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# CZECH REPUBLIC

## SELECTED ISSUES

June 2017

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INTERNATIONAL MONETARY FUND

# CZECH REPUBLIC

## SELECTED ISSUES

June 6, 2017

Approved By
**European Department**

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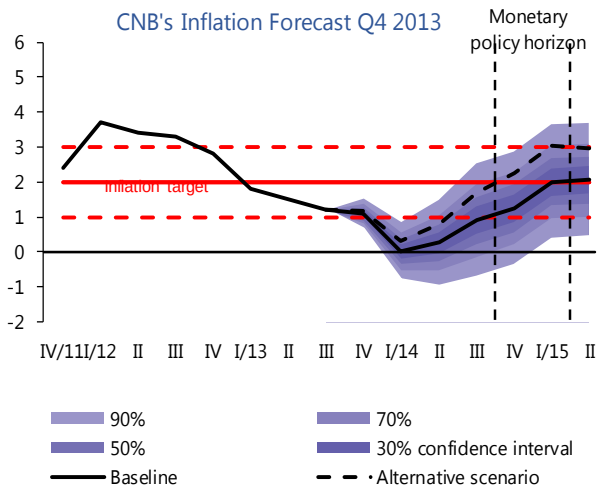
# MONETARY POLICY AFTER THE EXCHANGE RATE FLOOR EXIT

*The koruna:euro exchange floor that had been in place for more than three years was removed in the beginning of Q2:2017. Exit poses a number of challenging policy questions, including on the optimal monetary policy in its aftermath. Large uncertainty surrounding the reaction of real economy to the change in exchange rate regime makes the standard monetary policy trade-off more complex. Given the large uncertainty, the objective should be to design a policy response that minimizes potential policy errors. This paper studies policy responses and possible errors under a set of plausible macroeconomic scenarios. The scenarios are calibrated to vary the economy's response to the removal of the floor. The simulations indicate that a monetary policy response that is ex post too loose (a type I policy error) is likely to be less costly than a monetary policy response that is ex post too tight (a type II policy error). This suggests that a gradual approach to interest rate increases could be preferable.*

## A. Background

### *Why was the FX floor introduced?*

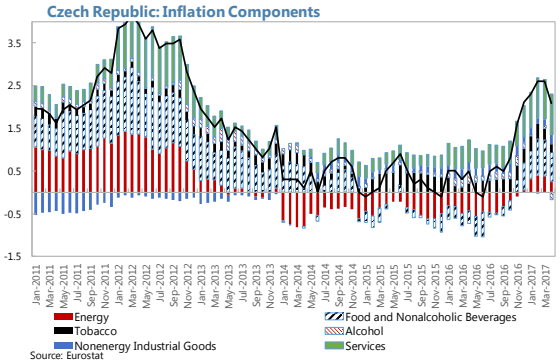
**1.** On November 7, 2013, the CNB started using the exchange rate as an additional instrument for easing monetary conditions, amid mounting disinflationary pressures, and announced a floor of 27 koruna to the euro. The currency remained above that level until July 2015 without any interventions (except the first few days after the announcement). Since July 2015, appreciation pressures on the koruna necessitated intervention in the FX market. Capital inflows accelerated in the run-up to the exit and amounted to 8 percent of GDP per month in January-March 2017, bringing the stock of foreign exchange reserves to 70 percent of GDP.

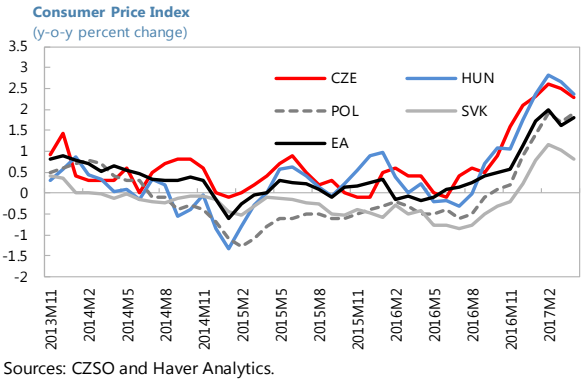



### *Has the floor been successful in its objectives?*

**2.** The exchange rate floor has been effective in mitigating effects of the disinflationary shock[1]. Domestic inflation (adjusted for food, fuel, and indirect taxes) remained around 1 percent. Wage agreements and inflation expectations did not show evidence of large second-round effects. Since the beginning of this year, headline and core inflation have exceeded the target.

[1] Caselli, F. "Did the Exchange Rate Floor Prevent Deflation in the Czech Republic?", IMF Working Paper forthcoming; Franta, M. et al. (2014), "The Exchange Rate as an Instrument at Zero Interest Rates: The Case of the Czech Republic." Research and Policy Notes 2014/03, Czech National Bank.

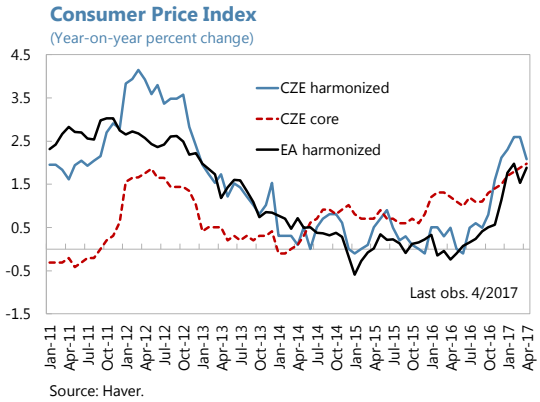


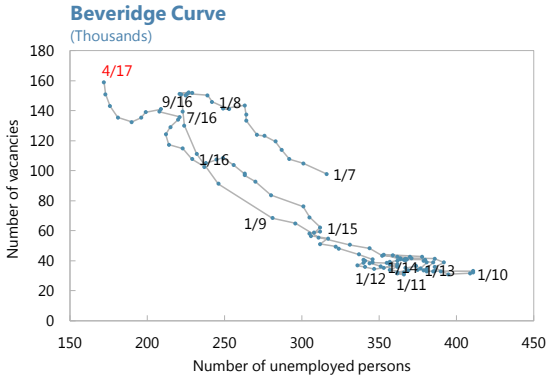




Sources: CZSO and Haver Analytics.

***Was the time right for removing the FX floor?***

**3. The macroeconomic conditions to leave the floor have been met**. Inflation is at the target, external deflationary pressures have faded, and the real exchange rate is somewhat below equilibrium, even with increasing domestic price levels.[2] In addition, production is running above capacity, labor markets are tight, and credit growth is high.




**4. The CNB ended the exchange rate commitment in April 2017.** The decision was widely expected, although the exact timing was uncertain. Financial market reaction so far has been muted. The koruna appreciated by 1½ percent on the day. The decision means the CNB resumes using repo tenders as its main instrument to pursue its 2 percent inflation target. The policy rate remains unchanged at 0.05 percent.

## B. Policy Objectives and Uncertainty

***What should the monetary policy do now?***

**5. Adjustment to leaving the floor is complex.** Many factors affect the direction and extent of exchange rate movement and its impact on inflation and output. The degree of exchange rate

[2] See Annex 1, Assessment of External Balances, Competitiveness and the Exchange Rate, Staff Report, pp. 42-45.

pass-through to the tradable sector will depend on the flexibility of price adjustments and exposure of Czech companies to foreign competition. The currency denomination of import and export contracts and the degree of price competition will also affect the adjustment of intermediate goods prices. Additionally, lower-than-expected inflation in the rest of the world could dampen imported inflation.

**6. Monetary policymakers are facing elevated uncertainty in their decisions**. Similar to other inflation targeting central banks, the CNB faces a tradeoff between minimizing the deviations of inflation from the target and reducing output gap volatility. The aftermath of the FX floor exit presents a more complex environment than usual. In designing its monetary policy response, the CNB has to make assumptions on a number of key parameters that are subject to large uncertainty, including the degree of direct exchange rate pass-through, the strength of cost-push effects on domestic inflation, and the long-run trend appreciation of the exchange rate.

## C. Model and Benchmark Scenario

**7. A small open economy model is calibrated for the Czech Republic.** This paper analyzes policy responses and possible errors with an aid of a small open economy "gap" model, calibrated to the Czech Republic, that facilitates testing the sensitivity of stylized simulations to the key parameters mentioned above. Aggregate demand is partially forward looking, and depends on the real interest rate, real exchange rate, and foreign demand. Headline inflation has three components: domestic inflation (non-tradable goods and services/ or core), imported (tradables) inflation, and regulated prices. Domestic inflation responds to the output gap and real exchange rate gap in a partially forward looking Philips curve equation. Imported inflation depends on changes in the nominal effective exchange rate and foreign inflation, and regulated price growth is given exogenously. An uncovered interest rate parity condition (modified with a lag term in addition to the lead) determines the dynamics of the exchange rate. A standard Taylor-type monetary policy rule equation closes the model (see Annex 1 for details).

**8. The model is specified to examine three channels of exchange rate pass-through separately**. Exchange rate appreciation reduces headline inflation directly via its imported component; this direct channel is reflected in the imported inflation equation (Annex 1, equation 3, parameter $a_7$). A stronger exchange rate will also put downward pressure on prices of intermediate goods (and wages); this channel is modeled via the impact of the exchange rate gap on domestic inflation (equation 2, parameter $a_5$). Worsening competitiveness will reduce the positive output gap and inflation; the third channel is modeled via the impact of the exchange rate gap on aggregate demand (equation 1, parameter $b_{42}$).

**9. A loss function is used to compare policy responses.** A standard loss function is used, defined as follows: $Loss = \sum_{t=1}^{N}\{\theta_\pi(\pi_t - \pi^*)^2 + \theta_y(y_t\text{-}\bar{y})^2\}$, where the first squared term in

parentheses is the inflation gap and the second the output gap. Losses are calculated under three sets of inflation versus output gap preferences.

**10. A benchmark scenario with the standard monetary policy rule shows a steep increase in the interest rate path (Figure 1).** Under this scenario, a positive output gap and headline inflation above the target cause policy rates to be increased through the second and third quarters by about 100 basis points. Catch-up with the long-term RER trend appreciation and the interest rate differential result in a significant exchange rate appreciation and overshooting in the short term. As a result, imported inflation turns negative by the end of the year. Higher interest rates and stronger real exchange rates lead to correction of the output gap; GDP growth declines in 2018. The negative output gap, together with downward cost pressures from the exchange rate appreciation, drag down domestic inflation. Headline inflation undershoots the lower limit of the inflation target band. Interest rates stay virtually flat for the next year before rising again in the medium term.

## D. Alternative Scenarios

***What if the degree of direct pass-through is higher?***

**11. Interest rates should increase by less if the direct exchange rate pass-through is higher** (or if the share of tradables in the CPI basket is larger). It is not unreasonable to assume that the degree of pass-through can be higher or more extensive, e.g. in the extreme case applying to all tradable goods. This assumption is consistent with the Czech Republic being very open to foreign competition and being a price taker on most markets. Under this scenario, imported inflation declines more sharply; consequently, headline inflation falls by more and policy rates increases are smaller than in the first scenario (Figure 2).

***…or the cost-push impact is stronger?***

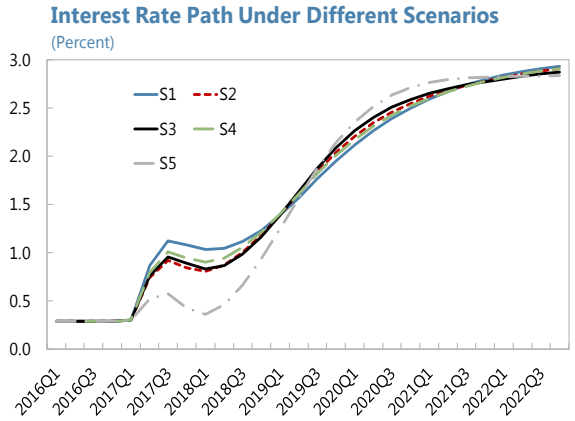
**12. Similarly, the interest rate increase will be smaller if the cost-push effect is stronger.** This could be the case if, for instance, most intermediate goods and services contracts are priced in euros**,** or are sufficiently flexible to renegotiate. Wages could be affected by more than would normally be expected, given the integration of the Czech companies in global supply chains and the importance of comparative dynamics of German manufacturing wages. This would lead to a sharper decline in domestic inflation and a more subdued policy rate response (Figure 3).

***…or the trend RER appreciation is larger?***

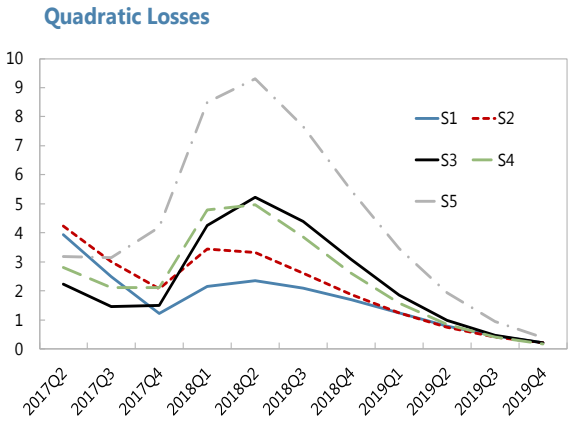
**13. Stronger exchange rate overshooting (caused by higher trend RER appreciation) implies smaller interest rate increases.** The first scenario assumes real exchange rate appreciation of 0.4 percent per year in the steady state. The CNB estimates structural RER appreciation at 1 to 1.5 percent a year. Figure 4 shows the projections of key variables if the assumption of trend RER appreciation is increased to 1 percent.

**14. The projected interest rate path is sensitive to small changes in parameters.** The simulations show that, within the reasonable range of assumptions of the pass-through coefficients

and trend exchange rate path, policy response can vary significantly, ranging from 0 to 100 basis points in one year's time. A shock that combines all three shocks would result in the interest rate hike delayed by a one year. (Figure 5).




Source: IMF staff projection.




Source: IMF staff projections.

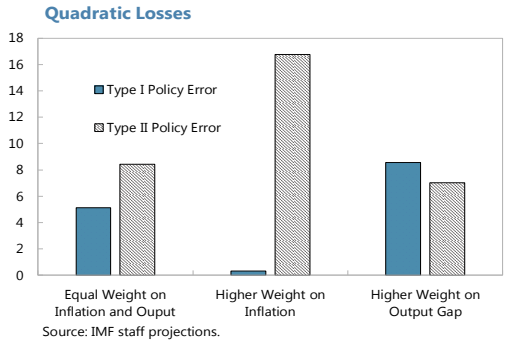
## E. Minimizing Policy Errors

***What if the central bank acts under the benchmark assumptions when the reality is a combined shock scenario?***

**15. Hiking rates too quickly risks stalling the recovery**. Scenario 6 is designed to assess the consequences of monetary policy that is ex post too tight. This is a type II policy error—that is, the central bank mistakenly acts assuming the economy will behave as in the benchmark scenario, when in fact exchange rate appreciation and pass-through are stronger. In practice, Scenario 6 is implemented by applying the path for the policy interest rate implied by Scenario 1 to a world in which the parameters are those from Scenario 5. Figure 6 shows the paths of the key variables. A steep interest rate hike and exchange rate overshooting result in a negative output gap. Headline inflation falls to -1 percent.

***What if the central bank acts under the combined shock scenario assumptions when the true state is the benchmark scenario?***

**16. Raising interest rates too slowly will result in inflation overshooting**. Scenario 7 is designed to assess the consequences of monetary policy that ex post is too loose. This is a type I policy error—that is the central bank mistakenly accepts the null hypothesis of higher direct and cost-push pass-through and stronger trend RER appreciation when in fact facing the benchmark scenario. Scenario 7 is implemented by applying the path for the policy interest rate implied by




Source: IMF staff projections.

Scenario 5 to a world in which the parameters are those from Scenario 1. Figure 7 shows the paths of the key variables. Delayed interest rate increases lead to the inflation and output gaps overshooting.

**17. The welfare costs of ex post too tight monetary policy error are smaller.** The difference between the losses under Scenario 7 (ex-post too loose monetary policy) and Scenario 1 are smaller than the difference between the losses under Scenarios 6 (ex-post too tight monetary policy) and Scenario 5 if the policy makers put more or equal weight on inflation deviations from the target and output gap volatility. The reverse holds when there is more weight on output gap volatility—in this case, the policy that risks being too loose is penalized by an output gap that is already positive at the start of the projection period.

| Interest Rate | Baseline Macro | Higher ER Pass-Through and Stronger Appreciation |
|---|---|---|
| Hike Quickly | Scenario 1 | Scenario 6<br>Policy Ex-Post Too Tight |
| Raise Gradually | Scenario 7<br>Policy Ex-Post Too Loose | Scenario 5 (and 2, 3, 4) |

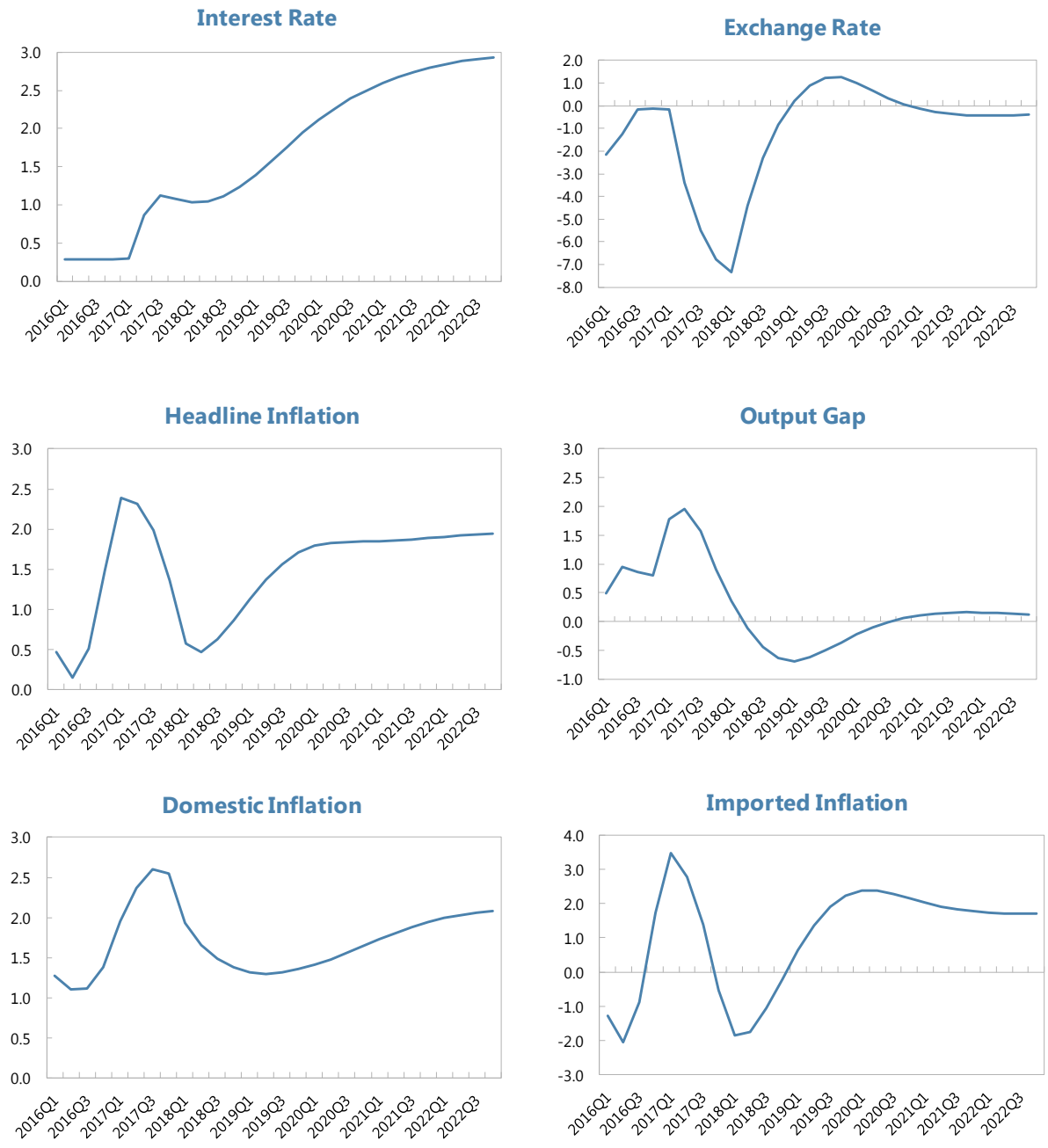
## F. Conclusion

**18. The optimal interest rate path depends on assumptions that are subject to uncertainty**. In particular, it is possible that the exchange rate could appreciate more quickly than anticipated in the baseline, that its pass-through to headline inflation could be more extensive, and that domestic prices might have to adjust by more than anticipated.

**19. Costs of policy errors are asymmetric.** If equal or more weight is put on achieving the inflation objective that to narrowing the output gap, it would be less costly to face higher-than-expected inflation with interest rates that are too lenient ex post than to face a worsening economy with interest rates already at the zero bound.

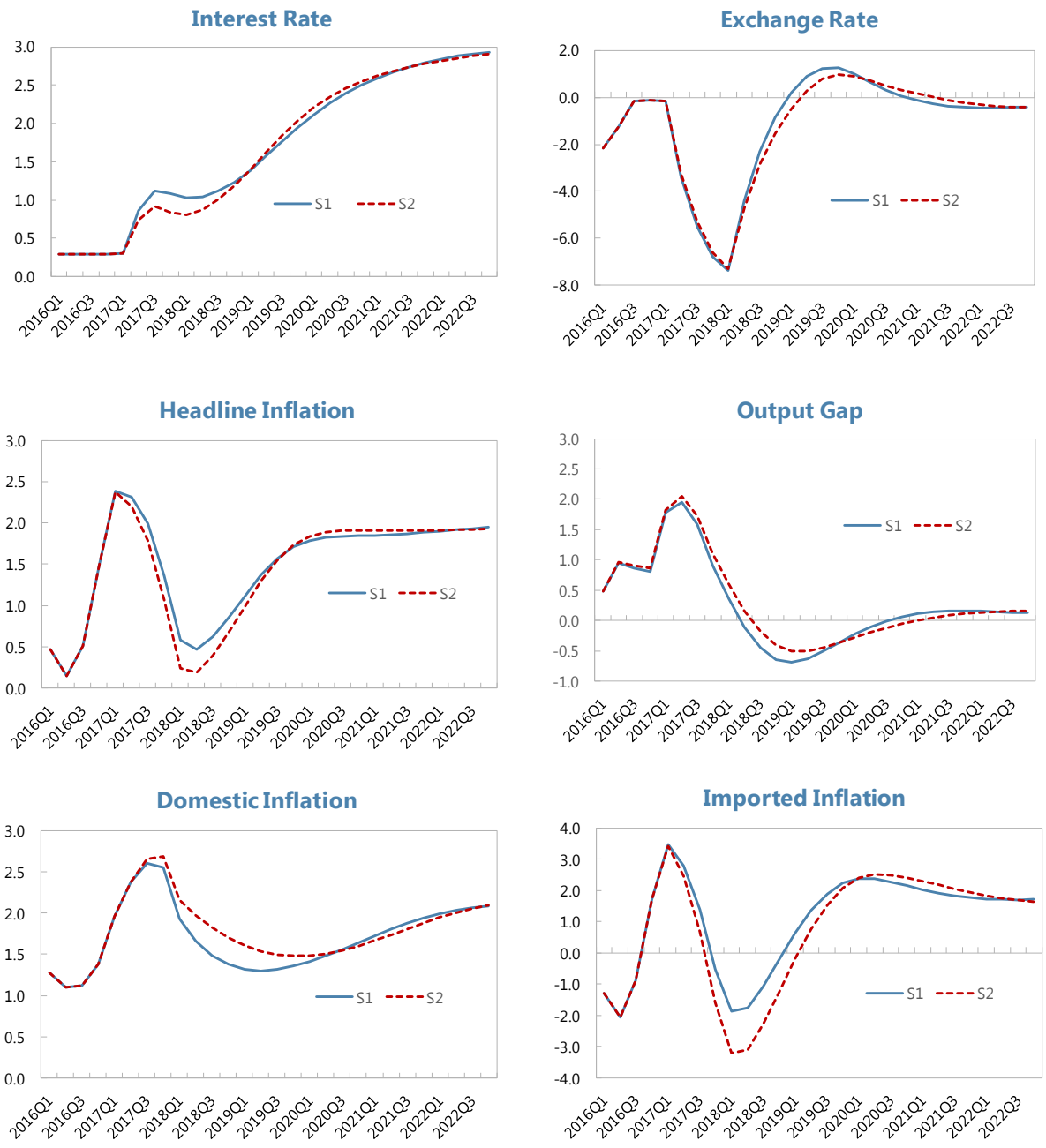
**20. A gradual approach to raising interest rates minimizes the costs under different preferences.** Simulations show that ex-post too loose monetary policy (a Type I policy error) is likely to be less costly than ex-post too tight monetary policy (a Type II policy error). The policy implication is that, to minimize potential policy mistakes, a gradual approach to interest rate increases is preferable.

## Figure 1. Czech Republic: Benchmark Scenario



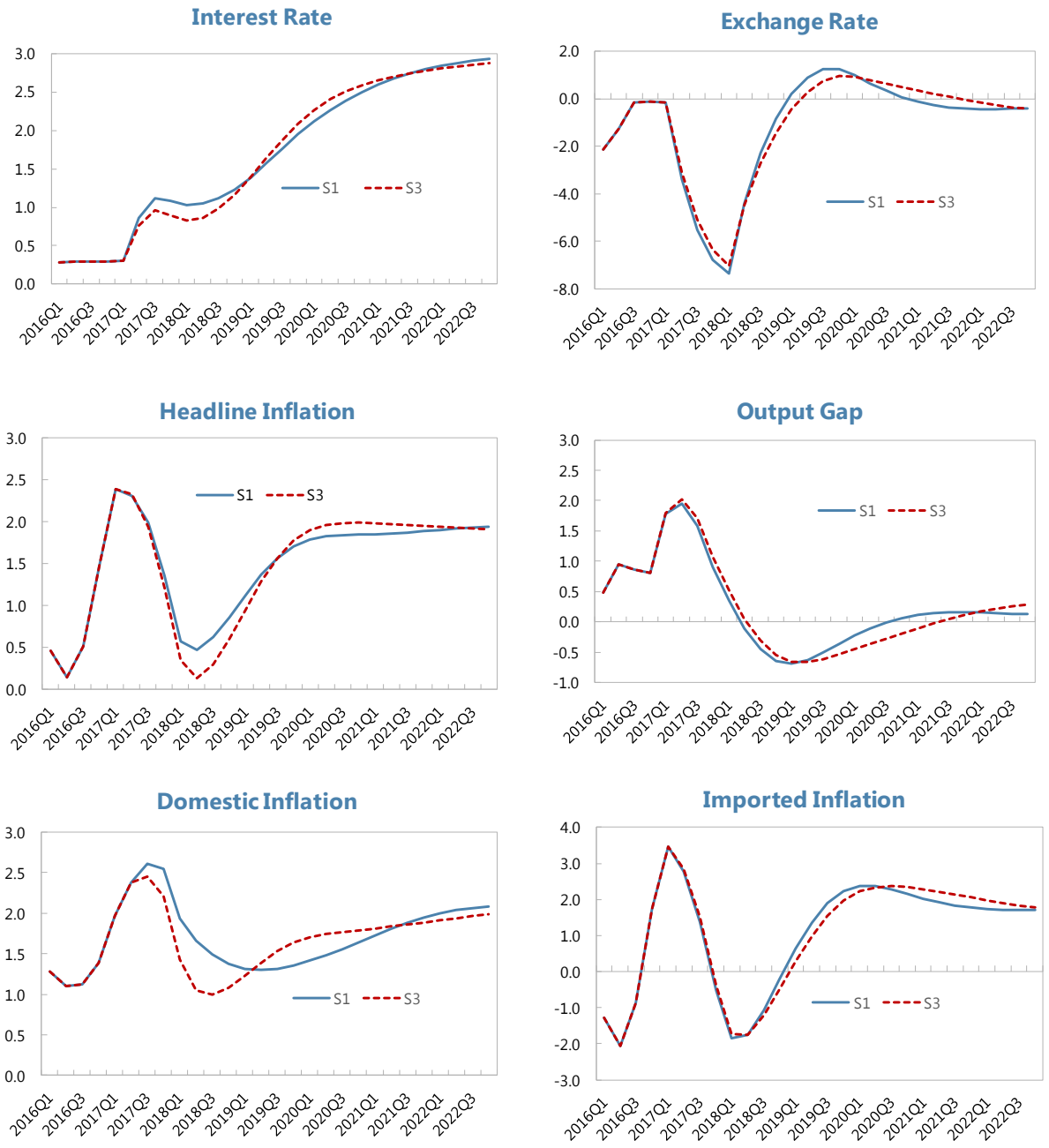

Source: IMF staff estimates.

## Figure 2. Czech Republic: Higher Direct Pass-Through



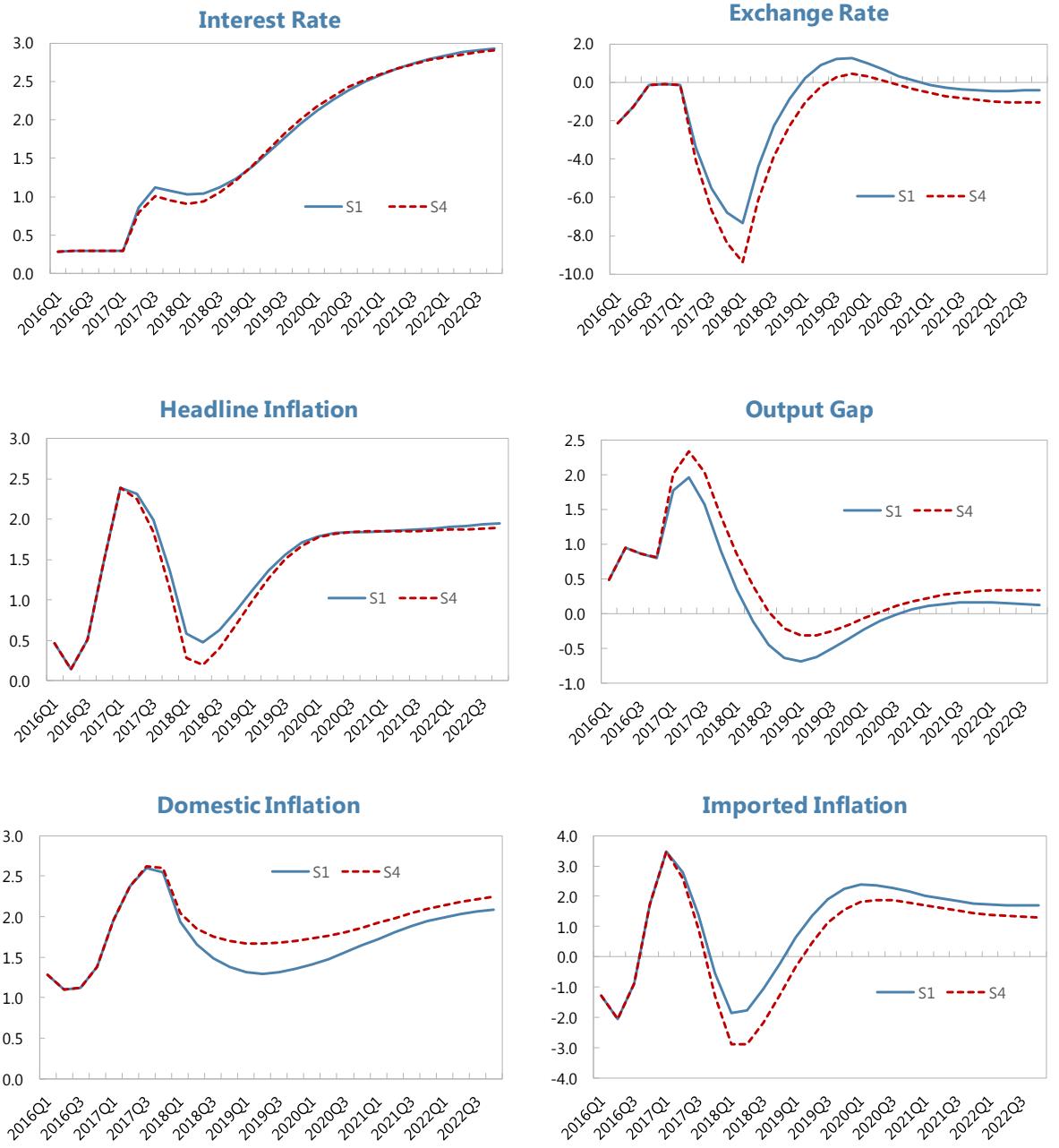

Source: IMF staff estimates.

## Figure 3. Czech Republic: Stronger Cost-Push (Pull) Effect



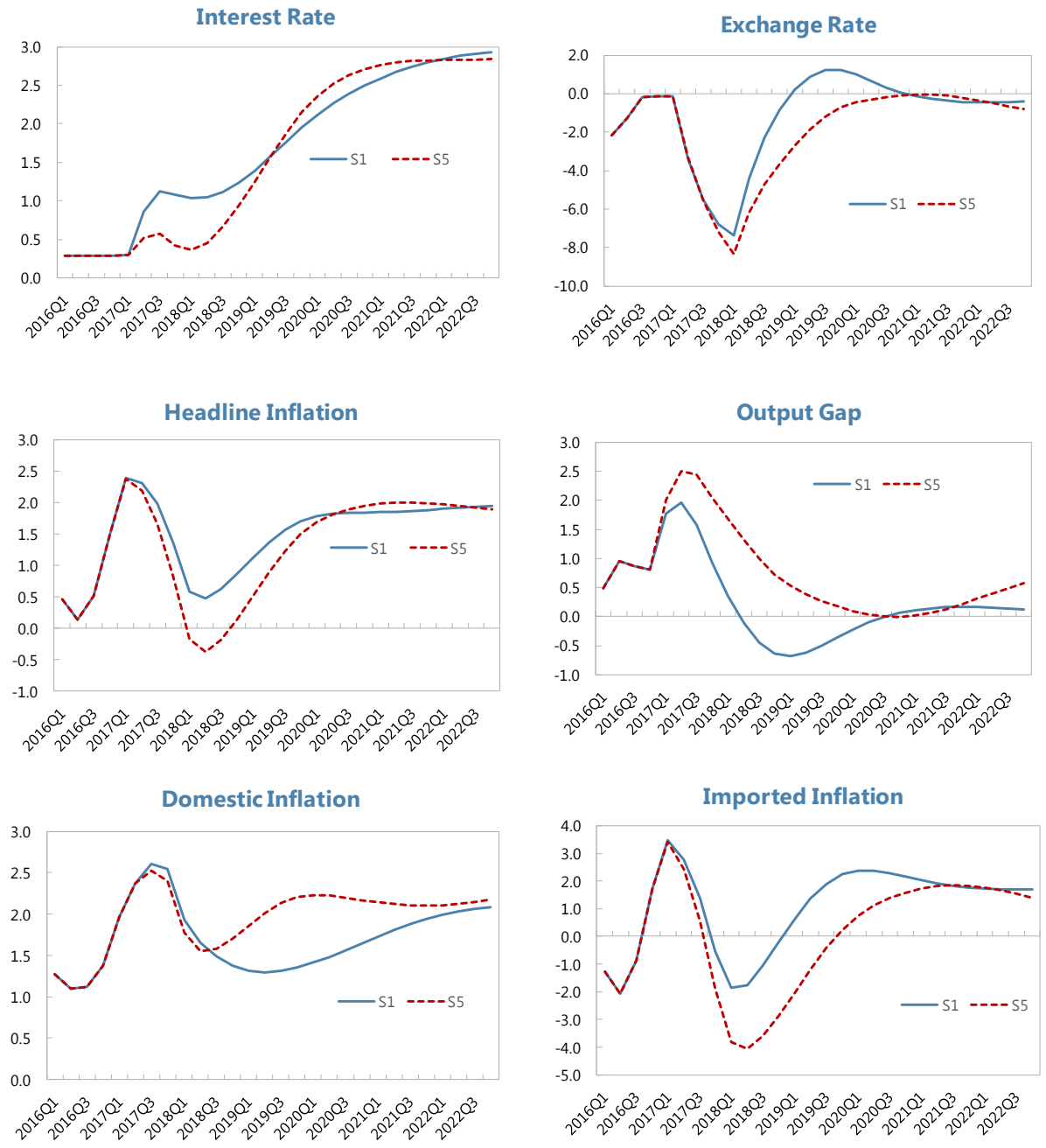

Source: IMF staff estimates.

## Figure 4. Czech Republic: Stronger RER Trend Appreciation



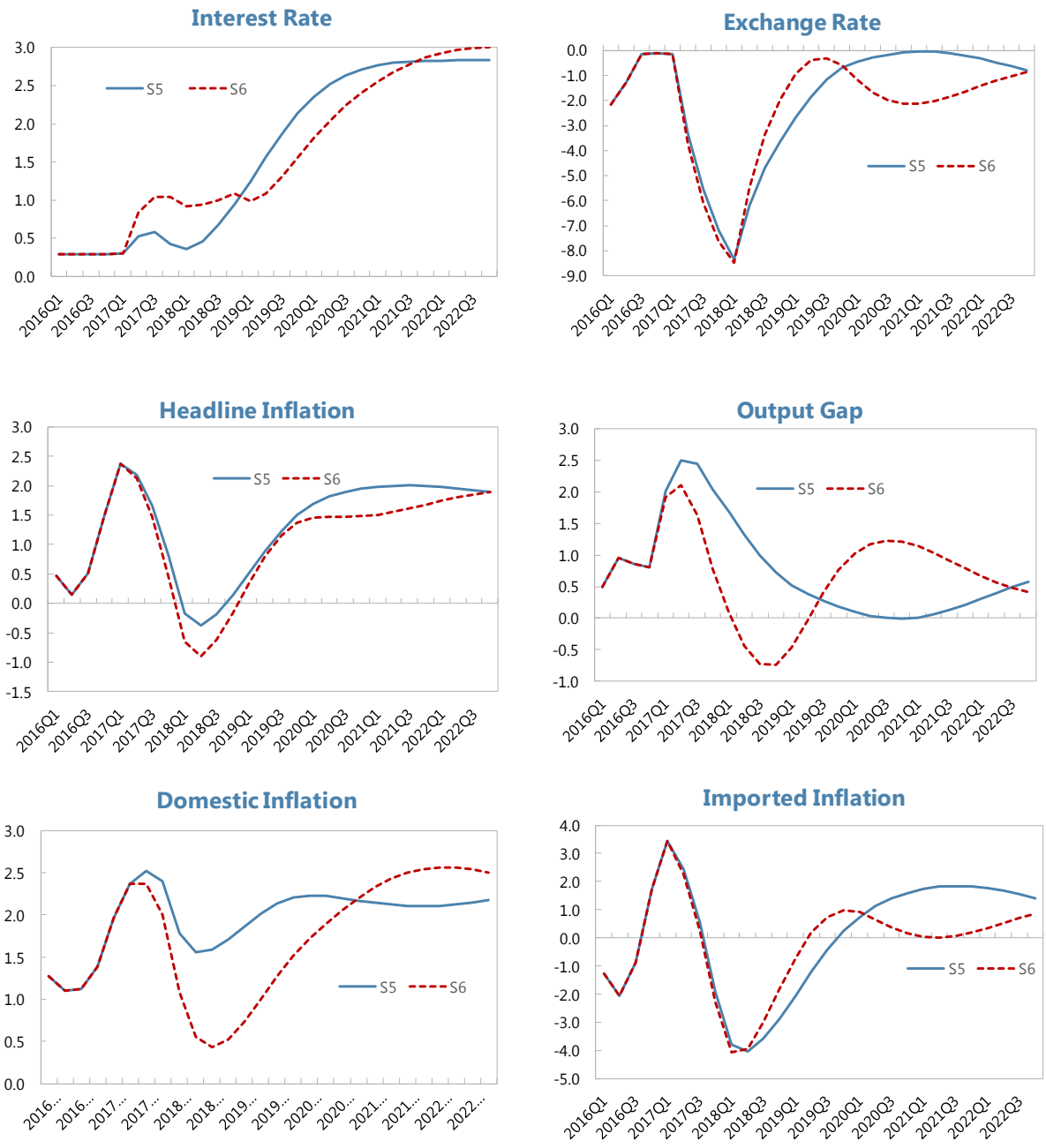

Source: IMF staff estimates.

## Figure 5. Czech Republic: Combined Shock



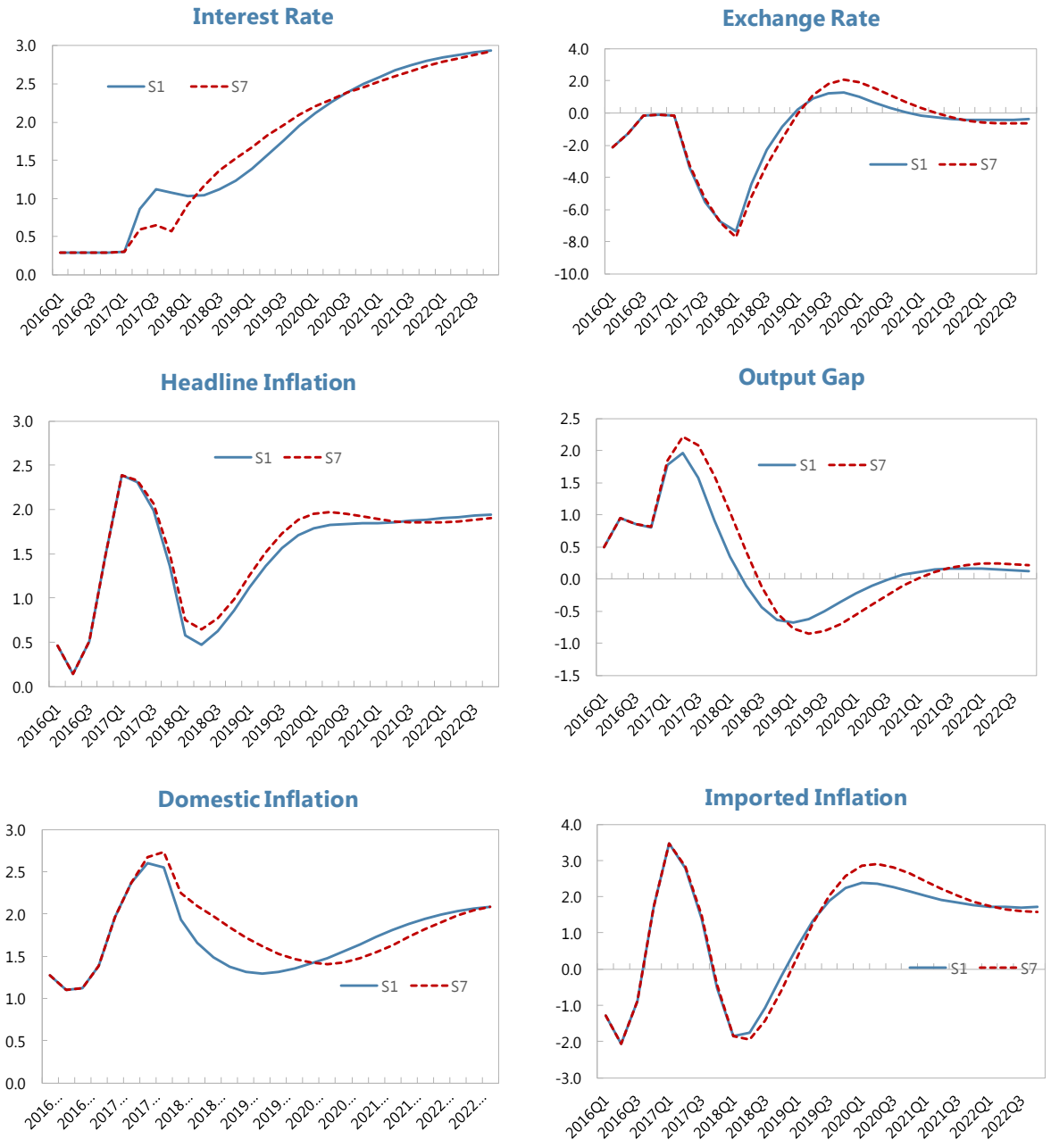

Source: IMF staff estimates.

## Figure 6. Czech Republic: Monetary Policy is Ex-post Too Tight (Type II Policy Error)




Source: IMF staff estimates.

## Figure 7. Czech Republic: Monetary Policy is Ex-post Too Loose (Type I Policy Error)



# Annex I. Model Specifications

Aggregate demand

$$\widehat{y_t} = b_{11}\hat{y}_{t-1} + (1 - b_{11})\hat{y}_{t+1} - b_{41}(\widehat{r_t} + prem_t) - b_{42}(-\hat{z}_t) + b_3\widehat{y_t^*} + \varepsilon_t^y$$

Domestic Inflation (Phillips curve)

$$\pi_t^d = a_1\pi_{t-1}^d + (1 - a_1)\pi_{t+1}^d + a_4\widehat{y_t} + a_5(4z_t - 4z_{t-1}) + \varepsilon_t^{\pi d}$$

Imported inflation

$$\pi_t^m = a_8\pi_{t-1}^m + (1-a_7-a_8)\pi_{t+1}^m + a_7(4s_t - 4s_{t-1} + \pi_t^*) + \varepsilon_t^{\pi m}$$

Regulated prices

$$\pi_t^r = \rho_1\pi_{t-1}^r + (1-\rho_1)\pi_{ss}^r + \varepsilon_t^{\pi r}$$

Headline inflation

$$\pi_t = \omega_d\pi_t^d + \omega_r\pi_t^r + (1 - \omega_d - \omega_r)\pi_t^m + \varepsilon_t^{\pi}$$

Uncovered Interest Rate Parity (UIP)

$$s_t = e_1(s_{t-1} + \frac{1}{2}(\bar{\pi} - \bar{\pi}^* + \bar{z}_t) + (1-e_1)s_{t+1} + \frac{1}{4}(i_t^* - i_t + prem) + \varepsilon_t^s$$

Monetary policy reaction function

$$i_t = g_1 i_{t-1} + (1-g_1)(\bar{\imath} + g_2(\pi_{t+6} - \bar{\pi}) + g_3\hat{y}_t + \varepsilon_t^i$$

## Table A1.1. Czech Republic: Model Parameters

| Parameters | Baseline | Direct channel | Cost-push | RER trend appreciation | Cumulative shock | Combined macro Shocks (S5) and Baseline Interest Rate Reponse (S1) | Baseline macro (S1) and combined shocks policy response (S5) |
|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S5=S2+S3+S4 | S6 | S7 |
| b11 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| b41 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| b42 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| b3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| a1 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| a4 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| a5 | 0.05 | 0.05 | **0.1** | 0.05 | **0.1** | **0.1** | 0.05 |
| a7 | 0.3 | **0.4** | 0.3 | 0.3 | **0.4** | **0.4** | 0.3 |
| a8 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| e1 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| g1 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| g2 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| g3 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Steady state | | | | | | | |
| RER trend | -0.4 | -0.4 | -0.4 | **-1** | **-1** | **-1** | -0.4 |
| Potential output | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Real interest domestic | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Real interest foreign | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

Source: IMF staff estimates,"Handout for the Modeling Workshop: Model Structure, Calibration, Forecasting and Policy Analysis" presented by Vlcek, J., A. Gonzales Gomez, and M. Pranovich (2016), manuscript, International Monetary Fund, Institute for Capacity Development; Strasky, J. (2005), "Optimal Forward-Looking Policy Rules in the Quarterly Projection Model of the Czech National Bank", Research and Policy Notes 5, Czech National Bank."