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The cost of disinflation in a small open economy vis-à-vis a closed economy*

Oleksandr Faryna[a], Magnus Jonsson[b], and Nadiia Shapovalenko[c]

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Abstract

We use a standard new Keynesian model to evaluate the cost of disinflation – in terms of the sacrifice ratio, the central bank's loss, and welfare – in a small open economy compared to a closed economy. We show that the cost of disinflation in terms of the sacrifice ratio and the central bank's loss is higher in the small open economy, and that the welfare benefit in terms welfare is lower. Lack of credibility is also more costly in terms of the central bank's loss in the small open economy. In terms of policy implications, optimised simple monetary policy rules imply that the relative weight on inflation stabilisation should be lower in the small open economy if the central bank minimises the loss function, but higher if it maximises welfare.

Keywords: Disinflation, sacrifice ratio, central bank loss, welfare cost, small open economy, New Keynesian model, optimised simple rules, imperfect credibility.

JEL classification: E31, E5, F41.

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1 Introduction

Studies of disinflation have a long tradition in monetary economics. Recent contributions have examined disinflation within a New Keynesian framework, see Ascari and Ropele (2012a, 2012b, 2013). Among other findings, Ascari and Ropele show that the cost of disinflation in this framework aligns closely with empirical estimates, concluding that the New Keynesian model provides a useful basis for analysing disinflation. Their analysis, however, is confined to a closed economy.

This paper extends the analysis to a small open economy, which is of both theoretical and practical relevance. Over the past three decades, inflation in many emerging markets – often small open economies – has declined to levels approximately 2–3 percentage points above the standard 2 per cent target in advanced economies. Consequently, assessing the cost and policy implications of disinflation is particularly important for emerging market economies.

Our analysis builds on the New Keynesian models of Galí (2008) and Woodford (2003), incorporating two additional features: the small open economy framework of Adolfson et al. (2007) and Galí and Monacelli (2005), and imperfect central bank credibility as in Ascari and Ropele (2013). The main frictions are price stickiness and imperfect credibility, with incomplete exchange rate pass-through introducing an additional channel in the open economy setting.

We quantify the cost of disinflation using the sacrifice ratio – the percentage of output lost for each percentage point reduction in steady-state inflation. In addition, we compute the central bank's loss based on a loss function that accounts for both output loss and deviations from the new inflation target, making it particularly relevant during disinflation episodes. Finally, we evaluate the cost of disinflation in terms of household welfare.

Monetary policy is modeled using simple rules. The benchmark is a standard Taylor rule, see Taylor (1993). We also consider two optimised simple rules: an optimised loss rule, where reaction coefficients minimise the central bank's loss function, and an optimised welfare rule, where reaction coefficients maximise household welfare. Calibration relies on standard parameter values from the literature, supplemented by sensitivity analysis with respect to openness and credibility.

The sacrifice ratio and the central bank's loss are higher in the small open economy. Both the sacrifice ratio and the central bank's loss increase with openness. Under the Taylor rule, the sacrifice ratio is about 43 per cent higher in the small open economy, while the central bank's loss rises by only 1 per cent. For optimised loss rules, the loss is roughly 21 per cent higher in the open economy.

The welfare benefit of disinflation is lower in the small open economy. Transition welfare costs are negligible in both cases, exerting only a marginal effect on total welfare gains. In terms of steady-state consumption equivalents, the overall welfare benefit of disinflation is about 13 per cent lower in the small open economy.

Lack of credibility is more costly in the small open economy. Imperfect credibility amplifies costs in the open economy under optimised rules: the central bank's loss is about 21 per cent higher compared to the closed economy at benchmark credibility. Assuming perfect credibility, the difference narrows to about 5 per cent.

The policy implications of disinflation depend on the central bank objective. If the objective is to minimise the loss function, the relative weight assigned to inflation stabilisation should be lower in a small open economy, but higher if the objective is to maximise welfare. This implies that the policy rate should be gradually reduced toward its long-run level in the small open economy, whereas in the closed economy it should be increased by approximately two percentage points when the objective is to minimise the loss function. Conversely, when the objective is welfare maximisation, the policy rate should be raised by about two percentage points in both economies.

1.1 Related literature.

There is a substantial empirical literature on the cost of disinflation. This literature review, however, focuses on the theoretical contributions most relevant to this paper. Ball (1994) shows that in a New Keynesian model where inflation is purely forward-looking, disinflation entails no cost, since firms that do not re-optimise keep prices unchanged between re-optimisation periods (see Calvo, 1983). In more recent work, prices that are not re-optimised are typically indexed to past inflation rates or to the inflation target, see Christiano et al. (2005) and Smets and Wouters (2007). This introduces a backward-looking component in the Phillips curve, generating output losses during disinflation. Imperfect central bank credibility also creates a backward-looking component and therefore additional output losses, see Ball (1995).

This paper is closely related to Ascari and Ropele (2012a, 2012b, 2013), who study the cost of disinflation in a closed economy. They show that the New Keynesian model produces sacrifice ratios consistent with empirical estimates and that the steady-state welfare gains from lower inflation outweigh the short-run transition costs – a result we also find in our small open economy setting.

Ferrara et al. (2020) analyse disinflationary policy in China using a medium-scale New Keynesian model under two monetary policy regimes. Their results suggest that disinflation is more costly when the central bank targets money supply rather than the nominal interest rate. Shin and Subramanian (2014) study disinflationary shocks in a nonlinear New Keynesian model with search and matching frictions and moral hazard in labor markets, focusing on welfare costs under such frictions. Assuming perfect credibility, they find that when the no-shirking condition binds, disinflation can lead to higher output and welfare in the steady state.

Few papers have quantified the cost of disinflation in a small open economy. Restrepo-Echavarria (2005) computes the welfare effect of achieving the long-run inflation target in Colombia using a model calibrated to the Colombian economy and finds long-run welfare benefits. Sunel (2018) examines the welfare consequences of the gradual but substantial disinflation observed in emerging markets. In a small open economy model with uninsurable idiosyncratic risk, a gradual decline of 12 percentage points in the quarterly inflation rate yields an aggregate welfare gain of 0.40 per cent in consumption-equivalent terms.

The remainder of the paper is organised as follows. The next section presents the economic environment and model calibration. Section 3 discusses the policy implications of disinflation, while Section 4 reports the cost of disinflation and provides the economic intuition behind the results. Section 5 concludes with suggestions for future research.

2 The economic environment

We consider a world economy composed of a small open economy and a foreign economy representing the rest of the world. The closed economy is treated as a special case of this framework, corresponding to zero openness.

2.1 Households

2.1.1 Intertemporal decision problem

A representative household has preferences $\mathcal{U}$ over an aggregate consumption index C and hours worked N according to,

$$\mathcal{U} = \sum_{t=0}^{\infty} \beta^t U(C_t, N_t), \tag{1}$$

where $U(\cdot)$ is the period utility function, and $\beta < 1$ is the subjective discount factor. The period utility function takes the following functional form,

$$U(C_t, N_t) = \ln C_t - \frac{N_t^{(1+1/\varphi)}}{1 + 1/\varphi}, \tag{2}$$

where φ is the Frisch elasticity of labor supply, i.e., elasticity of labour supply with respect to the wage rate for a constant marginal utility of wealth.

The representative household maximises utility subject to the following intertemporal budget constraint,

$$\begin{gathered} P_t C_t + B_t + S_t B_t^W = \\ B_{t-1}(1 + R_{t-1}) + S_t B_{t-1}^W (1 + R_{t-1}^w)\Psi_{t-1} + W_t N_t + D_{D,t} + D_{F,t} - T_t, \end{gathered} \tag{3}$$

where B is the stock of nominal bonds denominated in the domestic currency, B^W the stock of foreign nominal bonds denominated in the foreign currency, S the nominal exchange rate defined as the price of foreign currency in terms of domestic currency, W the nominal wage rate, R and R^W are the nominal interest rates on domestic and foreign bonds, respectively, Ψ is a risk premium, D_D and D_F are profits from owning the equity of domestic and importing firms, respectively, and T represents lump-sum transfers.

The risk premium depends negatively on the stock of net foreign assets measured in domestic consumption units A, i.e., SB^W/P. We assume the following functional form,

$$\Psi_t = \exp\{-\psi(A_t - \bar{A})\}, \tag{4}$$

where ψ is a risk premium parameter and a bar above a variable denotes steady state. The risk premium adds realism and induces stationarity in the net foreign asset position.

The first-order conditions of the household's intertemporal maximisation problem are summarised as follows,

$$\frac{W_t}{P_t} = -\frac{U_{N,t}}{U_{C,t}}, \tag{5}$$

$$1 + r_t = \frac{U_{C,t}}{\beta U_{C,t+1}}, \tag{6}$$

$$1 + r_t = \frac{1 + R_t}{\pi_{t+1}}, \tag{7}$$

$$1 + R_t = (1 + R_t^W)\frac{S_{t+1}}{S_t}\Phi_t, \tag{8}$$

where $\pi_{t+1} = P_{t+1}/P_t$ is gross inflation in period $t+1$, and r is the real interest rate. Condition (5) yields the familiar result that the real wage equals the marginal rate of substitution between labor supply and consumption. Condition (6) is the Euler equation, which states that the real interest rate equals the household's intertemporal marginal rate of substitution between current and future consumption. Condition (7) is the Fisher equation, indicating that the real interest rate equals the nominal interest rate minus expected inflation. Finally, condition (8) represents the uncovered interest parity condition, according to which the domestic nominal interest rate equals the foreign interest rate plus the expected depreciation of the exchange rate and a risk premium.

2.1.2 Intratemporal decision problem

The aggregate consumption index is given by,

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}}\left(C_{D,t}\right)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}}\left(C_{F,t}\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{9}$$

where C_D is an index of consumption goods produced domestically, C_F an index of foreign (imported) consumption goods. The parameter $\alpha \in [0,1]$ is the level of trade openness ($1-\alpha$ is often interpreted as a measure of home bias in preferences) and $\eta > 1$ measures the elasticity of substitution between domestic and foreign (imported) consumption goods. The indices for domestic and foreign (imported) consumption goods are given by,

$$C_{D,t} = \left(\int_0^1 C_{D,t}(i)^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}}, \tag{10}$$

$$C_{F,t} = \left(\int_0^1 C_{F,t}(i)^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}}, \tag{11}$$

where $\epsilon > 1$ is the elasticity of substitution between individual goods.

Formally, households first minimise the total expenditure required to purchase a given amount of total consumption $\tilde{C}$,

$$\min_{C_{D,t},C_{F,t}} P_{D,t}C_{D,t} + P_{F,t}C_{F,t}\,, \qquad s.t.\, C_t = \tilde{C}, \tag{12}$$

where P_D is the price of one unit of the domestic consumption good index and P_F is the price of one unit of the foreign (imported) consumption good index measured in the domestic currency. The first order conditions yield the following demand functions,

$$C_{D,t} = (1-\alpha)\left(\frac{P_{D,t}}{P_t}\right)^{-\eta} C_t \tag{13}$$

$$C_{F,t} = \alpha\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} C_t, \tag{14}$$

where P is the price of a consumption basket, i.e., the consumer price index expressed in units of domestic currency and is given by,

$$P_t = \left[(1-\alpha)\left(P_{D,t}\right)^{1-\eta} + \alpha\left(P_{F,t}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}}. \tag{15}$$

In a next step, households minimise the total expenditure required to purchase a given amount of total domestically produced consumption $\tilde{C}_D$ and a given amount of total foreign (imported) consumption, $\tilde{C}_F$. This yields the following demand functions for the individual goods,

$$C_{D,t}(i) = (1-\alpha)\left(\frac{P_{D,t}(i)}{P_{D,t}}\right)^{-\epsilon}\left(\frac{P_{D,t}}{P_t}\right)^{-\eta} C_t, \tag{16}$$

$$C_{F,t}(i) = \alpha\left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\epsilon}\left(\frac{P_{F,t}}{F_t}\right)^{-\eta} C_t. \tag{17}$$

By analogy, we assume that the foreign (export) demand for the domestically produced consumption good is given by,

$$C_{D,t}^W(i) = \alpha\left(\frac{P_{D,t}^W(i)}{P_{D,t}^W}\right)^{-\epsilon}\left(\frac{P_{D,t}^W}{S_t P_t^W}\right)^{-\eta} Y_t^W, \tag{18}$$

where P_D^W is the price of one unit of the export consumption good index, P^W the foreign consumer price index and Y^W foreign real output.

We assume that the law of one price holds. This means that when measured in the same currency, the price of consumption goods domestically produced and consumed is the same as the price of consumption goods domestically produced and exported,

$$P_{D,t}^W(i) = \frac{P_{D,t}(i)}{S_t}, \tag{19}$$

$$P_{D,t}^W = \frac{P_{D,t}}{S_t}. \tag{20}$$

2.2 Firms

There is a continuum of firms indexed by $i \in [0,1]$. Each firm produces a differentiated good, using a constant returns to scale production function with labor (hours worked) as the only input factor,

$$Y_t(i) = N_t(i), \tag{21}$$

where Y is output. The technology level, which is equal to all firms, is normalised to one. Firms sell their goods in domestic and foreign markets under so-called producer currency pricing, i.e., firms set a single price in domestic currency.

Following Calvo (1983), each firm can re-optimise its price in a given period with a constant probability $1-\theta_D$. These firms choose the optimal price, $P_D^*(i)$, to maximise profits while the prices remain effective,

$$\max_{P_{D,t}^*(i)} \sum_{k=0}^{\infty} \theta_D^k \Lambda_{\mathrm{t,t+k}} \left[\left(\frac{P_{D,t+k-1}}{P_{D,t-1}} \right)^{\omega_D} P_{D,t}^*(i) - (1+\tau) W_{t+k}(i) \right] Y_{t+k}(i)\,, \qquad (22)$$

where Λ is the nominal one-period stochastic discount factor and the parameter τ a subsidy set to eliminate the steady state distortion implied by imperfect competition. The maximisation is subject to the following demand constraint,

$$Y_t(i) = C_{D,t}(i) + C_{D,t}^W(i), \qquad (23)$$

where $C_D(i)$, and $C_D^W(i)$ are defined by equations (16) and (18), respectively. The first order condition is given by,

$$\sum_{k=0}^{\infty} \theta_D^k \Lambda_{\mathrm{t,t+k}} Y_{t+k}(i) \left(\frac{P_{D,t+k-1}}{P_{D,t-1}} \right)^{\omega_D} P_{D,t}^* = \sum_{k=0}^{\infty} \theta_D^k \Lambda_{\mathrm{t,t+k}} Y_{t+k}(i) \frac{\varepsilon}{\varepsilon - 1} (1+\tau) W_{t+k}\,. \qquad (24)$$

Firms that do not re-optimise set prices according to the following rule,

$$P_{D,t}(i) = P_{D,t-1}(i) \left(\frac{P_{D,t-1}}{P_{D,t-2}} \right)^{\omega_D}, \qquad (25)$$

where $\omega_D \in [0,1]$ is a parameter that measures the level of price indexation to previous period's inflation.

An aggregate domestic price can be derived as a weighted average of prices set by firms that re-optimise and by those that do not re-optimise,

$$\left(P_{D,t}\right)^{1-\epsilon} = (1-\theta_D)\left(P_{D,t}^*\right)^{1-\epsilon} + \theta_D \left(P_{D,t-1} \left(\frac{P_{D,t-1}}{P_{D,t-2}} \right)^{\omega_D} \right)^{1-\epsilon}. \qquad (26)$$

2.3 Import sector

There is a continuum of importing firms that acquire a homogeneous foreign consumption good on the international market. The price of this good in domestic currency is SP^W. The importing firms rebrand the good and sell it to domestic households under monopolistic competition.

Imperfect exchange rate pass-through is an important empirical feature, which means that changes in the nominal exchange rate affect import prices gradually. In the long-run pass-through is complete, though. A possible explanation for this behavior is sticky import prices. Importing firms can only optimally revise their price in any given period with a constant probability, $1-\theta_F$, and solve the following profit maximisation problem,

$$\max_{P_{F,t}^*(i)} \sum_{k=0}^{\infty} \theta_F^k \Lambda_{\mathrm{t+k}} \left[\left(\frac{P_{F,t+k-1}}{P_{F,t-1}} \right)^{\omega_F} P_{F,t}^*(i) - (1+\tau) S_{t+k} P_{t+k}^W \right] C_{F,t+k}(i), \tag{27}$$

subject to the foreign demand function $C_F(i)$ defined in equation (11). The first order condition is given by,

$$\begin{aligned} &\sum_{k=0}^{\infty} \theta_H^k \Lambda_{\mathrm{t,t+k}} C_{F,t+k}(i) \left(\frac{P_{F,t+k-1}}{P_{F,t-1}} \right)^{\omega_F} P_{F,t}^* = \\ &\sum_{k=0}^{\infty} \theta_H^k \Lambda_{\mathrm{t,t+k}} C_{F,t+k}(i) \frac{\varepsilon}{\varepsilon - 1} (1+\tau) S_{t+k} P_{t+k}^W . \end{aligned} \tag{28}$$

Importing firms that cannot re-optimise in a given period, update their prices according to the following rule,

$$P_{F,t}(i) = P_{F,t-1}(i) \left(\frac{P_{F,t-1}}{P_{F,t-2}} \right)^{\omega_F}, \tag{29}$$

where $\omega_F \in [0,1]$ measures the level of price indexation to previous period's foreign (import) inflation.

An aggregate import price can be derived as a weighted average of prices set by importing firms that re-optimise and by those that do not re-optimise,

$$\left(P_{F,t}\right)^{1-\epsilon} = (1-\theta_F)\left(P_{F,t}^*\right)^{1-\epsilon} + \theta_F \left(P_{F,t-1} \left(\frac{P_{F,t-1}}{P_{F,t-2}} \right)^{\omega_F} \right)^{1-\epsilon}. \tag{30}$$

2.4 Imperfect central bank credibility

Imperfect central bank credibility is an important factor of the cost of disinflation, see for example Goodfriend and King (2005), Erceg and Levin (2003), Gibbs and Kulish (2015). When credibility is imperfect, households revise their expectations of the new inflation target gradually. Over time – as new information becomes available – they put greater weight on the new inflation target.[1]

To model imperfect central bank credibility, we follow Ascari and Ropele (2013) and Goodfriend and King (2005). Expected inflation $\tilde{\pi}_{t+1}$ is defined as a weighted average of the rational expected value and the old (higher) inflation target,

[1] Price indexation to previous inflation can to a certain extent be viewed as a reduced-form substitute for imperfect credibility, since it adds a backward-looking component to the Phillips curve, see Ascari and Ropele (2013).

$$\tilde{\pi}_{t+1} = (1-\omega_t)(\pi_{t+1}) + \omega_t \, \bar{\pi}^{high}, \tag{31}$$

where $\omega \in [0,1]$ is a measure of central bank credibility. When $\omega = 0$ there is complete credibility and when $\omega = 1$ there is zero credibility. In the long-run, expectations converge to the rational expected value, i.e, $\tilde{\pi}_\infty = \pi_\infty$. Initially, households and firms are not convinced of the central bank's commitment to the new target, i.e., $\omega = 1$. Over time, the central bank credibility improves, which is modelled by an AR(1)-process,

$$\omega_t = \rho_C \, \omega_{t-1}, \tag{32}$$

where the parameter ρ_C measures the rate at which credibility converges to complete credibility. The formation of inflation expectations affects the Phillips curve, the Fisher equation, and the uncovered interest rate parity condition. Hence, the uncovered interest rate parity condition is an additional channel through which credibility can affect the cost of disinflation in the small open economy.

2.5 Monetary Policy

Monetary policy is an important determinant of the cost of disinflation. We compute so-called optimised simple rules to quantify to what extent these rules can mitigate the cost compared to the benchmark Taylor rule, see Taylor (1993). According to Taylor rule, the monetary policy rate R reacts to deviations of inflation from the target – the inflation gap – and deviations of output from steady state – the output gap,

$$\frac{1+R_t}{1+\bar{R}} = \left(\frac{\pi_t}{\bar{\pi}}\right)^{\rho_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\rho_Y}, \tag{33}$$

where the reaction coefficients ρ_π and ρ_Y show the strength by which the policy rate reacts to the inflation gap and the output gap, respectively. The Taylor rule may, however, be a poor guidance for monetary policy during a disinflation episode or other exceptional events. We therefore compute optimised simple rules that explicitly take the central bank's objective into account during the disinflation episode. The optimised simple rules are designed to perform well during the disinflation episode for a given loss function. From a policymaker's perspective, optimised simple rules are useful since they are easy to understand due to their simplicity and they are easy to compare to the Taylor rule, which is a common benchmark rule.

In the first type of optimised simple rules – so-called optimised loss rules – the reaction coefficients on the inflation gap and the output gap are chosen to minimise the central bank loss function during the disinflation episode. In the small open economy, the central bank can – in addition to the inflation gap and output gap – react to changes in the real exchange gap, i.e., deviations of the real exchange rate from its steady state value. The policy rule in the small open economy model is thus extended with a real exchange rate term when calculating the optimsed simple rules,

$$\frac{1+R_t}{1+\bar{R}} = \left(\frac{\pi_t}{\bar{\pi}}\right)^{\rho_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\rho_Y} \left(\frac{Q_t}{\bar{Q}}\right)^{\rho_Q}, \tag{34}$$

where the coefficient ρ_Q denotes the reaction to changes in the real exchange rate gap.

We assume that the central bank loss function $\mathcal{L}$ has equal weights on stabilising inflation and output,

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \left[\left(\pi_t - \bar{\pi}^{low}\right)^2 + \left(\frac{Y_t - \bar{Y}^{low}}{\bar{Y}^{low}}\right)^2 \right], \tag{35}$$

where superscript *low* indicates the value of a variable in the low inflation rate regime. Formally, the reaction coefficients in the policy rule are chosen to minimise the loss function during the transition to the new inflation target. Hence, we search for the parameter vector $\rho^{\mathcal{L}} = [\rho_\pi, \rho_Y, \rho_Q]$ that solves,[2]

$$\tilde{\rho}^{\mathcal{L}} = \arg\left\{\min_{\rho^{\mathcal{L}}} \mathcal{L}\right\}. \tag{36}$$

In the second type of optimised simple rules – so-called optimised welfare rules – the central banks objective is to maximise welfare, i.e., household utility $\mathcal{U}$. To compute the optimised welfare rules, we search for the parameter vector $\rho^{\mathcal{U}} = [\rho_\pi, \rho_Y, \rho_Q]$ that maximise $\mathcal{U}$,

$$\tilde{\rho}^{\mathcal{U}} = \arg\left\{\max_{\rho^{\mathcal{U}}} \mathcal{U}\right\}. \tag{37}$$

2.6 Market clearing conditions and trade

There are five markets that require market clearing: the labor market, the markets for domestically produced and imported goods and the domestic and foreign bond markets.

Labor market clearing requires that,

$$N_t^S = \int_0^1 N_t^D(i)di = N_t^D. \tag{38}$$

Domestic bonds cannot be traded in the international financial market and their net supply is zero, i.e., $B_t = 0 \ \forall\ t$. The supply of foreign bonds is assumed to be perfectly elastic at the foreign nominal interest rate.

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[2] Technically, we simulate the model for different values of ρ_π, ρ_Y, ρ_Q. For each set-up of parameter values, we compute the central bank loss and the transition welfare cost. Specifically, $\rho_\pi = [1.1{:}\,0.1{:}\,4]$, and for values between 4 and 150 the steps are exponentially increasing, $\rho_Y = [0{:}\,0.05{:}\,2]$, and $\rho_Q = [0{:}\,0.05{:}\,1]$. We get 8100 simulations for the closed economy and 170100 for the small open economy. In order to avoid corner solutions and extreme parameter values, we define a sub-optimal range covering five per cent of all simulations with the lowest loss and welfare cost values. This is the green area in the diagrams. From this sub-optimal range we select the simulation with the lowest parameter values of ρ_π, ρ_Y, and ρ_Q as the optimised loss rule.

Domestically and imported goods market clearing requires that for any firm the production is either consumed domestically or exported,

$$Y_t(i) = C_{D,t}(i) + C_{D,t}^W(i) \Longrightarrow \tag{39}$$

$$\int_0^1 Y_t(i)di = \int_0^1 C_{D,t}(i)di + \int_0^1 C_{D,t}^W(i)di. \tag{40}$$

An economy-wide goods-market clearing condition, including imported goods, is achieved by integrating over the continuum of goods and plugging in demand and production functions for individual goods,

$$\begin{aligned} &\int_0^1 N_t(i)di = \int_0^1 \left(C_{D,t}(i) + C_{D,t}^W(i)\right) di \iff \\ &N_t = \left[(1-\alpha)C_t + \alpha Q_t^\eta Y_t^W\right]\Delta_{D,t}, \end{aligned} \tag{41}$$

where $\Delta_{D,t} = \int_0^1 \left(\frac{P_{D,t}(i)}{P_{D,t}}\right)^{-\epsilon} \left(\frac{P_{D,t}}{P_t}\right)^{-\eta} di$ denotes price dispersion across firms.

Nominal domestic output $P_D Y$ equals nominal income consisting of labor income and profits from firms D_D and imported goods firms D_F, which equals nominal sales, i.e., nominal consumption plus nominal exports minus nominal imports,

$$P_{D,t}Y_t = W_t N_t + D_{D,t} + D_{F,t} = P_t(C_t + X_t - M_t). \tag{42}$$

The real exchange rate Q is defined as,

$$Q_t = S_t \frac{P_t^W}{P_t}. \tag{43}$$

Real exports X and real imports M are then given by,

$$X_t = \alpha \left(\frac{P_{H,t}}{P_t}\right)^{1-\eta} Q_t^\eta Y_t^W, \tag{44}$$

$$M_t = \alpha Q_t C_t \Delta_{F,t}, \tag{45}$$

where $\Delta_{F,t} = \int_0^1 \left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\epsilon} \left(\frac{P_{F,t}}{P_t}\right)^{-\eta} di$ is a measure of price dispersion across importing firms.

2.7 Stationarity and equilibrium

To make the model stationary, we divide the nominal variables P_H, P_F, W, and SB^W by the consumer price index P. In addition, domestic and foreign consumer price indices are replaced with the corresponding stationary inflation rates $\pi_t = P_t/P_{t-1}$ and $\pi_t^W = P_t^W/P_{t-1}^W$. Lastly, we replace the nominal exchange rate S with the stationary real exchange rate Q.

2.8 Calibration

We use standard values from the literature to calibrate the model, see Table 1. The length of a time period is one quarter. The discount factor β is set to 0.9951, which implies an annual long-run real interest rate of two per cent. The Frisch elasticity ϕ is generally between two and four in macroeconomic models, see Peterman (2016). We set ϕ to 2. Evidence from Nakamura and Steinsson (2008) suggests that the median duration between price changes is about 3–4 quarters. Hence, we set the Calvo parameters θ_D to 0.75 and θ_F to 0.5, implying an average duration between price changes of 4 and 2 quarters, respectively. The price indexation parameters ω_D and ω_F are set to 0.6 in line with estimates in Smets and Wouters (2003). Price markups are set to 20 per cent for both firms and importing firms, see Bayoumi, Laxton and Pesenti (2004). Estimates of the elasticity of substitution between domestic and foreign (imported) goods are around 5–20 in micro data (see references in Obstfeld and Rogoff (2000) and others). Estimates using macro data are, however, lower, see Collard and Dellas (2002). We therefore set the elasticity of substitution parameter η at the lower range of the estimates from the micro data, i.e., to 10. The openness parameter α is set at 0.4, in line with the value suggested by Adolfson et al. (2007). The central bank credibility parameter ρ_C is set to 0.7 as in Ascari and Ropele (2013). Finally, the weight on the inflation gap, ρ_π, is set to 1.5 and the weight on the output gap, ρ_Y, is set to 0.125, following Taylor (1993).

Table 1. Benchmark parameter values

Parameter	Description	Value
α	Openness	0.4
η	Substitution elasticity between domestic and imported goods	10
β	Discount factor	1.02^(−0.25)
ϕ	Frisch elasticity	2
θ_D	Price stickiness (firms)	0.75
θ_F	Price stickiness (importers)	0.5
ω_D	Price indexation (firms)	0.6
ω_F	Price indexation (importers)	0.6
$1/\epsilon + 1$	Price markup (firms and importers)	20 per cent
ψ	Risk premium	0.0015
ρ_C	Central bank credibility parameter	0.7
ρ_π	Weight on the inflation gap	1.5
ρ_Y	Weight on the output gap	0.5/4

To solve for the perfect foresight transition paths between the initial steady state and the new steady state, we stack the model's equilibrium conditions and solve the system of equations numerically with the non-linear solver in Dynare. The importance of non-linear effects is shown in Ascari (2004).

3 Policy implications of disinflation

This section shows the policy implications of disinflation and how they depend on the central bank objective. The inflation target is reduced from five to two per cent in all simulations. For an analysis of how the size of the reduction affects the cost of disinflation, see Ascari and Ropele (2013).

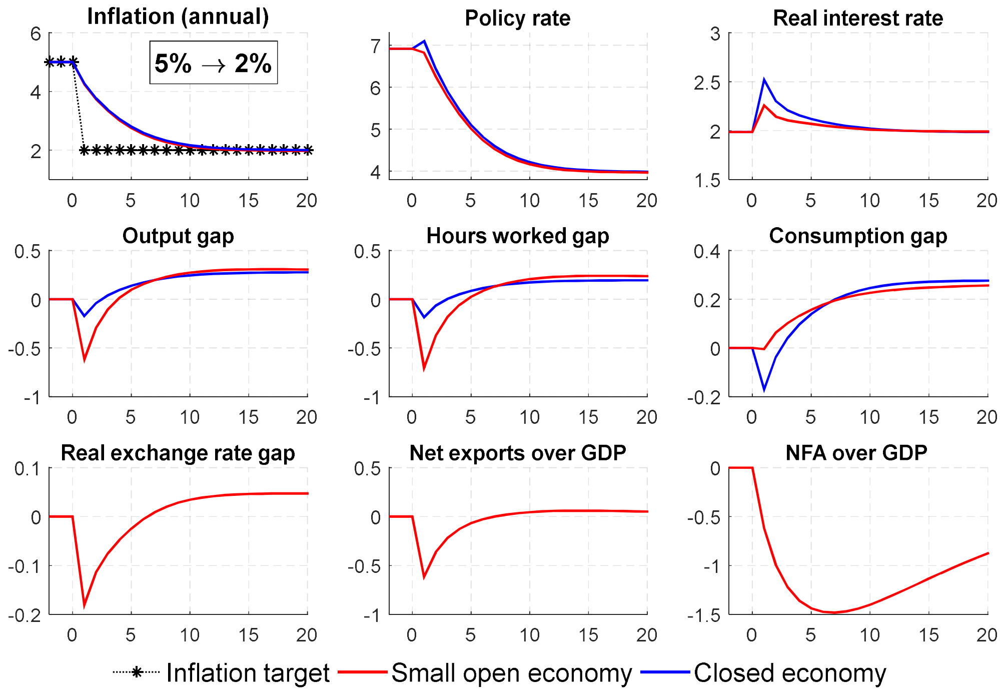
3.1 Taylor rule

Figure 1 illustrates the policy implications under the Taylor rule. The central bank announces a reduction in the inflation target from five to two per cent – a three-percentage point decrease. Households and firms begin revising their inflation expectations downward, and inflation gradually declines. In the steady state, the lower inflation target must correspond to a three-percentage point lower policy rate, consistent with the Fisher equation. However, in the short run, there is a slight initial increase in the policy rate in the closed economy. This adjustment reflects imperfect central bank credibility and is necessary to anchor inflation expectations at the new target.

During the transition, the policy rate declines more slowly than inflation, resulting in an increase in the real interest rate. This incentivises households to substitute current consumption for future consumption. Consequently, labor supply falls, and since output is a linear function of hours worked, output declines.

In the small open economy, the uncovered interest parity condition – combined with imperfect exchange rate pass-through – introduces an additional channel through which inflation and other variables respond to disinflation. The initial increase in the real interest rate leads to a short-run appreciation of the real exchange rate (with the foreign real interest rate held constant in all simulations). This has two main implications. First, it puts downward pressure on inflation through lower import prices. Unlike in the closed economy, the central bank in the small open economy does not need to raise the policy rate initially to anchor inflation expectations. Second, the appreciation incentivises households to substitute domestic consumption with imported goods. This substitution negatively affects net exports and domestic output. However, total consumption gradually rises to a new, higher steady-state level due to cheaper imported goods.

Figure 1. Disinflation with the Taylor rule



3.2 Optimised loss rules

The reaction coefficients for the optimised loss rules are reported in Table 2. In the small open economy, the coefficients are 4.1 on the inflation gap, 0.85 on the output gap, and zero on the real exchange rate gap. In the closed economy, the corresponding coefficients are 4.5 on the inflation gap and 0.325 on the output gap.

A simple and intuitive way to illustrate the policy implications of the optimised loss rules relative to the Taylor rule is to compute the relative weight on inflation stabilisation in terms of the weight on output stabilisation. For the optimised loss rules, this relative weight is 4.8 in the small open economy and 14.2 in the closed economy. By comparison, the Taylor rule assigns a relative weight of 6, which is close to the optimised loss rule for the small open economy, suggesting the Taylor rule is better in a disinflation scenario in a small open economy than in a closed economy.

The relative weight on inflation stabilisation should thus be substantially higher in the closed economy than in the small open economy. This difference reflects the appreciation of the real exchange rate in the open economy, which has two offsetting effects on the loss function. On one hand, appreciation accelerates the transition of inflation toward the new target. On the other hand, it deepens the negative output gap. To avoid excessive output losses, the central bank in the small open economy should therefore place a relatively modest weight on inflation stabilisation. This trade-off does not arise in a closed economy, where the relative weight on inflation stabilisation therefore should be higher.

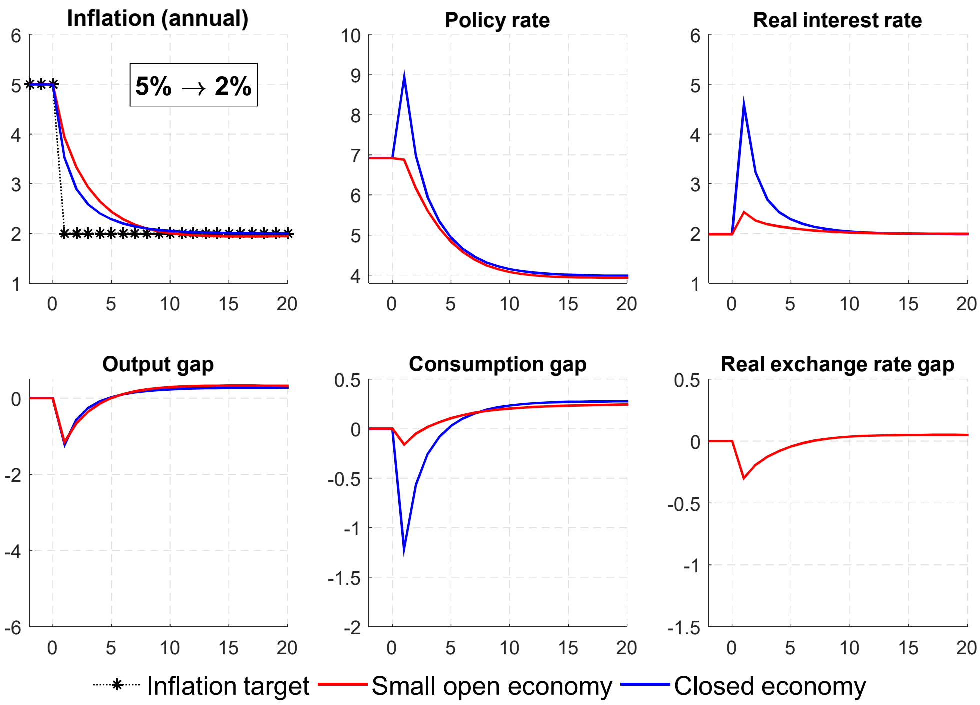
Table 2. Reaction coefficients for the optimised loss rules and the Taylor rule

	ρ_π	ρ_Y	ρ_Q	Relative weight on stabilising inflation
Small open economy	4.1	0.850	0.0	4.8
Closed economy	4.6	0.325	—	14.2
Taylor rule	1.5	0.125	—	6

Note. Relative weight on stabilising inflation is computed as ρ_π/ρ_Y.

Figure 2 illustrates the implications of disinflation under the optimised loss rules. In the small open economy, the relatively low weight on inflation stabilisation implies that the policy rate should be reduced gradually toward its new steady state. In contrast, the high weight on inflation stabilisation in the closed economy calls for a sharp initial increase in the policy rate of about two percentage points. As a result, inflation converges to the new target more quickly in the closed economy, while the decline in output is nearly identical across both economies.

Figure 2. Disinflation with optimised loss rules

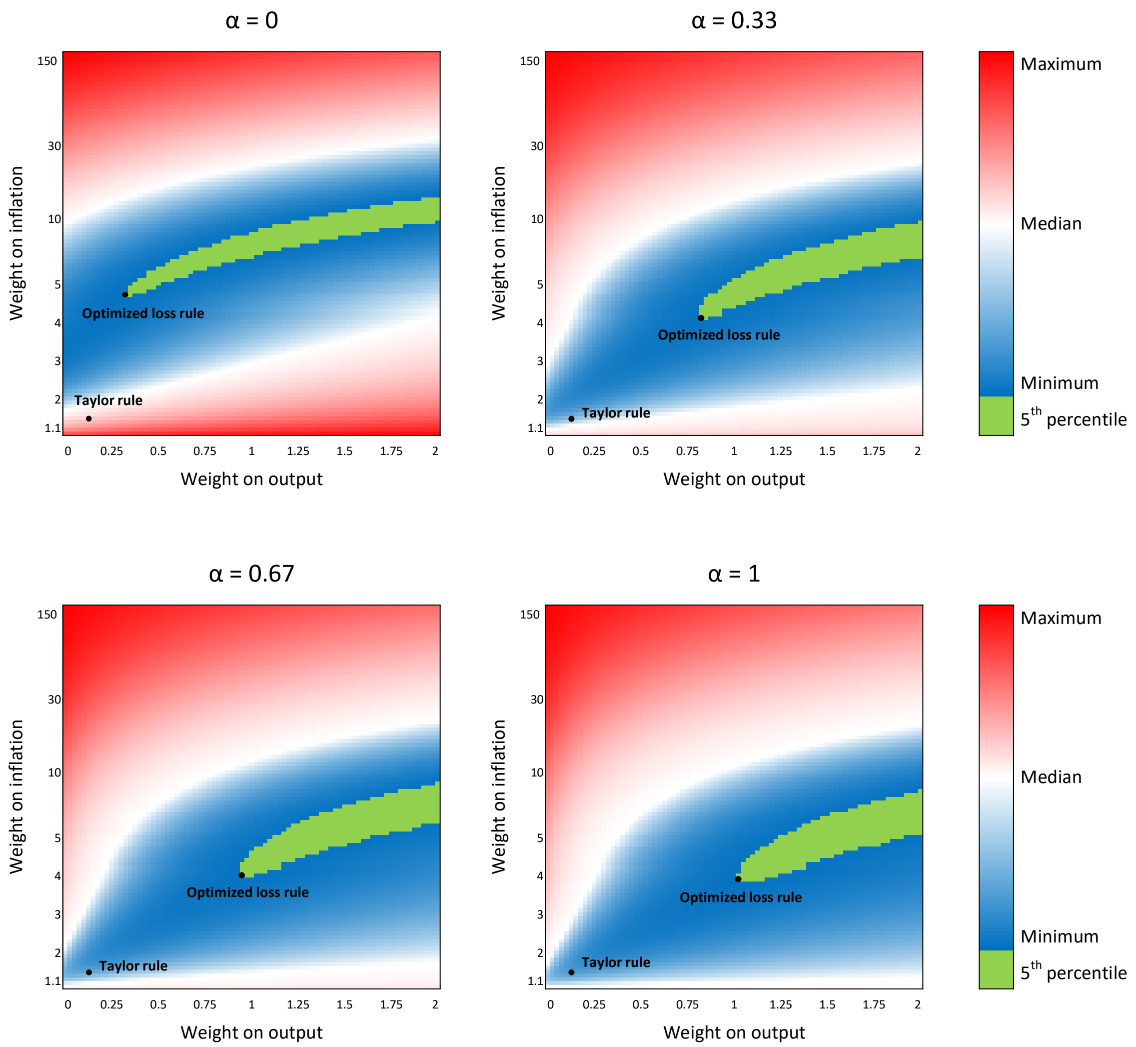


3.2.1 Effects of varying openness

To illustrate how different levels of openness affect the optimised loss rules, we compute heat maps, Figure 3. These heat maps display the central bank loss for various combinations of weights on the inflation gap and the output gap, given a specific openness parameter, α. Each of the four panels corresponds to a different value of α. For example, the upper-left panel represents the closed economy ($\alpha = 0$), while the bottom-right panel represents an economy with full openness ($\alpha = 1$).

In each panel, the red area indicates policy rules associated with a high central bank loss, the blue area represents rules with a lower loss, and the green area highlights rules where the loss is within five per cent of the minimum. These rules are considered "optimised." To select a specific optimised loss rule, we choose the policy rule within the green area that has the lowest weights on the inflation and output gaps. This approach strikes a balance between minimising loss and avoiding extreme reaction coefficients, making the rules easier to interpret for policymakers while preserving the core message. The black dots in the figure indicate the optimised loss rule and the Taylor rule.

Figure 3. Central bank loss for different weights on the inflation gap and the output gap, given different levels of openness

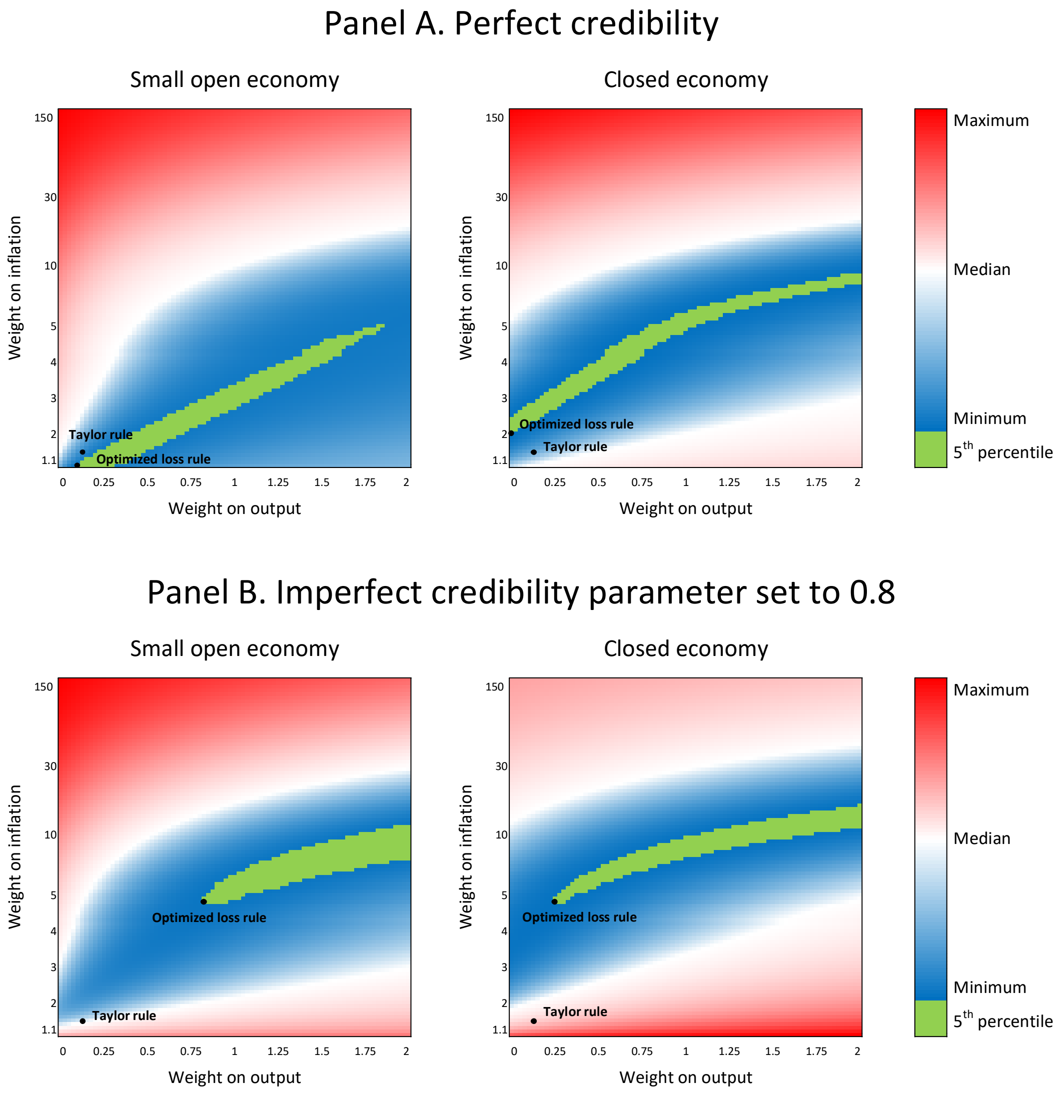


Across all levels of openness, the Taylor rule is not close to the optimised loss rule. However, for the benchmark calibration of openness $\alpha = 0.4$, the relative weight on inflation stabilisation in the Taylor rule is similar to that in the optimised loss rule, as noted earlier. The reaction coefficient on the inflation gap remains relatively high (around 4 to 5) across all levels of openness, while the coefficient on the output gap increases from about 0.25 to over 1. As openness rises, the relative weight on inflation stabilisation should decline due to the trade-off between inflation and output stabilisation created by the growing influence of the real exchange rate.

3.2.2 Effects of varying central bank credibility

Figure 4 illustrates how the optimised loss-based policy rules in both economies respond to varying levels of central bank credibility. We examine two extreme scenarios: Panel A assumes perfect credibility ($\rho_C = 0$), while Panel B reflects low credibility ($\rho_C = 0.8$). Under perfect credibility, the Taylor rule closely approximates the optimised loss rule. However, when credibility deteriorates, the optimised loss rule significantly outperforms the Taylor rule. As credibility weakens, central banks must assign greater weight to inflation stabilisation to anchor expectations. Notably, the inflation-gap coefficient remains relatively low in the small open economy. This is because real exchange rate appreciation exerts downward pressure on inflation, allowing a lower relative weight on inflation stabilisation to effectively anchor expectations.

Figure 4. Central bank loss for different weights on the inflation gap and output gap, given perfect credibility and imperfect (low) credibility



3.3 Optimised welfare rules

Table 3 reports the reaction coefficients for the optimised welfare-based policy rules. In the small open economy, the coefficients on the inflation gap and output gap are 29.6 and 0.7, respectively, with a zero coefficient on the real exchange rate gap. In the closed economy, the corresponding coefficients are 6.1 for the inflation gap and 0.3 for the output gap. In both cases, the relative weight on inflation stabilisation is substantial, 42.3 in the small open economy and 20.3 in the closed economy. These findings align with the standard result in sticky-price models that welfare-maximising monetary policy should prioritise inflation stabilisation, see Aoki (2001).

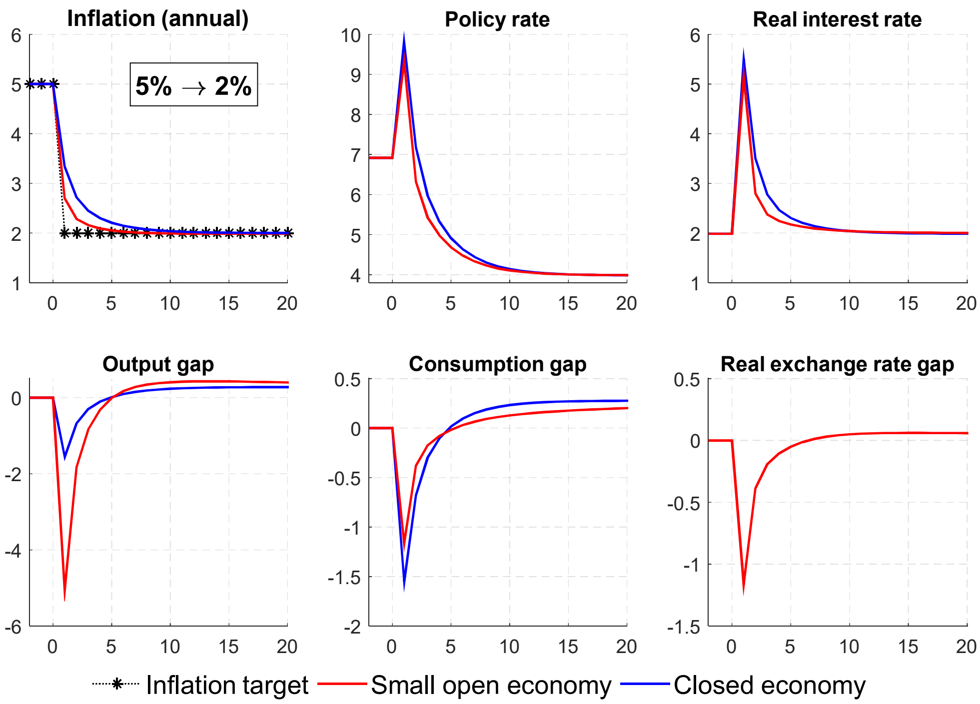
Table 3. Reaction coefficients for the optimised welfare rules and the Taylor rule

	ρ_π	ρ_Y	ρ_Q	Relative weight on stabilising inflation
Small open Economy	29.6	0.700	0.0	42,3
Closed Economy	6.1	0.300	—	20,3
Taylor rule	1.5	0.125	—	6

Note. Relative weight on stabilising inflation is computed as ρ_π / ρ_Y.

Figure 5 presents the policy implications of adopting the optimised welfare-based rules. These rules prescribe substantial weights on inflation stabilisation in both economies, implying a sharp increase in the policy rate—by nearly three percentage points in each case. This adjustment results in elevated real interest rates and a pronounced appreciation of the real exchange rate.

Figure 5. Disinflation with optimised welfare rules



In the small open economy, this appreciation accelerates the transition to the new inflation target. However, it also induces a significant decline in output, as households substitute domestic goods with cheaper imports. Consequently, total consumption falls by considerably less than output, reflecting the shift toward imported consumption goods.

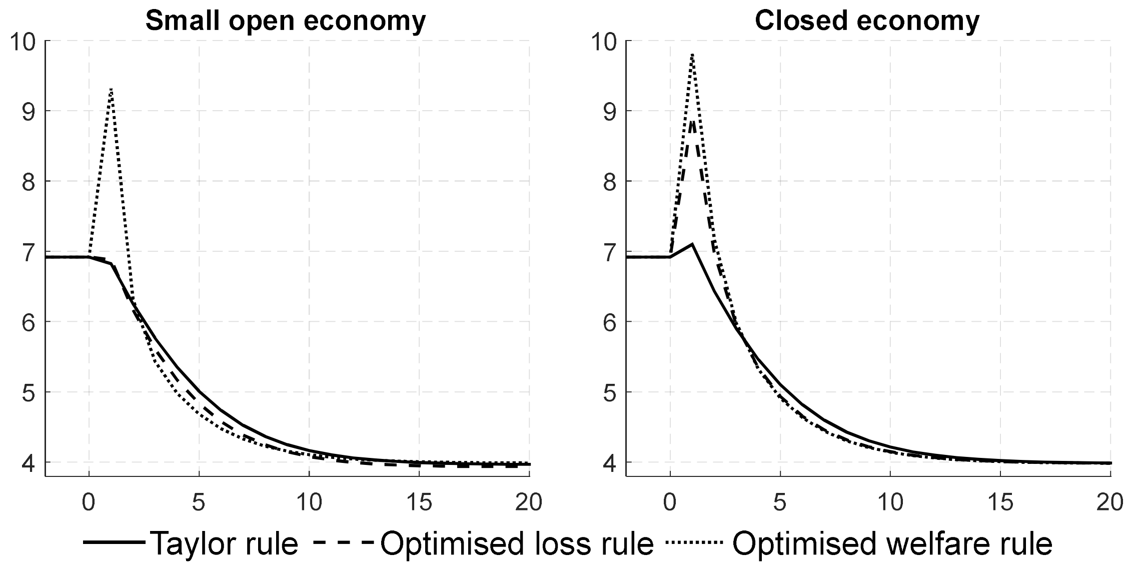
3.4 Summary of policy implications

Figure 6 summarises the policy implications of the Taylor rule, the optimised loss-based rules, and the optimised welfare-based rules. For both economies, the Taylor rule and the optimised welfare rule yield broadly similar implications: under the Taylor rule, the policy rate should decline gradually toward its steady state, whereas the optimised welfare rule prescribes an initial increase of more than two percentage points.

In contrast, the optimised loss rule generates markedly different recommendations across the economies. In the small open economy, the policy rate should be reduced smoothly toward the steady state, while in the closed economy it should rise by approximately two percentage points.

These differences underscore the importance of the central bank's objective when assessing monetary policy in a disinflation scenario. Under a welfare criterion, a high weight on inflation stabilisation is warranted, enabling a rapid convergence to the new inflation target but at the cost of a substantial output decline. This output loss is not necessarily detrimental to welfare, as lower output in the model is associated with increased leisure. However, reduced output directly worsens the central bank's loss function. Consequently, the relative weight on inflation stabilisation should be lower under a loss-function criterion, particularly in the small open economy.

Figure 6. The policy rate for different monetary policy rules



4 Cost of disinflation

We compute three measures of the cost of disinflation. First, we consider the sacrifice ratio $\mathcal{S}$, which represents the percentage of output the economy must forgo for each percentage point reduction in inflation,

$$\mathcal{S} = -\frac{1}{\bar{\pi}^{high} - \pi_T} \sum_{t=0}^{T} \frac{Y_t - \bar{Y}^{low}}{\bar{Y}^{low}}, \tag{46}$$

where $\bar{\pi}^{high}$ denotes inflation in the initial high-inflation regime, π_T inflation at period T, and $\bar{Y}^{low}$ steady-state output in the new low-inflation regime. Following Ascari and Ropele (2013), we set T equal to the number of periods required for inflation to fall below 2.1 per cent. In the benchmark case, this corresponds to 12 periods.

Second, we use a measure based on the central bank's loss function, see equation (35). In addition to output losses, this measure incorporates the cost of deviations from the new inflation target, thereby capturing the potential trade-off between inflation and output stabilisation.

The third measure computes the cost of disinflation in terms of the household's welfare. We follow Ascari and Ropele (2012) and compute a "welfare-based" sacrifice ratio, i.e., the percentage increase in consumption that a household would need to be as well off under the high inflation regime as under the low inflation regime. This value is normalised by the reduction of the inflation target (three percentage points). The welfare-based sacrifice ratio tells us how much extra initial steady state consumption a household would have to give up each period to reduce the inflation target by one percentage point. To compute this number, we first find the number Δ in the following equation,

Third, we compute the cost of disinflation in terms of household welfare. Following Ascari and Ropele (2012), we calculate a "welfare-based" sacrifice ratio, defined as the percentage increase in consumption required for a household to be as well off under the high-inflation regime as under the low-inflation regime. This value is normalised by the reduction in the inflation target (three percentage points). The welfare-based sacrifice ratio thus indicates how much additional steady-state consumption a household would need to give up each period to reduce the inflation target by one percentage point. To compute this measure, we first solve for Δ in the following equation,

$$\sum_{t=0}^{\infty} \beta^t U\big(C_t^{high}(1+\Delta), N_t^{high}\big) = \sum_{t=0}^{\infty} \beta^t U\big(C_t^{low}, N_t^{low}\big), \tag{47}$$

where C_t^{high} and N_t^{high} denote consumption and hours worked under the high-inflation regime (including the transition to the low-inflation target), C_t^{low} and N_t^{low} denote consumption and hours worked in the low-inflation regime. The welfare-based cost $\mathcal{W}$ is then computed as,

$$\mathcal{W} = \frac{\Delta}{\bar{\pi}^{high} - \bar{\pi}^{low}}. \tag{48}$$

The welfare measure can be decomposed into two components: the transition cost and the steady-state cost. The total welfare cost is obtained by summing these components. Note that a lower inflation target reduces price dispersion in steady state, which constitutes a benefit. Consequently, the steady-state welfare cost is negative.

4.1 Taylor rule

Table 4 reports the disinflation cost under the Taylor rule, along with the steady-state welfare cost. As illustrated in Figure 1, disinflation in the closed economy induces a modest initial increase in the real interest rate, which exerts a negative effect on output. In the small open economy, the appreciation of the real exchange rate further depresses output. Quantitatively, the exchange rate effect is more pronounced: the sacrifice ratio is 0.97 per cent in the small open economy compared to 0.68 per cent in the closed economy – approximately 43 per cent higher in the former.

The disinflation cost measured by the central bank's loss function is also greater in the small open economy, though only by about 1 per cent. Unlike the sacrifice ratio, the loss function discounts future output losses and assigns weight to inflation deviations from the target. This distinction is relevant because the transition to the new target occurs slightly faster in the small open economy, see Figure 1.

Table 4. Cost of disinflation for the Taylor rule

	Sacrifice ratio	Central bank loss	Welfare cost (transition)	Welfare cost (steady state)	Welfare cost (total)
Small open economy	0.97	2.228	0.0002	−0.024	−0.0238
Closed economy	0.68	2.209	0.0006	−0.028	−0.0274
Difference (PP)	0.29	-	−0.0004	0.004	0.0036
Difference (Per cent)	43	1	-67	-14	-13

Note. PP is an abbreviation of percentage points. The central bank loss is scaled by 1000. A negative welfare cost implies a welfare benefit.

The transition welfare cost is negligible in both economies. During disinflation, the economy experiences a recession in which consumption and hours worked fall below their steady-state levels. Lower consumption reduces welfare, while fewer hours worked has a positive effect by increasing leisure. These opposing effects result in a very small net transition welfare cost in both cases.

Quantitatively, the cost amounts to approximately 0.0002 per cent of steady-state consumption in the small open economy and about 0.0006 per cent in the closed economy. The smaller cost in the small open economy reflects two factors: (i) cheaper imported goods, which mitigate the decline in total consumption, and (ii) a larger reduction in output, which translates into fewer hours worked and thus more leisure.

In the closed economy, the transition welfare cost is roughly ten times lower in our model than in Ascari and Ropele (2012). Their model incorporates additional frictions – such as wage stickiness – which may explain the higher cost reported in their study.

4.1.1 The steady state welfare cost

In steady state, the welfare cost of disinflation is negative, indicating a welfare gain. This benefit is smaller in the small open economy. Quantitatively, the gain amounts to approximately 0.024 per cent of steady-state consumption in the small open economy, compared to about 0.028 per cent in the closed economy – roughly 14 per cent lower in the former. The steady-state welfare benefit is substantially larger than the transition welfare cost, implying that the latter has only a minor impact on total welfare. When the transition cost is included, the overall welfare benefit declines by about 13 per cent in the small open economy.

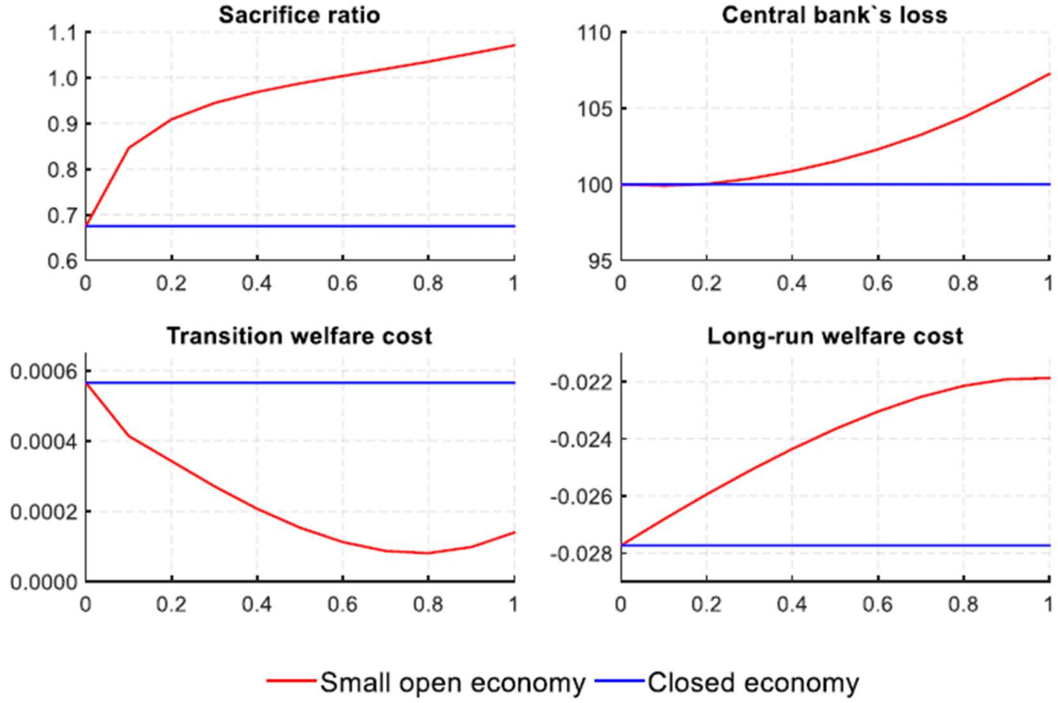
In Ascari and Ropele (2012), the welfare benefit of disinflation is approximately 0.07 per cent of steady-state consumption – around ten times higher than in our model. Their framework assumes full price indexation and no price dispersion in steady state. Instead, the welfare gain arises from a cash-in-advance constraint on firms' wage payments, a friction that appears significantly more costly than price dispersion in steady state.

4.1.2 Effects of varying openness

Figure 7 illustrates how varying degrees of openness affect the cost of disinflation. Openness is increased from complete autarky ($\alpha = 0$) to full openness ($\alpha = 1$). The sacrifice ratio is an increasing and concave function of openness, indicating that opening up an economy during a disinflation episode is particularly costly for economies that are initially closed or only slightly open.

By contrast, the central bank's loss function is increasing but convex in openness. Although disinflation becomes more costly as openness rises, the quantitative effect is moderate: a fully open economy exhibits a loss slightly above 7 per cent higher than that of a closed economy, while under the benchmark calibration ($\alpha = 0.4$) the loss is about 1 per cent higher.

Figure 7. Cost of disinflation for different levels of openness



The transition welfare cost generally declines with openness, except at very high levels, but remains quantitatively negligible. Greater openness strengthens the real exchange rate and further reduces output, limiting domestic consumption possibilities. However, households benefit from cheaper imported goods. In addition, lower production reduces hours worked, increasing leisure. The welfare gain from additional leisure outweighs the welfare loss from reduced total consumption as openness rises.

The steady-state welfare benefit of disinflation declines with openness. A lower inflation target reduces price dispersion in steady state, raising output and both domestic and imported consumption, thereby improving welfare in both economies. In the small open economy, an additional effect arises from the long-run depreciation of the real exchange rate (assuming zero net exports in steady state). This depreciation stimulates production and domestic consumption. However, in welfare terms, the gain from higher domestic consumption is offset by reduced leisure and lower imported consumption due to higher import prices. Consequently, the steady-state welfare benefit – which depends on total consumption and leisure – decreases as openness increases.

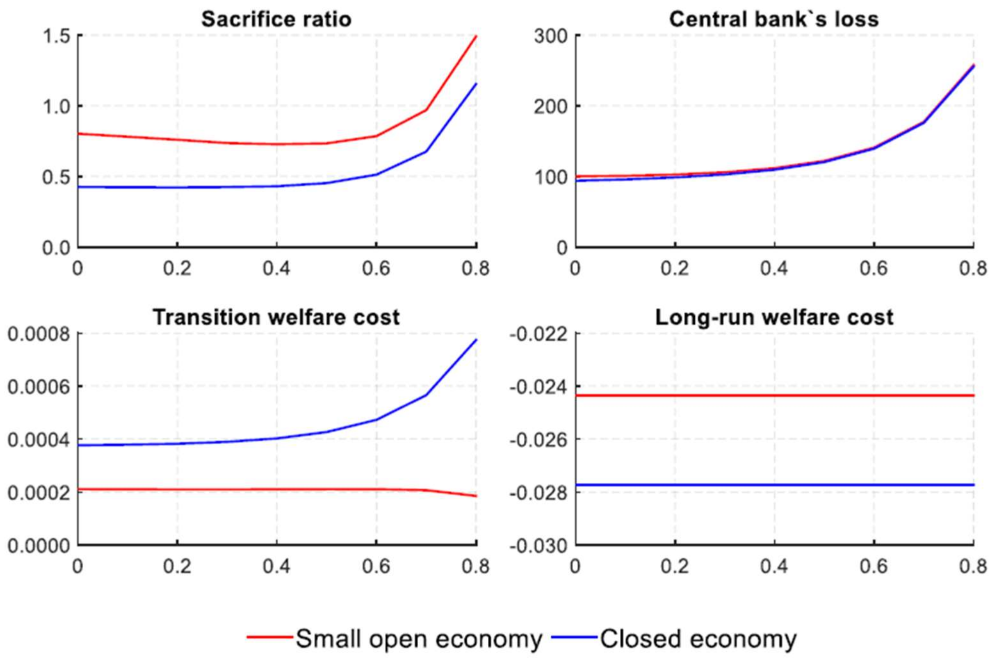
4.1.3 Effects of varying central bank credibility

Central bank credibility is a key determinant of the cost of disinflation. Under perfect credibility, inflation expectations adjust rapidly when a new inflation target is announced, resulting in a swift and relatively inexpensive disinflation process. When credibility is imperfect, expectations rely more heavily on past outcomes and respond more slowly to the new target. Over time, as additional information becomes available, households and firms place greater weight on the announced target. This gradual adjustment mitigates the initial rise in the real interest rate, but the rate remains above its steady-state level for a longer period. Consequently, output declines less initially but stays depressed for an extended time. In the small open economy, the appreciation of the real exchange rate is also dampened, further reducing the initial output contraction.

Figure 8 illustrates how disinflation costs evolve as credibility weakens from perfect ($\rho_C = 0$) to low ($\rho_C = 0.8$). While imperfect credibility softens the initial output drop, the prolonged output loss becomes increasingly significant at low credibility levels. Similarly, the central bank's loss function rises as credibility weakens. However, the impact of credibility on both the sacrifice ratio and the loss function is broadly similar across the two economies. Thus, under the Taylor rule, lack of credibility imposes approximately equal costs in the small open and closed economies.

The transition welfare cost of disinflation remains negligible and is unaffected by credibility. In the model, imperfect credibility is a short-term phenomenon and does not influence the steady-state welfare cost.

Figure 8. Cost of disinflation for different levels of central bank credibility



4.2 Optimised loss rules

Table 5 reports the central bank loss under the optimised loss rules. As expected, these rules reduce the loss relative to the Taylor rule, with a more pronounced improvement in the closed economy. Quantitatively, the loss in the small open economy remains about 21 per cent higher under the optimised loss rules, compared to only about 1 per cent under the Taylor rule.

In the small open economy, the appreciation of the real exchange rate creates a trade-off between stabilising inflation and output. The central bank cannot increase the weight on inflation stabilisation without further reducing output. This trade-off does not arise in the closed economy, where the central bank can assign a relatively high weight to inflation stabilisation without imposing a significant output loss – an efficient strategy for minimising the loss. In contrast, in the small open economy, the relative weight on inflation stabilisation under the optimised loss rule is nearly identical to that under the Taylor rule. Consequently, the scope for improvement over the Taylor rule is limited.

Table 5. Central bank loss with optimised loss rules

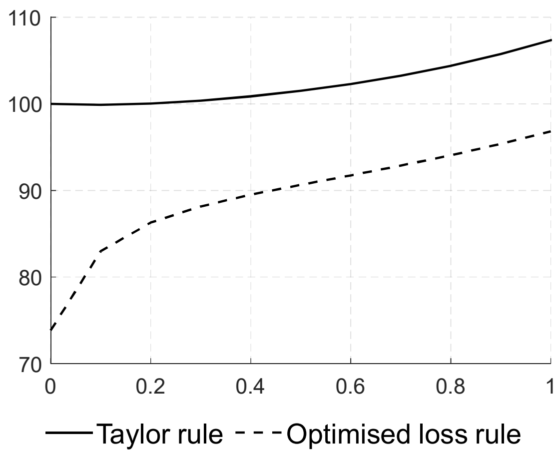
	Central bank loss
Small open economy	1.9774
Closed economy	1.6310
Difference in loss (per cent)	21.2

Note. The central bank loss is scaled by 1000.

4.2.1 Effects of varying openness

Figure 9 illustrates how varying levels of openness affect the central bank's loss under both the Taylor rule (solid line) and the optimised loss rule (dashed line). Openness ranges from complete autarky ($\alpha = 0$) to full openness ($\alpha = 1$). At low levels of openness, the optimised loss rule is particularly effective in reducing the loss. Once the openness parameter exceeds the benchmark value of 0.4, the central bank loss rises at approximately the same rate for both rules as openness increases.

Figure 9. Central bank loss for different levels of openness



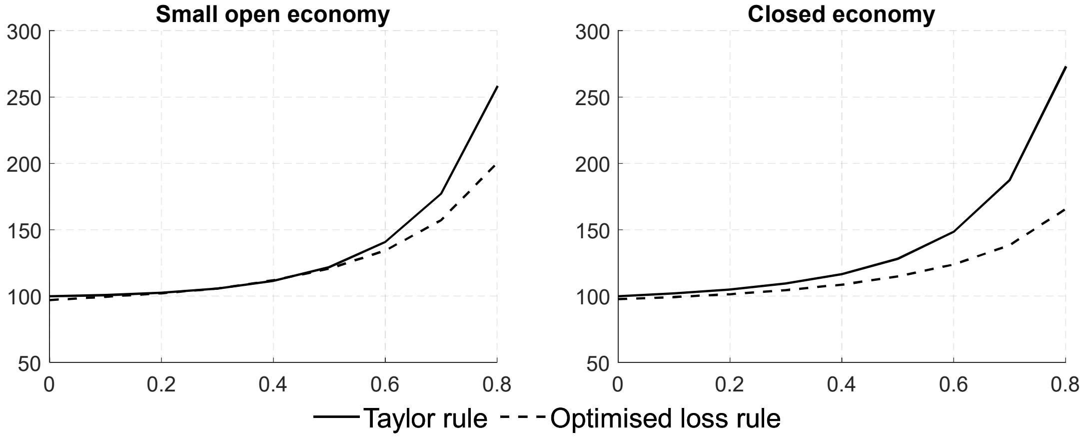
Note. The loss is normalised to 100 for the Taylor rule with no openness ($\alpha = 0$).

4.2.2 Effects of varying central bank credibility

Figure 10 illustrates how the central bank's loss varies with different levels of credibility, ranging from perfect credibility ($\rho_C = 0$) to low credibility ($\rho_C = 0.8$). The solid line represents the loss under the Taylor rule, while the dashed line corresponds to the optimised loss rule.

When credibility is high, the optimised loss rule and the Taylor rule perform similarly in mitigating the central bank's loss. However, as credibility declines, the optimised loss rule becomes significantly more effective than the Taylor rule in both economies, with a more pronounced improvement in the closed economy. For low credibility ($\rho_C = 0.8$), the loss is approximately 100 percentage points lower under the optimised loss rule in the closed economy, compared to about 50 percentage points lower in the small open economy.

Figure 10. Central bank loss for different levels of central bank credibility

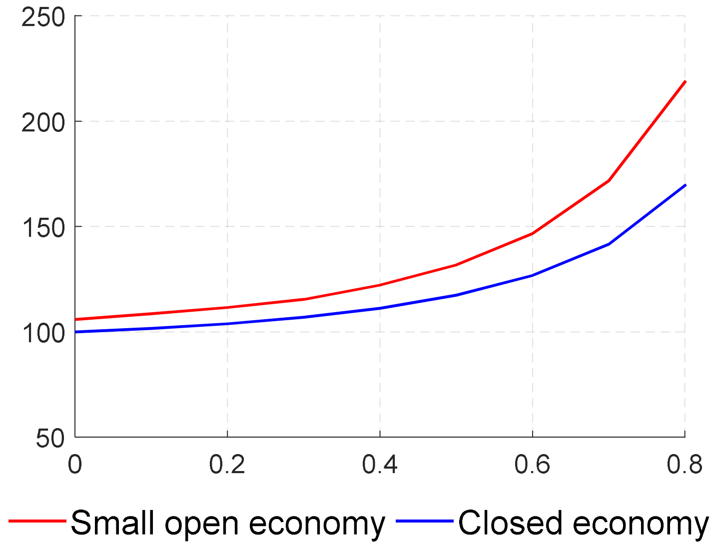


Note. The loss is normalised to 100 for the closed economy with perfect credibility.

Figure 11 demonstrates that lack of central bank credibility is particularly costly in the small open economy. In both economies, the central bank's loss is an increasing and convex function of imperfect credibility. However, the cost is higher in the small open economy. For example, at low credibility ($\rho_C = 0.8$), the loss is approximately 26 per cent greater in the small open economy than in the closed economy, compared to about 5 per cent when credibility is perfect.[3]

[3] These numbers are computed as (215-170)⁄170·100 ≈ 26 per cent and (105-100)⁄100·100 = 5 per cent.

Figure 11. Central bank loss for different levels of central bank credibility



Note. The loss is normalised to 100 for the closed economy with perfect credibility.

4.3 Optimised welfare rules

We have already established that the transition welfare cost under the Taylor rule is very small. The optimised welfare rule reduces this cost even further. Specifically, it lowers the transition welfare cost from 0.0006 per cent to 0.00043 per cent in the closed economy, see Tables 4 and 6. In the small open economy, the transition cost becomes negative, indicating a slight welfare gain.

This welfare gain in the small open economy can be explained as follows. The optimised welfare rule assigns a relatively high weight to inflation stabilisation compared to the Taylor rule. As a result, real interest rates rise sharply, causing a substantial decline in output and, to a lesser extent, consumption, see Figure 5. However, the pronounced reduction in output leads to fewer hours worked and thus more leisure, which improves welfare. The welfare gain from increased leisure outweighs the welfare loss from reduced consumption, resulting in a small net welfare benefit during the transition.

Table 6. Transition welfare cost with optimised welfare rules

	Welfare cost (transition)
Small open economy	−0.00035
Closed economy	0.00043
Difference in welfare (percentage points)	−0.00078
Difference in welfare (per cent)	-181

Note. A negative welfare cost implies a welfare benefit.

5 Concluding remarks

We have shown that there is a welfare gain from disinflation in both the small open and closed economies, although the benefit is smaller in the small open economy. Despite this welfare advantage, policymakers may hesitate to pursue disinflation. Such reluctance may stem from political pressures or from focusing on alternative measures of disinflation costs. According to the sacrifice ratio and the central bank loss, disinflation is costly – particularly in the small open economy. From a policymaker's perspective, these measures may appear more salient or relevant than the welfare-based benefit.

Policymakers in small open economies may be especially reluctant to disinflate: the welfare benefit is lower, while the sacrifice ratio and central bank loss indicate higher costs. Moreover, lack of credibility is more costly in the small open economy, a factor that can be decisive. If the central bank abandons disinflation, this decision may reinforce credibility problems, potentially trapping the central bank in a "credibility trap". Avoiding such a trap is particularly important for small open economies, many of which are emerging markets.

This work can be extended in different directions. More frictions can be added. We have considered price stickiness and central bank credibility that are two key frictions during disinflation. However, other frictions such as wage stickiness, search and matching frictions, financial frictions or heterogeneous agents are potentially important. Modifying the exogenous framework of central bank credibility to endogenous credibility could be another interesting extension. Finally, optimal monetary policy instead of optimised simple rules would be a natural extension to consider.

This analysis can be extended in several directions. Additional frictions could be incorporated. We have considered price stickiness and central bank credibility – two key frictions during disinflation – but other frictions such as wage rigidity, search and matching frictions, financial constraints, or heterogeneous agents may also be relevant. Another promising extension would be to model credibility endogenously rather than treating it as exogenous. Finally, exploring optimal monetary policy instead of optimised simple rules would be a natural next step.

The theoretical results presented here have empirical implications that can be tested. We find that the cost of disinflation rises with openness. One approach would be to compare disinflation costs across countries and plot them against openness. This may be challenging, however, as disinflation episodes and countries differ along many dimensions beyond openness. Another testable hypothesis is that as openness increases, lack of credibility amplifies the cost of disinflation.

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