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Getting FIT with Imperfect Policy Credibility: DYNARE/JULIA Workshops with an Application for a Small Open Economy

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Getting FIT with Imperfect Policy Credibility

DYNARE/JULIA Workshops with an Application for a Small Open Economy

by Asya Kostanyan, Anahit Matinyan, and Angela Papikyan[1]

ABSTRACT

Following the work done by Argov and others (2007), we develop a small-open-economy model with endogenous policy credibility and a policy loss function (Open ENDOCRED). The model also builds on the ENDOCRED model presented in Kostanyan and others (2022b), which is a simple workhorse model of flexible-inflation targeting under imperfect credibility, and adapts it for small open economies with an interaction of credibility and country-risk premium. The first version of the model is calibrated to Armenia. This Open ENDOCRED model can serve as a core quarterly production model (QPM) for small emerging economies, particularly for those implementing the Mark II adaptation of the Forecasting and Policy Analysis System (FPAS Mark II) to better incorporate uncertainty and nonlinearities, and support monetary policy as a risk management exercise. We also provide empirical estimates of credibility for Armenia, and demonstrate the crucial role of understanding credibility as an endogenous process. The paper also discusses the important role of linear satellite models, which were employed as core models in the FPAS Mark I framework but can serve as essential analytical tools for current economic analysis in the FPAS Mark II system.

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I. INTRODUCTION

Central banks in advanced economies have always tended to treat monetary policy credibility (hereafter simply "credibility") as given and unchanging. Linkages between central banks' policy actions and their credibility were ignored, largely because a historically unique period of low inflation and policy inertia during the Great Moderation of the 1990s and 2000s, followed by the low inflationary environment between the Global Financial Crisis and the Covid-19 pandemic, provided policymakers with this luxury and luck. The experience of advanced-economy central banks since the Covid crisis, however, has made explicitly clear what emerging-economy central banks have always known to be true: that credibility is not a given, that it can be lost quickly, and the cost of losing it is significant and painful. Once the public loses trust in the ability of policymakers to reach their policy objectives, it becomes much more difficult for the central bank to lower inflation and re-anchor medium- and long-term inflation expectations to the inflation target without incurring significant welfare costs on society.

Building off scholarship by Alichi and others (2009), Archer and others (2022) and Kostanyan and others (2022), this paper crucially treats monetary policy credibility as an endogenous process. In other words, monetary policy credibility—referred to throughout this paper as simply "credibility"—is understood to be a stock, where central banks can lose credibility very quickly if inflation is elevated and persistent and if long-term inflation expectations become de-anchored from the long-term inflation target. On the other hand, the process by which credibility is regained is slower and nonlinear, with long-term inflation expectations only gradually returning to the target once inflation has become entrenched and expectations have become de-anchored. This formulation of credibility as an endogenous process has important implications for how policy responses to inflationary situations ought to be made, and serves as the basic foundation upon which we build our analytical framework.

The analytical framework presented in this model represents a small-open-economy adaptation of a simple workhorse model with endogenous policy credibility first developed for closed economies by Kostanyan and others (2022). Parts of our approach are also indebted to pioneering work done by Argov and others (2007) in formulating a small-open-economy model for Israel with endogenous credibility.

A. Closed-Economy ENDOCRED Model: Kostanyan and others (2022b)

Kostanyan and others (2022b) present foundational elements of an analytical framework that is better able to deal with uncertainty and nonlinearities for flexible-inflation targeting central banks. These flexible-inflation targeting banks include those who have adopted the first iteration of the Forecasting and Policy Analysis System (FPAS Mark I), first pioneered by the Bank of Canada and the Reserve Bank of New Zealand, as well as those seeking to develop and implement the second iteration. Known as FPAS Mark II, this system adapts the existing institutional and analytical frameworks of the FPAS to think of monetary policymaking as a risk-management strategy (MPRM) in order to better deal with uncertainties and nonlinearities.[2] The closed-economy ENDOCRED model presented in Kostanyan and others (2022b) offers the foundational elements for a simple, nonlinear, workhorse model that can be used as a key component of an analytical framework of a suite of models by FPAS Mark II central banks.

[2] See Archer, Galstyan, Laxton (2022).

Specifically, Kostanyan and others (2022b) modify the canonical models used in FPAS Mark I central banks in three crucial ways:

1. Endogenous policy credibility: monetary policy can lose credibility if inflation is high and persistent and if long-term inflation expectations become de-anchored from the inflation target, but regain credibility only gradually over time.
2. Crucial nonlinearities: convex inflation-expectations-augmented Phillips curve and nonlinear credibility-generation process
3. Explicit loss function: quadratic loss minimization function that replaces the conventional reaction function for the policy interest rate.[3]

We highly encourage the reader to explore the paper by Kostanyan and others (2022b), which explains in detail the structure and equations for the closed-economy ENDOCRED model upon which this paper expands. While a general overview of the closed-economy ENDOCRED model is presented in Section II of this paper, the reader will find a more thorough explanation of these equations and parameter values (and ranges) in the referenced paper.

B. Small-Open-Economy Model: Argov and others (2007)

Eyal Argov and a team of researchers from the Bank of Israel and the International Monetary Fund developed an open-economy model for Israel, which itself was an adaptation of a standard New Keynesian open-economy linear FPAS model for Israel, first described in Epstein and others (2006). Argov and others expanded the standard FPAS model by incorporating two crucial nonlinearities:

1. Nonlinear effect of the output gap on inflation, due to convexity in the Phillips curve, which creates high inflationary costs and welfare implications when monetary policy is overly expansionary.
2. Endogenous credibility stock

The model presented by Argov and others (2007) provides an important example of a small-open-economy with endogenous policy credibility. In particular, the authors demonstrate that these types of models are better suited for explaining how credibility can be lost, and the major welfare costs (including in the short-run inflation-output tradeoff) associated with attempting to regain credibility once it has diminished.

C. Small-Open-Economy Model with Endogenous Credibility for Armenia

Against the background of this important research, this paper presents an adaptation of the closed-economy ENDOCRED model developed in Kostanyan and others (2022b), with inspiration from Argov and others' (2007) small-open-economy model with endogenous credibility. As a companion piece to Kostanyan and others (2022b), this paper represents an important step in the development and documentation of the workhorse model and analytical framework for the FPAS Mark II. The

[3] Loss functions are preferred to policy reaction functions because they: (1) are more robust to the changes needed to the model structure when evaluating scenarios involving alternative economic dynamics; and (2) allow the calculation of a metric for total losses over the policy-relevant full horizon, an important ingredient for risk assessment. See Archer, Galstyan, and Laxton (2022).

FPAS Mark II system is intended to help central banks avoid the dark corners of monetary policy, which is especially pertinent in periods of high uncertainty such as the present. As one ingredient of the FPAS Mark II analytical toolkit, the model presented in this paper demonstrates the importance of having in place analytical frameworks that treat monetary policy credibility as endogenous and incorporate crucial nonlinearities. In doing so, the issues with Mark I iterations of FPAS—the folly in baselines and in local approximations—are avoided, enabling and incentivizing central banks to avoid tail risks and dark corners.

To emphasize the importance of these frameworks in policymaking, we present a clear illustrative example with real-world, current implications. We apply this small-open-economy ENDOCRED model within the FPAS Mark II framework to explore implications for policy framework in Armenia in the present. This paper uses scenario analysis to demonstrate how assumptions of perfect or exogenous credibility can lead policymakers into making dangerous decisions that can take the economy toward dark corners or stagflation, and how this can be avoided when credibility is thought of as an endogenous process.

We would like to emphasize the key innovations of this analytical framework, as well as what makes it interesting and relevant for policymakers and researchers today. The small-open-economy ENDOCRED model presented in this paper contains three important features: endogenous policy credibility, a non-linear inflation-expectations-augmented Phillips curve, and a loss function. These model characteristics make it an especially useful tool for analyzing small open vulnerable economies that face stagflationary shocks. Governor Galstyan, in his recent comments to the Central Banking Journal, has noted that some of the errors that advanced economies have made since Covid might derive from their lack of experience in fighting stagflationary shocks. Others, such as economist William White, have emphasized that the key lessons to be learned from Covid are that we need to prepare for more of these stagflationary shocks. As the period of the Great Moderation is clearly behind us, as the globalization forces that kept inflation in check during this period began to dissipate during and after the pandemic, and as risks of other types of shocks (climate, geopolitical, etc.) continue to grow, central banks around the world and particularly in vulnerable small open economies need to be prepared to deal with future stagflationary shocks. This paper presents the foundation of an analytical framework that can help economists and policymakers better think about what these shocks mean, and what optimal policy responses to these shocks might look like.

This paper begins with a brief description of the closed-economy ENDOCRED model developed by Kostanyan and others (2022b) in Section II, which is a companion piece to this paper and model. We explore at a high level the equations and key assumptions driving the closed-economy model, and refer the reader to the cited paper for further detail. Section III introduces the small-open-economy adaptation of the ENDOCRED model by introducing an exchange-rate equation and making important changes to other equations. Section IV provides a historical narrative overview of the Armenian economy over the past two decades, helping the reader understand the nuances unique to this economy and understand how this type of model could provide a useful analytical tool for policymakers in that country. Section V applies this model within the FPAS Mark II scenario framework, and highlights the importance of treating credibility as an endogenous process. Section VI provides concluding remarks.

II. CLOSED-ECONOMY ENDOCRED MODEL: A BRIEF OVERVIEW

We begin with a brief introduction of the closed-economy ENDOCRED model, first developed by Kostanyan and others (2022b) and applied to the United States. As discussed in the introduction, the closed-economy ENDOCRED model contains three novel features relevant to quarterly projection models in use at central banks:[4]

- Endogenous policy credibility process—where standard linear models assume that central bank credibility is perfect, the ENDOCRED model recognizes that credibility is often, and in some cases almost always, imperfect, and of course depends on how well-anchored medium- and long-term inflation expectations are. 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. In a starting point where inflation is expected to remain high, policymakers may develop credibility over time, with public expectations of inflation converging only gradually to the target, or may lose credibility as market participants doubt policymakers' commitment to achieving the inflation target.

- Number of nonlinearities—the most important nonlinearities incorporated in ENDOCRED is in the specification of both convexity in Phillips curve and in the process through which credibility is gained or lost.

- Loss function for monetary policy—the model is built to recognize the costs of deviations of inflation (from the target) and output (from potential), along with the costs of fluctuations in interest rates. This replaces the conventional reaction function for the policy interest rate.

We present to the reader a brief overview of the primary ideas and equations of the closed-economy ENDOCRED model in the following sub-sections. We refer the reader to Kostanyan and others (2022b) for detailed discussions of these model equations. Because the small open-economy adaptation of the model augments the key equations of the closed economy model, further discussion of these equations can be found in Section III.

A. Endogenous Credibility

A key innovation of the closed-economy ENDOCRED model developed in Kostanyan and others (2022b) is the incorporation of endogenous policy credibility in the analytical model itself. This key feature of the model illustrates the value of analytical frameworks that treat monetary policy credibility as endogenous—in other words, the understanding that analytical tools need to reflect 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 their models) do not think of credibility as endogenous, they underestimate the timing and aggressiveness of policy actions (i.e. interest rate increases) that would be needed to bring inflation back to target and re-anchor medium- and long-term inflation expectations to the target in a reasonable timeframe, particularly in the context of an efficiently managed inflation-output and inflation-unemployment tradeoff. The research by Kostanyan and others (2022b) demonstrates how thinking of credibility as exogenous rather than endogenous could have

[4] As discussed in Kostanyan and others (2022b), the ENDOCRED model is the latest descendant of the family of models and ways of thinking about analytical framework developed by Laxton and N'Diaye (2002), Isard, Laxton, Eliasson (2001), Epstein and others (2006), Argov and others (2007), and Benes and others (2017 a,b).

played a role in the Fed's underappreciation of the policy response it needed to make in the Summer of 2021, and shows how models such as the ENDOCRED that treat credibility as endogenous can help policymakers better understand and appreciate how errors in their policy decisions could create inflationary spirals and make the economy especially vulnerable to stagflationary shocks.

B. Inflation Expectations

The process by which inflation expectations are formed is both forward- and backward-looking. In other words, market participants tend to consider both past inflation as well as expectations of future inflation. The following equation reflects these two processes, and is more backward-looking than in standard DSGE models.

$$\pi 4_t^e = \gamma_t * \pi 4_{t+4} + (1-\gamma_t) * \pi 4_{t-1} + \kappa * (1-\gamma_t) + \varepsilon_t^{\pi^e} \quad (1)$$

The first two terms represent a weighted average of a model-consistent forecast of the 4-quarter ahead year-on-year inflation rate (forward-looking component) and the year-on-year inflation rate observed last quarter (backward-looking component). The weight on the forward-looking component, γ_t, is a measure of the stock of credibility, and ranges between 0 (no credibility) and 1 (full credibility), and determines how forward- versus backward-looking this expectation-forming process is. An additional term, κ, represents how inflation expectations can ratchet up when there are declines in credibility, reflecting the bias in the transition from imperfect to perfect credibility.

C. Output Gap Equation

The output gap represents the deviation, in percentage points, of actual output from a measure of the potential level of GDP. A positive number indicates that output is above potential, while a negative number indicates that output is less than its potential. The output gap equation is expressed in terms of deviations from equilibrium values, and is a function of past and future output gaps, the lagged reaction to the real interest rate gap, and the term premium gap:

$$\hat{y}_t = \beta_1 * \hat{y}_{t-1} + \beta_2 * \hat{y}_{t+1} - \beta_3 * \hat{r}_{t-1} + \beta_4 * \hat{\varphi}_t^{10YR} + \varepsilon_t^{\hat{y}} \quad (2)$$

The short-term real interest rate gap is the difference between the real short-term interest rate and the equilibrium real short-term interest rate. The model includes a real term-premium gap measuring the deviation between the 10-year term premium and the equilibrium value. A shock value is also included, indicating when demand rises by more or less than supply. The β parameters represent the weight of each variable. The weights for the past output gap (β_1) and future output gap (β_2) depend on how rigid the economy is. The weights for interest rate and for the term premium are represented respectively by β_3 and β_4.

D. Inflation-Expectations Augmented Phillips Curve

The model employs the standard-inflation expectations-augmented Phillips curve, expressed below:

$$\pi_t = \lambda_1 \pi 4_t^e + (1-\lambda_1)\pi 4_{t-1} + \lambda_2 \left(\frac{\hat{y}_{t-1}}{\hat{y}_{max} - \hat{y}_{t-1}} \hat{y}_{max} \right) + \varepsilon_t^{\pi} \quad (3)$$

$\pi 4_t^e$ and $\pi 4_{t-1}$, respectively, are the forward-looking and backward-looking components of our sticky-price quarterly inflation measure π_t. This reflects the process by which inflation expectations are formed, as described above. $\hat{y}_{t-1}$ is the output gap in period t–1; and $\hat{y}_{max}$ is the maximum possible excess demand pressures. The term ε_t^{π}represents the critical role for cost-push supply shocks that directly impact inflationary forces and create the short-run tradeoff between the output gap and inflation.

E. Nonlinear Output Gap Effect

The standard-inflation expectations-augmented Phillips curve, presented above, assumes that the effect of the output gap on inflation is nonlinear (relying on empirical evidence provided by, for example, Debelle and Laxton, 1997).

$$\lambda_2 * \left(\frac{\hat{y}_{t-1}}{\hat{y}_{max} - \hat{y}_{t-1}} \hat{y}_{max} \right) \tag{3.A}$$

The parameter λ_2 represents the marginal effect of an increase in the output gap on inflation, when the output gap is near zero. The other takeaway is that the output gap cannot exceed a maximum value of $\hat{y}_{max}$. As the gap approaches this value, it has a greater and greater effect on the inflation rate, which constrains the extent to which demand expansions can catalyze output increases. This is consistent with research by Evans (1985), who argues that bottlenecks in labor supply in certain sectors of the economy steepen the Phillips curve by contracting the maximum output that a given economy can produce in the short run, which in turn can generate further inflationary pressures as sectors of the economy push up against the limits of what they can produce.[5] This non-linearity implies that economies with output gap near the maximum will have to experience long periods of negative output gaps in order to get back to the desired inflation rate.

F. Monetary Policy Loss Function

For flexible-inflation-targeting central banks, the loss function assigns a high cost to deviations of inflation from the target. In the short run, monetary actions also affect interest rates and output, and policymakers are averse to deviations of output from potential and to significant variability of the policy rate from one period to the next. Aiming to keep output near its potential level—i.e., minimizing the amplitude of the business cycle—has an obvious justification, since this is a fundamental objective of macroeconomic policy.

$$Loss_t = \sum_{j=0}^{\infty} \rho^j [\, \omega_1 \, (\pi 4_{t+j} - \pi^*)^{\,2} + \omega_2 y_{t+j}^2 + \omega_3 \, (i_{t+j} - i_{t+j-1})^{\,2}] \tag{4}$$

With this in mind, the loss function in the ENDOCRED model cumulates a weighted sum of the squared deviations from the inflation target (year-on-year); squared output gaps; and squared one-quarter changes in the policy rate. The ρ term stands for the discount rate, while the weights (ω_i) represent the costs attached by policymakers attach to these items. Monetary policy minimizes this loss function, subject to the constraints imposed by the structure of the model.

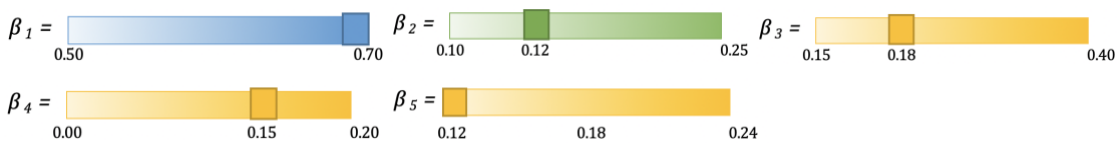
[5] See Evans (1985).

III. EXTENDING THE ENDOCRED MODEL FOR SMALL OPEN ECONOMIES

A. Output Gap Equation

The output gap represents the deviation, in percentage points, of actual output from a measure of the potential level of GDP. A positive number indicates that output is above potential, while a negative number indicates that output is less than its potential. The output gap equation is expressed in terms of deviations from equilibrium values. The equation for the output gap is modified from the closed economy model to account for the real exchange rate and an export-weighted average of relevant-country and regional-specific output gaps.[6] The output gap equation presented below is a function of past and future output gaps, lagged reaction to the real interest rate gap, lagged reaction to the exchange rate gap, and the world output gap:

$$\hat{y}_t = \beta_1 * \hat{y}_{t-1} + \beta_2 * \hat{y}_{t+1} - \beta_3 * \hat{r}_{t-1} + \beta_4 * \hat{\zeta}_{t-1} + \beta_5 * \hat{y}_t^w + \varepsilon_t^{\hat{y}} \quad (5)$$



The short-term real interest rate gap ($\hat{r}_t$) is simply the real short-term interest rate minus the equilibrium real short-term interest rate, expressed in percentage points. The real exchange rate gap ($\hat{\zeta}_t$) represents the difference between the real exchange rate and the equilibrium real exchange rate, also in percentage points. A positive value for the exchange rate gap represents depreciation of the local currency, while a negative value indicates appreciation. We provide an approximate guide to parameter uncertainty for these weights in the slider scales above, though critical judgment is necessary in determining these values for each economy. The weights for the past output gap (β_1) and future output gap (β_2) depend on how rigid the economy in question is. The weight for the interest rate are represented by β_3, describing the role of the interest rate in relative contribution to economic demand (consumption and investment decisions). The weight for the exchange rate is reflected by β_4, and the weight for the world output gap is expressed as β_5. The latter two parameters reflect the relative openness of the economy from the perspectives of relative price and external demand elasticities.

B. Exchange Rate Equation

The exchange rate in this model, as in virtually every macroeconomic model, is determined by a solution to a complete macroeconomic model that ensures that arbitrage conditions are satisfied and the economy converges to a full stock-flow equilibrium, where inflation is expected to be on target. We also allow for the possibility that the expected target could be different than the announced target (e.g. imperfect monetary policy credibility). In the small-open ENDOCRED gap model, real interest rates and real exchange rates must adjust sufficiently to find a path for the real economy that is consistent with

[6] For the country of Armenia, there is a need for a global perspective, to monitor commodity prices, which represent an important source of terms-of-trade shocks on their economy. Second, because of the strong ties to the Russian, European, and American economies, the FPAS Mark I analytical framework included a fairly developed analytical framework for modeling and doing surveillance on key external assumptions to support the scenarios. It is important for nonlinear models such as that presented in this paper to be cross-checked with specific linear models. Refer to Kostanyan and others (2022b), which demonstrates this approach.

bringing inflation to the perceived target. Stochastic processes are used for the equilibrium values of the country risk premium, that need to be thought through in larger and more complicated models with stock-flow dynamics. At this point, it would be unwise to try to put all of these different features in one model. As a consequence, we employ satellite models to understand issues that involve those dynamics, including current account imbalances and net foreign liability dynamics.

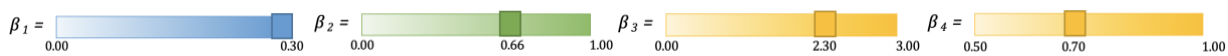
The exchange rate equation is presented below.

$$r_t = (r_t^{US} + \psi_t) + (\zeta_{t+1}^e - \zeta_t) * 4, \text{ where} \tag{6}$$

$$\psi_t = \beta_1 * \bar{\psi}_t^{**} + (1 - \beta_1) * \psi_{t-1} + \beta_2 * \left(\pi 4_t^b\right) + \beta_3 * \left(\pi 4_t^b - \pi 4_{t-1}^b\right) + \varepsilon_t^{\psi}, \text{ and} \tag{7}$$

$$\bar{\psi}_t^{**} = \bar{\psi}_{t-1}^{**} + \varepsilon_t^{\bar{\psi}_t^{**}} \tag{8}$$

$$\zeta_{t+1}^e = \beta_4 * \zeta_{t+1} + (1 - \beta_4) * \zeta_{t-1} \tag{9}$$



A bar over a given variable indicates that it is a measure of equilibrium. The "**" symbol represents the steady state. The real interest rate (r_t) is defined as a function of the US real interest rate plus a country risk premium (ψ_t), plus the expected change in the real exchange rate (difference in the future expected exchange rate (ζ_{t+1}^e) and the current exchange rate (ζ_t)). The country risk premium is defined as the weighted sum of the equilibrium steady state risk premium ($\bar{\psi}_t^{**}$) and the lagged risk premium (ψ_{t-1}), plus a measure for monetary policy credibility, which here is represented by the bias term in one-year ahead inflation expectations ($\pi 4_t^b$).

The intuition for the latter comes from the fact that the loss of credibility which acts as an additional shock to the inflation expectations is expressed in the excessive increase of dollarization (or capital flight) with an consequent impact on nominal depreciation (positive sign) of the currency. The future expected exchange rate (ζ_{t+1}^e) is the weighted sum of the forward-looking expected one-period-ahead exchange rate as well as the backward-looking prior-period exchange rate.

β_1 represents the weight on the equilibrium steady state value on the country risk premium versus the lag. β_2 represents the weight on the credibility bias term, and β_3 represents the weight on the divergence in the bias term over time. β_4 represents the weight on forward- versus backward-looking components in the future expected exchange rate.

C. Inflation Equation

C.1. Inflation-Expectations Augmented Convex Phillips Curve

We begin with the standard inflation-expectations augmented Phillips Curve, and expand it to include the exchange rate. Inflation is defined as the weighted sum of forward-looking inflation expectations and lagged actual inflation, plus the output gap and exchange rates.

$$\pi_t = \lambda_1 \pi 4^e_{t+4} + (1-\lambda_1)\pi 4_{t-1} + \lambda_2 \left(\frac{\hat{y}_{t-1}}{\hat{y}_{max} - \hat{y}_{t-1}} \hat{y}_{max} \right) + \beta_1 * (\hat{z}_t - \hat{z}_{t-1}) + \beta_2 * \hat{z}_t + \varepsilon^{\pi}_t \qquad (9)$$

Inflation is understood as the combination of its backward- and forward-looking components. The weight of λ_1 on inflation expectations versus (1-λ_1) on past inflation can be thought of as an inflation process where there are prices that are set throughout the year over a one-year horizon. A good example of this would be apartment rents, but of course, most sticky prices (e.g. haircuts) are changed relatively infrequently, compared to prices for goods or services that are much more flexible to change. $\hat{y}_{t-1}$ represents the output gap in period t–1, and $\hat{y}_{max}$ signifies the maximum excess demand pressures possible. The exchange rate is presented as the weighted sum of the deviation between current and lagged inflation, and the current level exchange rate.

The β_1 and β_2 coefficients parameters determine the direct effects of the exchange rate on inflation. Based on the insights of a structural DSGE model that embodies the state of new economy macroeconomics developed by Obstfeld and Rogoff, Laxton and Pesenti (2003) develop New Open Economy Macro (NOEM) that explore these relationships further.[7] The weights on these variables—the β_1 and β_2 coefficients—are based on considerations about the distribution of imported goods that are sold directly, and that are used as factors of production. The parameter values can be understood as a function of these processes. In addition, they will also be influenced by the size of the distribution center.[8] The first inference about the β_1 and β_2 coefficients can come from the relative share of imported goods in the CPI or core CPI basket in Armenia, which are both estimated to be around 40% of total. There is a specific statistical peculiarity to this calculation: the statistical definition of imported goods in the CPI basket of Armenia includes both directly-sold imported goods and goods with significant component of imported intermediate costs. For the rest of goods and services, the imported component can be considered to be negligible. So we can assume that the β_1 and β_2 coefficients are quite significant for an economy like Armenia. At the same time, the import of goods to Armenia comprises almost 35% of GDP, out of which nearly 33% are consumption and 52% and 15% are intermediate and capital goods, respectively. Hence, on average, domestic production have 20-25% imported cost. So, we can calibrate the β_1 and β_2 coefficients reflecting the idea that there is a roughly even share of imported goods that are sold directly, and that are used as factors of production.[9] In calibrating these values, one has to remember that there are significant lags and forward-looking mechanisms in the equation. The error term in the equation, ε^{π}_t, represents cost-push supply shocks, which could play a significant role in

[7] See Obstfeld and Rogoff (1995) and Laxton and Pesenti (2003).
[8] See Laxton (2008).
[9] In a recent paper the exchange rate pass-through to core inflation for Armenia is estimated to range from 0.17-0.23. See, for example, Mnoyan (2019).

impacting inflationary forces, laying the foundation for the short-run tradeoff between the output gap and inflation.

The nonlinear convexity of the Phillips curve (see Figure 1) is an extremely important consideration with meaningful policy and welfare implications, which deserves further exploration with real-world examples. We begin with the example of European Union, and how to think of the convexity of the curve in the area of excess supply. The EU, of course, is an economy with significant downward nominal wage rigidity (DNWR). Dickens and others (2006) estimate that an average of 26% of workers in the EU are subject to downward nominal wage rigidity, with this number much higher in Southern Europe; in Portugal, for example, it was estimated to be 58%.[10] Holden and Wulfsberg (2007) show that strict employment protection legislation and higher union density play a role in generating stronger DNWR.[11] In the EU, and in particular in Southern European countries (e.g. Spain, Portugal, Italy, and Greece) where DNWR tends to be stronger, these downward rigidities play a role in meaningfully flattening the Phillips curve in regions of excess supply.[12] This was explored by Ball, Mankiw, and Romer (1988), who showed that wages have downward stickiness. Because inflation can be relied upon to generate real wage declines, firms tend to prefer inertia and relying on inflation to play its role, rather than taking action and reducing wages. We see the flatness of the Phillips curve in the region of excess supply in practice, too, and here the Southern European economies in the 2010s provide illustrative examples. These economies, of course, had been suffering competitiveness problems, in particular following the eastward expansion of the EU, and this factor, coupled with the downward nominal wage rigidities, contributed to high unemployment in the slow recovery from the Global Financial Crisis, in particular among youth. In 2013, Spain had unemployment of 26%, but among youth, it was meaningfully higher, at 55%; in Greece, unemployment was similar and even slightly higher, at 27% and 58%, respectively. DNWR played an important role in driving this increase in unemployment, particularly among youth. As Dickens and others (2006) show in the International Wage Flexibility Project, DNWR prevents wage cuts from taking place.[13] In places like Spain and Greece, workers needed to take massive wage cuts to be competitive, but because of DNWR, these wage cuts did not take place at the necessary level of magnitude, leading to high rates of unemployment for youth. Here, the role of government is critical, not only in contributing to higher wage rigidities through institutional factors like strict employment protection legislation, but also, by attempting to "deal" with the problem through transfer payments to youth.

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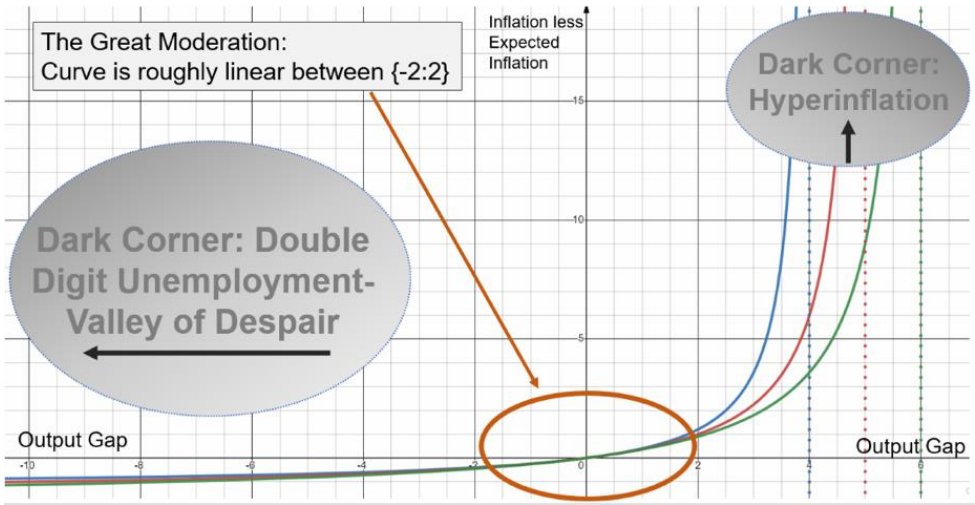
[10] Refer to Dickens and others (2006).

[11] Refer to Holden and Wulfsberg (2007).

[12] See, for example, Gagnon and Sarsenbayev (2022), who provide excellent empirical evidence of a very low, almost flat, slope for the Phillips curve in areas of excess supply. Joseph Gagnon elaborates on these ideas in a recent Better Policy Project seminar, the discussion of which can be found on YouTube: https://www.youtube.com/@thebetterpolicyproject1425 Clark, Laxton, and Rose (1996) and Laxton, Rose, and Tambakis (1999) similarly argue that the Phillips curve has an important asymmetry, in that periods of high excess demand are much more inflationary than regions of high excess supply are disinflationary.

[13] See Dickens and others (2006) for their important research on DNWR as part of the OECD's International Wage Flexiiblity Project. Holden and Wulfsberg (2007), reviewing Dickens and others as well as the relevant literature, find that DNWR represses prevent anywhere between 9 and 66% of all wage cuts from taking place.

Figure 1. Convex Phillips Curve According to Different Values of y_{max} between 4 and 6



Source: Author calculations

The role of labor scarcity is an essential driving factor in these considerations. In periods of high globalization such from the 1990s leading up to the Global Financial Crisis, where the cost of labor was exploited globally, OECD economies like the EU and the United States experienced very high growth and low inflation, rendering the management of the inflation-output tradeoff relatively simple for most central banks. But in the present period, forces of deglobalization are acting as stagflationary supply-side shocks that are posing serious challenges to central bank credibility.

The other region of the Phillips curve—that of excess demand—also deserves further attention. Early research by Clark, Laxton, and Rose (1996) and Laxton, Rose, and Tambackis (1998) demonstrated that in areas of excess demand, the Phillips curve is convex with an accelerating slope, meaning that aggregate demand has an increasingly inflationary impact the closer we get to the maximum output of the economy (as represented by $\hat{y}_{max}$ in our Phillips curve equation, and by the vertical asymptotes in Figure 1). George Evans (1985) emphasizes the role of labor bottlenecks (i.e. meaning areas where there is no excess supply in labor, that is unemployment is at least equal to or below the natural rate, which can also be understood as areas of excess demand). Evans develops a disaggregated model of bottlenecks in distinct labor markets, with the assumption that, at any given point in time, workers are located in specific labor markets, where the base wage is slow to adjust to excess demand and provides a floor below which the actual rate may not fall. This implies two states of labor: bottlenecked (i.e. labor is fully employed) or an excess supply state. The net labor flow into each sector, then, is a function of the bottleneck (i.e. market-clearing) wage in that sector and the economy-wide average. Evans' analysis suggests that the relationship between inflation and aggregate demand is nonlinear, and reflective of what share and distribution of sectors are characterized by bottlenecks. In the short run, bottlenecks serve to steepen the Phillips curve by contracting the maximum output that a given economy can produce. This argument also tracks with research done by Laxton and Clark (1997), who also provide empirical support that the relationship between inflation and excess demand is in fact nonlinear. In this formulation, therefore, unemployment can be thought of as an equilibrium effect in response to the inflation effects of bottlenecks.

With this framework in mind, we explore the implications of these ideas in the context of what is certainly a hot topic today: the wage-price spiral. Many commentators argue that the beginnings, or first

phase, of a wage-price spiral have already begun in most places globally. To return to our small-open-economy example of Armenia, year-over-year wage growth as of September 2022 (the last date of published data available as of the issuance of this paper) stood at 17.4%, while year-over-year core inflation for the same period stood at 10.5%. With wage growth now far outpacing core inflation in Armenia and in many other countries as well, this would seem to indicate the beginning of a wage-price spiral, as the increase in wages can be seen to reflect steep inflation. The question, then, naturally arises as to whether prices will begin to reflect increases in wages. Will this, in turn, lead to increases in wages to reflect higher inflation? In other words, when will the second part of the wage-price spiral begin, and is it a matter of when, or if? These questions are particularly important because of concerns about overheating in the Armenian economy, driven at least in part by strong demand pressures stemming from the conflict in Ukraine. The influx of high-skilled immigrants from Russia (also including ethnic Armenians who were Russian or Ukrainian citizens), many of whom are concentrated in high-paying technology sectors and have strong purchasing power, has increased the potential output of the economy, but in the short run has primarily represented generalized excess demand pressures concentrated in sectors such as tourism and food services, but also sectors like housing where excess supply cannot easily be generated.

In Kostanyan and others (2022b), the closed economy version of the ENDOCRED model, applied to the United States, explored lower values for $\hat{y}_{max}$ (5), reflecting the fact that a closed economy would have to rely on domestic labor. An open economy can always import goods and services if the cost of domestic production becomes too high, which serves as part of the intellectual basis for having a higher $\hat{y}_{max}$ value of 6 in this small open-economy model versus the large closed-economy model presented in Kostanyan and others (2022b).[14] Of course, we recognize that there is always going to be considerable uncertainty about what the actual level of potential output is going to be in a given economy. The purpose of this exercise, thus, is to explore the implications of uncertainty in estimating the output gap, specifically in models that assume that monetary policy credibility is endogenous.

C.2. Inflation Expectations

$$\pi 4^{e}_{t+4} = \gamma_t * \pi 4_{t+4} + (1-\gamma_t) * \pi 4_{t-1} + \pi^{b}_{t} + (1-\gamma_t) * \varepsilon^{\psi+}_{t} + \varepsilon^{\pi^e}_{t} \quad (10)$$

The weight on the forward-looking component, γ_t, is a time-varying measure of the stock of credibility, and ranges between 0 (no credibility) and 1 (full credibility). When credibility is imperfect, two trends tend to emerge: existing inflation becomes more persistent, and inflation expectations ratchet upwards.[15] The last term describes the contribution of asymmetric exchange rate shocks to inflation expectations in the lower credibility phase. Conditional on the level of

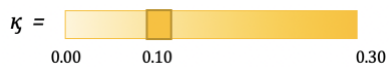
[14] A good illustrative example of the role of importing foreign labor to address capacity constraints is Singapore or Saudi Arabia. Both of these countries face considerable capacity constraints in terms of having sufficient domestic labor (i.e. citizens), but they are able to readily address this problem by easily importing foreign labor. Moreover, the practice of importing labor is so advanced that these countries are able to import precisely the type and quantity of labor for exactly what is needed. This is particularly the case for the production of non-traded goods and services (e.g. restaurant work, elderly care, etc.), where appropriately trained foreign labor can be easily brought in to produce these goods and services, meaning the overall domestic capacity constraints aren't binding. This, of course, is not true for all countries (e.g. India, Portugal, etc.), where a combination of labor laws, cultural practices, and other factors make it more difficult to easily bring in foreign labor to address capacity constraints.

[15] For an explanation of why bank credibility could fall in this context, refer to the forthcoming paper by Kostanyan and others (2023a).

credibility (γ_t) the exchange rate pass through to inflation can change.[16] In low credible environment we expect relatively higher pass-through from depreciating exchange rate shocks, while the appreciation is usually "ignored". This asymmetry reflects the role of exchange rate in the inflation expectations and declines to disappear as the credibility of the inflation-targeting objectives increases to the perfect.

C.3. Bias-Term in Inflation Expectations

$$\pi_t^b = \kappa * [\gamma_t * \pi 4_{t+4}^{e_L} + (1-\gamma_t) * \pi 4_{t+4}^{e_H} - \pi 4_t^*] \quad (11)$$



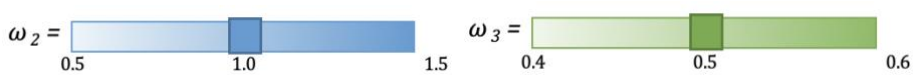
We demonstrate bias effect in inflation expectations when credibility declines by including a coefficient for the bias term, κ, to capture this bias in the transition from imperfect to perfect credibility. We emphasize that the bias term can serve as a source for stagflationary shocks in Emerging Market economies that are highly dollarized. We make the assumption that κ is equal to 0.10 which is consistent with what we have seen in the literature for dollarized economies. This crucial nonlinearity of credibility is an essential component of the model.[17]

D. Monetary Policy Loss Function

For flexible-inflation-targeting central banks, the loss function assigns a high cost to deviations of inflation from the target. In the short run, monetary actions also affect interest rates and output, and policymakers are averse to deviations of output from potential and to significant variability of the policy rate from one period to the next. Aiming to keep output near its potential level—i.e., minimizing the amplitude of the business cycle—has an obvious justification, since this is a fundamental objective of macroeconomic policy.

$$Loss_t = \sum_{j=0}^{\infty} \rho^j [\, \omega_1 \, (\pi 4_{t+j} - \pi^*)^{\,2} + \omega_2 y_{t+j}^2 + \omega_3 \, (i_{t+j} - i_{t+j-1})^{\,2}] \quad (4)$$

$\rho = 0.95,\ \omega_1 = 1,$



With this in mind, the loss function in the ENDOCRED model cumulates a weighted sum of the squared deviations from the inflation target (year-on-year); squared output gaps; and squared one-quarter changes in the policy rate. The ρ term stands for the discount rate, while the weights (ω_i) represent the costs attached by policymakers attach to these items. Monetary policy minimizes this loss function, subject to the constraints imposed by the structure of the model.

[16] See Carrière-Swallow and others (2016).

[17] This idea is illustrated by the examples of the Bank of England following its adoption of inflation-targeting in 1997, and by the Bank of Israel in the early 2000s. Once people have been burned by the effects of high inflation, they become skeptical that the central bank is in fact committed to—and capable of—delivering low inflation. As a result, both medium- and long-term inflation expectations become upwardly biased. See the appendix of Kostanyan and others (2022a) for further details.

IV. THE CASE OF ARMENIA: HISTORICAL NARRATIVE APPROACH

In 2006, the Central Bank of Armenia adopted an inflation-targeting strategy, where the primary objective of the central bank is clearly defined to be achieving long-term price stability equivalent to a specific point target (in the case of Armenia, the target was set at 4%). In the framework of inflation-targeting, particular importance is placed on inflation expectations as a measure of central bank credibility, because achieving price stability over the long run requires medium- and long-term expectations to remain well-anchored to the target. For the case of Armenia, we rely on a sticky price index based on non-traded, non-regulated goods[18] as our preferred measure of inflation expectations and incorporate them to calculate Central Bank credibility indicator.[19]

To provide historical context of inflation and central bank credibility in Armenia, we explore four successive time periods.

A. 2006-2009: Double-Digit Economic Growth

Before the GFC the global economy was in booming condition, with clear inflationary implications for the prices in the commodity market. 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 during (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, sticky prices had begun to surge upwards reflecting the effect of significantly positive demand (Figure 2). Hence, the main challenge for the monetary policy was to design an appropriate response to the domestic demand expansion in the case of capital flows and currency appreciation.

[18] Sticky price items are defined as the part of the core inflation basket that experiences less frequent price changes. Research by the Atlanta Fed shows that sticky prices may do a better job of incorporating inflation expectations. Since price setters understand that it will be costly to change prices, their price decisions account for inflation over the periods between their infrequent price changes, in a way that is both backward- and forward-looking. Apartment rents are a good example of sticky prices, since rents tend to be set for a fixed lease term (e.g. 6 or 12 months). Landlords will tend to look at recent historical trends and comparables to understand where prices have been and where they might be currently in the market, but they also factor in expectations of how much rents may rise over the term of the lease, since the rent amount will be fixed at the same rate for the lease duration. Therefore, sticky prices serve as an important way to gain context about longer-term trends and potentially policy-relevant features of the inflation process. In the case of Armenia, for our measure of sticky price inflation, we explore prices of non-traded, non-regulated goods, which are far less susceptible to volatile changes in the exchange rates or external demand shocks that can impact some of the price movements in core or headline inflation.

[19] See Kostanyan and others (2022b).

B. 2009-2014: Slow Growth, High Risk Premia

Armenia was significantly impacted by the global demand contraction caused by the Global Financial Crisis. The economy, similar to the whole emerging world, faced a significant reappraisal of the country risk causing 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 the debt 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. 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. However, high sticky price inflation relative to the target was reflecting persistently high inflation expectations in an environment of volatile supply shocks and relatively slow economic growth (Figure 3).

C. 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 spill-overed to other currencies of the region. 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, brought in destabilization of inflation expectations. 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. As inflation expectations continue to remain high and the risks for destabilization still existent, the Central Bank undertook a disinflationary policy since 2015. Even though the period thereafter was a 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 have 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.

D. 2020-2022: Post-War, Post-Pandemic

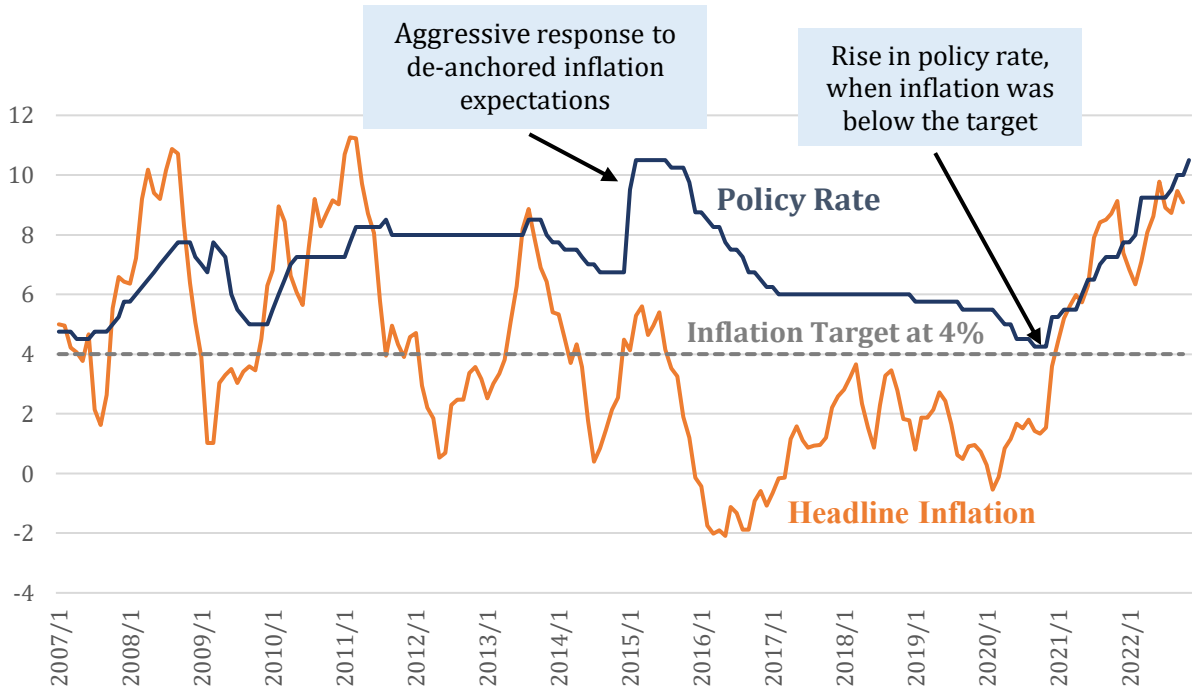
The Covid-19 pandemic generated incredible disruptions to global supply chains, and this, coupled with social distancing/quarantine requirements for workers, represented major supply shocks. On the other hand, the crisis generated parallel demand shocks, with consumers demonstrating hesitation to maintain 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, which

resulting in over 3,800 deaths in Armenia alone and internally displacing over 100,000 people. 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.

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 has 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. In light of these upward pressures on aggregate demand, the Central Bank of Armenia has resumed its consistent raising of interest rates. In total, since the first policy rate increase in December 2020, the policy rate has increased by 625 basis points, and stands at 10.5% as of November 2022.

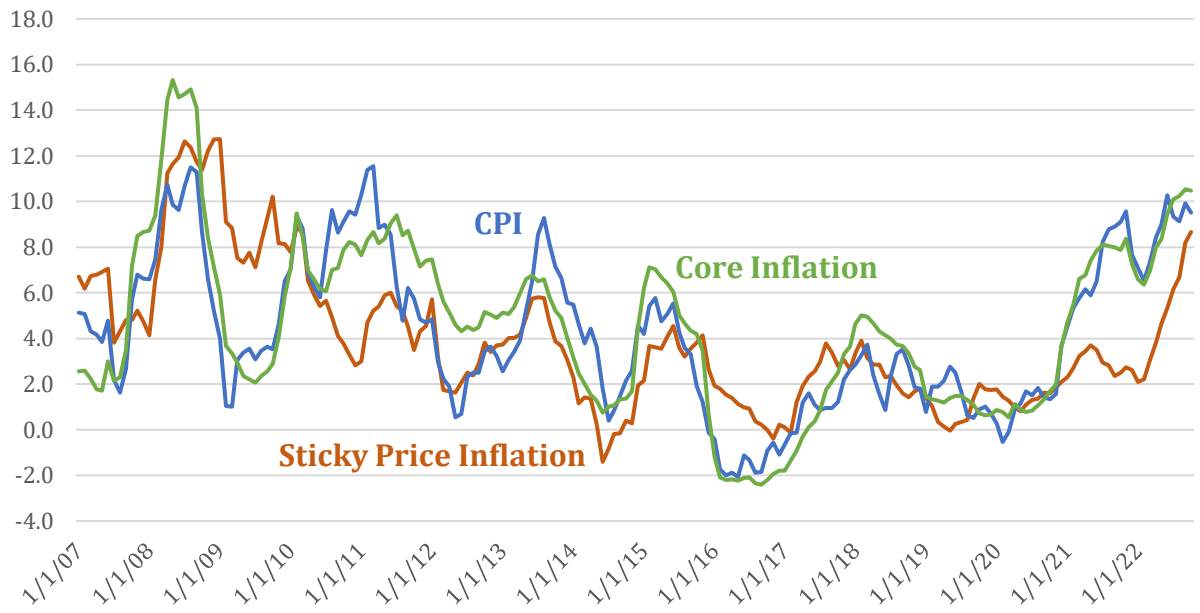
Figure 2. Year-over-Year Headline Inflation and the Policy Rate, Percentage



Source: Central Bank of Armenia; Armstat; Author calculations

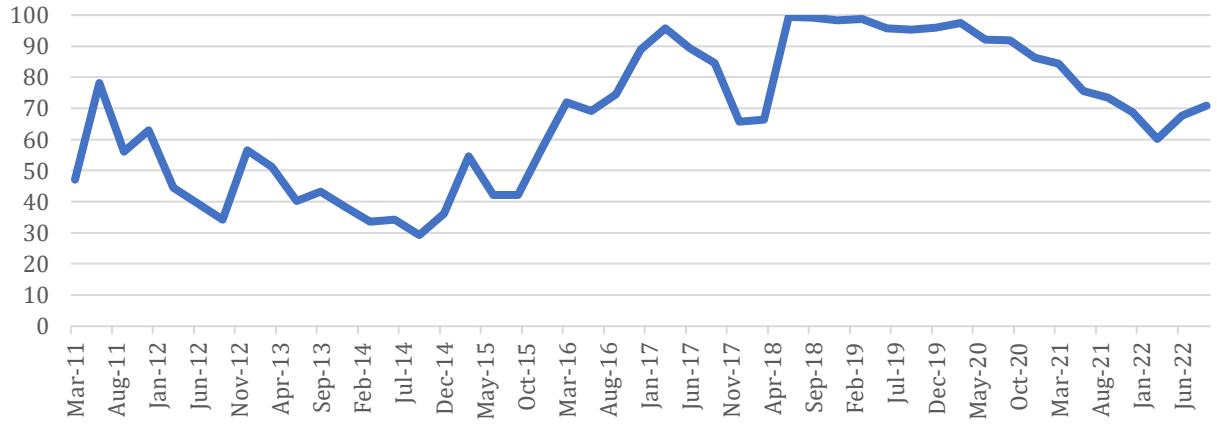
Figure 3. Sticky Price Index and Central Bank Credibility Stock Index

Panel A: Armenia Sticky Price Inflation, CPI, and Core Inflation[20], Y-o-Y, %



Source: Armstat; Central Bank of Armenia; Author calculations

Panel B: Central Bank Performance Indicator[21]



Source: Central Bank of Armenia

[20] CBA Core inflation measure as defined by a method of exclusion of volatile seasonal food products and regulated services from the basket. See https://www.cba.am/en/sitepages/statrealsector.aspx.

[21] The Central Bank Performance Indicator presented here is a proxy measure, based on the share of respondents of the proprietary CBA survey of inflation expectations that do not expect inflation to increase. As with any survey, there is significant uncertainty about these estimates, which are meant to serve an illustrative purpose rather than providing an exact measure, in contrast to measures of inflation expectations in advanced economies based on bond markets.

V. SCENARIO ANALYSIS: IMPLICATIONS FOR POLICY IN ARMENIA

Based on discussions among policymakers and economists in Armenia regarding the macroeconomic conditions in Q1 2022—in particular related to the high degree of uncertainty resulting from the Russia-Ukraine conflict—we construct several scenarios to illustrate how the model could have been applied to Armenia and used effectively during this period of significant uncertainty. The period of Q1 2021, and in particular, the onset of the Russia-Ukraine conflict, was a period of incredible uncertainty and risk for Armenia from a policymaking perspective. In the aftermath of shocks related to the Covid-19 pandemic, the 2020 Nagorno-Karabakh War, and rising global inflation, the Russia-Ukraine crisis presented the Armenian economy with some of the greatest sets of uncertainties since the country achieved its independence in 1991.

Just two-and-a-half weeks after the biggest conflict in Europe since World War II began, the Board of the Central Bank of Armenia met in its regularly-scheduled policymaking meeting to determine changes to the policy rate, as appropriate. This was a textbook case of monetary policymaking under uncertainty.[22] It is in times of extreme uncertainty such as Q1 2022 that policymaking frameworks that better deal with uncertainties and nonlinearities—the FPAS Mark II, see Archer and others (2022)—become especially useful and important. In this context of extreme uncertainty, when the geopolitical and economic situation is changing every day, attempts to construct baseline forecasts and ascribe a degree of confidence in these baselines as representing a "most likely future" do not make very much sense. Instead, a different approach such as that advocated by FPAS Mark II—developing multiple illustrative scenarios that identify the relevant risks and outline necessary policy responses if the risks should materialize, in a way that blends quantitative and qualitative analysis—would have been a much more useful framework for communicating and dealing with this uncertainty. The following exercise of developing Case A and Case B scenarios within the FPAS Mark II framework seeks to illustrate how such an approach could have helped policymakers better think about, and communicate, these uncertainties and risks.

Figure 4. Policymaking in the Time of Uncertainty

[22] A similar story unfolded in March 2020, immediately after Covid-19 had been recognized as a global pandemic and the world was beginning to impose severe lockdowns. As with many central banks, the period of extreme uncertainty that the Covid crisis represented cast doubts on the value of publishing monetary policy reports, considering the seeming folly of attempting to make forecasts in such situations. Some central banks, such as the Bank of Canada, did not publish a MPR. At its policymaking meeting on March 17, 2020, the CBA Board explicitly debated this topic, and ultimately settled on publishing the MPR. In the introduction to the MPR, the CBA stated: "The forecasts in this report are based on the information available as of March 17, 2020—the interest rate decision date. The current state of public health in the world and of the global economy is extremely uncertain, which makes any forecast and even short-term quantitative assessment highly conditional. The situation is changing every day, and a large amount of new information available at the time this report is released has not been incorporated in the published forecasts. We believe, however, that the aim of the Inflation Report is not only the accuracy of the forecasts, but also the transparency of the monetary policy decisions, as well as the communication of the Central Bank's judgments in the time of unprecedented economic uncertainty. The quantitative figures in the forecast are conditional and serve mainly as a guiding baseline scenario. **As the situation may unfold in different ways, the Central Bank is constructing a wide range of alternative scenarios and is ready to react to any development to ensure price stability**." [our emphasis]

We develop the Case A and Case B scenarios using the initial conditions from Q4 2021 within the FPAS Mark II framework, where the bank should produce multiple scenarios that maintain macro-consistency. The development of the illustrative scenarios—both in this paper and as tools within the policymaking process—should reflect conversations among policymakers and economists in Armenia, which follow the framework of understanding and providing answers to the three essential ingredients of an FPAS scenario:

1. Where is the economy now?
2. What are the underlying forces driving the economy?
3. How do policy instruments need to be adjusted to reach policy objectives?

In the FPAS Mark II framework, these scenarios are labeled as Case A's, Case B's and Case X's.

- Case A's are scenarios where the policy rate would need to be higher than the rate the market currently expects. A hawkish scenario.
- Case B's are scenarios where the policy rate would need to be lower than the rate the market currently expects. A dovish scenario.
- Case X's are tail risk scenarios as well as scenarios that incorporate avoiding the dark corners of monetary policy; for example, high and variable inflation or a low inflation trap.[23]

The following section applies the small-open-economy ENDOCRED model within this case-scenario framework, and demonstrates how a model with crucial nonlinearities and endogenous credibility can help policymakers better understand the magnitude and timing of the policy response needed to meet the policy objectives. At the same time, we demonstrate how the FPAS Mark II framework of thinking in terms of multiple case scenarios rather than a single baseline could have allowed policymakers to have identified—and better communicated—the risks and uncertainties that were most pertinent at that time, and what policy responses might had been, had any of those risks materialized.

Specifically, we proceed with two approaches. First, in subsection A, we assume that credibility is endogenous, using the nonlinear small-open-economy ENDOCRED model developed in this paper. Then, in subsection B, to highlight the advantages of this analytical approach and the follies of assuming things like perfect credibility or linear approximations, we repeat the exercise for the Case A scenario with three modifications to the analytical approach:

1. first, we employ the same model, but explore the implications of a delayed policy response;
2. second, we employ a standard linear DSGE-like model with a linear Phillips curve and assume exogenous credibility (meaning that policy is always assumed to be perfectly credible);
3. and third, we explore the implications of a delayed policy response in the standard linear model.

[23] For the purpose of simplicity, this paper does not present a "Case X" scenario.

A. Scenario Analysis: Small-Open-Economy (Armenia) with Endogenous Policy Credibility, Q1 2022

Case A. Persistent Inflation with Further Upward Demand Pressures

Amidst the outbreak of the Russia-Ukraine conflict, early concerns were raised by minority voices (including members of the CBA Board) that rather than leading to a contraction in demand, the war would actually generate positive demand shocks on a vulnerable Armenian economy that was already experiencing upward demand pressures. In January 2022, before the conflict broke out, year-over-year core inflation in Armenia stood at 6.6%, and core inflation was consistently above the target rate of 4% for 13 consecutive months. That being said, because the Central Bank of Armenia had been proactive in preemptively raising interest rates since December 2020 (being among the first central banks in the world to do so), inflation had been decreasing for several months before the Russia-Ukraine conflict broke out, and was well below the peak level of 9.6% that was seen during this period. This pre-conflict inflationary environment was of course at least partly a result of the ongoing disruptions in supply chains, which generated continuous expansions of the inflationary environment in partner economies as well as in international commodity markets, at the same time, the recovery of pent-up demand outpacing the constrained supply was putting additional pressures in the goods market.

Against this background of concerns about an existing (but declining) inflationary environment, the Case A scenario reflects the view that the Russia-Ukraine conflict would actually have expansionary impacts on the Armenian economy and generate further demand pressures on a vulnerable Armenian economy that was just beginning to overcome the Covid-era inflation. The reasoning for this view was the following. Because of a strict Western sanctions regime, the Russian economy would be effectively closed off from Western goods, creating a preference shock for Armenian-produced goods that would have to serve as substitute goods for items previously produced in Europe. While Armenian goods are fairly well-established in the Russian market already, stepping up to fill the void left by European goods would require significant increases in productivity to achieve. The prevailing view of the Case A scenario was that due to bottlenecks in production capacity, it would be very difficult for Armenian producers to quickly and meaningfully increase their productivity. As Evans (1985) argues, in the short run, these bottlenecks serve to steepen the Phillips curve by contracting the maximum output that a given economy can produce, generating further inflationary pressures as sectors of the economy push up against the limits of what they can produce.[24] This would mean that the increase in external demand would create significant demand pressures in Armenia. At the same time, the sanctions regime against Russia would mean that Russian tourists who formerly may have chosen to spend their holidays in the West could no longer do so, and many would instead turn to places like Armenia, which would be reasonably expected to experience a sharp influx of tourists from Russia. Additionally, as Western-based companies no longer do business with Russia, many Russians employed in high-tech sectors of the economy who can "work-from-anywhere" could choose to immigrate to Armenia, drawn by to its visa-free regime and existing strong technology base and perception as a regional hub for IT and technology (i.e. "Silicon Mountains"). Even if not large in number, even a small migration of these high-wage-earning, high-skilled technology workers to Armenia would generate meaningful demand pressures in sectors such as housing, food services, and so on, which would ripple throughout the economy. All of these factors would compound to create meaningful upward shifts in aggregate demand, which would be reflected in both high and persistent core inflation and the appreciation of the Armenian dram. Policy would therefore need to act quickly and aggressively—higher than what the

[24] Refer to Evans (1985).

totality of indicators suggests the market currently expects—in order to bring inflation back down and re-anchor medium- and long-term inflation expectations to the target. Otherwise, there would be meaningful hits to central bank credibility, and delaying these rate increases or underestimating their magnitude would result in significantly higher welfare costs.

Case B. A Mixed Bag

The Case B perspective reflects some of the concerns about the impacts of the Russia-Ukraine crisis, but with the view that the crisis would result in a number of multi-vector impacts that would result in relatively less upward pressure on inflation. Like Case A, this view posited that the sanctions regime was likely to create reorientation or preference shocks that would increase demand for Armenian goods in the Russian market, allowing Armenia to export more to Russia, become a more competitive trade partner, and devote more resources to the tradeable sector. However, the key difference for the Case B perspective lies in the interpretation of how this shock would impact on the Armenian economy. Specifically, noting the relatively low level of productivity of Armenian goods producers and meaningful excess capacity in production, the assumption was that Armenian producers would be able to meet the increased demand for these goods by increasing their productivity and reaching levels of full capacity utilization. Because of this much higher excess capacity, in Case B, production-oriented sectors of the economy would hit the critical bottlenecks of production capacity much later than in Case A. This would mean that in contrast to Case A, the increases in external demand in Case B could be absorbed by excess capacity and not hit bottlenecks so early, avoiding the nonlinear areas of the Phillips curve where these bottlenecks would generate meaningful and steepening inflation pressures. The implication, of course, would be that the inflationary effects of the increase in external demand would be much less significant under the Case B than the Case A because of fewer bottlenecks in production capacity.

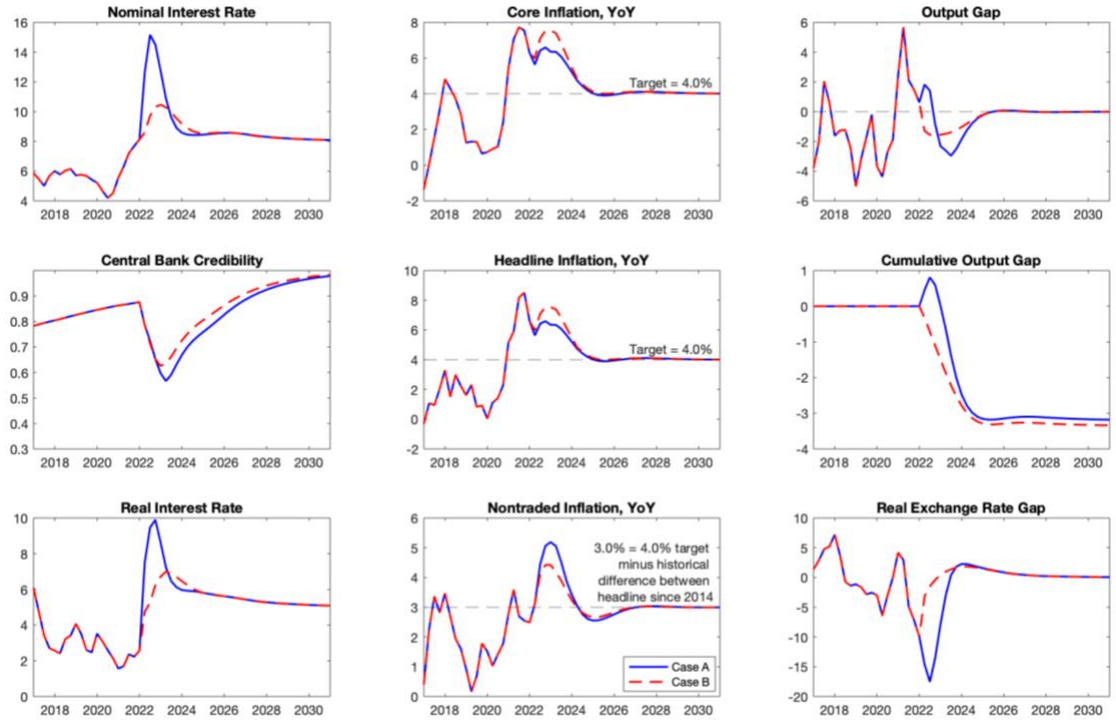
At the same time it would have been unwise to overestimate the impact of external demand from the conflict. The increase in external demand for Armenian goods could be attributed primarily to preference shocks—the result of Western goods being unavailable—but it would be reasonable to assume that the heightened uncertainty and the sanctions regime would have negative impacts on domestic economic conditions in Russia. In other words, demand for Armenian goods could increase even as domestic economic conditions and uncertainties worsened in Russia. Given the major role of remittances from Russia to Armenia (driven by the large number of seasonal migrant workers, extended families, etc. sending remittances to family in Armenia), however, a decline in Russian domestic demand conditions would cause remittances to likely decline, creating depreciation pressures on the dram. Moreover, the uncertainty of, and instability generated by, the conflict would be expected to lead to increases in the country risk premium, which in its turn would create upward pressure on interest rates.[25]

However, the implications of fewer bottlenecks in productive capacity, in combination with lower demand from decreased remittances, outpace the implications of exchange rate depreciation and results in relatively lower inflationary impact as compared to Case A scenario.

[25] To avoid overcomplicating this illustrative exercise, we do not play out the importance of the risk premium channel in a very complex or realistic way. This is a topic that could be further explored in the future in the context of Case X tail risk scenarios. Of course, there can be risk premium shocks that could really lead to increases interest rates, but we assume that the demand effects on interest rates would dominate in the Case B.

Taken together these factors would indicate that interest rates would not need to rise less aggressively as in the Case A scenario, and core inflation could return back to the target without needing a high-magnitude series of rate hikes.

Figure 5. Q1 2022 Scenarios for Armenia



Source: Author calculations

Figure 5 highlights the main results of this analytical exercise in graphical form, and tracks intuitively with the qualitative narrative presented on the previous pages. Under the assumptions in the Case A scenario, where external demand shocks create upward inflation pressures in an economy facing production bottlenecks, the policy rate would need to rise aggressively and quickly—to a peak of about 15%—in order for inflation to return to the target within 2-3 years. The impact on credibility of this period of high inflation, and the time it takes for inflation to return to the target, is fairly meaningful, with a decline of credibility to approximately 0.6, from about 0.9 before the geopolitical shocks. Under the assumptions of the Case B scenario, where there would be fewer bottlenecks that would allow increases in production to absorb the demand shocks, the policy rate still increases, but not as significantly as in Case A to contain inflation. Core, headline, and nontraded inflation would remain lower in Case B, and the ensuing impact on credibility would be less significant than in Case A.[26] Further, the shock to the country risk premium in the Case B scenario would result in some depreciation of the exchange rate, while in Case A, we would see the

[26] For nontraded inflation, we set a target of 3.0%, which is one percentage point lower than the 4.0% target set by the Central Bank for core inflation. Because nontraded goods prices don't experience the same magnitude of increases relative to core and headline inflation that are caused by exchange rate effects or external shocks, a lower target is appropriate, and the target that we set of 3.0% is based on the historical data for the spread between nontraded and core inflation.

currency appreciate due to increases in external demand. Moreover, the greater magnitude of the external demand shocks in the Case A scenario would create greater overheating in the economy, which we see reflected in the smaller cumulative output gap than in the Case B scenario, where the impacts of the lower remittances and country risk premium shocks would be evident.

B. Folly Analysis: Case A Scenario with Different Credibility Assumptions

The primary contribution this paper seeks to make to the literature and to practitioners is to provide an example of the type of analytical tool that can be useful as a workhorse quarterly projection model for small-open-economy countries practicing flexible-inflation targeting. In particular, the key advantage of this analytical framework is to emphasize the role of endogenous policy credibility in the policymaking process. Thinking of policy credibility as an endogenous process—meaning that credibility is a stock that can be quickly lost if inflation is high and persistent, and inflation expectations become de-anchored from the target, and that credibility is regained only gradually—allows policymakers to understand better the magnitude of the policy actions needed to reach their policy objectives in a reasonable time frame. Further, this ensures that they avoid slides into what Olivier Blanchard terms "dark corners where danger lurks" if they make the false assumption that credibility is always perfect. The greatest danger is that this thinking can lead to underestimating both the timing and magnitude of the necessary policy response, which can compound existing stagflationary risks. Small open economies, in particular in emerging markets, have always been acutely aware that credibility is endogenous and not a given, and therefore it is essential to have workhorse models that incorporate this reality as an essential feature of the analytical tools. The dangers of developed-country central banks falsely assuming that credibility is a given—and not as something that can be quickly lost due to policy errors—is explored in Kostanyan and others (2022b).

At the same time, we emphasize the folly—and dangers—of local approximations. Using models that employ local approximations that treat complex processes as simply linear can be particularly dangerous, as they presume that policymakers can have "free lunches." In models with local approximations, where, for example, the Phillips curve is presumed to be linear, the costs of high and persistent inflation are underestimated. In other words, if policymakers employ analytical frameworks that assume that the inflation-output or inflation-unemployment tradeoff follows a linear logic, then there is little basis for increasing rates at the degree of magnitude or timing that would in reality required to bring down inflation and re-anchor medium- and long-term inflation expectations to the target. The implication, of course, is that these linear models are inconsistent with the third basic principle of monetary policy: that it is the role of the central bank to raise policy rates sufficiently aggressively to bring about disinflation and anchor inflation expectations to the long-term point target.[27]

To demonstrate the importance of nonlinearities and endogenous credibility, we repeat the above Case A scenario using the same exact assumptions, but we introduce three different analytical assumptions that incrementally demonstrate the following:

- B.1 Why is it so costly to delay the necessary policy response?
- B.2 Why is it folly to assume perfect credibility and linearities?
- B.3 Why is it particularly dangerous to delay policy responses when you assume perfect credibility and linearities?

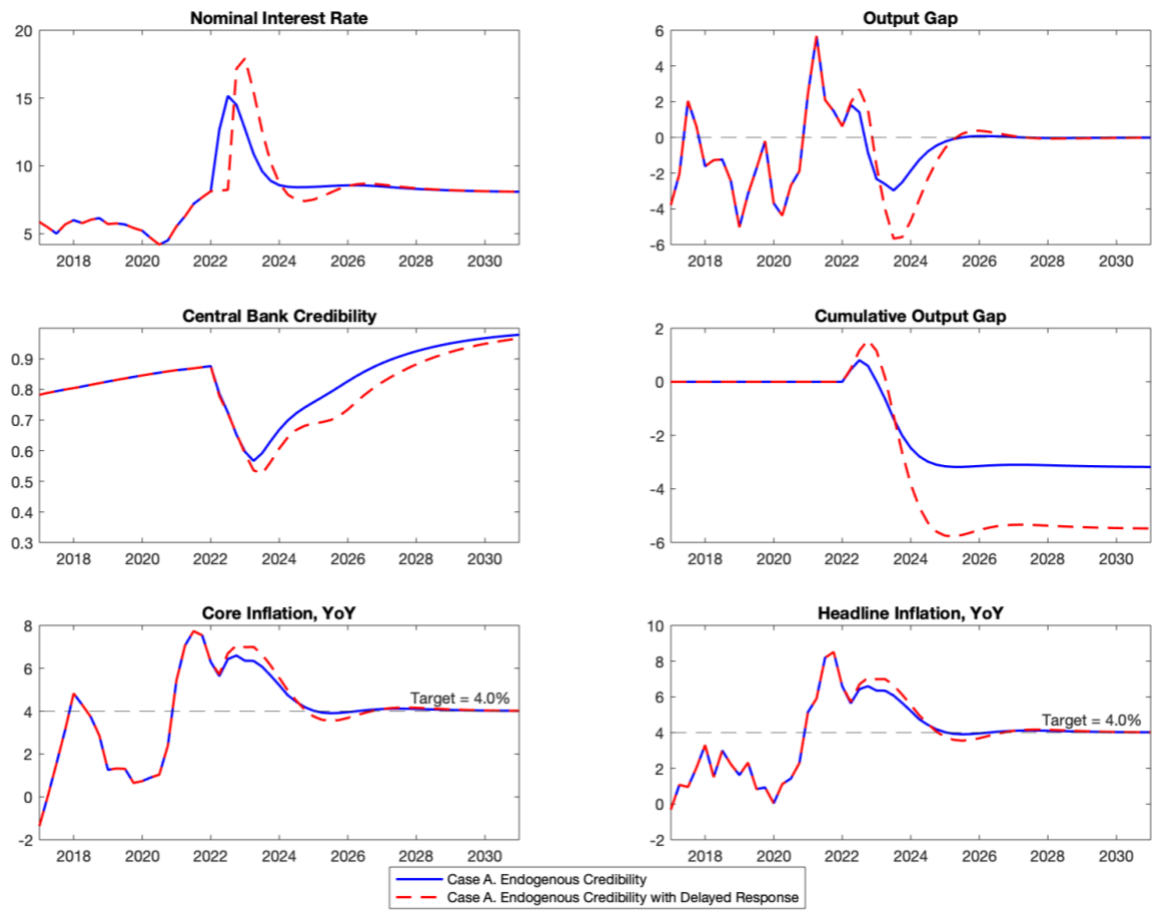
[27] See Freedman and Laxton (2009).

B.1. Delayed Policy Response, Q1 2022

To illustrate the implications of a delayed policy response, we repeat the Case A exercise with the same exact assumptions, with one crucial difference: what if the Board resists raising interest rates, and holds the policy rate constant for two quarters, before ultimately deciding to act?

As shown in Figure 6 below, resisting the necessary rise in interest rates at the appropriate time, and delaying the response, has several adverse impacts. First, inflation expectations (shown as central bank credibility) are allowed to ratchet further upwards (downward), raising the risk of entrenchment, which results in the central bank needing a longer period of time to bring inflation back down and re-anchor long-term inflation expectations back to the target. Second, delaying the necessary policy response means that when rates are increased, they need to be raised by a far greater amount (up to a peak of 18%, or 3 percentage points above when there is no delay) to achieve the policy objective. This, in turn, has significant negative impacts on welfare outcomes, as this leads to a mismanagement of the short-term inflation-output tradeoff and creates a much worse recession, where the cumulative output gap reaches almost -6%—a meaningfully worse loss in output than the -3% that is experienced when the policy response is not delayed.

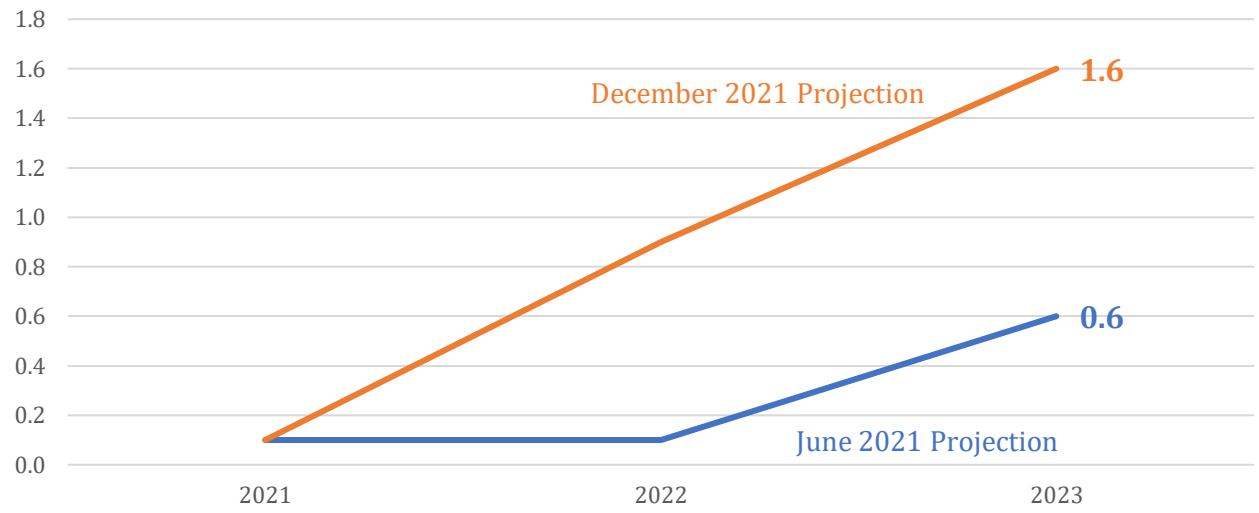
Figure 6. Q1 2022 Case A Scenario: Delayed Policy Response



Source: Author calculations

This logic can also be related to what took place in the United States in the Summer of 2021 and beyond. As discussed in Kostanyan and others (2022b), at the time, debates were raging as to whether inflation was transitory or persistent, and the Fed adopted the logic of the former in its communications. This line of thinking led to delaying increases in the Fed Funds Rate, as the Fed resisted higher interest rates. The figure below presents the Market Probability Tracker for the Fed Funds Rate, as compiled by the Atlanta Fed, which calculates the market-implied probabilities of various ranges for the three-month average fed funds rate. In June 2021, when the Fed was communicating that inflation was transitory and was resisting the increase in interest rates, the path of policy rate was expected by market participants to peak at 0.6%. But because the Fed resisted the necessary rate increase, just two quarters later, in January 2022, the expected peak Fed Funds Rate had risen meaningfully by 100 basis points to 1.6%. This mirrors the same logic and process as what our illustrative example shows, in a real-world application.

Figure 7. FOMC Projection of Fed Funds Rate, June 2021 and December 2021[28]



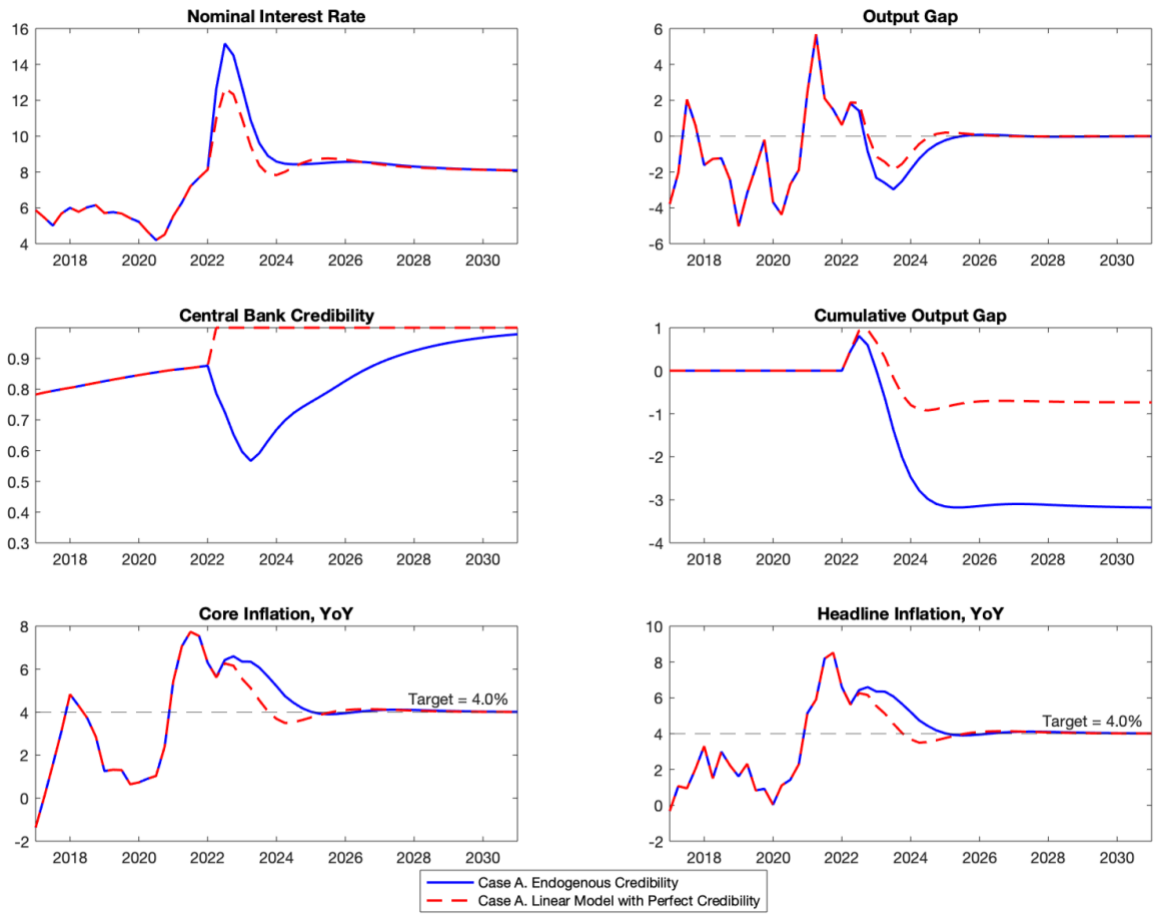
Source: Federal Reserve Board

B.2. Linear Model with Exogenous Policy Credibility, Q1 2022

To demonstrate the importance of having analytical frameworks that are nonlinear and presume endogenous credibility (as something that is not a given, but can be gained or lost in nonlinear ways, and is directly linked to policy actions), we again repeat the Case A scenario using the same exact assumptions as before, but with two critical differences: credibility is assumed to be always perfect, and the model is made to have local approximations (a DSGE-like model). Figure 9 shows the results of this analysis.

[28] Per the Fed's Summary of Economic Projections, "The projections for the federal funds rate are the value of the midpoint of the projected appropriate target range for the federal funds rate or the projected appropriate target level for the federal funds rate at the end of the specified calendar year or over the longer run." Because historical data from the AtlantaFed Market Probability Tracker is not publicly available, we instead present the FOMC's projections, which the market has relied on in forming its own expectations in the post-Covid period.

Figure 8. Q1 2022 Case A Scenario: Linear Model with Exogenous Credibility



Source: Author calculations

In the Case A scenario, when we assume perfect policy credibility and local approximations, the implied policy rate peaks at approximately 12%, which is meaningfully lower than the approximately 15% peak when we correctly assume that credibility is endogenous and the world is nonlinear.[29] In other words, this illustrative example demonstrates very clearly that if a central bank were facing these types of risks and shocks, then if it were to assume that it had perfect credibility and employed linear analytical tools, then it would systematically underestimate the extent of the policy response needed to bring inflation down and anchor medium- and long-term inflation expectations to the target. Assuming perfect credibility tricks policymakers into ignoring

[29] We note that this analytical exercise is not a policy recommendation or forecast, and the shocks and assumptions that we present in this model do not perfectly align with what has happened in the world and in the Armenian economy. Rather, this analytical exercise is intended to demonstrate illustratively and hypothetically how factors like nonlinearity and credibility would impact policymaking thought processes and decisions. The resulting policy rates (e.g. 12% and 15%) are dependent on the specific assumptions (and in particular shocks) that we make in this model and described in the text above, which are meant to serve an illustrative purpose rather than serving as a basis for recommendations for policy rate movements. This disclaimer is important, as the scenarios presented in this page do not (and cannot) represent policy recommendations for the CBA—but rather, are hypothetical examples intended to illustrate a conceptual point.

the linkages between their policy actions and inflation and expectational outcomes, which means that there is little incentive to act aggressively to bring inflation back to the target, because there is no hit to credibility if inflation is allowed to be high and persistent, and there is no price to be paid later on (as discussed later).

At the same time, models with local approximations that assume that the Phillips curve is linear fail to appreciate that in areas of excess demand, particularly as the economy nears its maximum potential output, the convexity of the Phillips curve means that the inflationary consequences are going to be greater and greater—and this relationship is not linear. Linear models that do not take this crucial characteristic into account fail to communicate to policymakers the importance of acting quickly and aggressively to reach their policy objectives. This is a recipe for severely mismanaging the inflation-output and inflation-unemployment tradeoff.

The welfare implications of these lines of thinking cannot be overstated. Because of this belief in perfect credibility and a linear world, and due to the complacency with folly assessments about the relative lower output and inflationary costs of the shock, undershooting the policy response in the magnitude of necessary rate increaseswould result in a failure to lower inflation and would allow medium- and long-term inflation expectations to ratchet significantly upwards. This would have catastrophic welfare impacts in the long run as well, as in reality, it would require the central bank to eventually make a much more drastic rate increase at a later point in the future in order to overcome inflation, which would result in a far worse inflation-output tradeoff and potentially lead to stagflation.

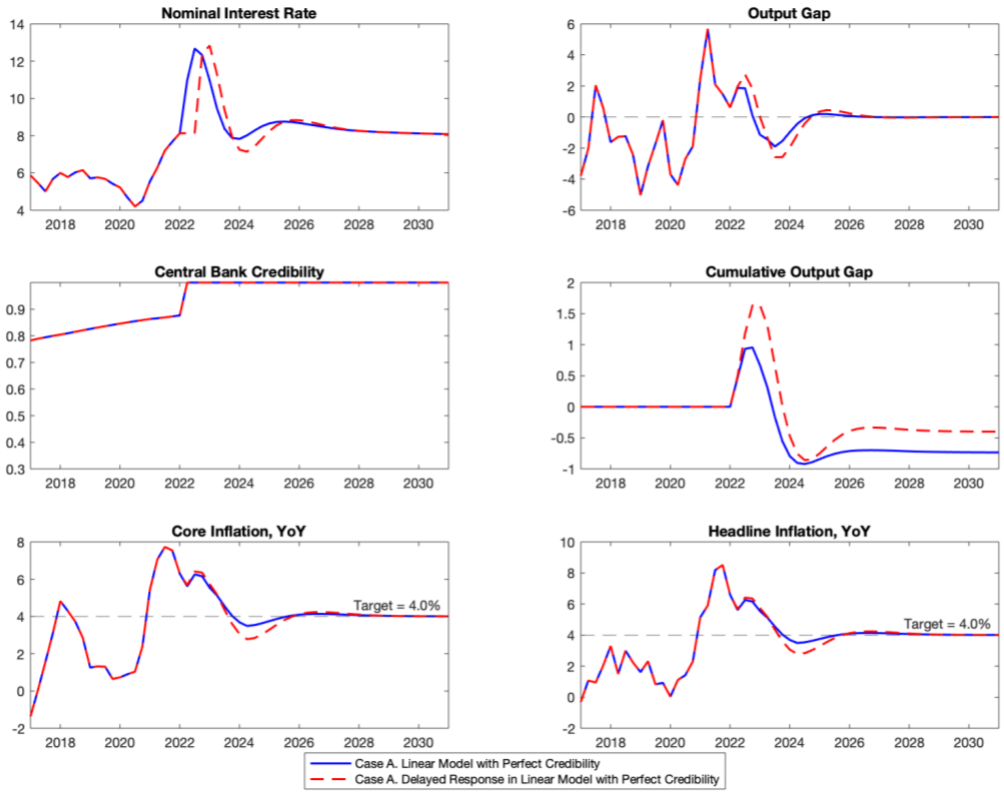
B.3. Linear Model with Exogenous Policy Credibility and Delayed Response, Q1 2022

The final thought experiment that we present is a combination of the above two ideas. Specifically, what happens if a central bank that assumes it has perfect credibility and relies on linear models (or thinking) delays its policy response? As the results in Figure 9 highlight, this flaw in reasoning completely prevents the central bank from seeing the imperative to do its main function: adjusting the policy rate sufficiently aggressively to lower inflation and re-anchor medium- and long-term inflation expectations to the point target.

Having explored the consequences of delayed policy responses in B.1, and the importance of endogenous credibility and nonlinearities in B.2, we focus the reader's attention on one important point, which is the missing part form the discussion when the credibility is assumed to be perfect Because there is a crucial nonlinearity to the credibility generation process, once credibility is lost, it is very difficult to regain, and the re-accumulation of credibility occurs only gradually. The central bank has to eventually pay for the higher inflation that it allowed to persist, particularly because it falsely assumed that inflation expectations were always going to be anchored to the target, when in fact the central bank's (lack of) policy actions allowed them to drift upward. In fact the analysis in Figure 9 highlight the folly in this assumptions, where the delay of necessary policy reaction ends up with lower cumulative output loss and welfare implications for later inflation stabilization. This, in many ways, is akin to what took place in advanced economies such as the US during the Great Inflation of the 1970s, when policymakers believed they had perfect credibility, ignored crucial nonlinearities in their thinking and analytical tools, delayed the necessary policy response, and thus allowed inflation to become entrenched and a stagflationary environment to emerge. The straw that broke the camel's back wasn't a straw, but an entire bushel—Volcker's disinflation required an increase of the policy rate to 20 percentage points and a fairly severe recession to achieve, and even still, credibility (i.e. long-term inflation expectations) took over a decade to become well-anchored

to the point target. Worryingly, echoes of this can be seen in the macroeconomic situation in advanced economies during the Covid era, which is explored further in Kostanyan and others (2022b).

Figure 9. Q1 2022 Case A Scenario: Linear Model with Exogenous Credibility



Source: Author calculations

C. FPAS Mark II and the Role of Transparent Communications

The above three subsections illustrate how the model developed in this paper can serve as a helpful analytical tool for policymakers to better understand the policy implications of their actions in times of great uncertainty, particularly in the context of nonlinearities and endogenous credibility. But without a comprehensive and transparent framework in place to communicate this way of thinking to the public, these analytical tools on their own do not add very much value. Rather, only by having in place a systematic approach for communicating these ideas to the public and moving away from the role (whether perceived or actual) of "expert forecaster"—in other words, the policymaking framework of FPAS Mark II—analytical tools like the model presented in this paper - can help policymakers better manage situations of great uncertainty and risk.

To be more precise, in the period that we examine in the preceding pages (early 2021, namely the beginning of the Russia-Ukraine conflict), the principal challenge that a vulnerable small-open-economy FPAS central bank like the Central Bank of Armenia faced was not necessarily related to its analytical framework and resulting policy decisions. In fact, the actual path of the policy rate in

Armenia during and after this period is supported by both the narrative thinking and quantitative analysis that we retrospectively conduct on the prior pages. Therefore, if the issue was not the analytical tools or the policy decisions themselves—what was it?

The primary challenge for banks like the Central Bank of Armenia—and arguably all central banks around the world, not just vulnerable small open economies—lies in how these narratives are being communicated to the public, how the public is perceiving this messaging, and how this impacts central bank credibility. There remains a perception among both market participants, the public sector, and the general public that the role of the Central Bank of Armenia and other central banks is to be an "expert forecaster" and predict most-likely outcomes. This perception, in no small part, is the product of having a policymaking and communications framework that is built around baseline scenarios. Having a single baseline forecast around which the optimal future path of the policy rate is set creates a false set of assurances and confidence, and implies to the public (whether intentionally or not) that there is a certain degree of confidence that the baseline forecast—and closely interlinked forecasts of GDP growth, the output gap, and so on—are the most accurate representations of what is going to happen in the future. This means that the central bank's credibility is closely interlinked with whether these baseline forecasts prove to be true or false. But because central banks—like any other economic or financial analyst—are inherently bad at forecasting an unknowable future, the forecasts of even the best flexible-inflation-targeting central banks are virtually always wrong.[30] This means that the credibility of the central bank is unnecessarily at stake each time a baseline forecast is published and inevitably proves to be wrong, particularly when we consider the language and style of monetary policy communications. Further, this problem is closely interlinked with another misperception: that the baseline forecast is the same as policy. In seasoned FPAS Mark I central banks, there is an explicit acknowledgement and understanding within the institutions, that the baseline is just one of the inputs for policy decisions. Part of the reason that key stakeholders believe that it is so important to have a "perfect" baseline scenario and be able to forecast well is that they believe that the baseline is the policy, when in fact the actual path of the policy rate tends to always deviate from the expected path published in prior baselines.[31]

Therefore, what the above exercise highlights most forcefully is the need to shift away from the role of expert forecaster and baseline forecasts—which makes credibility excessively vulnerable to forecasting errors—and adopt a framework that instead prioritizes multiple scenarios in the context of monetary policymaking as a risk management exercise, or MPRM. This approach of FPAS Mark II seeks to avoid precisely this folly in baselines that can get in the way of central banks effectively communicating their policy decisions and commitment to their policy objectives in times of great uncertainty. Instead of a single baseline, the FPAS Mark II communications framework instead prioritizes presenting "what if" Case A/B/X/Y scenarios that provide illustrative examples of the major risks and uncertainties facing the economy, without suggesting that such a path is the most-likely expectation.

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[30] Archer and others (2022), drawing on Alsterlind (2017), explore this point at length, noting how some of the best FPAS Mark I central banks (Sweden, Norway, the Czech Republic, and New Zealand) have consistently been incorrect in their forecasts of the projected path for policy rates and other variables, despite differences across time, geography, and economic conditions. More worryingly, they find a consistent tendency to underestimate the policy rate when economic activity and inflation pressures are above target levels.

[31] See Alsterlind (2017).

The narrative-based approach of FPAS Mark II—which presents the scenarios and the thinking behind the three essential ingredients that informed the construction of these illustrative scenarios—has several advantages. First, it helps communicate to the public the connections between the macroeconomic stability risks and the policy responses needed. This provides key stakeholders (financial markets, journalists, etc.) with a greater richness of information about how the central bank is thinking about key risks and uncertainties (and what those risks are). Most importantly, it clearly communicates what the anticipated policy response of the central bank would be if any of the risks materialized. This is the key value add of the central bank in the FPAS Mark II framework. To summarize, rather than communicating one baseline that is draped in false assurances, the FPAS Mark II seeks to communicate the key uncertainties to the public stakeholders, with the emphasis being on what would the central bank do if certain concerns or risks—including tail risks—became true. Further, adopting a narrative-based approach seeks to make central bank communications much more accessible to market agents or the general public who are critical to setting prices and forming expectations, but who may not be experts in, for example, the complex algebra of policy loss functions. Of course, this greater engagement with market actors and journalists requires meaningful training and background work with journalists and financial markets to demonstrate the value-add of this approach and get them accustomed to dealing with more information rather than less, for thinking about risks and uncertainty rather than seeking out the false assurances of baselines. This will allow a higher dimension and robustness of conversations between the central bank and key stakeholders, which is an important part of central banks' desire to be more transparent and accountable.

In a world of significant and growing uncertainty, a communications approach that gets rid of baselines and forecasting most likely outcomes—and instead recognizes and clearly communicates the uncertainties that are inherent to policymaking—can play a significant role in helping central banks maintain their credibility because they have linked it to the validity of their forecasts. Only with this FPAS Mark II policymaking and communications framework in place can nonlinear analytical tools like the ENDOCRED model best serve their function, and in doing so, eliminate both the folly in baselines and the folly in local approximations.

VI. CONCLUSION

This paper builds on work done by Argov and others (2007) and Kostanyan and others (2022b) to develop a small-open-economy adaptation of the workhorse model of flexible-inflation targeting under imperfect credibility, calibrated to Armenia. We present a practical illustration of how such an analytical toolkit and framework can be used by policymakers today as a core quarterly production model for small emerging economies, in particular those implementing FPAS Mark II. We show how this framework can help policymakers to think more critically about effective policymaking in times of great uncertainty and high inflation. Applying the model and framework retrospectively to the recent economic challenges confronting Armenia in the aftermath of geopolitical shocks, this paper highlights the critical role of conceiving of credibility as an endogenous process rather than as an unchanging and given thing. Failing to treat credibility as endogenous, and refusing to accept the obvious linkages between policy actions and credibility, can lead policymakers to underestimate the magnitude and timing of the necessary policy response. This only delays the inevitable, but compounds the scale of what is needed at a time when most policy responses become "too little, too late." The policy and welfare implications of treating credibility as exogenous, therefore, are immense and far too costly to not take seriously.

More importantly, this paper emphasizes that the analytical improvements that the ENDOCRED model introduces only truly add value when dovetailed within a broader FPAS Mark II framework that shifts the central bank's perceived or actual role from that of "expert forecaster" to "monetary policy risk manager." Instead of tying credibility to the ability to make accurate forecasts, FPAS Mark II prioritizes a scenario-based approach (as we illustrate with a real-world application in Section V), where the focus of the central bank is to think critically about uncertainties and risks, and understand and communicate the policy actions that would be necessary in the event that these risks or scenarios materialize. In this context, robust, nonlinear core workhorse models such as ENDOCRED provide key analytical tools for this scenario-based approach and far better account for (relative to linear DSGE models) the types of nonlinearities and uncertainties that policymakers must confront when making policy decisions. Most importantly, these frameworks give policymakers the incentives to more effectively and more transparently communicate uncertainties and policy actions with the public. The ultimate goal is preventing slides into "dark corners where danger lurks," which all good and effective monetary policy should strive to avoid.

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