Introducing ECES's Macroeconomic Model for the Egyptian Economy

application 1:
detailed analysis of recent inflation trends

An ECES Project

ECES
المركز المصري للدراسات الإقتصادية
The Egyptian Center for Economic Studies

Agenda

- **Introducing the Macroeconomic Model for Egypt (MME).**
- Application 1: Recent Inflation Trends under the Lens of the MME.
- Suggested Policy Options and the Way Forward.

"The Recent Developments in the Specification and Estimation of Disequilibrium Models" in Research in Human Capital and Development, edited by I. Serag El-din and R. Dahel (New York, JAI Press, Inc., 1997)

-       Also translated into Arabic in "Survey of Developments in Methodology and Estimation of Macro-Models and its Use in Policy Evaluation and Forecast," I-Limam, et. al, (Syria: Tallas House of Publishing, 1997)

The Story of Macroeconomic Modelling ..

- Time series analysis aims at smoothing past data to separate the underlying pattern of the data from randomness.

- This underlying pattern can then be broken down into sub-components that drive the series values: decomposition.

- By decomposition, the underlying pattern is separated into short-term business cycles and long-term structural trends.

- Macroeconomic models try to use both components for short-term forecasting and/or for systematic storytelling.
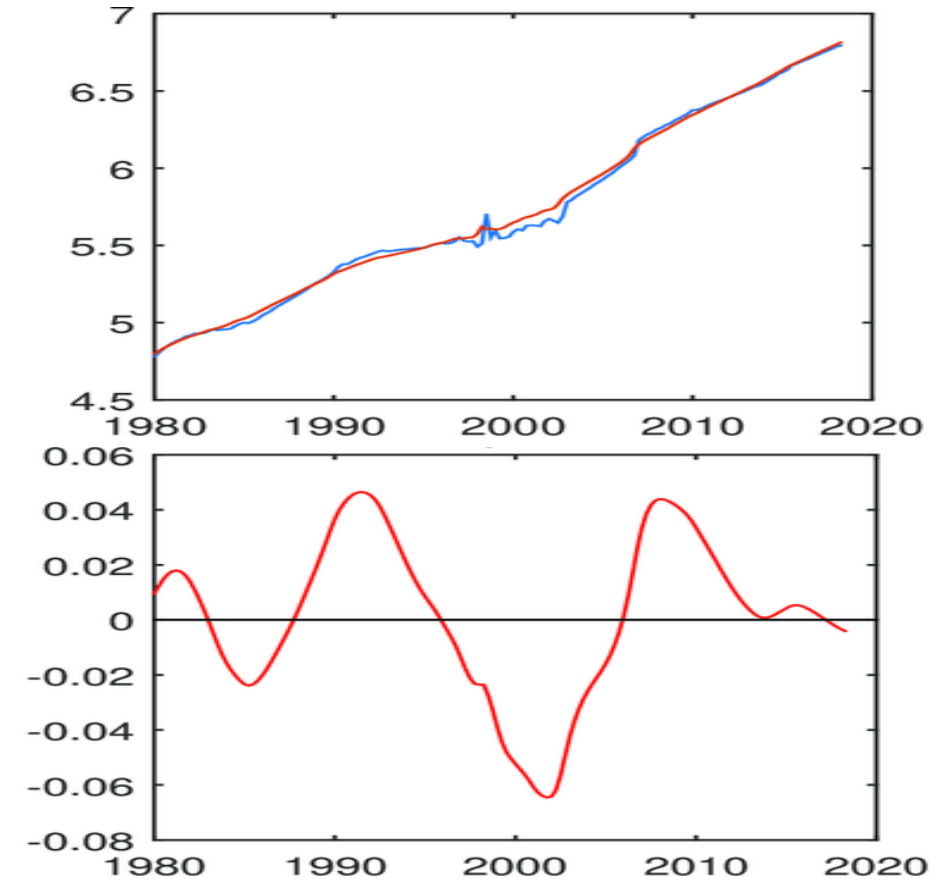
Building A Macroeconomic Model for Egypt (MME) ..

- Policymakers in central banks and statistical offices around the world use models, macroeconomic and/or econometric, as standard tools for policymaking.

- ECES takes the initiative and builds a quarterly macroeconomic model for Egypt (MME) that mimics the structural characteristics of the domestic economy.

- The MME is intended to be used as a modeling battery to perform a variety of tasks ranging from systematic storytelling to short-term projections such as:

  - Evaluate the efficiency of policy actions (e.g. exchange rate revaluation).
  - Simulate the usefulness of planned interventions (e.g. interest rate cut).
  - Measuring the impacts of external shocks (e.g. US monetary policy).

- The MME is particularly valuable for making policy exercises in today's volatile, uncertain, complex and ambiguous (VUCA) environment.

- The MME should also be useful in benchmarking the macroeconomic outcomes of standardized international models for the case of Egypt economy.

Our MME in a Nutshell ..

MME

General Equilibrium Model
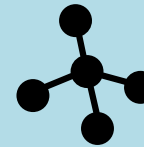It has a system of 34 reduced-form and structural equations to start with ..

Semi-Structural Model
The key building blocks say for monetary policy are structural; AD, AS, UIP, CBR ..

Stochastic Model
The model allows for stochastic shocks in its main equations.

Moderate Period
The dataset covers long period (2001Q1-2022Q1) that features recent developments.

An Overview of the MME Methodology ..

1 Creating model dataset from raw data ..
(consistency, missingness, transformations, ..)

2 Decomposing data into tr...
using univariate and mult...

3 Building model equations
calibrating parameter val...

4 Solving out the quarterly
macroeconomic model ..

5 In-sample and out-of-sam...
robustness checks

Variables	GDP_U	CPI	S	RS	GDP_RW	CPI_RW	RS_RW	D4L_CPI_TAR
Text	▼Number	▼Number	▼Number	▼Number	▼Number	▼Number	▼Number	▼
Variables ->	GDP_U	CPI	S	RS	GDP_RW	CPI_RW	RS_RW	D4L_CPI_TAR
Comments ...	Real GDP (E...	Headline CP...	Nominal Ex...	Nominal Po...	US Real GD...	US Personal...	US Effective...	Inflation Tar...
Class[Size] ->	tseries[85-b...	tseries[85-b...	tseries[85-b...	tseries[85-b...	tseries[85-b...	tseries[85-b...	tseries[85-b...	tseries[85-b...
2001Q1	4.18160000...	1.63000000...	3.79000000...	1.20000000...	1.33013940...	7.97210000...	3.97000000...	5.00000000...
2001Q2	4.29380000...	1.63600000...	3.84000000...	1.10000000...	1.32481420...	7.97610000...	3.07000000...	5.00000000...
2001Q3	4.38610000...	1.64600000...	4.04000000...	1.10000000...	1.32848810...	7.97940000...	1.82000000...	5.00000000...
2001Q4	4.54410000...	1.65700000...	4.21000000...	1.10000000...	1.33949100...	7.99540000...	1.73000000...	5.00000000...
2002Q1	4.86530000...	1.67200000...	4.50000000...	1.10000000...	1.34773560...	8.05470000...	1.75000000...	5.00000000...
2002Q2	4.67380000...	1.68200000...	4.50000000...	1.10000000...	1.35317410...	8.09640000...	1.75000000...	5.00000000...
2002Q3	4.53110000...	1.69800000...	4.50000000...	1.10000000...	1.35494210...	8.13420000...	1.24000000...	5.00000000...
2002Q4	4.69490000...	1.71000000...	4.50000000...	1.00000000...	1.36194340...	8.19640000...	1.25000000...	5.00000000...
2003Q1	5.00630000...	1.73500000...	5.22000000...	1.00000000...	1.37411070...	8.20460000...	1.22000000...	7.00000000...
2003Q2	4.82530000...	1.75300000...	5.91000000...	1.00000000...	1.39701570...	8.25870000...	1.01000000...	7.00000000...
2003Q3	4.72450000...	1.78400000...	6.12000000...	1.00000000...	1.41313790...	8.29930000...	9.80000000...	7.00000000...
2003Q4	4.89440000...	1.82000000...	6.14000000...	1.00000000...	1.42123400...	8.36330000...	1.00000000...	7.00000000...
2004Q1	5.19940000...	1.92400000...	6.17000000...	1.00000000...	1.43230170...	8.41960000...	1.03000000...	7.00000000...
2004Q2	5.01740000...	1.95900000...	6.19000000...	1.00000000...	1.44578320...	8.46100000...	1.61000000...	7.00000000...
2004Q3	4.90910000...	1.99600000...	6.21000000...	1.00000000...	1.46055950...	8.53330000...	2.16000000...	7.00000000...
2004Q4	5.11330000...	2.02600000...	6.22000000...	1.00000000...	1.47678460...	8.58290000...	2.63000000...	7.00000000...

An Overview of the MME Methodology ..

1 Creating model dataset from raw data .. (consistency, missingness, transformations, ..)

2 Decomposing data into trends, cycles and noise using univariate and multivariate techniques ..
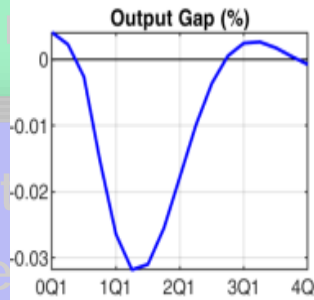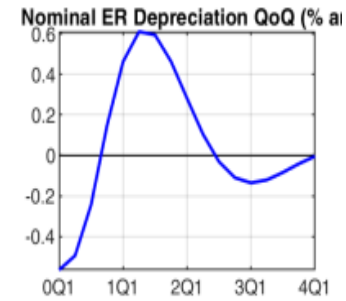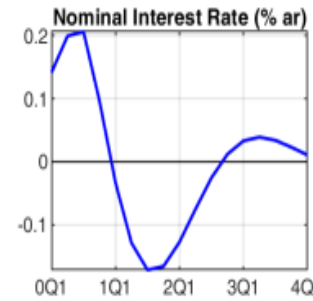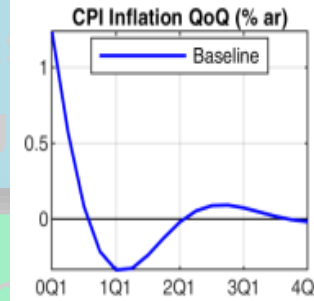
3 Building model equations calibrating parameter

4 Solving out the quarterly macroeconomic model

5 In-sample and out-of-sample robustness checks

1 Creating model dataset from raw data .. (consistency, missingness, transformations, ..)

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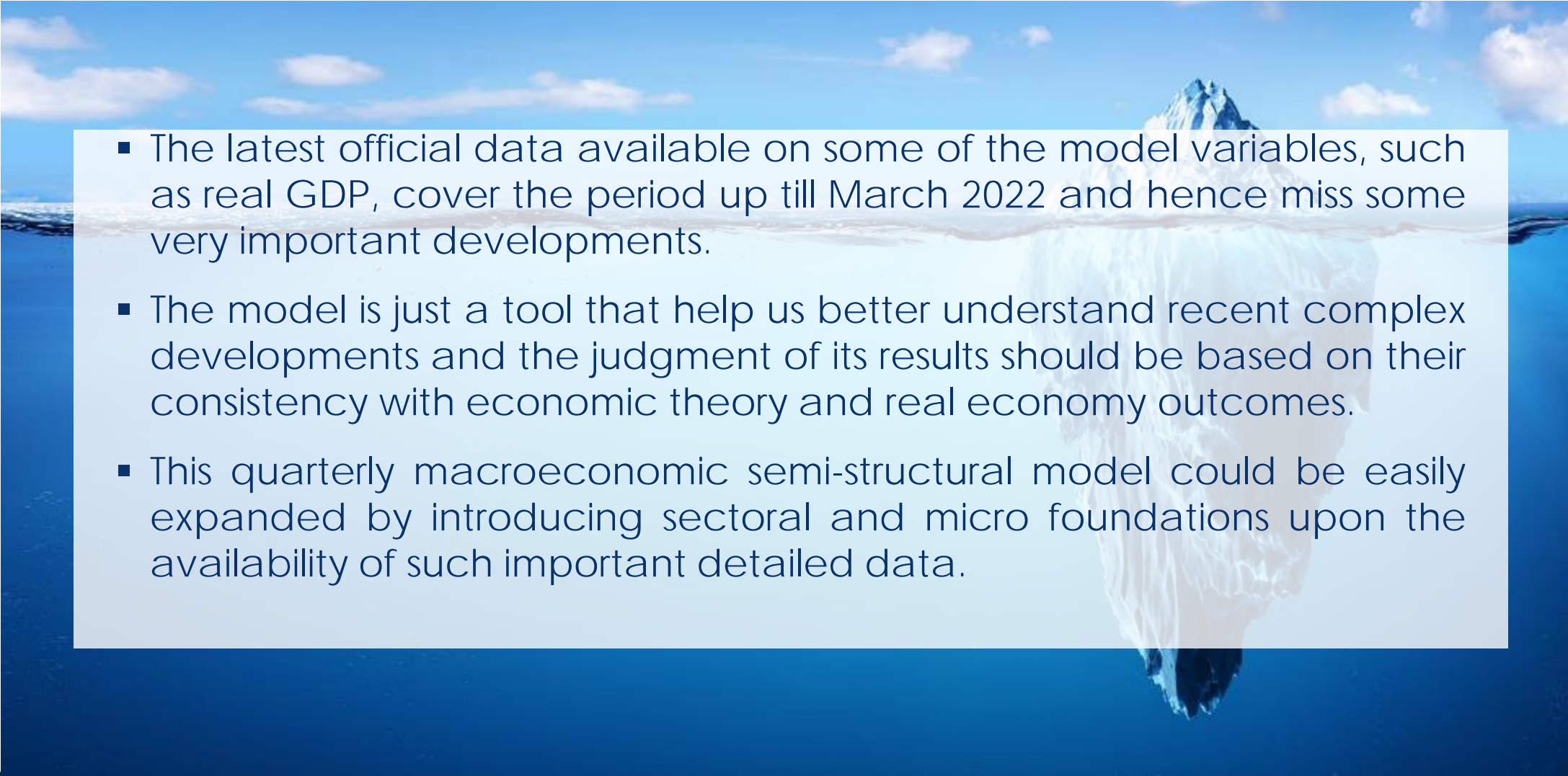
3 Building model equations and calibrating parameter values ..

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```
%% === Aggregate Demand (the IS curve) ===
L_GDP_GAP = b1(0.85)*L_GDP_GAP{-1} - b2(0.05)*MCI + b3(0.175)*L_GDP_RW_GAP + SHK_L_GDP_GAP(σ=0.75);

%-- Real Monetary Conditions Index
MCI = b4(0.7)*RR_GAP + (1-b4(0.7))*(- L_Z_GAP);

%% === Inflation (the Phillips curve) ===
DLA_CPI =  a1(0.5)*DLA_CPI{-1} + (1-a1(0.5))*DLA_CPI{+1} + a2(0.3)*RMC + SHK_DLA_CPI(σ=4);

%-- Real marginal cost
RMC = a3(0.6)*L_GDP_GAP + (1-a3(0.6))*L_Z_GAP;

%- expected inflation
E_DLA_CPI = DLA_CPI{+1};

%% === Monetary policy reaction function (a forward-looking Taylor-type Rule) ===
RS = g1(0.7)*RS{-1} + (1-g1(0.7))*(RSNEUTRAL + g2(0.7)*(D4L_CPI{+4} - D4L_CPI_TAR{+4}) + g3(0.5)*L_GDP_GAP) + SHK_RS(σ=1);

%- Neutral nominal policy interest rate
RSNEUTRAL = RR_BAR + D4L_CPI{+1};

%% === Modified Uncovered Interest Rate Parity (UIP) condition ===
L_S = (1-e1(0.6))*L_S{+1} + e1(0.6)*(L_S{-1} + 2/4*(D4L_CPI_TAR - ss_DLA_CPI_RW(2) + DLA_Z_BAR)) + (- RS + RS_RW + PREM)/4
σ=5);
```

An Overview of the MME Methodology ..

1 Creating model data
(consistency, missing

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using univariate and

3 Building model equat
calibrating paramete

4

5

Solving out the quarterly
macroeconomic model ..

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5 Solving out the quarterly macroeconomic model ..
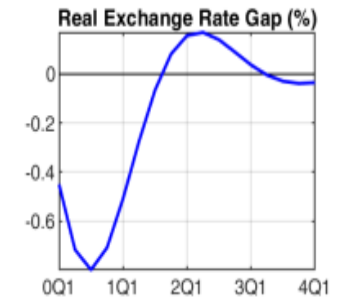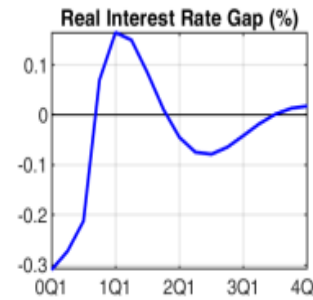
CPI Inflation Year on Year YoY (in % pa)

In-sample and out-of-sample robustness checks
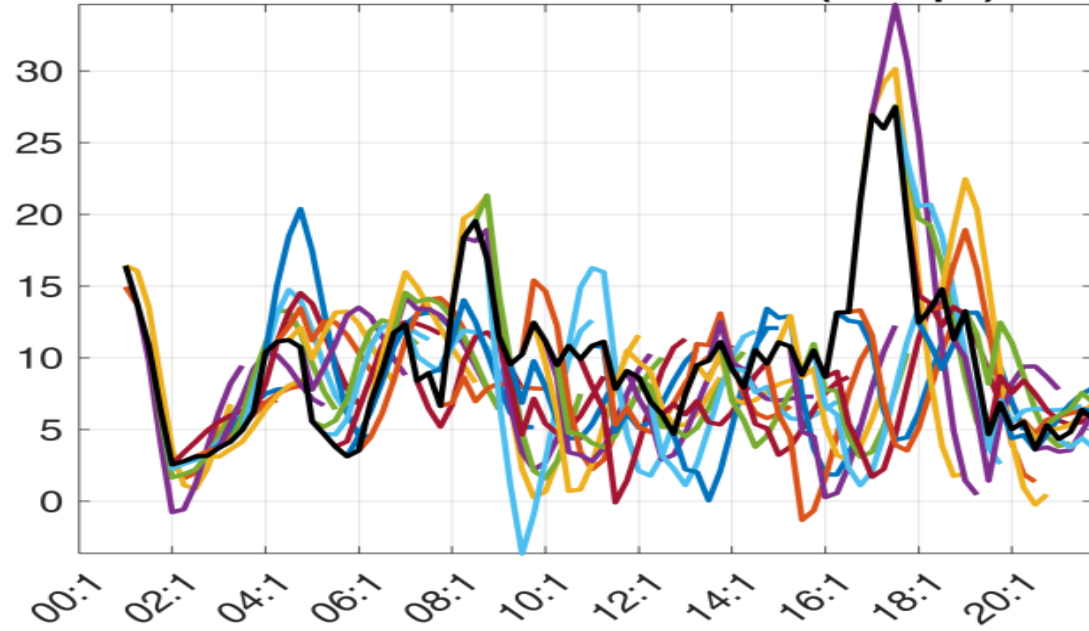
Assumptions and Limitations ..

- The latest official data available on some of the model variables, such as real GDP, cover the period up till March 2022 and hence miss some very important developments.

- The model is just a tool that help us better understand recent complex developments and the judgment of its results should be based on their consistency with economic theory and real economy outcomes.

- This quarterly macroeconomic semi-structural model could be easily expanded by introducing sectoral and micro foundations upon the availability of such important detailed data.

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How Does Monetary Policy Affect the Real Economy?
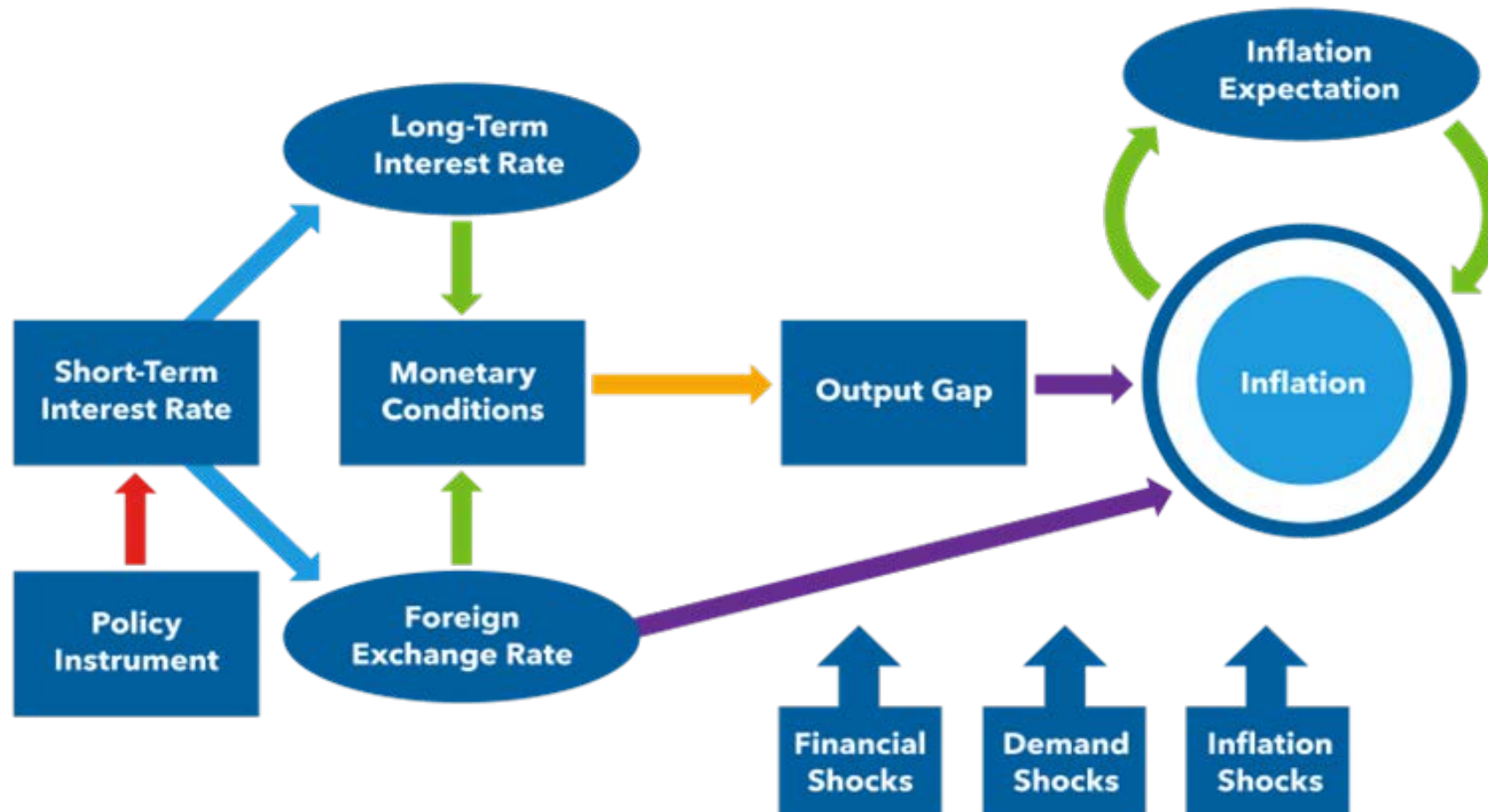
Source: IRIS MATLAB Toolbox, 2021.

What Drives the Recent Surge in Inflation Rate?

- In the past few quarters, there has been a surge in inflation rate that proved to be quite persistent.

- To understand this surge in inflation we need answers to the following:

  - **Is the inflation surge driven by a cost-push?, a demand-pull?, or a blend of the two shocks?**

  - How much of it is due to domestic or/and foreign factors?

  - Is the current inflationary wave a previously seen trend or a start of a whole new structural trend?

CPI Inflation and GDP Growth, (Annual, YoY%)
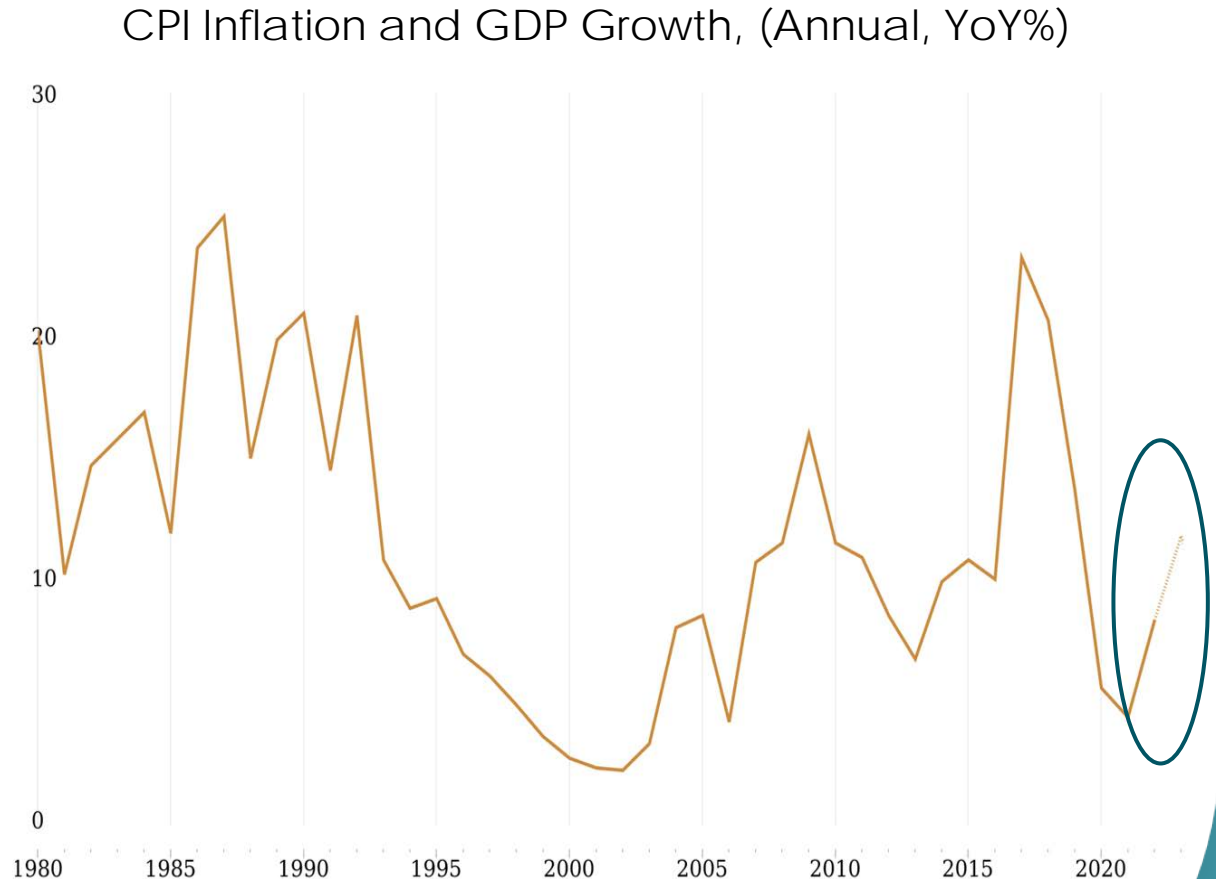
Source: IMF Data Mapper, 2022.
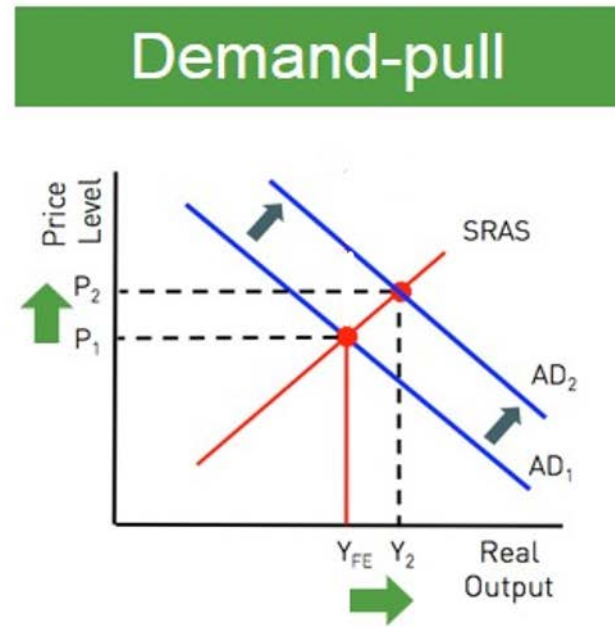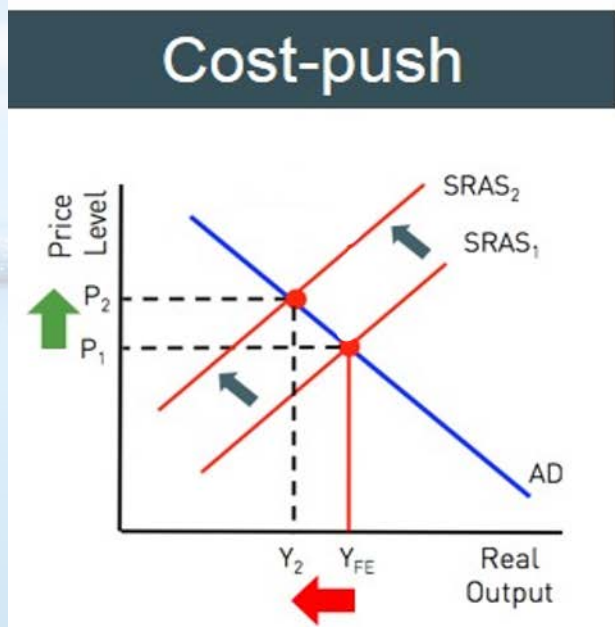
- To distinguish between the types of inflationary shock we follow the direction of inflation and output:

  same direction (demand-pull) vs **opposite direction (cost-push)**

- This is how the MME identifies the nature of the recent inflation shock.

Does It Matter if Cost-Push or Demand-Pull? Yes, It does.

- Cost-push inflation is more difficult to handle as it entails monetary policy tradeoffs (obligatory sacrifice):

- For example, increasing interest rate works well in case of confirmed demand-pull inflation but can cause significant loss in output in case of cost-push inflation (other monetary policy tools may be appropriate).

- Simply, identifying the source of the recent inflation surge is crucial to:

  ➤ Estimate the visible macroeconomic impacts of such a shock.

  ➤ Suggest suitable policy interventions and corrections.

  ➤ Predict the long-term consequences of the policy interventions.

Results of the MME: Detection of the nature of the recent Inflation Shock/s
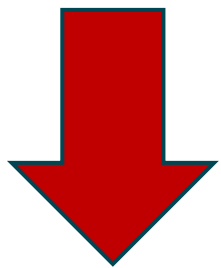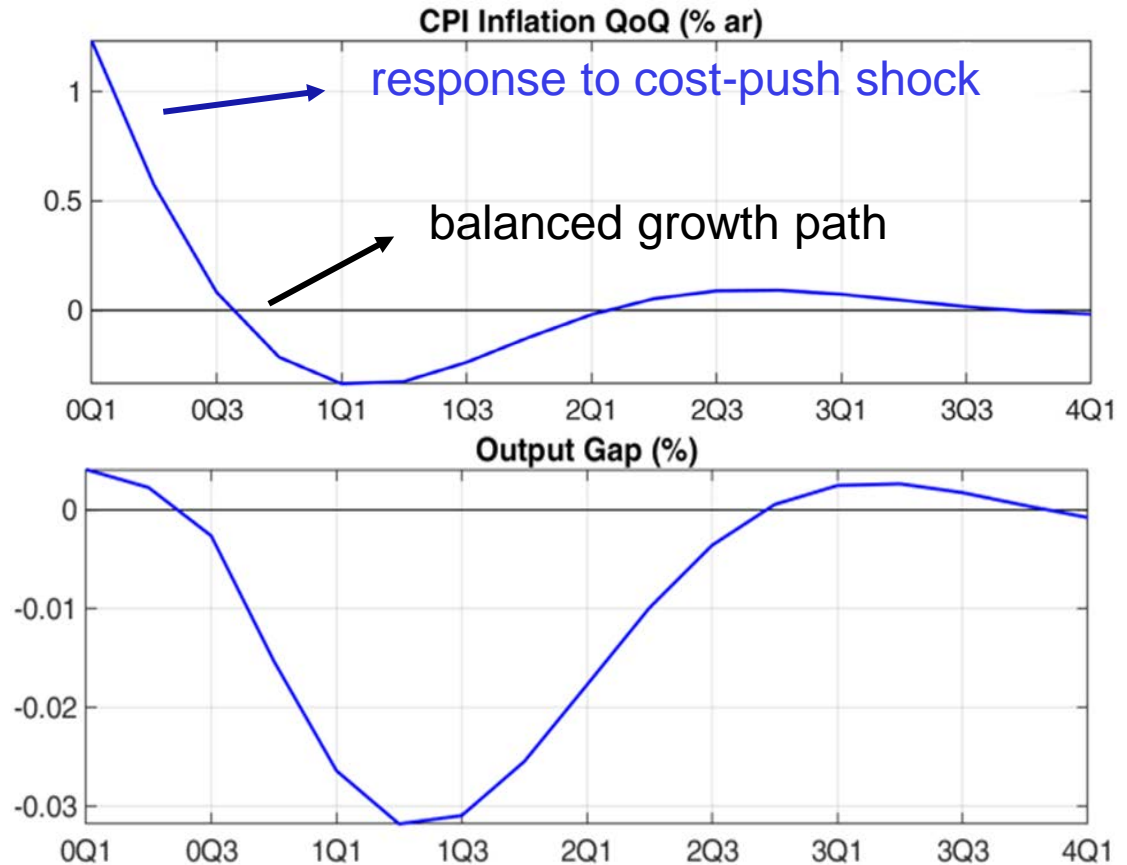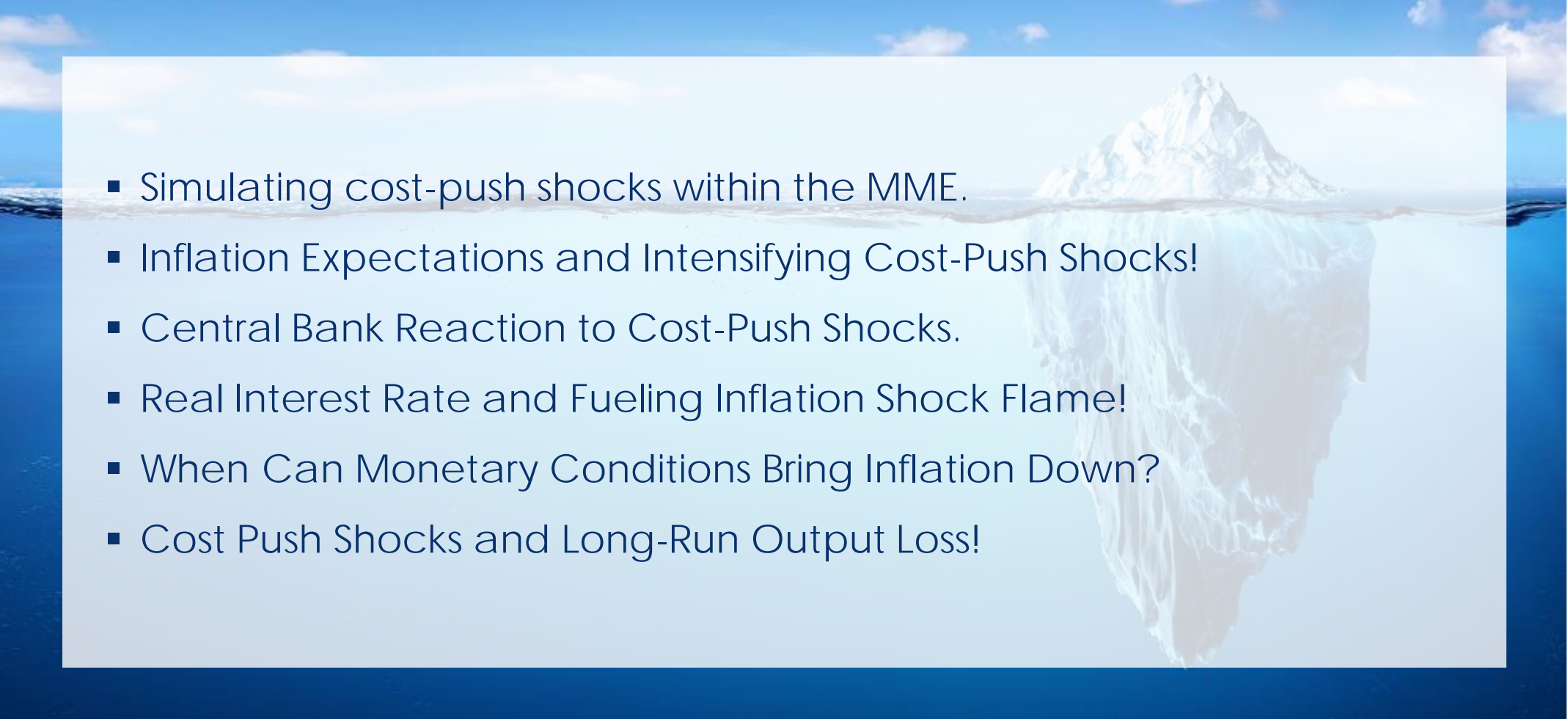
Opening the MME Box: Analyzing Recent Cost-Push Shock under the Lens of the MME ..

- Simulating cost-push shocks within the MME.

- Inflation Expectations and Intensifying Cost-Push Shocks!

- Central Bank Reaction to Cost-Push Shocks.

- Real Interest Rate and Fueling Inflation Shock Flame!

- When Can Monetary Conditions Bring Inflation Down?

- Cost Push Shocks and Long-Run Output Loss!

How Does the Model Function: Analysis of Inflation Equation based on the behavior of economic agents

$$\pi_t = \alpha_0 + \alpha_1 \pi_{t-1} + (1 - \alpha_1) \pi_{t+1} + \alpha_2 rmc_t + \varepsilon_t$$

$$rmc_t = \alpha_3 y_t + (1 - \alpha_3) z_t$$

- Phillips curve summarizes the price setting behavior of different economic agents when they respond to changes in production costs (real marginal cost - RMC).
- The RMC has two components; domestic cost pressures captured by the output gap and foreign pressures approximated by the real exchange rate gap.
- When setting prices some agents are backward-looking (α_1) while others are forward-looking ($1 - \alpha_1$).
- In our exercise, we assumed a 1% shock, so we set epsilon t to 1 in the first quarter of the simulation.
- This shock then stimulate the reaction of the rest of our variables in the system.

How Inflation Expectations by Different Economic Agents Can Intensifying Cost-Push Shocks!

Forward-Looking Agents ..

- The initial jump in inflation is bigger than 1% as $(1-\alpha_1)$ of firms are forward-looking and index their prices to future inflation.

- These firms correctly anticipated a rise in inflation, so they increased their prices without fear of losing competitiveness.

Backward-Looking Agents ..

- Despite that CPS should last one period, inflation remains high for three quarters.

- This is because the backward-looking firms (α_1) that index their prices to past inflation experience (inertia).
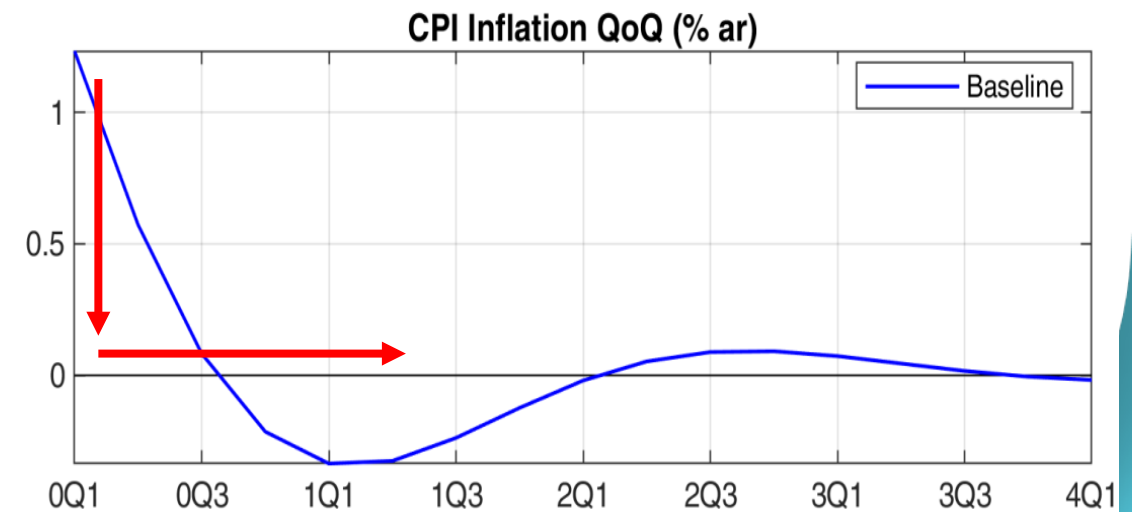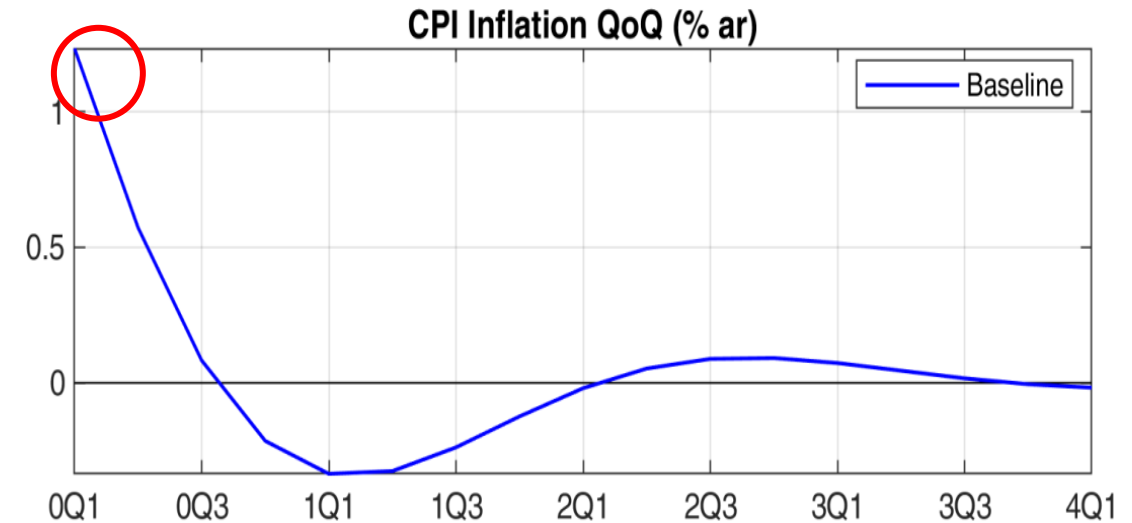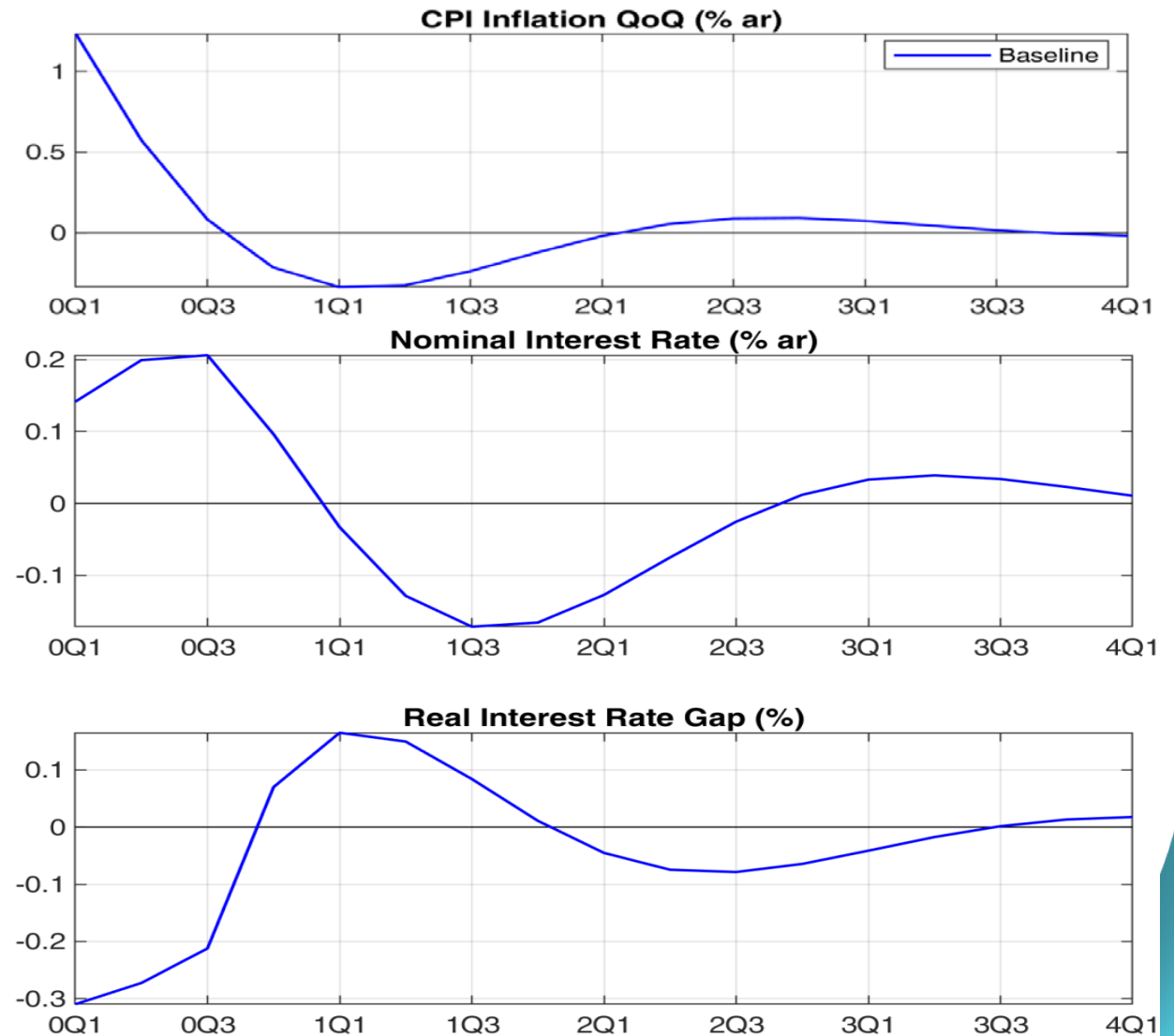
Typical Reaction of Central Bank of Egypt to Inflation Shock

- The results of our MME show that **on average**:
- CBE increases interest rate above the neutral level to contain higher inflation rate due to CPS.
- CBE, not to disrupt market, prefers incremental rather than abrupt changes in policy rate.


CPI Inflation QoQ (% ar)

Nominal Interest Rate (% ar)
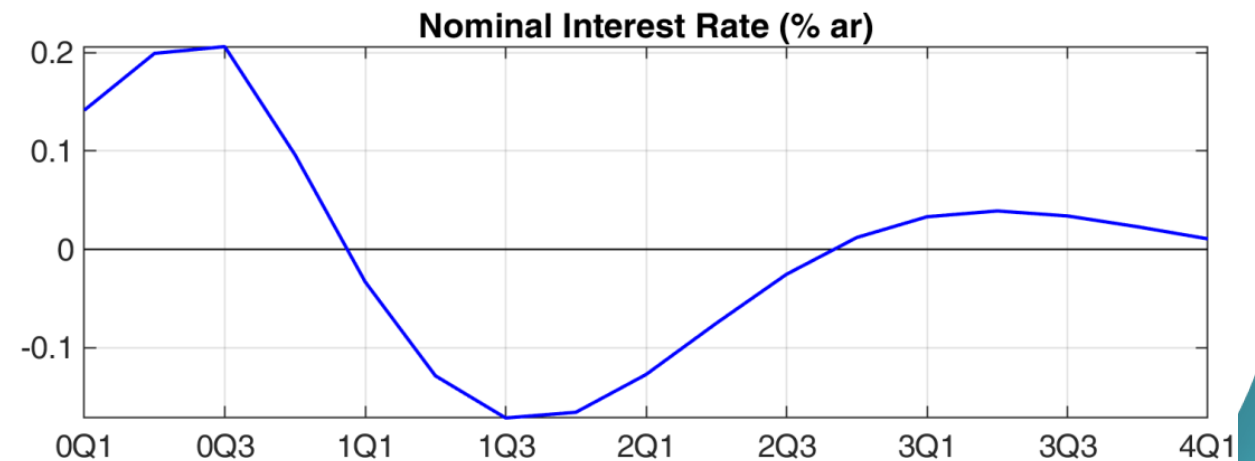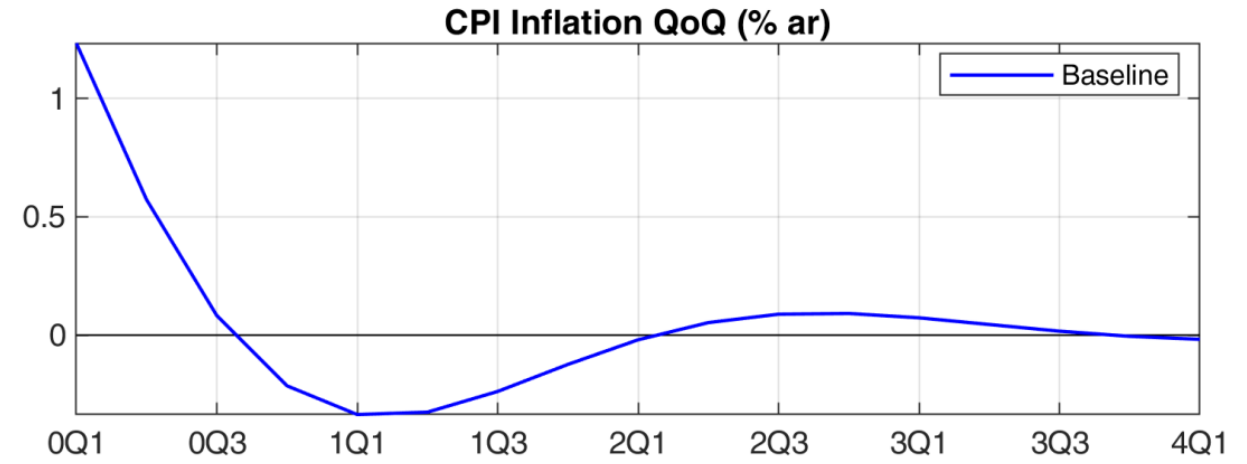
Central Bank Policy Interventions and Fueling Inflation Flame Due to Resulting Trend of Real Interest Rate

- The CBE gradually adjusts interest rate, while, the increase in actual and expected inflation happens immediately after the shock.

- The combined effect of these two forces is that the real interest rate (RIR) is expansionary (as RIR is negative in the first few quarters).

- And thus fuel inflationary pressures at least in the short run ..

- By rising nominal rate, demand for EGP-dominated assets rises, and exchange rate appreciates.

- After a year from the shock, nominal exchange rate will go through a period of depreciation.

- The combined effect of nominal exchange rate appreciation and higher inflation is negative real exchange rate gap indicating an overvalued EGP.

- Both higher interest rate and real exchange appreciation signal tighter monetary conditions.

Nominal Interest Rate (% ar)

Nominal ER Depreciation QoQ (% ar)

Real Exchange Rate Gap (%)
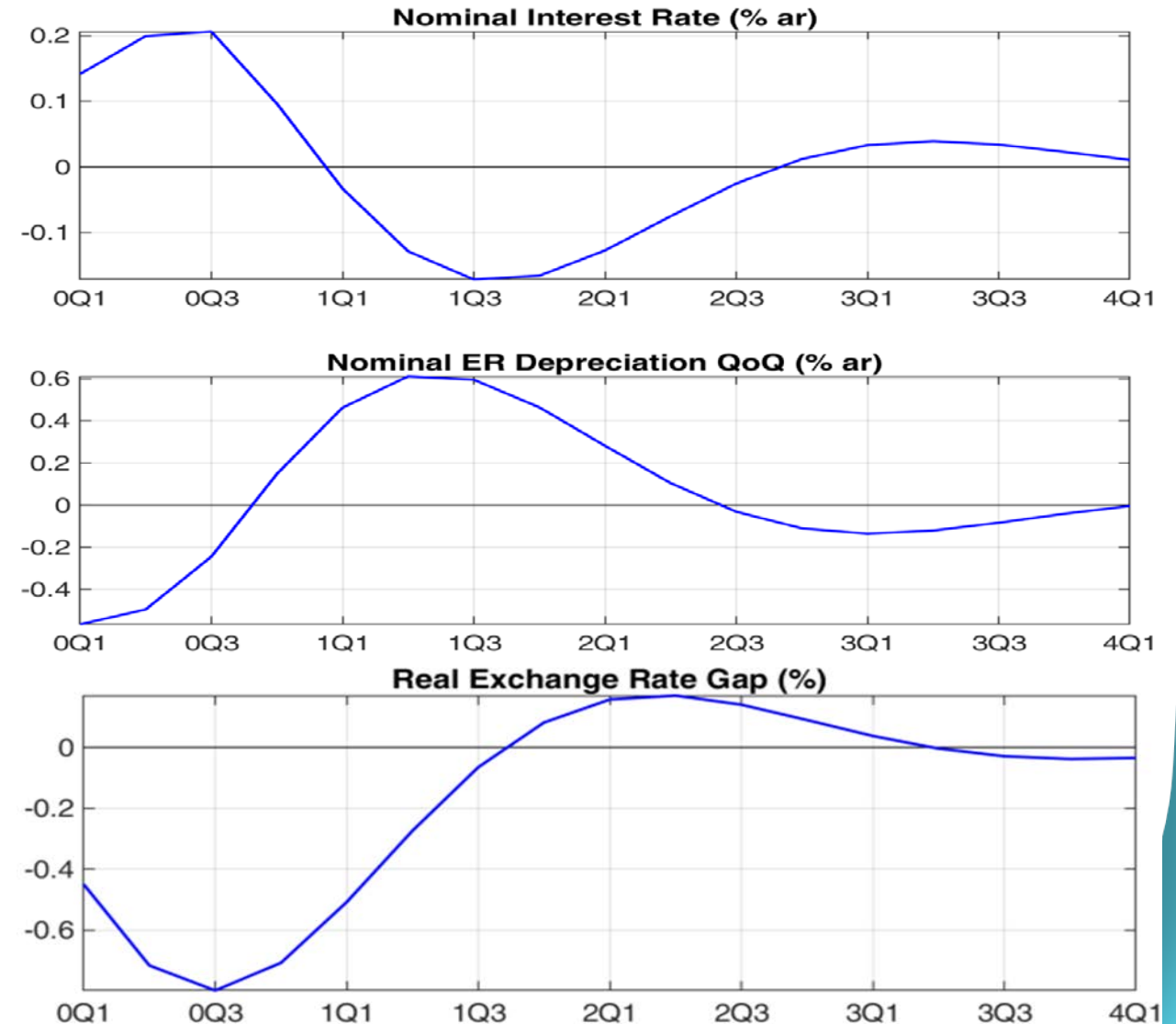
Cost-Push Shocks and Short-Run Output Loss!

- Higher interest rate reduce demand for domestic goods while real exchange rate appreciation, reduce foreign demand.

- The reduction in demand leads to a negative output gap.

- The negative output gap implies lower cost pressures for producers, that bring inflation down.

Real Monetary Condition Index (%)
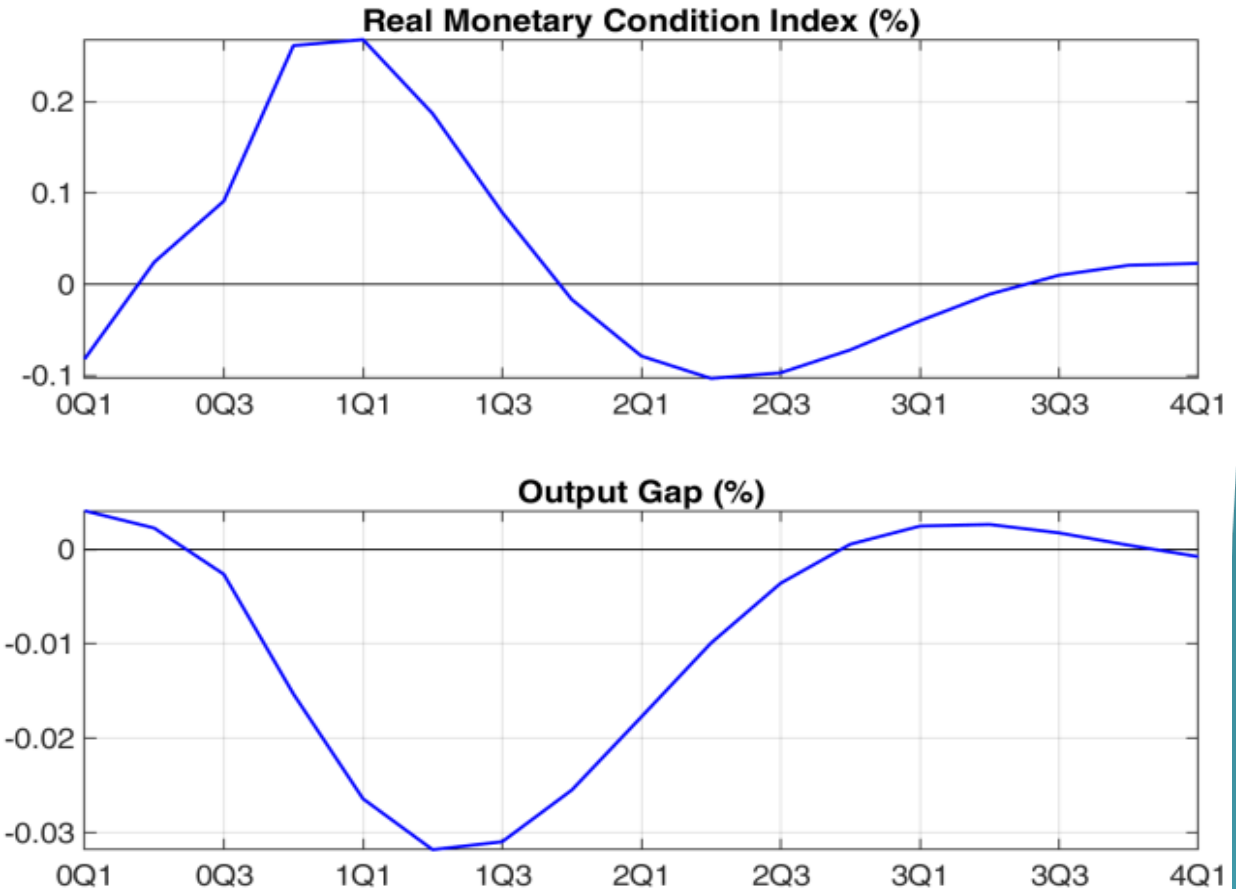
Output Gap (%)

Cost-Push Shocks Lead not only to Short-Run Output Losses but also it Can Persist in the Long-Run!
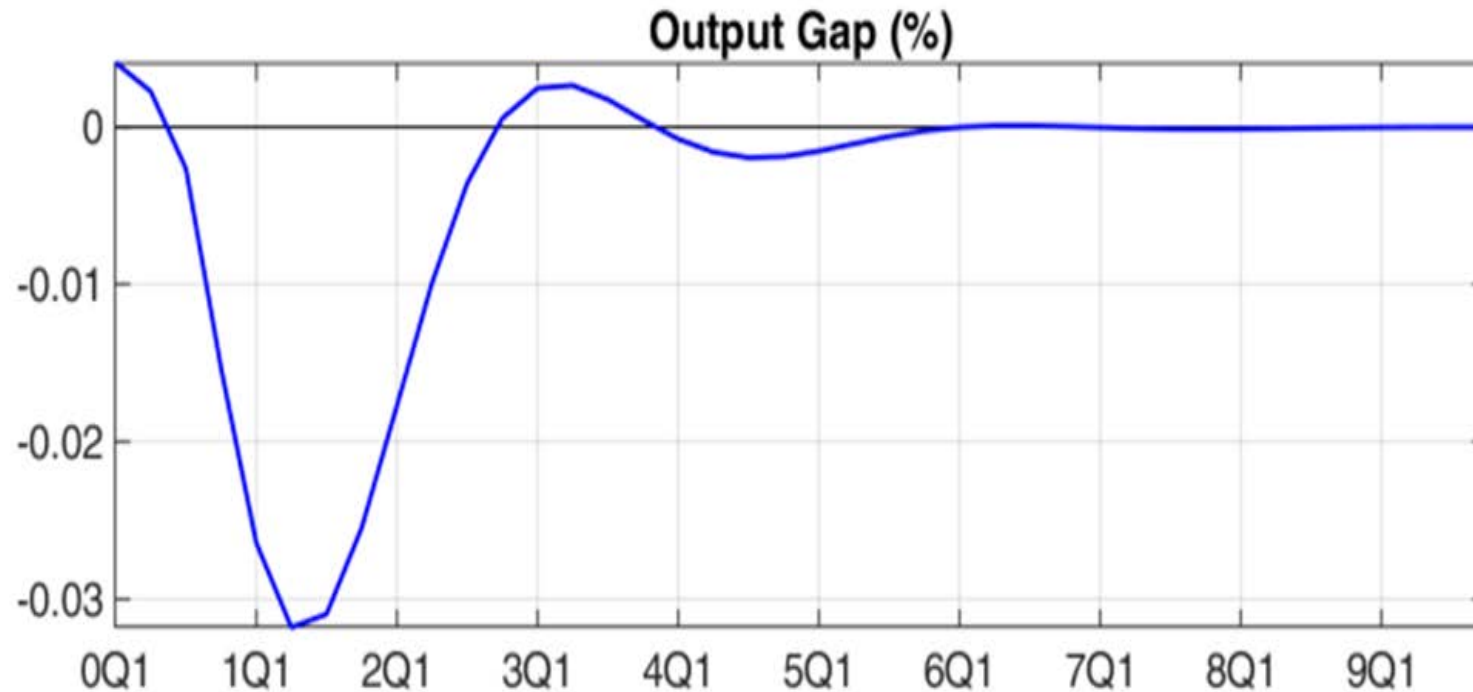
Output Gap (%)

In the long run, all real variables return to their trend values, except for output gap which settles at a weaker level than under the "no-shock" scenario.

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Observed New Trends: Changing Monetary Tradeoffs!

- Flat Phillips curve is no more valid to describe monetary policy tradeoffs, i.e. slack has a little effect on inflation).

- Phillips curve is now much steeper meaning higher inflation cost.

- The reliability of MP strategies, e.g., running the economy hot, needs to be revisited.

Phillips Curve Before & After Covid-19
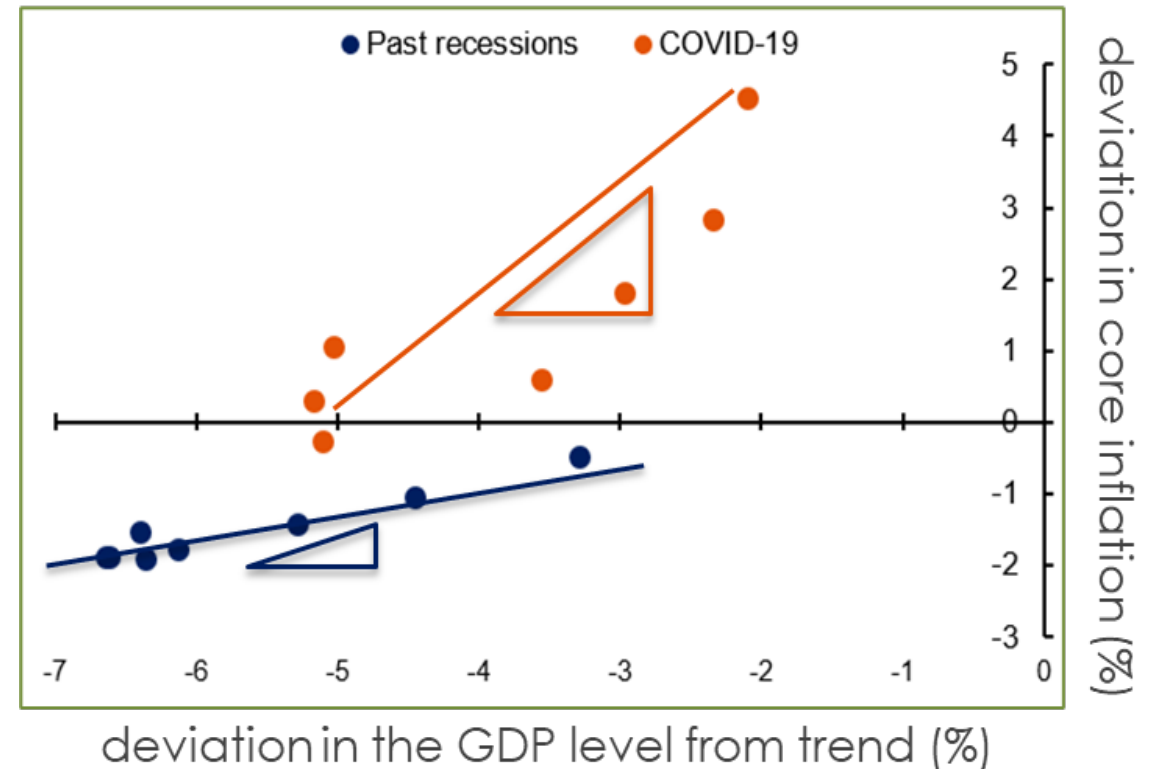
Source: Gudmundsson and Others, forthcoming.

Expectations Anchoring in High Inflation Episodes!

Source: Ragab, 2021.

Source: Brando-Marques and Others, forthcoming.

Under Cost-Push Inflation Shock, the Potential Danger of Increasing Interest Rate When not Needed!

Higher uncertainty and the preference shift for precautionary savings and safe assets (-)

Increased urgency to finance the high investment needs of climate change agenda (+)

Hawkish monetary policy in the US and other advanced economies (+)

Pandemic- and war-driven increase in public debt to finance basic goods (+)

Exchange rate fluctuations, stronger dollar and higher energy prices (+)
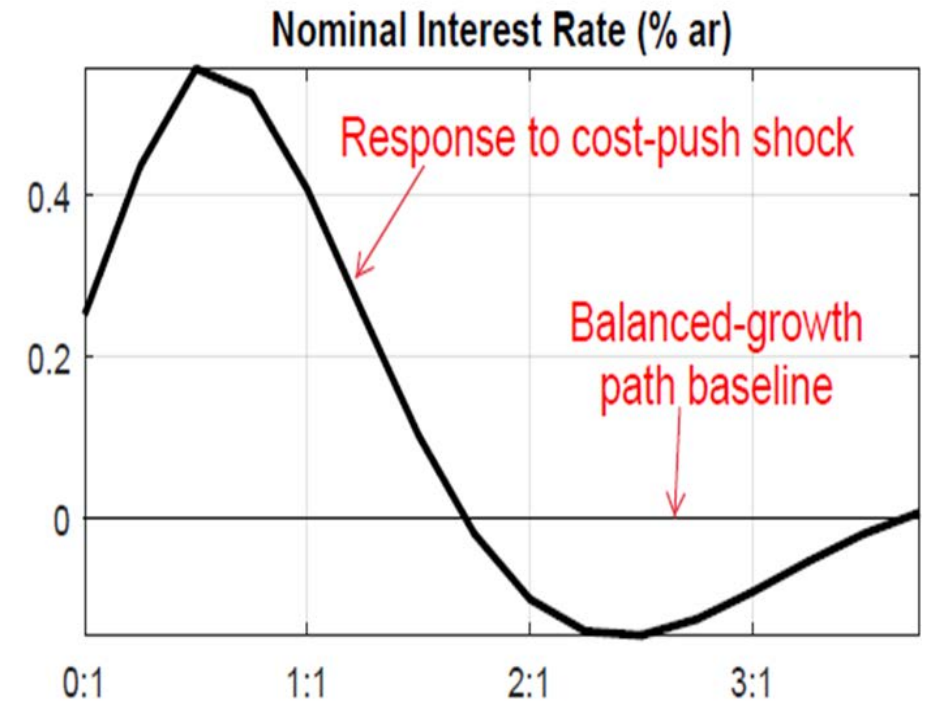
Suggested Policy Options and the Way Forward!

- Increasing interest rate may only be helpful in absorbing some of the inflationary pressures resulting from the early demand-pull shocks.

- In case of the current cost-push inflation, increasing interest rate may actually do more harm than good due to its potential (persistent) effect on output losses with difficulty to get it back in this complex setting.

- There is an urgent need to use other tools of monetary policy to achieve inflation target with minimum harm to key macroeconomic variables, particularly savings and investments.

- A coordinated and targeted monetary and fiscal measures is a must to increase production and employment and hence resulting in a natural deacceleration in inflation and a healthy stronger pound.

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- **Appendix.**

Understanding MME Responses to Shocks

- In our MME, many variables are not constant, even in the steady state, e.g., the growth rate of the price level is given by the inflation target.

- Even without any unexpected shocks, variables are following a balanced growth path (BGP).

- We need to disentangle the response of model variables to shocks than that of the BGP that would have happened anyway.

- Our IRF are then treated as deviations from the balanced growth path.

Source: An example.

Thank You