradual pace.

From the perspective of monetary policy, even in times of supply shock the reaction should emphasize the possible spillovers of this shock into the more persistent components of inflation. Most measures of inflation—including those that central banks care most about, such as CPI, core, and even sticky price inflation—include traded goods. Therefore, these measures also exhibit an excessive level of volatility, adding complexity to the decision-making process and posing challenges in communicating with the public. Consequently, the underlying inflation considered within the Forecasting and Policy Analysis System (FPAS) framework should offer insights into the long-term drivers of inflationary conditions, aiding in clear

and effective communication of monetary policy deliberations during periods of heightened volatility and uncertainty.

II.B. The Role of Exchange Rate Dynamics and the Monetary Policy Transmission Mechanism

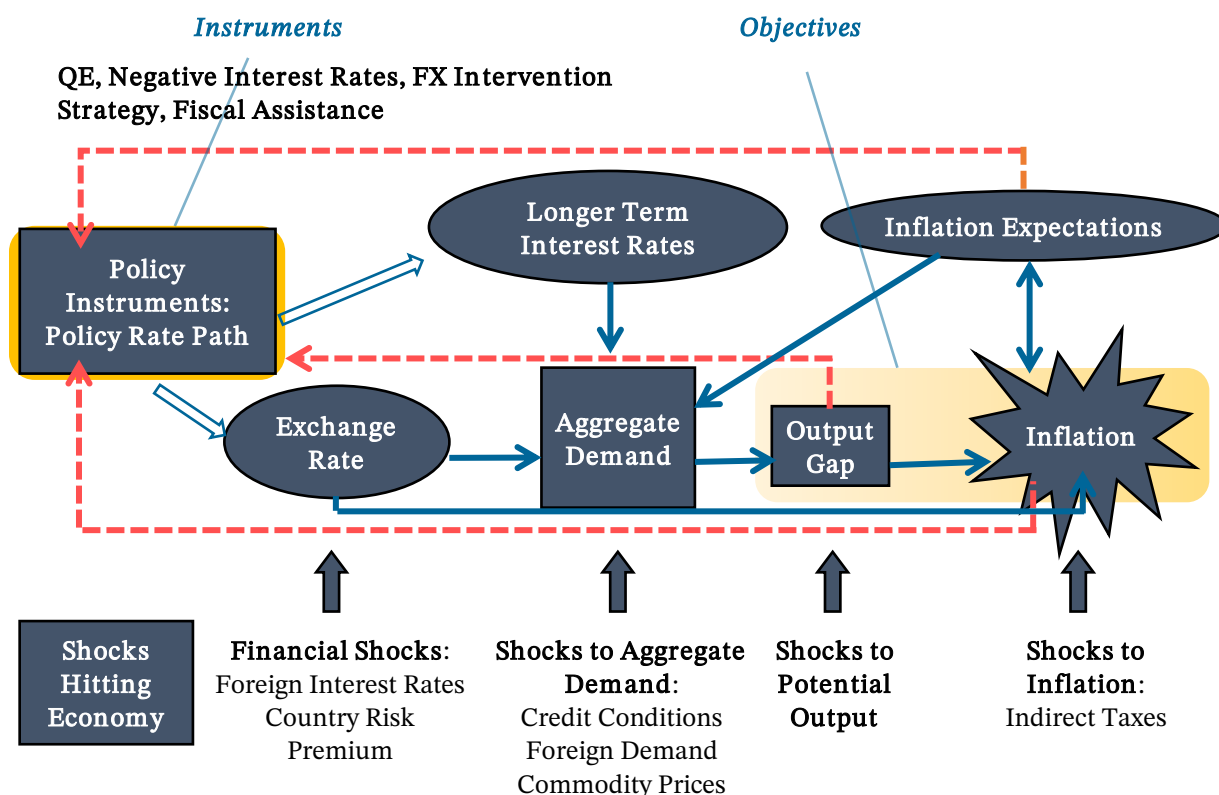
For open economies, traded goods are also subject to volatility stemming from the exchange rate. By distinguishing between sticky price non-traded and flexible traded goods, we can understand and communicate the important role the exchange rate plays in monetary policy analysis. Having separate measures for flexible non-traded versus sticky traded prices—which are affected by different types of shocks and factors within the economy—allows the central bank to develop better narratives about how the transmission mechanism works, what the driving forces are in the economy, and ultimately, the direction the central bank is adjusting policy.

How does the exchange rate impact prices for traded goods? The Global Economy Model (GEM), developed at the IMF and presented in Laxton (2008), provides a simple but robust illustration of this principle. The GEM framework assumes the presence of a distribution sector, through which all domestic and foreign goods need to go before they can be bought. The final prices of all goods include both the cost of producing these goods and the distribution costs, meaning that the prices of imported traded goods are not solely determined by changes in the exchange rate, and can be tempered by other factors.

Given this setup, when there is a shock to the country risk premium, the impact of the exchange rate pass-through on the relative price for traded goods in the GEM model is tempered by a number of inertias, in terms of the adjustment of the domestic retail price of the imported good and in terms of the adjustment of import volumes to the new relative price. The key conclusion is that when a shock enters domestic inflation through import prices, there are many things that can break the “law of one price.” The presence of a distribution sector, coupled with both nominal and real rigidities, reduce the short- and long-run sensitivity of import prices and the CPI to changes in the exchange rate. The presence of these rigidities also means that the exchange rate must adjust more in the short run to facilitate adjustments in the real economy.

Having a coherent narrative about the exchange rate pass-through *conceptually* and how it relates to the transmission mechanism (rather than simply referring to the concept in a way that oversimplifies complex exchange rate dynamics) is an essential part of central bank analytics and communications. The central bank must have a story to tell about exchange rate dynamics, how it relates to the policy rate and transmission mechanism and what is happening in the broader economy, and it must avoid the communication-related mistakes that can happen when the central bank oversimplifies complex processes.

Figure 1. The Monetary Policy Transmission Mechanism



Source: Clinton and others (2015)

To illustrate exchange rate dynamics and the transmission mechanism, we return to the example of furniture prices in the United States. In response to the Covid-19 pandemic, the US Fed launched a highly expansionary monetary policy (a combination of pushing interest rates to the effective lower bound and unconventional policies), with the intention of spurring aggregate demand and having higher price levels. By pushing the real interest down relative to other currencies and reducing real interest rate differentials, the result was depreciation in the US dollar, both at that time and into the future. The effects of this depreciation in currency, and its impact on prices for traded goods, can be seen when looking at prices for furniture.

Table 1. Furniture Prices in the United States

Furniture and bedding in U.S. city average, all urban consumers, not seasonally adjusted			
	April 2020	April 2022	% Change
Prices in USD	100 \$	124 \$	24.0%
CNY to USD	7.1	6.4	
Prices in CNY	710 ¥	789 ¥	11.2%

Source: BLS, St. Louis FRED

In domestic currency, furniture prices in the US between April 2020 and April 2022 rose by a cumulative 24%. However, over the same time period, the US Dollar depreciated by over 10% relative

to the Renminbi. China is the source for upwards of 42% of all US furniture imports as of 2019, and therefore, fluctuations in the exchange rate between the two currencies would meaningfully impact furniture prices for final consumers in the US. When looking at the same prices in Chinese currency, prices rose by a much less dramatic 11%. Here, the effect of the exchange rate on traded goods prices is clear: while prices for furniture certainly did increase (impacted by supply chain disruptions, labor shortages, and so on), much of the increase in prices could be attributed to depreciation in the domestic currency.

This exchange rate effect would be present for virtually all traded goods. Of course, this exchange rate effect would not be something that policymakers would want to see pass-through into non-traded goods prices; when the system is well-anchored, it would be expected that non-traded goods prices do not include exchange rate effects. However, recognizing the behavior of non-traded goods is also important for dollarized economies where such goods are primarily produced and consumed within the domestic market, but can still be sensitive to external economic conditions. For countries small open economies, such as Armenia, some non-traded goods prices might be set in the US dollar rather than the local currency (the best example being apartment rents) due to excessive dollarization, and therefore are subject to these exchange rate effects. Normally, we expect non-traded goods prices to be relatively stable and less responsive to international market movements. However, in cases of excessive dollarization, these prices can become more volatile, reacting to changes in the prices of traded goods. This nuanced understanding is crucial for distinguishing between tradable and non-tradable inflation. It underscores how non-traded goods, typically characterized by slower price adjustments, can under certain economic conditions, exhibit sensitivity to global economic shifts. Accurately capturing these dynamics is essential for effective monetary policy analysis that seeks to eliminate excessive pass-through of the exchange rate on non-traded goods prices.

In this context, there is significant value for small open economies to have measures of non-traded sticky price inflation. Distinguishing between prices for traded and non-traded sticky prices allows the central bank to first strip away the volatility that results from external supply shocks that in a flexible exchange rate is usually absorbed by the respective adjustment of the exchange rate, and second, to be able to communicate more coherently about the impact of exchange rates on traded prices. This enables a greater focus on the narrative about *how* the economy works, how the exchange rate is an important channel within the transmission mechanism, how relative prices work, and so on.

III. Methodology & Results for Estimating NTSPI for Armenia

Virtually all Flexible Inflation Targeting (FIT) and FPAS central banks closely follow a number of measures of underlying inflation. For example, the Atlanta Fed publishes its Underlying Inflation Dashboard, which presents many alternative measures of inflation that each seek to provide a better understanding of underlying inflation rather than just monitoring movements in core inflation alone.

Figure 2. Underlying inflation Dashboard

Measure of underlying inflation	12-month growth rate		Average difference Measure - Core PCE	Target based on 2% Core PCE	Stats for 1-mo growth rates (2009–2019)			
	Feb-22	Feb-23	2009–2019		Mean	Median	P25	P75
Core CPI	6.4	5.5	0.3	2.3	1.9	2.0	1.3	2.5
FRB Cleveland Median CPI	4.8	7.2	0.6	2.6	2.2	2.3	1.9	2.5
FRB Cleveland 16% Trimmed-Mean CPI	5.8	6.5	0.3	2.3	1.9	1.9	1.3	2.4
Atlanta Fed Sticky CPI	4.5	6.7	0.5	2.5	2.1	2.2	1.7	2.6
Core PCE	5.4	4.7	0.0	2.0	1.6	1.5	1.1	2.1
Market-Based Core PCE	5.1	4.9	-0.2	1.8	1.4	1.3	0.8	1.9
FRB Dallas Trimmed-Mean PCE	3.8	4.6	0.1	2.1	1.7	1.8	1.3	2.0
FRB San Francisco Cyclical Core PCE Inflation	6.1	8.0	0.7	2.7	2.3	2.5	2.0	2.8
Cyclically Sensitive Inflation (Stock and Watson (2019))	5.1	7.1	-0.1	1.9	1.5	1.5	1.0	2.1

*CPI-based measures last updated on March 14, 2023 with data through February 2023. PCE-based measures last updated on February 24, 2023 with data through January 2023. Median, P25 and P75 statistics of FRB San Francisco Cyclical Core PCE Inflation are based on 12-month growth rates. Sources: Bureau of Labor Statistics; Bureau of Economic Analysis; Federal Reserve Banks of Atlanta, Cleveland, Dallas, and San Francisco; Stock and Watson (2019); staff calculations

■ Measure is within target range (-/+0.25 from target)

■ Measure is between 0.25 and 0.50 ppt below target

■ Measure is more than 0.50 ppt below target

■ Measure is between 0.25 and 0.50 ppt above target

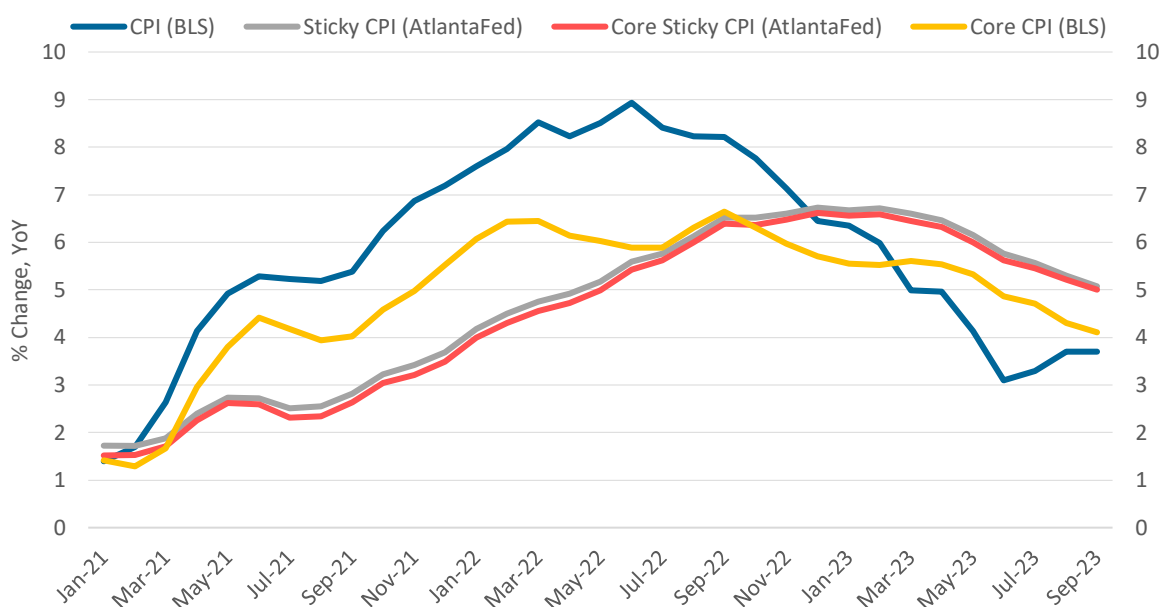
■ Measure is more than 0.50 ppt above target

Source: Atlanta Fed

The dashboard presents many different measures of inflation, including standard measures such as Core CPI and Core PCE as well as various measures put together by different FRBs. The overall CPI basket, from which items for all of these measures are selected, includes a number of goods and services that are affected by highly volatile factors such as seasonality, regulated items (e.g. public transportation, public utilities, etc.), and so on. The price movements of such products within the overall CPI are often based on factors that have very little to do with the concept of sticky prices. Core inflation (CPI less food and energy) solves some of the issues connected to seasonal movements (which are primarily related to food prices), but it still contains a significant share of goods and services that are vulnerable to frequent price changes (price “flexibility”) as well as external shocks (exchange rate fluctuations, supply chain disruptions, etc.).

The development of “sticky” price inflation, pioneered by the Atlanta Fed, represents one example of a price measure that attempts to incorporate the concept of sticky prices. The intuition behind the Atlanta Fed’s development of the sticky price inflation (SPI) measure is that certain prices are set less frequently than other prices. Because sticky prices do not respond to changes as quickly as “flexible” price goods, it is reasonable to think that they may incorporate a degree of forward-looking expectations about future inflation. In this way, these sticky prices are more forward looking than flexible prices and may provide better signals about underlying inflation.² The Atlanta Fed looked at all the items in the CPI basket, and divided them into sticky and flexible price components, based on the average frequency of price changes. Items whose prices change more often than the average frequency are labeled as flexible (30% of the CPI basket mainly food and energy), whereas those that change less often than, on average every 4.3 months, are considered sticky prices (70% of the CPI basket). Items in the Atlanta Fed’s SPI include, for example, service-based categories (e.g. personal care, medical services, education, etc.) and housing.

Figure 3: Atlanta Fed Measure of Sticky CPI and Core Sticky CPI; % Change, Year-over-Year



Source: Atlanta Fed; BLS

This methodology is helpful in eliminating a lot of the categories sensitive to exchange rate fluctuations as in traditional CPI and Core, but it has a few limitations. Most importantly, it includes traded goods which are affected by the exchange rate and therefore confounds the analysis and communication for policy. In other words, we need to distinguish between sticky price nontraded and traded goods to understand, communicate the first-round effects of exchange rates on traded and second-round effects on nontraded goods.

The methodological technique that we employ to derive such a measure considers the progress made by the Atlanta Fed while recognizing the limitations of its approach, this paper proposes an

² See Bryan and Meyer (2010).

alternative inflation measure: Non-Traded Sticky Price Inflation (NTSPI) for Armenia. We synthesize the methodology developed by the Atlanta Fed for sticky versus flexible prices with the BLS' segmentation of traded versus non-traded goods to develop the NTSPI index. The NTSPI is more impacted by domestic factors, most importantly inflation expectations, labor market conditions, aggregate demand conditions, and others.

The development of NTSPI fits neatly within the framework of FIT and FPAS, where the role of the central bank when dealing with these inflation measures is to articulate a logical economic narrative that explains the factors driving movements in these variables and what implications it has on policy decisions. The separation of tradable goods from non-traded sticky price inflation illustrates this. Moreover, under the next generation of policymaking frameworks known as FPAS Mark II, the measure could bring an essential benefit for the communication of the central bank's commitment to its price-stability objective in the face of significant uncertainty. Our methodological approach underscores the importance of two dimensions in constructing an acceptable measure within the FPAS framework.

III.A. Tradability Thresholds

Defining tradability criteria for goods and services can be difficult due to the various factors that come into play. For example, some goods may be considered non-tradable due to their scarcity, while others may be seen as tradable due to their abundance. Additionally, some goods or services may be considered tradable in one country but not in another. This can be due to a variety of reasons, such as cultural differences or the availability of resources, etc. To distinguish between tradable and non-tradable goods and services, it is important to determine criteria for tradability by setting thresholds for tradability first.

As described in Dwyer (1992), tradability refers to the ease with which a good or service can be traded. Tradability can be affected by a number of factors, including the availability of resources, the level of technology, and the level of development. According to Dwyer (1992), setting the tradability threshold requires a thorough analysis of the economic, political and social factors that contribute to a good or service's tradability. Economic factors such as production cost, availability of resources and level of development need to be considered along with political factors like stability of government, degree of regulation and bureaucracy. Additionally, social factors such as education level, social cohesion and trust need to be considered. Once these factors have been analyzed, a threshold can be set based on the level of tradability required for an efficient allocation of resources. The threshold can then be adjusted based on changing market conditions or changes in the underlying factors affecting the tradability of the good or service.

Knight and Johnson (1997) expanded on Dwyer's work by analyzing a broader set of factors that affect the determination of the tradability threshold. Their approach included considering the volatility of exchange rates, the size and nature of the domestic market, and the degree of competition in the relevant industry. Through this analysis, they provided a more nuanced understanding of the tradability threshold and how it can vary across different contexts. In both works the tradability threshold is 10% whereby those goods and services which had imports or exports above 10 percent of the total amount of the good or service produced were designated tradable, and those which did not were considered non-tradable.

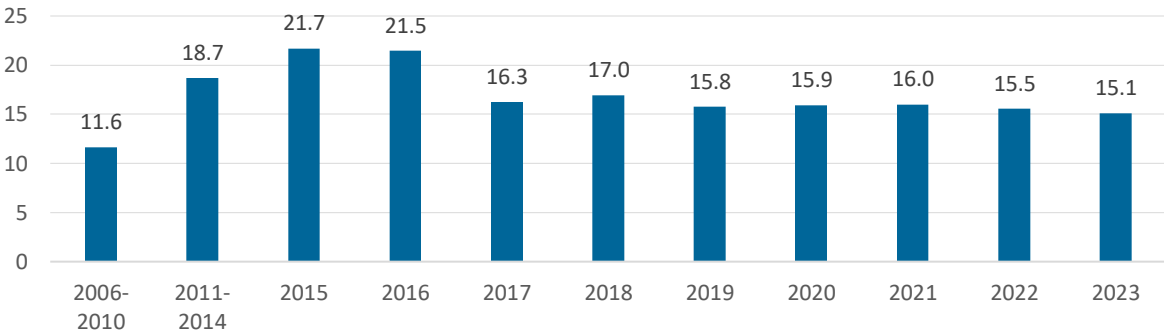
Dixon et al (2004) of Statistics New Zealand have conducted research on tradable and non-tradable indexes based on input-output tables. These indexes are used to measure the relative prices of tradable and non-tradable goods and services in the economy. The research involves identifying the industries that produce each type of good or service and then calculating their respective shares of total output, imports, and exports. This information is then used to construct the indexes, which can help policymakers understand the competitiveness of different sectors of the economy and make more informed decisions regarding trade policy. In this study, 15% was considered to be the best tradability threshold.

Our work builds upon the important contribution made by Johnson (2017). Their work primarily focuses on the classification of goods as either tradable or non-tradable in order to better understand the inflation dynamics within an economy. Their proposed methodology involves identifying goods that are subject to international competition and can hence be traded across borders, and contrasting them with goods that are only produced for domestic consumption. The author also provides empirical evidence to support their classification method, demonstrating that the measurement of inflation using a CPI that excludes non-traded goods can lead to more accurate forecasts of future inflation rates. The classification method can also be used to identify sectors of an economy that are exposed to international competition or are heavily reliant on domestic demand. We employ this classification to distinguish between traded and non-traded goods, and then construct the non-traded sticky price index for Armenia.

III.B. Composition of Armenian NTSPI basket

The NTSPI basket for Armenia is composed of goods and services that are not traded internationally, such as housing, healthcare, education, and other services. In addition, the basket includes items such as utilities, transportation, and communication services. As of 2023, the non-traded goods and services account for approximately 15% of the Armenian CPI basket as of 2023. Historically, between 2006 and 2023, the non-traded component has composed between 12 and 22 percent of the overall CPI basket.

Figure 4. Non-Traded Goods and Services Share of Armenian CPI Basket

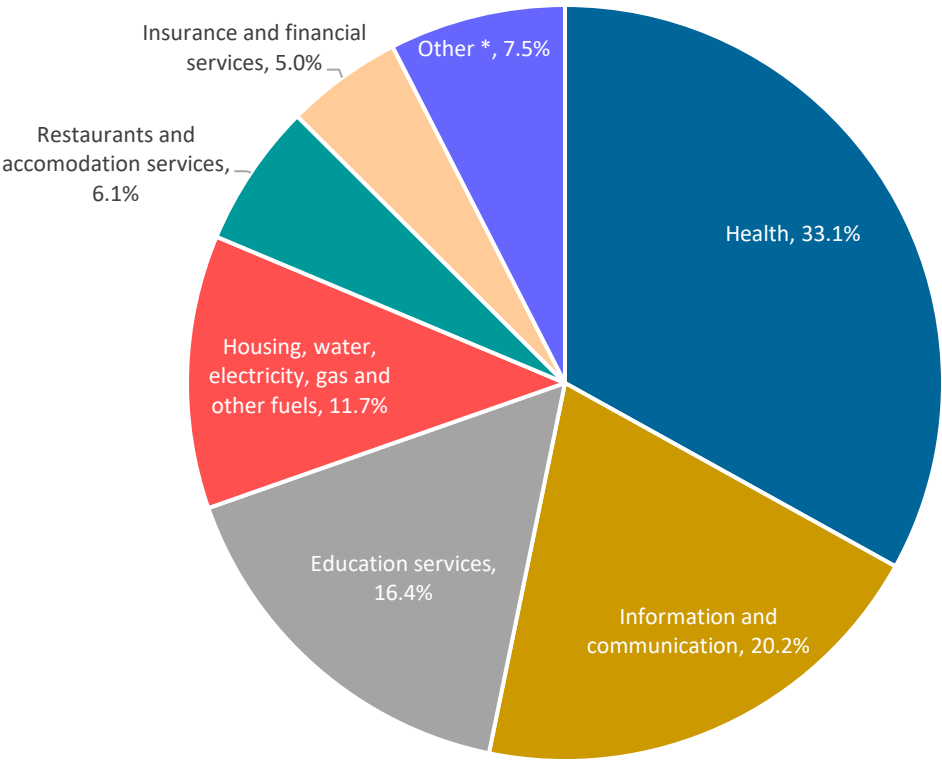


Source: Author calculations, based on raw data from National Statistical Service of Armenia

As shown in Figure 5 below, the greatest contributors to the non-traded goods and services basket includes health (primarily services such as dentistry, imaging, and so on), which comprises 33% of

the basket; information and communication (including phone/internet/television subscription services, repair services, etc.), which make up 20% of the basket; and education services (including tuition), at 16% of the basket. The remainder of the basket includes categories such as housing, water, electricity, gas, and other fuels (including residential rent, home repair/maintenance, etc.); restaurants and accommodation services (e.g. fast food); insurance and financial services (including bank fees, legal fees, and so on), as well as a small number of goods and services in other categories such as transport; recreation, sport, and culture; and personal care, among others, which collectively make up 8% of the basket. The basket is entirely composed of goods and services (with services very heavily dominating) that are non-traded in nature. Refer to the appendix for a detailed listing of the goods and services that make up the Armenian basket.

Figure 5. Distribution of NTSPI Basket



* Other includes such categories as recreation, sport, culture, personal care, etc.

Source: Author calculations, based on raw data from National Statistical Service of Armenia and item classification from the Classification of Individual Consumption According to Purpose (COICOP)

III.C. Calculation Methodology

The methodology used to calculate the non-traded sticky price index follows the same methodology as is used to construct the official CPI in Armenia by the National Statistical Service. The methodology was developed by the NSS jointly with the IMF, We provide a brief summary of the

methodology, but refer the reader to the official methodological note published by the NSS for further detail.³

The CPI (and NTSPI) are calculated on a monthly basis using the Laspeyres formula with fixed weights. Indicators required for the formation of the weights of the CPI basket of goods and services are obtained based on the data on monetary expenditures made by households, based on results from the Integrated Household Living Conditions Survey (IHLCS). The previous year is taken as the base period for indices and weights for the calculation of the price index, but the household survey upon which the weights are based on have a two-year lag. (e.g. 2023 CPI weights are based on the 2021 IHLCS). The weights for the items in the NTSPI basket are provided in the appendix.

³ Refer to Statistical Committee of the Republic of Armenia (2020) and (2021).

IV. The Economic and Policy Relevance of the NTSPI

IV.A Using NTSPI to Calculate Central Bank Credibility

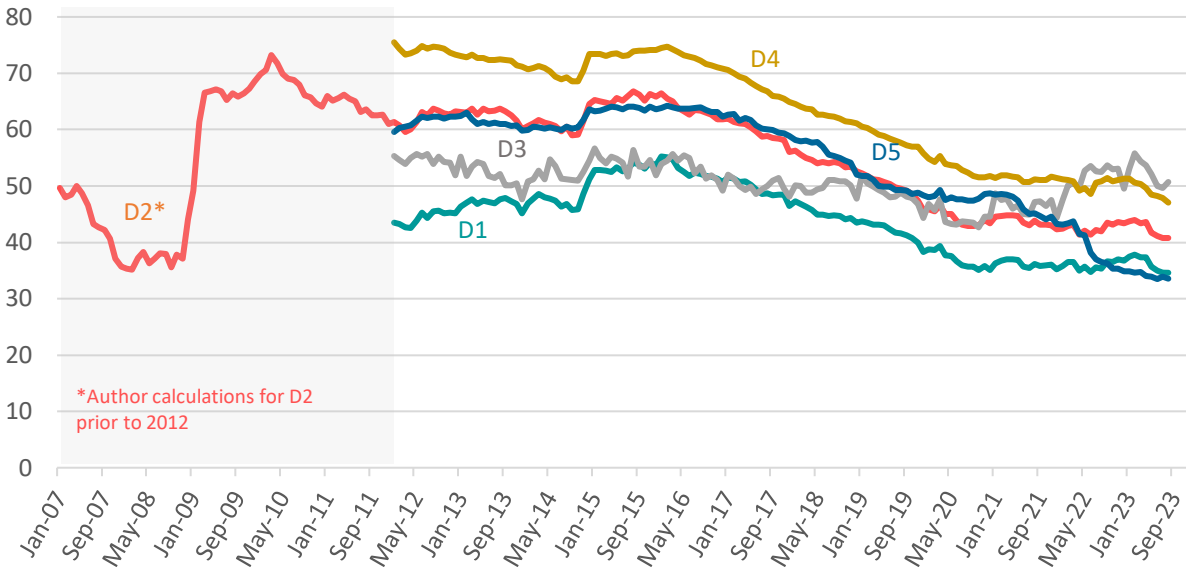
Under FPAS Mark II, we emphasize the value of analytical frameworks that treat monetary policy credibility as endogenous—in other words, the understanding that central bank credibility is not fixed and unchanging, but rather, that the central bank’s policy actions may have implications on its credibility. When policymakers (and models) do not think of credibility as endogenous, policy responses can be delayed or be insufficiently aggressive. The workhorse model used in FPAS Mark II, known as ENDOCRED, is designed to address the issue of credibility in monetary policy decision-making.

Credibility is equivalent to the reputation that the central bank has developed by first specifying a numerical objective for long-term inflation, and second by whether or not it has been able to achieve that target on average over time. The term “on average” is simply meant to represent that many measures of inflation contain significant noise in the data, and even if a central bank was behaving perfectly, inflation will not be equal to the target on a period-by-period basis. However, the public will obviously be skeptical if the performance of the central bank has allowed periods of high and variable inflation. We therefore think of credibility as a stock, in the sense that it depends on the accumulated performance of the central bank over time. When inflation is allowed to deviate from target and inflation expectations start to de-anchor from the target, credibility can be lost very quickly. Once lost, the process to regain credibility is a slow and gradual one. The loss of credibility becomes costly, because if the public loses trust in policymakers’ ability to achieve their policy objectives, then the central bank has to adjust its policy rate much more aggressively, implying larger cumulative output and unemployment costs to reduce inflation. This logic reflects an underlying principle that delaying policy actions in response to different types of shocks (such as overheating, or upward shifts in the equilibrium real interest rate) is costly.

To measure central bank performance, we take two approaches. First, which is a “standard” approach for evaluating performance for inflation-targeting regimes, we evaluate the deviation of NTSPI from high levels (defined as 10%, corresponding to a high and unstable inflation regime) and its target level (judged to be 2%—see section III.F). The NTSPI index is a perfect candidate in the credibility context, because by design it reflects the slower moving and long-run drivers of inflation, namely monetary policy relevant inflation expectations. The latter is the key criteria for estimating and monitoring the central bank credibility.

Second, we take another measure of central bank performance that evaluates levels of excessive dollarization. This is based on the idea that excessive dollarization reflects the low levels of trust in the domestic currency or in the macroeconomic environment, and can be seen as another proxy for central bank performance. This second performance measure utilizes the D2 measure of dollarization (see Figure 6), which represents the share of residents’ foreign currency deposits and advances in residents’ total deposits and advances. Similar to the NTSPI measure of performance, the dollarization approach evaluates the deviation of dollarization from high levels (defined as 80%, representing an economy with high and excessive dollarization) and low levels (judged to be 30%, consistent with an estimate for non-excessive “optimal” level of dollarization for Armenia).

Figure 6. Historical Levels of Dollarization in Armenia



D1-D5 are compiled based on the indicators of the Central Bank of Armenia, commercial banks and credit organizations.
 D1 is the share of residents' foreign currency deposits and advances in money supply
 D2 is the share of residents' foreign currency deposits and advances in residents' total deposits and advances
 D3 is the share of resident natural/physical persons' foreign currency demand deposits and advances in total demand deposits and advances of resident natural persons
 D4 is the share of resident/natural/physical persons' foreign currency time deposits and advances in total time deposits and advances of resident natural persons
 D5 is the share of foreign currency loans to residents in total loans

Source: Central Bank of Armenia; Author calculations

CBA Performance Indicator:

NTSPI Approach:

$$CBPI_t^{NTSPI} = \frac{(NTSPI_t - 10)^2}{(NTSPI_t - 10)^2 + (NTSPI_t - 2.0)^2}$$

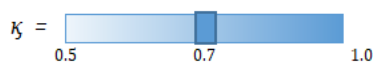
Dollarization Approach:

$$CBPI_t^{Dollarization} = \frac{(D2_t - 80\%)^2}{(D2_t - 80\%)^2 + (D2_t - 30\%)^2}$$

We then take a weighted average of the two approaches to arrive at a single performance indicator. We assume weights of 70% for the NTSPI approach and 30% for the dollarization approach, but recognizing that there is uncertainty and room for judgment to adjust these depending on different economic factors and behavioral characteristics at any given time period, we provide slider scales for plausible ranges for these weights.

Weighted Average Performance Indicator:

$$CBPI_t = \kappa * CBPI_t^{NTSPI} + (1 - \kappa) * CBPI_t^{Dollarization}$$



Credibility is then calculated using the weighted average performance indicator. It is defined as a stock that depends on the accumulated performance of the central bank over time. Credibility is thus calculated as a function of the lag of central bank's credibility (as it is a stock that can be lost very quickly and gained only gradually over time) and its current performance.

CBA Credibility:

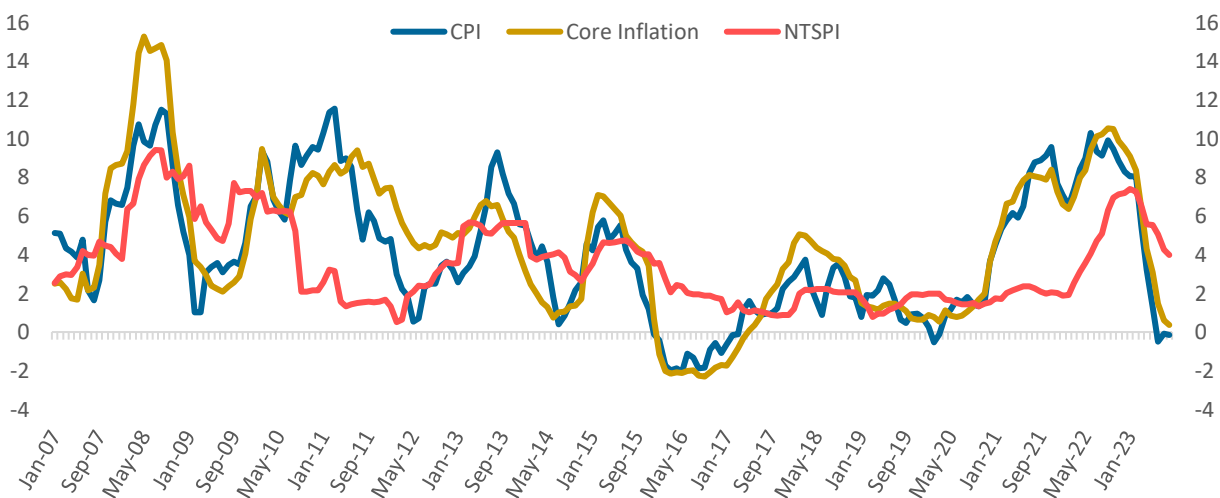
$$CRED_t = 0.1 * CBPI_t + 0.9 * CRED_{t-1}$$

IV.B. Non-Traded Sticky Price Inflation Measure for Armenia: Historical Narrative Approach

This section presents the results of the Non-Traded Sticky Price Inflation for Armenia, and uses the historical narrative approach to explain the results, how they compare with headline CPI and Core inflation measures, and highlighting the power of NTSPI in the context of price stability, particularly in times of economic risk and uncertainty. The historical narrative also discusses central bank credibility in the context of NTSPI.

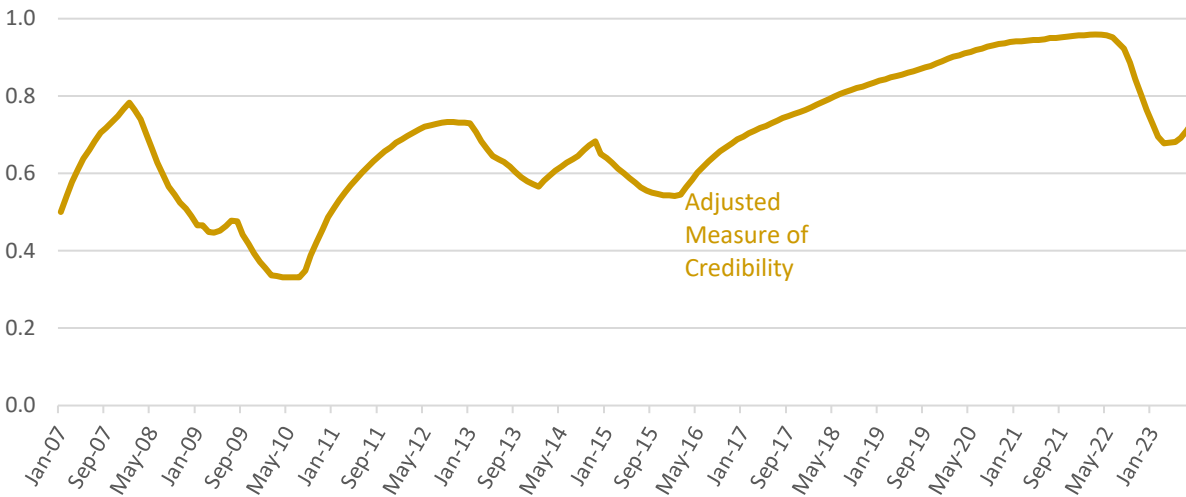
Figure 7. Measures of Inflation and Credibility for Armenia

Panel A. CPI, Core, and Non-Traded Sticky Price Inflation for Armenia, Year-over-Year, January 2007-September 2023



Source: National Statistical Service of Armenia; Central Bank of Armenia; Author calculations

Panel B. Proxy for Central Bank Credibility



Source: National Statistical Service of Armenia; Central Bank of Armenia; Author calculations

IV.C.1. 2006-2009: Double-Digit Economic Growth

In the years leading up to the GFC, the global economy was booming, with clear inflationary implications for prices in commodity markets. Oil prices and all commodity prices were high around the world, contributing to the expansion of inflation in Armenia, as the imported part of CPI was quite large. At the same time, the period was described by substantial capital flows to emerging countries that resulted in a significant appreciation of the currency and the expansion of economic growth especially in the non-tradable and construction sectors. Similar to other emerging economies, a rise in foreign investments and capital flows during the period accompanied exchange rate appreciation of about 50 percent, while the economy has been expanding with double-digit growth during 2006-2008. During the second half of the 2000s, Armenia experienced a major real estate boom, with for-sale home prices growing dramatically (by over 250% between January 2003 and September 2007), and with the construction sector representing a significant 25 percent share of GDP.

Driven by a confluence of these factors, and despite the exchange rate appreciation, non-traded sticky prices had begun to surge upwards reflecting the effect of significantly positive demand and inflation expectations ratcheting upwards in a period of sustained high inflation. However, while still above the inflation target of 4% during this inflationary period, NTSPI remained below CPI and Core measures of inflation. This reflects that the primary drivers of inflation during this period was global and domestic demand conditions and high commodity prices, but that this high inflationary environment, by leading to upward ratcheting in inflation expectations, also caused non-traded sticky prices to increase as well. The main challenge for monetary policy in this context was to appropriately respond to domestic demand expansion given capital flows and currency appreciation, and to re-anchor medium and long-term inflation expectations to the 4% target.

IV.C.2. 2009-2014: Slow Growth, High Risk Premia

Armenia was significantly impacted by the global demand contraction caused by the Global Financial Crisis. The economy, along with the rest of the emerging world, faced a significant reappraisal of the country risk premium, resulting in a sudden stop of capital flows and consequent contractions in demand and negative economic growth followed by slow recovery. Due to the significant accumulation of public and private debt in order to support the growth that appeared to suffer from structural problems, the sustainability of debt levels became a key question, reflected in a persistently high risk-premium.

Flexible prices were volatile during the period, due to shocks in gas prices and global food prices, while non-traded sticky prices had generally stabilized around target levels. There was much debate as to whether monetary policy should react to these types of shocks. For a non-credible central bank, it might be reasonable to design a reaction in prevention of the possible implications for inflation expectations. Importantly, after 2010, sticky and flexible price indices diverged. Movement in flexible prices facilitated resource allocation in the economy in an environment of volatile supply shocks and relatively slow economic growth, while NTSPI declined, reflecting low underlying demand conditions.

IV.C.3. 2014-2020: Disinflation

At the end of 2014, the global oil price shock, as well as the geopolitical issues and economic sanctions generated negative expectations about the Russian economy, causing a depreciation of the Russian ruble that spilled over to other regional currencies. Depreciation pressures in the domestic currency market, coupled with the speed at which prices of certain goods grew on the back of a depreciating local currency, caused inflation expectations to destabilize. This led to a sharp increase in demand for goods and foreign currency, amplifying the inflationary pressures and jeopardizing policy credibility.

Monetary policy responded to this event with substantial tightening of financial conditions (more than 12 percentage points on impact increase in the effective operational policy rate since the end of 2014), that helped to contain the inflationary pressures and stabilize the financial markets. NTSPI, which had ticked upward during the geopolitical crisis, began to stabilize around target levels, as sufficiently aggressive monetary policy helped keep underlying inflation in check.

Given the high degree of uncertainty, inflation expectations and risks for destabilization continued to remain high. The Central Bank undertook an opportunistic disinflationary policy since 2015. Even though the period thereafter was deflationary by itself, the remaining high inflation expectations was the key motivation for following a relatively tighter monetary policy. As a result of such policy, the inflation expectations decelerated significantly, accompanied by substantial decrease of dollarization and essential gain in the credibility. In other words, monetary policy was compensating for high inflation in previous periods, and in doing so, accumulating credibility.

IV.C.4. 2020-2022: Post-War, Post-Pandemic

The Covid-19 pandemic generated incredible disruptions to global supply chains, and this, coupled with social distancing/quarantine requirements for workers, represented major supply shocks. On

the other hand, the crisis generated parallel demand shocks, with consumers demonstrating hesitation to maintain pre-Covid levels of spending in the face of the public health crisis and restrictions on their free movement. These shocks were further compounded by Azerbaijan's aggression in the Autumn of 2020, when it launched the Second Nagorno-Karabakh War, resulting in over 3,800 combat deaths in Armenia alone and the internal displacement of over 100,000 civilians. The combination of war and pandemic created a sharp drop in demand for goods and services, leading to a decline in the prices of certain items in the CPI basket. While the double shock also affected the supply side of the economy, destroying some part of the potential, in the initial phase the demand deficiency was over-pacing, and general consumer price inflation actually slowed down following similar trends at the global level between March 2020 and March 2021.⁴

At the end of 2020, the Central Bank of Armenia was concerned about the prospect of likely rising of inflation expectations in the face of projected quicker recovery of pent-up demand. Hence, the CBA acted in a proactive and forward-looking manner as one of the first central banks in the world to raise interest rates, by one percentage point in December 2020 when inflation was still lower than the inflation target of 4%. With this meaningful step, the CBA made clear that credibility and the commitment to price and financial stability are of paramount importance. This and the subsequent steps helped to control inflation and contain expectations. Thus, by February 2022, the inflation in Armenia stood at 6.5% down from its peak of around 10% and was gradually drifting down to the target while in majority countries of the world it had been accelerating at quick rates.

Since February of 2022 high economic activity continued to be observed in Armenia, predominantly driven by external demand factors. The main contributors are the significant influx of international visitors and remittances. High demand also contributes to the overheating of the labor market, to the expansion of overall inflationary environment and to the persistence of high inflation expectations. The fact that high aggregate demand conditions—rather than external supply shocks—were the primary driver of inflationary conditions is reflected in the inflation data. Whereas NTSPI remained largely stable (below target) in the early phases of Covid-era inflation, the robust expansion in aggregate demand and domestic economic conditions caused NTSPI to significantly increase beginning in early 2022. In light of these upward pressures on aggregate demand, the Central Bank of Armenia began an aggressive policy of raising interest rates. In total, since the first policy rate increase in December 2020, the CBA increased the policy rate by 650 basis points, to a peak of 10.75% in December 2022.

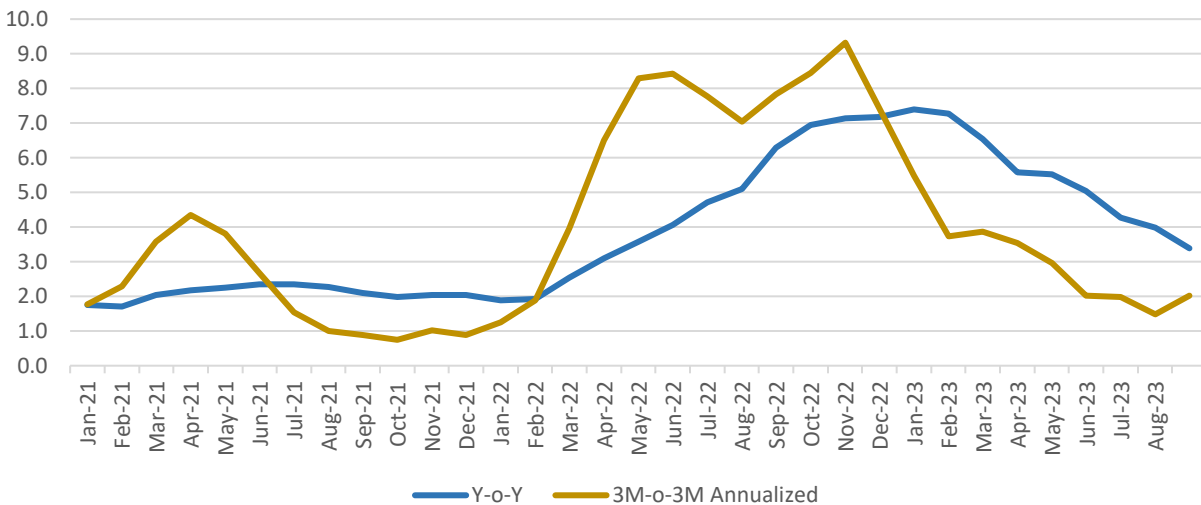
As global commodity prices continued to cool, and global demand conditions began to slacken amidst risk of global economic slowdown and weakening financial conditions in many of Armenia's key trading partners, headline inflation began to decline, dipping below target levels and even into negative territory since April 2023. On the other hand, NTSPI, which better reflects domestic demand conditions and underlying inflation, continues to remain high, albeit with slowing momentum, and stands at 3.4% as of September 2023. While representing a continued decline, NTSPI has been above headline numbers since April, for the first time in the post-Covid era. In this period, the primary policy challenge for central banks like the CBA, given this context, is navigating the messages coming from headline inflation measures on one hand, and underlying inflation on the other. Underlying inflation, as reflected in NTSPI, appears to remain high. Whether one believes this to be reflective of persistently high demand conditions that are being masked by declines in global

⁴ See ILOSTAT (2019). <https://test-ilstat.pantheonsite.io/covid-19-is-driving-up-food-prices-all-over-the-world/>

commodity prices, or a real phenomenon reflective of cooling demand conditions, has drastically different implications on policy. Getting this question right about inflation uncertainty is critical for policymakers, not just in Armenia, but globally. Understate the presence of underlying inflation when it is actually high, and risk easing off the gas too soon. Overstate underlying inflationary pressures when a slowdown has begun, and risk exacerbating potentially recessionary conditions.

The situation during this period illustrated in Figure 8 provides an excellent example of the value of the NTSPI and alternative measures of underlying inflation. While global demand pressures and imported inflation have declined considerably, one reading of the NTSPI data reflects the narrative that there continues to be relatively high aggregate demand in the domestic economy, which continues to exert meaningful inflationary pressures, even as headline numbers recede. To be clear, the NTSPI does not offer a magical solution to the communications challenges, nor does it serve as the only source of truth that should lead policymakers or make policy decisions. Rather, it is merely one of many helpful tools that, when used within a robust policymaking framework that emphasizes risk management, transparent communications, and historical narrative-based critical thinking, can help policymakers make and communicate better-informed decisions.

Figure 8. Non-Traded Sticky Price Inflation, Y-o-Y and 3M-o-3M Annualized



Source: Central Bank of Armenia; Author calculations

V. Conclusion

For a concept of sticky and flexible prices to be useful, it must align with our understanding of how monetary policy influences the economy and help us answer the three essential questions of good analysis:

- What is the current state of the economy?
- What are the underlying forces driving the economy and inflation?
- How should we use our monetary policy tools, such as setting the policy rate, a very short-term interest rate, and shaping market expectations of the policy rate path?

These actions, along with clear and transparent communication about future monetary policy adjustments, affect market interest rates and the exchange rate. The role of monetary policy communications is crucial, as it reduces uncertainty by clarifying the central bank's actions and intentions. This transparency improves the effectiveness of monetary policy, ensuring that the central bank does not amplify fundamental uncertainties faced by everyone.

In this paper we have briefly discussed the conceptual underpinnings of sticky prices within the New Open Economy Macroeconomic framework, addressed the breadth and limitations of core measures that exist today, provided a unique sticky price index for Armenia and explored its use within a policy framework that considers central bank credibility and finally reviews its practical use in the history as well as the latest developments connected to the COVID pandemic.

Appendix: Composition of Armenian NTSPI Basket

Item	COICOP Category	Share of CPI Basket	Share of NTSPI Basket
Secondary education (university) tuition	Education services	2.17%	14.27%
Surgical services	Health	1.56%	10.25%
Internet access provision services (monthly subscription)	Information and Communication	1.23%	8.11%
Bundled telecommunication services	Information and Communication	1.20%	7.86%
Actual rentals paid by tenants for secondary residences	Housing, water, electricity, gas and other fuels	1.13%	7.40%
Fast food and take away food services	Restaurants and accomodation services	0.94%	6.15%
Actual rentals paid by tenants for main residence	Housing, water, electricity, gas and other fuels	0.61%	3.98%
Optometry services	Health	0.60%	3.97%
Cardiological services	Health	0.55%	3.64%
Annual bank card service fee	Insurance and financial services	0.51%	3.37%
Gynecology services	Health	0.35%	2.31%
Other Diagnosis Services (Covid)	Health	0.33%	2.15%
Wireless telephone services (prepaid)	Information and Communication	0.29%	1.90%
Funeral services	Personal care, social protection and miscellaneous goods and services	0.28%	1.84%
Endocrinological services	Health	0.28%	1.82%
Dentistry	Health	0.25%	1.65%
Charges by banks and post offices	Insurance and financial services	0.25%	1.63%
General blood test	Health	0.23%	1.49%
X-Ray examination	Health	0.21%	1.36%
Dental prosthesis	Health	0.20%	1.32%
Wireless telephone services (postpaid)	Information and Communication	0.19%	1.28%
Urine analysis	Health	0.18%	1.16%
Tomography	Health	0.15%	0.99%
Child care services	Personal care, social protection and miscellaneous goods and services	0.15%	0.99%
Ultrasound examination	Health	0.15%	0.96%
Wired telephone services (monthly subscription)	Information and Communication	0.14%	0.92%
Women's hair cut	Personal care, social protection and miscellaneous goods and services	0.14%	0.89%
Household textile and bed linen washing, dry cleaning	Furnishings, household equipment and routine household maintenance	0.11%	0.72%
Preschool education tuition	Education services	0.09%	0.56%
Primary education	Education services	0.08%	0.54%
Secondary Vocational Education (College, Technical School)	Education services	0.08%	0.52%
Taxi transportation services	Transport	0.08%	0.52%
Elementary education	Education services	0.06%	0.40%
Automobile tire balancing services	Transport	0.05%	0.30%

Carpet washing, dry cleaning	Furnishings, household equipment and routine household maintenance	0.04%	0.28%
Women's hairdressing and styling services	Personal care, social protection and miscellaneous goods and services	0.04%	0.26%
Washing machines repair	Furnishings, household equipment and routine household maintenance	0.04%	0.23%
Refrigerator repair	Furnishings, household equipment and routine household maintenance	0.03%	0.21%
Women's hair dyeing services	Personal care, social protection and miscellaneous goods and services	0.03%	0.21%
Men's haircut and styling services	Personal care, social protection and miscellaneous goods and services	0.03%	0.20%
Car washing, polishing services	Transport	0.02%	0.16%
Repair of furniture, furnishings and floor coverings	Furnishings, household equipment and routine household maintenance	0.02%	0.16%
Tiling services	Housing, water, electricity, gas and other fuels	0.02%	0.15%
Drywall and plaster services	Housing, water, electricity, gas and other fuels	0.02%	0.12%
Legal services	Personal care, social protection and miscellaneous goods and services	0.02%	0.10%
Shoe Repair	Clothing and footwear	0.01%	0.10%
Private foreign language courses	Education services	0.01%	0.09%
Driving courses, tests and driver's licenses and fees for the right to technical tests	Transport	0.01%	0.08%
Dry Cleaning	Clothing and footwear	0.01%	0.08%
TV Repair	Furnishings, household equipment and routine household maintenance	0.01%	0.07%
Wired telephone services (interregional fees)	Information and Communication	0.01%	0.05%
Color photo print services for passport	Personal care, social protection and miscellaneous goods and services	0.01%	0.04%
Repair of jewellery, clocks and watches	Personal care, social protection and miscellaneous goods and services	0.01%	0.04%
Tailoring	Clothing and footwear	0.00%	0.03%
Swimming pool-related services	Housing, water, electricity, gas and other fuels	0.00%	0.03%
Private computer courses	Education services	0.00%	0.03%
Repair of telephone or telefax equipment	Information and Communication	0.00%	0.02%
Cinema ticket	Recreation, sport, and culture	0.00%	0.02%
Zoo ticket	Recreation, sport, and culture	0.00%	0.02%
Services of painters	Housing, water, electricity, gas and other fuels	0.00%	0.01%
Repair of computers and computer equipment	Information and Communication	0.00%	0.01%
Television services (monthly subscription)	Information and Communication	0.00%	0.01%
Payments for copying documents	Information and Communication	0.00%	0.01%
Wired telephone services (per minute fees)	Information and Communication	0.00%	0.00%

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