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# MONETARY POLICY AND EXCHANGE RATE DYNAMICS IN A BEHAVIORAL OPEN ECONOMY MODEL*

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Abstract. We analyze the implications of adding boundedly rational agents á la Gabaix (2020) to the canonical New Keynesian open economy model. We show that accounting for myopia mitigates several "puzzling" aspects of the relationship between exchange rates and interest rates and helps explain why some of them only arise in the nested case of rational expectations. Bayesian estimation of the model demonstrates that a high degree of "cognitive discounting" significantly improves empirical fit. We also show that this form of bounded rationality makes positive international monetary spillovers more likely and exacerbates the unit root problem in small open economy models with incomplete markets. On the normative side, the model with behavioral agents provides arguments against using the exchange rate as a nominal anchor.

Keywords: Monetary Policy, Exchange Rates, UIP Condition, Bounded Rationality
JEL Codes: F41, E70, E52, E58, G40

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## 1. Introduction

International economics has long had to contend with a number of puzzles, and a lot of research has been devoted to resolving them by including realistic frictions in otherwise standard general equilibrium international macroeconomic models. The puzzles concern both long-term developments[1] as well as ones observed over the business cycle. The latter group often involves exchange rates, which tend to be very volatile when allowed to freely float, exhibit disconnect with macroeconomic fundamentals, and allow arbitrage in foreign exchange (FX) markets.

In a recent paper, Itskhoki and Mukhin (2021) propose a model that can simultaneously account for a number of the exchange rate-related anomalies. A key ingredient of the underlying theoretical setup – which draws on earlier work by De Long et al. (1990), Jeanne and Rose (2002), and Gabaix and Maggiori (2015) – are segmented FX markets, in which noise traders and financial frictions limit arbitrage. This framework gives rise to deviations from uncovered interest rate parity (UIP), which are largely driven by exogenous shifts in noise traders' portfolio decisions. If the corresponding shocks are sufficiently volatile, model fit significantly improves as the exchange rate becomes disconnected from macroeconomic fundamentals, including interest rate differentials. This result aligns well with the literature that estimates open economy DSGE models, which typically finds that shocks to the UIP premium are the major drivers of exchange rates (see, e.g. Adolfson et al., 2007 or Justiniano and Preston, 2010).

However, some puzzles cannot be simply explained by the inclusion of such shocks. One of them is the forward guidance exchange rate puzzle identified by Galí (2020), who showed that expectations of interest rate differentials in the distant future have much smaller effects on the real exchange rate than what is implied by a standard open economy model. Moreover, some recent papers additionally suggest that UIP-related anomalies do not necessarily reflect the failure of the UIP condition *per se*, but more the standard companion assumption of rational expectations (see, e.g., Kalemli-Ozcan and Varela, 2021; Candian and De Leo, 2021; Müller et al., 2024).[2] In other words, the deviations from the famous international arbitrage condition become much smaller if we calculate them using agents' actual (and not necessarily rational) expectations about the future exchange rate.

Against this backdrop, the goal of this paper is to investigate the open economy consequences of allowing agents to be myopic as in Gabaix (2020), with a particular focus on the exchange

[1] This group of puzzles includes home bias in trade and asset holdings or limited current account imbalances. Obstfeld and Rogoff (2001) argue that these anomalies can be explained by frictions in international trade in goods.

[2] Earlier papers making this claim in the context of the forward premium puzzle include Froot and Frankel (1989), Bacchetta et al. (2009) and Bussiere et al. (2022).

rate dynamics and transmission of monetary policy. The reason for picking this type of bounded rationality, often referred to as behavioral (or cognitive) discounting, is its success in the closed economy setting. In particular, cognitive discounting has been shown to resolve the so-called forward guidance puzzle (Carlstrom et al., 2015; Giannoni et al., 2015; McKay et al., 2016), which is relevant here as it has a similar flavor to the aforementioned exchange rate puzzle (Galí, 2020). Moreover, as shown by Gust et al. (2021), allowing for discounting improves the fit of a closed economy New Keynesian model relative to its standard, fully-rational counterpart.

Our point of departure is the well-established, new open economy macroeconomics (NOEM) paradigm,[3] and we cast the analysis in a, now standard, incomplete asset market version of that environment. We estimate the model using Bayesian methods and standard macroeconomic time series that also include the exchange rate. We find that overall model fit, as measured by the marginal likelihood, significantly improves for a high degree of myopia, despite the fact that the stochastic structure of the model includes UIP premium shocks, as advocated by Itskhoki and Mukhin (2021).

We then analyze the implications of our model for the relationship between the exchange rate and interest rates conditional on other shocks. We find that, for degrees of myopia consistent with our econometric estimates, the behavioral extension goes a considerable way towards mitigating the forward premium puzzle (Fama, 1984), the predictability reversal puzzle (Bacchetta and van Wincoop, 2010), and the Engel puzzle (Engel, 2016). We also show that incomplete financial markets are key for the model to successfully address the second and third puzzles. Since Itskhoki and Mukhin (2021) show that these three UIP puzzles can be rationalized in a multi-shock model using exogenous variations in the UIP risk premium, therefore one way to interpret our results is that one can rely less on this type of shock if cognitive myopia is also accounted for. Perhaps more importantly, behavioral discounting additionally helps resolve the forward guidance exchange rate puzzle (Galí, 2020).

We next discuss how the implications of the behavioral New Keynesian model of Gabaix (2020) are modified if it is extended to an open economy setting. One result that transpires directly from inspecting the modified IS curve is that cognitive discounting exacerbates the well-known unit root problem prevalent in small open economy models, requiring stronger remedial mechanisms.[4] Turning to implications for monetary policy, and broadly in line with closed economy results, cognitive discounting also resolves the "forward guidance puzzle" (FGP, see also Carlstrom et al., 2015; Giannoni et al., 2015; McKay et al., 2016) in an open economy context. There are, however, notable differences between closed and open

[3] See, among others, Corsetti and Pesenti (2001), Schmitt-Grohé and Uribe (2001), Kollmann (2002), Benigno and Benigno (2003), Gali and Monacelli (2005).

[4] The issue arises on account of asset market incompleteness and is discussed in Schmitt-Grohe and Uribe (2003).

economy behavioral models. The key one is that, while the sensitivity of domestic prices in the fully rational case increases approximately linearly as a function of the forward guidance horizon, this is not the case for the exchange rate. This implies that the FGP is considerably less dramatic in an open economy to begin with, and hence myopia translates into *relatively* less dampening of future interest rate changes, at least in an environment of high exchange rate pass-through to import prices as advocated by the dominant currency paradigm literature (Gopinath et al., 2020). Finally, we show that behavioral discounting has interesting implications for the size of international monetary policy spillovers. In particular, monetary easing in one economy is more likely to be expansionary for its trading partners if these are populated by behavioral agents, which occurs because cognitive discounting attenuates exchange rate-induced expenditure switching.

Our paper is related to the extensive literature that looks at the puzzling relationship between exchange rates and interest rates. Most of the proposed solutions maintain the assumption that agents are rational. Some recent contributions in this line of papers include Bacchetta and van Wincoop (2021), who propose a model of delayed portfolio adjustment, with Valchev (2020) relying on financial frictions. Our work is closer to approaches that allow for irrationality or information frictions. Gourinchas and Tornell (2004) and Burnside et al. (2011) show theoretically how the forward premium puzzle may arise from distorted beliefs of investors, while Ilut (2012) proposes an explanation that combines imperfect information with ambiguity aversion. More recently, Candian and De Leo (2021) and Müller et al. (2024) develop general equilibrium models where information frictions and shock misperception help account for the observed behavior of excess returns. Du et al. (2021) look at learning in an open economy framework, their key finding being that it goes a considerable way towards better accounting for exchange rate dynamics. Na and Xie (2023) show how limited foresight can account for dynamic overshooting of forecast errors in the real exchange rate.

More broadly, our results relate to the literature developing structural models with bounded rationality. One of the early contributions was due to Brock and Hommes (1997), who integrated heterogeneous expectations and a partial equilibrium cob-web model into the NK framework. Evans and Honkapohja (2001) and Bullard and Mitra (2002) introduced learning where agents forecast only immediate future variables. An alternative form of learning based on infinite horizons was promoted by Preston (2005). Branch and McGough (2009) and De Grauwe (2011) proposed models where some agents are rational while others either learn adaptively or follow simple rules-of-thumb. More recently, and as an alternative to the cognitive discounting setup that we are closest to, Bordalo et al. (2018) formalized the concept of diagnostic expectations and demonstrated how they can lead to financial cycles, while Bianchi et al. (2021) showed how this concept can be introduced into fully-fledged DSGE models.

The remainder of this paper is structured as follows. Section 2 introduces the theoretical setup with two countries and boundedly rational agents. In Section 3, we use a linearized small open economy version of the model to discuss how behavioral discounting changes the key equilibrium relationships, also presenting the range of parameter values used in numerical experiments. Section 4 shows how allowing for behavioral discounting helps mitigate some exchange rate puzzles. In Section 5, we characterize the implications of myopia for the output and inflation aspect of the forward guidance puzzle. Section 6 discusses the impact of discounting on international monetary policy spillovers. Section 7 analyzes how agents' myopia impinges on model stationarity and equilibrium determinacy. Implications for optimal monetary policy are presented in Section 8. Section 9 concludes.

## 2. Theoretical Setup

We develop a two-country NOEM model with myopic agents. We refer to one of the economies as Home and the other as Foreign. Both are populated by a continuum of households and monopolistically competitive firms. We normalize the world population to unity and use $\zeta \in (0,1)$ to indicate the share of Home agents, with the mass of Foreign agents equal to $1-\zeta$. The two economies are linked by trade in goods and cross-border borrowing, and they have separate monetary authorities. Since both countries are isomorphic, in the rest of this section we focus only on problems faced by Home agents.

### 2.1. Households.

The household sector is populated by a large number of infinitely-lived dynasties. At any time $t$, household $h$ maximizes a discounted stream of period utility flows that depends on consumption $C_t^h$ and labor supply $N_t^h$

$$U_t^h = \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[ \frac{\left(C_T^h\right)^{1-\sigma}}{1-\sigma} - \frac{\left(N_T^h\right)^{1+\varphi}}{1+\varphi} \right], \tag{2.1}$$

where $0 < \beta < 1$ is the subjective discount factor, $\sigma > 0$ is the inverse of the elasticity of intertemporal substitution, $\varphi > 0$ is the inverse of the Frisch elasticity of labor supply, and $\hat{\mathbb{E}}_t$ indicates the expected value operator under the subjective expectations of households that we shall specify subsequently. The consumption basket is made of goods produced domestically $C_{H,t}^h$ and imports $C_{F,t}^h$, aggregated according to

$$C_t^h = \left[ (1-\alpha)^{\frac{1}{\eta}} \left(C_{H,t}^h\right)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} \left(C_{F,t}^h\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{2.2}$$

where $0 < \alpha < 1$ controls the degree of openness and $\eta > 0$ is the trade elasticity.

Households have access to one-period bonds denominated in Home currency $B_t^h$ and in Foreign currency $B_t^{*,h}$, of which only the latter is internationally traded, and which pay nominal interest rate $i_t$ and $i_t^*$, respectively. Labor is remunerated at the real rate $W_t$, and each dynasty also receives an aliquot share in real firm profits $D_t$. The real budget constraint can hence be written as

$$C_t^h + \frac{B_t^h}{1+i_t} + \frac{Q_t}{\Phi_t}\frac{B_t^{*,h}}{1+i_t^*} = \frac{B_{t-1}^h}{\Pi_t} + Q_t\frac{B_{t-1}^{*,h}}{\Pi_t^*} + W_t N_t^h + D_t, \tag{2.3}$$

where $P_t$ and $P_t^*$ are the prices of Home and Foreign consumption baskets, $\Pi_t \equiv P_t/P_{t-1}$ and $\Pi_t^* \equiv P_t^*/P_{t-1}^*$ are the associated gross inflation rates, $Q_t \equiv \varepsilon_t P_t^*/P_t$ is the real exchange rate, with $\varepsilon_t$ denoting the number of units of domestic currency per unit of foreign currency, and $\Phi_t = \Phi(B_t^*, \varrho_t)$ representing a risk premium that depends on the Home country's per capita net foreign asset (NFA) position and an exogenous shock $\varrho_t$.[5]

2.2. **Firms.** Final goods sold domestically $Y_{H,t}$ and for exports $Y_{H,t}^*$ are made of intermediate inputs indexed by $f$ and aggregated according to the following Dixit-Stiglitz technology

$$Y_{H,t} = \left[\int_0^1 \left(Y_{H,t}^f\right)^{\frac{1}{\mu}} \mathrm{d}f\right]^{\mu}, \qquad \text{and} \qquad Y_{H,t}^* = \left[\int_0^1 \left(Y_{H,t}^{*,f}\right)^{\frac{1}{\mu}} \mathrm{d}f\right]^{\mu}, \tag{2.4}$$

where $\mu > 1$ controls the degree of substitution between individual inputs.

Intermediate inputs are produced by monopolistically competitive firms that operate a production function linear in labor

$$Y_{H,t}^f + Y_{H,t}^{*,f} = z_t N_t^f. \tag{2.5}$$

where $z_t$ is a common productivity shock. Firms set the same prices for domestic and export sales, quoting them in domestic currency (producer currency pricing) so that $P_{H,t}^f = \varepsilon_t P_{H,t}^{*,f}$ in every period $t$. They are subject to a Calvo-style friction. More specifically, each period only a fraction $0 < \theta < 1$ of firms is allowed to reoptimize their prices. The problem of intermediate goods producers is then to maximize

$$V_t^f = \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \theta^{T-t} \Lambda_{t,T} \left[P_{H,t}^f (Y_{H,T}^f + Y_{H,T}^{*,f}) - W_T N_T^f\right], \tag{2.6}$$

subject to production technology (2.5) and demand constraints implied by aggregation (2.4). Since firms are owned by households, they discount future profits using $\Lambda_{t,T} \equiv \beta^{T-t} u_1(C_T, N_T)$, i.e., their stochastic discount factor is consistent with household preferences, and their expectations are in line with those in Equation (2.1).

2.3. **Myopia.** When solving their problems in every period $t$, households and firms form subjective expectations denoted by the operator $\hat{\mathbb{E}}_t$. We deviate from rational expectations

[5] This can be microfounded by assuming that international capital flows are intermediated by specialized agents facing limited risk-bearing capacity, with exogenous fluctuations in the premium reflecting the presence of noise traders. See Gabaix and Maggiori (2015) or Itskhoki and Mukhin (2021).

by assuming that agents are myopic and cannot correctly anticipate the evolution of variables that are beyond their control. More specifically, we follow Gabaix (2020) and the microfoundation discussed therein, and assume that when agents anticipate the future, they shrink their expectations toward a benchmark represented by the economy's steady state.

Formally, for any variable $X_t$ that agents take as given during optimization, the perceived equilibrium law of motion is

$$X_{t+1} - X = m\mathbf{G}^X(\mathbf{X}_t - \mathbf{X}, \epsilon_{t+1}), \tag{2.7}$$

where $\mathbf{X}_t$ is a vector of aggregate state variables, $\epsilon_t$ is a vector of mean-zero innovations to stochastic processes driving economic fluctuations, $\mathbf{G}^X$ is the equilibrium aggregate policy function for variable $X_t$, and where variables without time subscripts indicate steady state values, with $0 \leq m \leq 1$ denoting a cognitive discounting parameter. The specification nests the standard case of rational expectations, which readily obtains for $m = 1$, with lower values of $m$ making agents myopic in that they expect future macroeconomic conditions to revert back to the steady state faster.

It is important to stress that agents misperceive laws of motion of variables beyond their individual control. More specifically, and as in Woodford (2013), households and firms correctly perceive the constraints defining their individual problems, and hence their decisions are optimal, conditional on subjective beliefs about the future evolution of variables that they take as given.

2.4. **Monetary Authority.** Unless indicated otherwise, the monetary authority follows a standard Taylor-like feedback rule

$$i_t = \rho i_{t-1} + (1-\rho)\left[i + \phi_\pi(\Pi_t - \Pi) + \phi_y \log(Y_t/Y)\right] + \nu_t, \tag{2.8}$$

where $0 \leq \rho < 1$ controls the degree of interest rate smoothing, $\phi_\pi$ and $\phi_y$ determine the reaction to deviations of inflation $\Pi_t \equiv P_t/P_{t-1}$ and output $Y_t \equiv Y_{H,t} + Y^*_{H,t}$ from their steady state levels, and $\nu_t$ denotes a monetary policy shock.

2.5. **General Equilibrium.** In equilibrium, all households make identical choices so that individual allocations are equal to aggregate per capita quantities, implying $C^h_t = C_t$, $N^h_t = N_t$, $B^{*,h}_t = B^*_t$, $B^h_t = B_t = 0$, where the last equality follows from the fact that bonds denominated in Home currency can only be traded by Home households.

Labor supplied by households must be equal to labor demand, leading to the following condition

$$N_t = \int_0^1 N^f_t \mathrm{d}f, \tag{2.9}$$

while goods market clearing requires

$$Y_{H,t} = C_{H,t}, \qquad \text{and} \qquad Y^*_{H,t} = \frac{1-\zeta}{\zeta} C^*_{H,t}. \tag{2.10}$$

## 3. Linearized Model for a Small Open Economy

3.1. **Linear Approximation to Behavioral Discounting.** For tractability, we consider a linearized version of the model defined in the previous section. As shown by Gabaix (2020), this simplifying assumption allows us to approximate behavioral $k$-period ahead expectations of any variable $X_t$ that agents take as given during optimization as

$$\hat{\mathbb{E}}_t \left\{X_{t+k} - X\right\} = m^k \mathbb{E}_t \left\{X_{t+k} - X\right\}, \tag{3.1}$$

where $\mathbb{E}_t$ is the rational expectations operator. As this formula reiterates, agents are myopic with respect to deviations from the – correctly perceived – steady state, particularly if those deviations occur in the distant future.

3.2. **Linearized Equilibrium Conditions.** When linearizing the model, we focus on the small open economy case, which obtains as the limit when $\zeta \to 0$. We also assume zero steady state inflation ($\Pi = 1$) and zero steady state net foreign assets ($B^* = 0$), which also implies $C = Y$. We define the following transformations: $\hat{i}_t \equiv \log(1 + i_t) - \log(\beta^{-1})$, $\hat{\pi}_t \equiv \log(\Pi_t)$, $\hat{B}^*_t \equiv (B^*_t Q_t - B^*)/Y$, with corresponding expressions for their Foreign analogs. All other 'hat' variables are defined as percent deviations from steady state, i.e. $\hat{X}_t \equiv (X_t - X)/X$.

Below we present and discuss the linearized equilibrium conditions. Let us reiterate here that agents are assumed to be myopic only about aggregate states (and hence prices), but not about their individual choices given these states. This means that deriving some of the equilibrium conditions is not straightforward. For example, it requires formulating the household-level consumption function that depends only on those (current and future) variables that are beyond control of individual agents. Only by doing this can we apply formula (3.1). We outline the key steps associated with the model derivation in Appendix (A).

Solving the household problem results in the following modified IS curve

$$\hat{C}_t = m\mathbb{E}_t\hat{C}_{t+1} - \frac{1}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right) + (1-m)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}^*_t. \tag{3.2}$$

The standard New Keynesian relationship can immediately be recovered by setting $m = 1$. If $m < 1$, expectations about future consumption and inflation are discounted, similarly to the closed economy New Keynesian model considered by Gabaix (2020).[6] Notably, however, the move to an open economy setup is associated with an extra term in the behavioral IS

[6] In his baseline formulation, and for reasons alluded to in footnote 17, Gabaix (2020) assumes that agents correctly perceive the ex ante real interest rate, which means that expected inflation in Equation 3.2 is not discounted. Crucially, none of our main findings hinge on whether we follow Gabaix in assuming that the

curve, which now additionally depends on the country's net foreign asset position. This term crops up because Equation (3.2) is derived using subjectively optimal consumption plans. More specifically, agents do not apply discounting to their individual choices, i.e. $\hat{\mathbb{E}}_t \hat{B}^{*,h}_{t+k} \neq m^k \mathbb{E}_t \hat{B}^{*,h}_{t+k}$ for $k \geq 1$, but do it only when forming expectations about variables beyond their control. In particular, they correctly predict their future consumption and accumulated assets *conditional on* expectations about future prices, and only have distorted views about the latter. As a result, following an asymmetric positive income shock that Home households want to smooth over by increasing foreign bond holdings (net foreign assets in aggregate), the equilibrium response of consumption will be bigger than it would have been without the final term in Equation (3.2).[7]

Relatedly, optimal bond holdings of myopic households can be shown to imply an uncovered interest rate parity (UIP) condition

$$\hat{i}_t - m\mathbb{E}_t \left\{\hat{\pi}_{t+1}\right\} = \hat{i}^*_t - m\mathbb{E}_t \left\{\hat{\pi}^*_{t+1} - \hat{Q}_{t+1}\right\} - \hat{Q}_t - \phi \hat{B}^*_t + \varrho_t, \tag{3.3}$$

where $\phi = \Phi'(0,0)$. Again, a standard risk premium-augmented UIP condition obtains for $m = 1$.

Optimal price setting by myopic firms leads to the following Phillips curve for domestic prices

$$\hat{\pi}_{H,t} = m\beta\mathbb{E}_t\{\hat{\pi}_{H,t+1}\} + \kappa \hat{MC}_t, \tag{3.4}$$

where $\kappa \equiv \frac{(1-\theta)(1-\beta\theta)}{\theta}$, and which collapses to the canonical New Keynesian Phillips curve for $m = 1$ (see also Appendix A.4 for details).

The remaining equilibrium conditions are not affected by discounting. In particular, the real marginal cost, deflated by the producer price index is

$$\hat{MC}_t = \sigma\hat{C}_t + \varphi\hat{Y}_t + \frac{\alpha}{1-\alpha}\hat{Q}_t - (1+\varphi)\hat{z}_t, \tag{3.5}$$

the consumer price inflation (CPI) is given by

$$\hat{\pi}_t = \hat{\pi}_{H,t} + \frac{\alpha}{1-\alpha}\left(\hat{Q}_t - \hat{Q}_{t-1}\right), \tag{3.6}$$

while the aggregate goods market clearing condition can be written as

$$\hat{Y}_t = (1-\alpha)\hat{C}_t + \alpha\hat{Y}^*_t + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_t. \tag{3.7}$$

current real interest rate is "special" and perceived without bias, or if we instead treat it in line with all other variables beyond an agent's control, as implicit in Equation 3.2.

[7] See also Appendix A.3 for more details and Appendix C for a discussion of how this result is modified when markets are complete so that accumulation of net foreign assets becomes irrelevant.

Aggregating the budget constraints of all Home agents leads to the following law of motion for net foreign assets

$$\hat{B}_t^* = \beta^{-1}\left(\hat{B}_{t-1}^* + \hat{Y}_t - \hat{C}_t\right). \tag{3.8}$$

Finally, the linearized version of the monetary policy rule (2.8) is

$$\hat{i}_t = \rho\hat{i}_{t-1} + (1-\rho)(\phi_\pi\hat{\pi}_t + \phi_y\hat{Y}_t) + \nu_t. \tag{3.9}$$

Equations (3.2)–(3.9) jointly define the equilibrium evolution of $\hat{Y}_t$, $\hat{C}_t$, $\hat{\pi}_t$, $\hat{\pi}_{H,t}$, $\hat{MC}_t$, $\hat{Q}_t$, $\hat{i}_t$, $\hat{B}_t^*$, driven by productivity shocks $z_t$, monetary policy shocks $\nu_t$, risk premium shocks $\varrho_t$, and foreign variables $\hat{Y}_t^*$, $\hat{\pi}_t^*$, $\hat{i}_t^*$, which are exogenous from the Home country perspective (on account of the SOE assumption).

For given foreign productivity shocks $z_t^*$ and monetary shocks $\nu_t^*$, equilibrium conditions characterizing the evolution of foreign output, inflation and interest rates are then given by

$$\hat{Y}_t^* = m\mathbb{E}_t\hat{Y}_{t+1}^* - \frac{1}{\sigma}\left(\hat{i}_t^* - m\mathbb{E}_t\hat{\pi}_{t+1}^*\right), \tag{3.10}$$

$$\hat{\pi}_t^* = m\beta\mathbb{E}_t\{\hat{\pi}_{t+1}^*\} + \kappa(\sigma+\varphi)\left(\hat{Y}_t^* - \hat{z}_t^*\right), \tag{3.11}$$

$$\hat{i}_t^* = \rho\hat{i}_{t-1}^* + (1-\rho)(\phi_\pi\hat{\pi}_t^* + \phi_y\hat{Y}_t^*) + \nu_t^*. \tag{3.12}$$

These equations follow from the same principles as in the Home economy, but additionally account for the fact that the Foreign economy can be treated as closed.

3.3. **Estimation.** To investigate the implications of behavioral discounting in an open economy, we shall combine closed-form derivations – which help account for results of stylized experiments – with numerical simulations designed to shed light on more analytically-involved questions. For the latter, we will need to assign numerical values to model parameters. To that end, we perform a full Bayesian estimation of the model, more details on which are provided in Appendix E. Broadly, the Home and Foreign economies are represented by Canada and the US, respectively. We use standard macroeconomic time series (output, inflation, short-term interest rate) for each of the two countries as well as their bilateral exchange rate. Our baseline sample of quarterly data covers the period 1972-2007, but we also verify the robustness of our results by using a subsample starting in 1982 (so that it excludes the Great Inflation), and an extended sample that ends in 2019 (so that it includes the Great Recession and its aftermath up to the COVID-19 pandemic).

As is standard in the DSGE literature, we fix the subset of parameters that can be pinned down by long-term averages observed in the data, or which are weakly identified when using standard macroeconomic time series. We make the economy fairly open by setting the import share parameter $\alpha$ equal to 0.4. The discount factor $\beta$ is calibrated to 0.99, which, for zero average inflation, implies a steady state nominal interest rate of 4 per cent per annum.

The steady state markup in the goods market $\mu$ is set equal to 1.2. We set the slope of the risk premium in the UIP condition $\phi$ to a relatively small value of 0.01.[8] As discussed subsequently, this value is sufficient to induce stationarity for empirically relevant degrees of myopia.

We center the prior distributions of the remaining parameters on values used by Gali and Monacelli (2005), except that we choose a higher value of the Calvo probability to make our model consistent with more recent empirical evidence on the slope of the Phillips curve. The tightness of the prior distributions is motivated by the DSGE literature that estimates open economy models (see, e.g., Adolfson et al., 2007; Justiniano and Preston, 2010). Most importantly, the cognitive discounting parameter $m$ is assumed to follow a beta distribution with mean 0.8 and standard deviation of 0.07. The mode of the prior hence implies that an innovation materializing in a year's time would affect decision rules by about half as much as a contemporaneous one (as chosen by Gabaix, 2020). This choice can be considered a fairly conservative take on the degree of myopia.[9]

Table 1. **Estimation Results**

| | | Rational ($m = 1$) | Behavioral | Inflated Priors |
|---|---|---|---|---|
| Prior $m$ | Mean | - | 0.80 | 0.80 |
| | Std. | - | 0.07 | 0.10 |
| Posterior $m$ | Mean | - | 0.68 | 0.62 |
| | Median | - | 0.69 | 0.64 |
| | [5%, 95%] | - | [0.54, 0.83] | [0.37, 0.81] |
| Log Marginal Likelihood | | -1075.4 | -1050.6 | -1020.5 |

Table 1 summarizes the key results of Bayesian estimation. Comparing the first two columns reveals that the marginal likelihood is significantly improved for the behavioral open economy model relative to its rational benchmark (obtained by fixing $m$ at 1). Moreover, the posterior distribution of the myopia parameter $m$ is significantly shifted from the prior, with the posterior mean coming in as low as 0.68 for our baseline model. As the marginal posterior distribution of this parameter is left skewed, which reflects the shape of the prior distribution

[8] In models with debt-elastic UIP premia like ours, $\phi$ can also be interpreted as a measure of FX market depth, see Gabaix and Maggiori (2015). The assumed value of 0.01 is consistent with fairly deep markets that typically characterize advanced economies, in line with evidence presented in Chen et al. (2023). As that paper shows, $\phi$ can be significantly higher for emerging market economies.

[9] Empirical estimates of the Euler equation by Fuhrer and Rudebusch (2004) are consistent with an $m$ of 0.65. Relatedly, Gust et al. (2022) estimate a closed economy New Keynesian model with a finite planning horizon as in Woodford (2019), and arrive at discounting in the IS curve close to 0.5. Brzoza-Brzezina et al. (2025) estimate a two-country behavioral model for Poland and the euro area, obtaining $m = 0.68$. Ilabaca et al. (2020) allow for a different degree of behavioral discounting by households and firms, estimating corresponding values of $m$ equal to 0.71 and 0.41, respectively.

that we tilt towards the rational benchmark, the posterior median is somewhat higher but still indicates a large deviation from rationality. The high empirical relevance of behavioral discounting is further supported by an alternative specification, in which we increase the standard deviation of the prior distributions of all estimated parameters by a half, keeping the means unchanged, so that the posterior estimates are more influenced by the data. In this case, fit is further improved and the mean and median estimates of $m$ shift away from unity even more.[10]

## 4. Exchange Rate Puzzles

The estimates presented in the previous section are based on models that allow for an exogenous shock to the UIP risk premium. Itskhoki and Mukhin (2021) argue that this type of shocks is key to resolve a number of puzzles associated with the exchange rate, including its relationship with the interest rate differential. However, even though we use all these variables as observable when estimating our models, and despite the presence of UIP shocks, our results speak strongly in favor of sizable myopia. This suggests that the framework we propose may offer a complementary explanation of UIP-related puzzles relative to that advocated by Itskhoki and Mukhin (2021).[11] To check if this is indeed the case, we investigate the extent to which we can mitigate the puzzles without relying on UIP-premium shocks. We focus on three now classical results: forward premium puzzle of Fama (1984), the predictability reversal puzzle (Bacchetta and van Wincoop, 2010), and the Engel puzzle (Engel, 2016). Additionally, we consider Galí's (2020) exchange rate forward puzzle, which cannot be explained by exogenous UIP shocks. As is typically done in the literature, and mainly for expositional purposes, we present the intuition conditional on monetary shocks, though we note that very similar results obtain for productivity and cost-push shocks as well.

As discussed in Section 3, our approach implies a standard risk-adjusted uncovered interest rate parity condition, except for the fact that the expectation operators appearing in it are behavioral rather than rational. Once these behavioral terms are reexpressed as a function of their rational equivalents and the exogenous UIP premium is dropped, we arrive at the

[10] Increasing the standard deviation of the prior distribution of $m$ in a way that preserves its mean can lead to bimodality in the posterior distribution. This bimodality vanishes if we assume a symmetric prior distribution, i.e., center it on 0.5 rather than closer to the rational benchmark. The resulting posterior estimate of this parameter then becomes even lower than reported in Table 2.

[11] This conclusion is reinforced by the outcomes of global sensitivity analysis (Ratto, 2008) of our model, which indicates that smaller values of $m$ are particularly crucial for the fit of the exchange rate series (and also for domestic inflation, in line with the literature estimating closed economy models with behavioral discounting).

following "behavioral" UIP condition, which simply rewrites Equation (3.3) for $\varrho_t = 0$

$$\hat{i}_t - \hat{\imath}_t^* = m\mathbb{E}_t\left\{\Delta\hat{\varepsilon}_{t+1}\right\} - (1-m)\hat{Q}_t, \tag{4.1}$$

and where we define $\hat{\imath}_t^* \equiv \hat{i}_t^* - \phi\hat{B}_t^*$ as the foreign nominal interest rate adjusted by the endogenous component of the risk premium.[12] We will make extensive use of this formula when explaining why our model can significantly mitigate the extent of the aforementioned puzzles.

4.1. **Forward Premium Puzzle.** Under uncovered interest rate parity, the domestic currency is expected to depreciate if the home interest rate exceeds the foreign. As alluded to above, however, Fama (1984) famously showed that this simple prediction is at odds with the data, where high interest currencies tend to offer higher returns. We now investigate whether our behavioral model can help account for this feature of the data.

The UIP condition ((4.1)) in our behavioral model points to two opposing forces affecting the forward premium. On the one hand, the fact that the expected future depreciation is discounted tends to generate lower returns on high-interest currencies, thus deepening the Fama puzzle. On the other hand, the premium will be affected by the comovement between interest rates and the real exchange rate, which is typically negative and hence acts in the opposite direction.

To move beyond such qualitative statements and to compare the relative contributions of both terms, we first rewrite the UIP condition as

$$\mathbb{E}_t\left\{\Delta\hat{\varepsilon}_{t+1}\right\} = \frac{1}{m}\left(\hat{i}_t - \hat{\imath}_t^*\right) + \left(\frac{1}{m} - 1\right)\hat{Q}_t. \tag{4.2}$$

This formulation is designed to resemble "Fama (1984) regressions" typically used to document the forward premium puzzle, i.e.,

$$\Delta\hat{\varepsilon}_{t+1} = a_0 + a_1\left(\hat{i}_t - \hat{\imath}_t^*\right) + \epsilon_t, \tag{4.3}$$

where $\epsilon_t$ is the regression residual. It is well known that empirical estimates of this equation suggest values of the slope coefficient $a_1$ that is close to zero, or even negative, while standard UIP counterfactually implies $a_1 = 1$.

[12] We define the "premium adjusted" nominal interest rate for analytical convenience as it allows us to write the UIP condition in its canonical form. Note that, since we calibrate $\phi$ to be small, $\hat{\imath}_t^*$ is very close to $\hat{i}_t^*$. We have verified that all results presented further in this section, and which use the "premium adjusted" foreign rate, are very similar to those obtained without such an adjustment.

If we estimated Equation (4.3) using data simulated from our behavioral model, the expected value of the $a_1$ coefficient would be

$$\mathbb{E}a_1 = \frac{1}{m} + \left(\frac{1}{m} - 1\right) \frac{\mathbb{E}\left\{\hat{Q}_t \left(\hat{i}_t - \hat{\imath}_t^*\right)\right\}}{\mathbb{E}\left\{\left(\hat{i}_t - \hat{\imath}_t^*\right)^2\right\}}$$

$$= \frac{1}{m} + \left(\frac{1}{m} - 1\right) Corr\left\{\hat{Q}_t, \hat{i}_t - \hat{\imath}_t^*\right\} \frac{Std\left\{\hat{Q}_t\right\}}{Std\left\{\hat{i}_t - \hat{\imath}_t^*\right\}}, \tag{4.4}$$

where we have combined the population regression and omitted variable bias formulas. We first observe that, for $m = 1$, the second term vanishes and so $\mathbb{E}a_1 = 1$, replicating the original forward premium puzzle. We also see that as $m$ becomes lower than unity, the first term pushes the model-implied regression coefficient above one, exacerbating the puzzle. However, this effect can be more than offset by the second term if it is sufficiently negative. This is typically the case, especially conditional on monetary shocks as they imply that the real exchange rate is almost perfectly negatively correlated with the interest rate differential.

Indeed, as we show in Table 2, the posterior mean parameter values obtained by estimating our baseline behavioral model bring the Fama coefficient down to 0.61, which can be considered a significant improvement over the rational expectations benchmark. Bearing in mind that the empirical estimates typically find this coefficient to be close to zero, we can go as far as half-way towards resolving the forward premium puzzle if we consider our model estimation with inflated priors, since it implies an even higher degree of behavioral discounting (i.e., lower $m$).

TABLE 2. **Fama Regression Coefficients**

| MODEL | $m$ | $\rho$ | FAMA COEFF. |
|---|---|---|---|
| Rational | 1.00 | 0.87 | 1.00 |
| Baseline | 0.68 | 0.86 | 0.61 |
| Inflated priors | 0.62 | 0.86 | 0.53 |
| Baseline, low $\rho$ | 0.68 | 0.75 | 0.75 |
| Baseline, high $\rho$ | 0.68 | 0.95 | 0.35 |

More generally, and as is clear from Equation (4.4), the extent to which behavioral discounting helps address the Fama puzzle crucially depends not only on the value of $m$, but also on the variability of the real exchange rate relative to that of the interest rate. The last two rows in Table 2 document this model property by recomputing the expected value of the slope coefficient $a_1$ for alternative values of the interest rate smoothing parameter $\rho$, keeping all other parameters at their baseline posterior means. A large degree of behavioral discounting is capable of generating particularly low values of the Fama coefficient if it is coupled with high interest rate smoothing. Intuitively, the reason why such parameter combinations perform well is because higher values of smoothing decrease the volatility of interest rates relative to the real exchange rate. This, in turn, occurs because real exchange rates depend on the whole future path of interest rates, and the fact that these become positively autocorrelated under greater smoothing tends to amplify the variance of the sum (i.e., makes it exceed the sum of individual variances by more).

4.2. **Predictability Sign Reversal Puzzle.** We next turn to Engel-style regressions and discuss our model's ability to match the empirical patterns documented in Bacchetta and van Wincoop (2010) and confirmed in real form by Engel (2016). To that effect, we focus on regressions specified as

$$r^x_{t+1} \equiv \hat{i}_t - \hat{i}^*_t - \Delta\hat{\varepsilon}_{t+1} = b_{s,0} + b_{s,1}\left(\hat{i}_{t-s} - \hat{i}^*_{t-s}\right) + \epsilon_t, \tag{4.5}$$

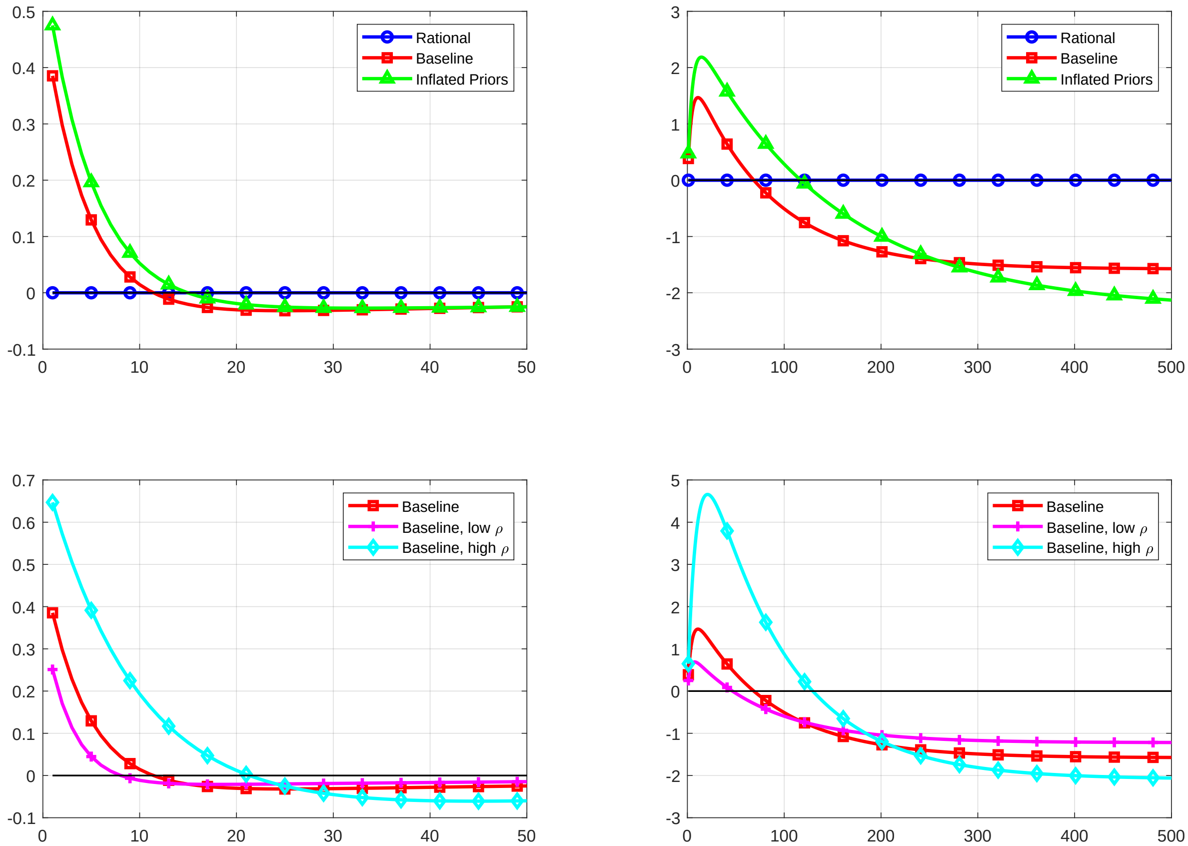
where $s = 0, 1, ....$[13] As first shown by Bacchetta and van Wincoop (2010), the coefficient $b_{s,1}$ turns from positive to negative in the data for some $s$. Engel (2016) additionally argues that the data satisfy an even stronger requirement, namely that $Cov\left\{\mathbb{E}_t \sum_{s=0}^{\infty} r^x_{t+s+1}, \hat{i}_t - \hat{i}^*_t\right\} < 0$, which can be shown to be equivalent to $\sum_{s=0}^{\infty} b_{s,1} < 0$. An immediate implication of this condition (Engel condition henceforth) is that the *level* of the high-yielding country's exchange rate is stronger than implied by UIP, or, expressed alternatively, that exchange rate volatility exceeds what could be predicted based on the simple uncovered interest rate parity condition.

To relate our open economy behavioral model to these stylized facts, Figure 4.1 provides an overview of its key implications. Specifically, for the different model variants defined when discussing the forward premium puzzle, the left panels show the model-implied $b_{s,1}$ coefficients as a function of $s$ (x-axis). Given the equivalence between $Cov\left\{\mathbb{E}_t \sum_{s=0}^{\infty} r^x_{t+s+1}, \hat{i}_t - \hat{i}^*_t\right\} < 0$ and infinite sums of $b_{s,1}$ appearing in the Engel condition, the right-hand panels additionally plot the cumulative sums $\sum_{s=0}^{T} b_{s,1}$ for values of $T$ ranging from 0 to 500.

The first row of Figure 4.1 confirms two important findings. First, and as shown in the left panels, cognitive discounting is capable of generating sign reversals in Engel regression coefficients. We see, in particular, that $b_{s,1}$ eventually becomes negative for both estimated versions of the behavioral model, but not for the rational expectations (RE) case. It thus appears that the RE model's inability to match the sign reversal findings of Bacchetta and van Wincoop (2010) is a knife-edge result specific to "full rationality". Second, and as made

[13] Note that for $s = 0$ the above is equivalent to a Fama-type regression (Equation 4.3), in which $b_{0,1} = 1 - a_1$.

FIGURE 4.1. **Engel Regression Results**




(A) Engel Coefficients

(B) Cumulative Sums of Engel Coeffs.

**Note:** The left panels show Engel regression coefficients, i.e., $b_{s,1}$ from Equation (4.5), as a function of $s$, using various versions of the estimated model (first row) or the baseline behavioral model with alternative assumptions on the interest rate smoothing coefficient $\rho$. The right panels plot the corresponding cumulative sums $\sum_{s=0}^{T} b_{s,1}$ for $T$ ranging from 0 to 500.

clear by the right panels, the behavioral model can account for Engel's excess volatility puzzle.

To build intuition for these findings, we start by expressing excess returns as

$$\mathbb{E}_t r^x_{t+1} \equiv \hat{i}_t - \hat{\imath}^*_t - \mathbb{E}_t \left\{\Delta\hat{\varepsilon}_{t+1}\right\} = (m-1)\mathbb{E}_t \left\{\hat{Q}_{t+1} + \hat{\pi}_{t+1} - \hat{\pi}^*_{t+1}\right\}. \tag{4.6}$$

We first note that the real exchange rate depreciates persistently in response to a domestic policy tightening. This initially leads to a decumulation of net foreign assets on account of lower price competitiveness. However, the real exchange rate must eventually depreciate relative to its steady state to facilitate the accumulation of net foreign assets, allowing them to converge to the steady state. We note that, as per Equation (4.6), excess returns depend negatively on the real exchange rate if agents are myopic ($m < 1$). Accordingly, the evolution of this premium will reflect the adjustment process that we described above, i.e., an increase in the interest rate differential will initially lead to a persistent exchange rate appreciation and an increase in excess returns, followed by a depreciation and a fall in excess returns below zero. Which is precisely the sign reversal documented in Figure 4.1.

The second row of panels in Figure 4.1 presents the sensitivity of these results to different values of the interest rate smoothing coefficient in the monetary policy rule. The higher is $\rho$, the more delayed the sign reversal. The intuition behind this result is closely related to the argument of Bacchetta and van Wincoop (2021), who show that – in their gradual portfolio adjustment model – the Engel condition may be violated whenever interest rate inertia is very high. This is because higher interest rate autocorrelation amplifies the initial response of excess returns, which also inherit some of the underlying persistence, the confluence of which implies that they may not be offset by future reversals. Notably, however, in our behavioral model even a high value of $\rho$ eventually generates the sign reversal in excess returns, at least for the estimated value of behavioral discounting.

4.3. **Exchange Rate Forward Guidance Puzzle.** We now discuss the exchange rate forward guidance puzzle identified by Galí (2020), who showed that the interest rate differentials in the near (distant) future have much larger (smaller) effects on the real exchange rate (RER) than what would be implied by the standard UIP condition. It is important to note that this puzzle is robust to the presence of a time-varying exogenous risk premium, and hence cannot be resolved by the approach advocated in Itskhoki and Mukhin (2021).

To investigate how behavioral discounting affects this puzzle, we can iterate forward on the UIP condition (3.3), so that we arrive at

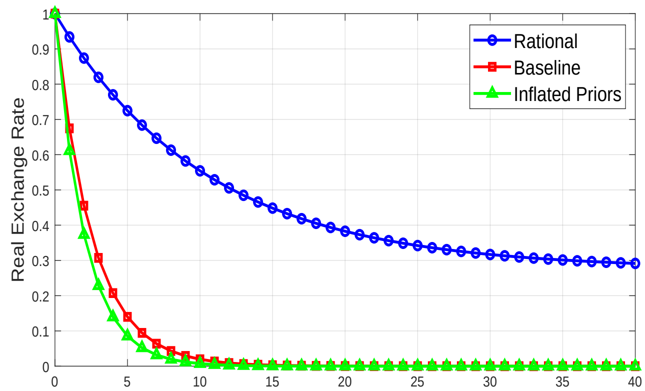
$$\hat{Q}_t = -\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t} \left( \hat{r}_T - \hat{r}_T^* + \phi \hat{B}_T^* \right), \tag{4.7}$$

where we have defined Home and Foreign real interest rates as $\hat{r}_t \equiv \hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}$ and $\hat{r}_t^* \equiv \hat{i}_t^* - m\mathbb{E}_t\hat{\pi}_{t+1}^*$. The responses of the real exchange rate to exogenous changes in the Home real interest rate at different horizons are also depicted in Figure 4.2. Our presentation closely follows that of Gabaix (2020) for inflation, i.e., we shall obtain valuable insights into how monetary policy and forward guidance propagate by studying the impact of real interest rate changes in selected periods, while holding their values fixed at all other horizons.[14] Both the formula and the figure make it immediately apparent that cognitive discounting dampens

[14] We normalize by dividing through the response to an unanticipated shock at horizon zero.

the effects of future real interest rate changes on the current exchange rate, making them less relevant the longer the horizon. In so doing, the move from rational expectations to behavioral discounting thus appears to immediately address one of the two key elements of the exchange rate forward guidance puzzle.

FIGURE 4.2. **Effects of Forward Guidance on the Real Exchange Rate**




**Note:** This figure shows the normalized initial response of the real exchange rate as a function of forward guidance horizon.

It is worth noting that the RER response depicted in Figure 4.2 is declining in forward guidance horizon at a rate *faster* than $m$, and even absent discounting (e.g., the blue line corresponding to $m = 1$ decays instead of being flat). This arises because of the endogenous response of net foreign assets, which compresses the premium-adjusted interest rate differential. Crucially, net foreign assets respond differently at different forward guidance horizons, even for $m = 1$.

To see why, it proves useful to iterate forward on the consumption Euler condition (Equation 3.2) to obtain the following relationship

$$\hat{C}_t = -\frac{1}{\sigma}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T + (1-m)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{B}^*_T. \tag{4.8}$$

Absent discounting, and because we fix $\hat{r}_t = 0$ at all horizons except for the forward guidance horizon $H$, the expression simplifies to

$$\hat{C}_t = \begin{cases} \forall t \leq H: & -\frac{1}{\sigma}\hat{r}_H, \\ \forall t > H: & 0. \end{cases}$$

We thus see that the initial response of consumption does not depend on $H$, and that consumption remains elevated at that higher level for the entire duration of forward guidance. For example, an anticipated 1pp decrease in the real interest rate ten periods ahead (holding real rates in all other periods unchanged) implies that consumption will be $\frac{1}{\sigma}$ percent above the steady state level for exactly eleven periods. As we shall discuss below, a similar relationship can be derived for output (see Equation 5.2), with the crucial difference that, for realistic calibrations, the interest rate elasticity exceeds $\frac{1}{\sigma}$. This means that the longer the horizon of an anticipated decrease in the real interest rate, the longer the period over which the economy generates trade surpluses. This translates into larger NFA accumulation and lower premium-adjusted future interest rate differentials, thus helping mitigate the exchange rate forward guidance puzzle, even under rational expectations. Importantly, however, in that case the forward guidance puzzle is still present and future policy announcements remain very potent even at distant horizons. This is because the blue line corresponding to $m = 1$ does not asymptote to zero but eventually stabilizes somewhat below 0.3.

4.4. **The Role of Market Incompleteness.** As has become standard in the NOEM literature, our model assumes that international financial markets are incomplete. We now discuss how the results presented so far change if we adopt a less realistic, but analytically more tractable, complete markets setup.

The key implication of complete markets is that the perfect international risk sharing condition holds. Using our notation, it can be written in log-linear form as

$$\sigma\left(\hat{C}_t - \hat{C}_t^*\right) = \hat{Q}_t. \tag{4.9}$$

Note that this relationship is not affected by myopia as long as subjective probabilities of future states are the same for all agents, which we have assumed throughout. Further, as we show in Appendix C, the last term in the IS curve (3.2) vanishes when markets are complete, leading to

$$\hat{C}_t = m\mathbb{E}_t\hat{C}_{t+1} - \frac{1}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right). \tag{4.10}$$

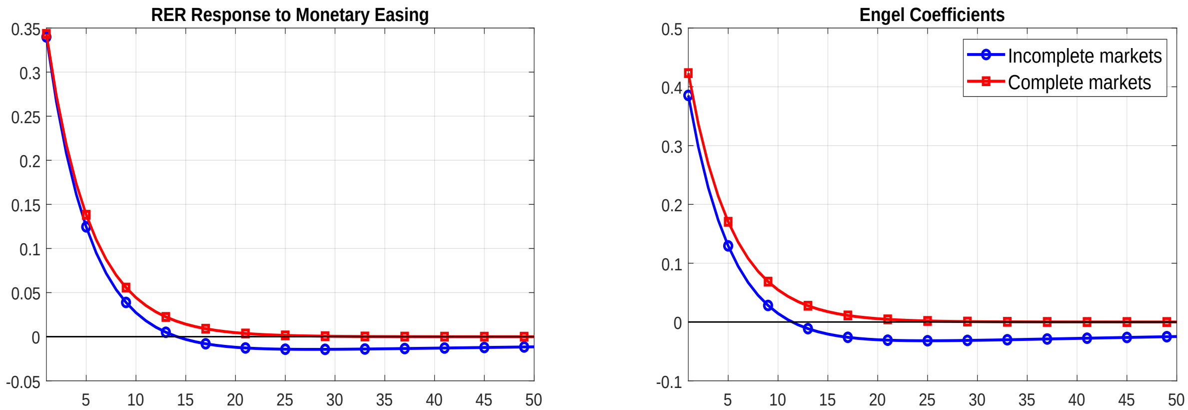
Combining the modified IS curve and its Foreign analog with the risk sharing condition (4.9) yields the following UIP relationship

$$\hat{i}_t - m\mathbb{E}_t\left\{\hat{\pi}_{t+1}\right\} = \hat{i}_t^* - m\mathbb{E}_t\left\{\hat{\pi}_{t+1}^* - \hat{Q}_{t+1}\right\} - \hat{Q}_t, \tag{4.11}$$

which is like formula (3.3) in our baseline model except for the stationarizing risk premium component $\phi\hat{B}_t^*$ no longer being present. As $\phi$ is assumed small, we can expect behavioral discounting to help address UIP-related anomalies also when markets are complete. Indeed, this version of our model implies Fama regression coefficients very similar to those reported in Table 2 for the incomplete markets setup and it still helps mitigate the exchange rate forward guidance puzzle.

However, market incompleteness turns out to be key in the context of the predictability sign reversal puzzle. The explanation is linked to the role played by the exchange rate in restoring the long-run equilibrium, which we described in Section 4.2, and which we additionally

FIGURE 4.3. **Engel Regression Results – Role of Market Incompleteness**




**Note:** The left panel shows the impulse response of the real exchange rate to a 25bp (100 bp annualized) negative monetary policy shock, expressed in percent deviation from the steady state. The numbers are generated using the posterior mean parameter values from the baseline estimation of the model. The right panel shows the corresponding Engel regression coefficients, i.e., $b_{s,1}$ from Equation (4.5), as a function of $s$.

illustrate in Figure 4.3. As the figure demonstrates, when markets are incomplete, net foreign asset accumulation driven by the initially-weak exchange rate must eventually be reversed, allowing the trade balance to deteriorate. As indicated by formula (4.6), this is exactly what flips the excess return sign. While the former relationship still holds in the complete markets case, net foreign assets no longer play a role in equilibrium exchange rate dynamics, which eliminates the flip in the exchange rate and excess returns.

## 5. Output and Inflation Forward Guidance Puzzle

We now investigate the impact of discounting on the transmission of future monetary policy announcements to two other macroeconomic variables, namely output and inflation, highlighting the role played by openness.

5.1. **Output.** Combining the consumption Euler Equation (3.2) with the resource constraint (3.7) and the UIP condition (3.3), ignoring the exogenous component of the risk premium, and using the small open economy assumption to eliminate foreign variables, allows us to derive an IS curve for output[15]

$$\hat{Y}_t = m\mathbb{E}_t\hat{Y}_{t+1} - \left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right)\hat{r}_t - \left[\eta\frac{\alpha(2-\alpha)}{1-\alpha}\phi\hat{B}^*_t - (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\right]\hat{B}^*_t. \tag{5.1}$$

[15] See also Appendix B for details of the derivation.

Iterating forward on this equation yields

$$\hat{Y}_t = -\left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right)\mathbb{E}_t\sum_{T=t}^{\infty} m^{T-t}\hat{r}_T \\ - \left[\eta\frac{\alpha(2-\alpha)}{1-\alpha}\phi - (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\right]\mathbb{E}_t\sum_{T=t}^{\infty} m^{T-t}\hat{B}^*_T, \quad (5.2)$$

where the closed economy case readily obtains by setting $\alpha = 0$ and imposing $\hat{B}^*_t = 0$ for all $t$.

Initially focusing on the first line allows us to derive some key predictions. First we observe that, relative to a closed economy, the same change in the real interest path will have a stronger direct effect on output, unless trade elasticity $\eta$ is very low. More specifically, the formal criterion for the real interest rate to be more powerful can be stated as

$$\eta > \frac{1-\alpha}{2-\alpha}\sigma^{-1} \geq \frac{1}{2}\sigma^{-1},$$

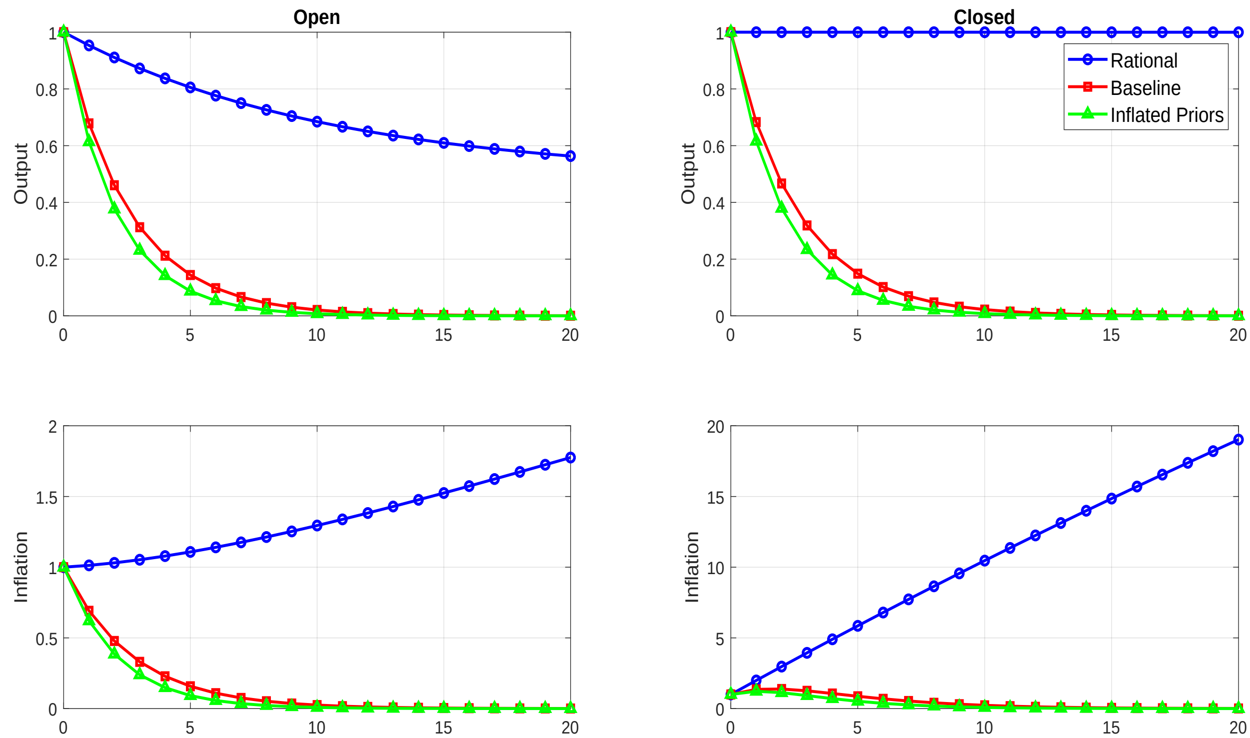
which is satisfied by the posterior mean in all model versions that we estimate, and which also holds more broadly when one takes into account typical parameterizations used in the open economy macroeconomic literature, including papers allowing for low trade elasticity.[16] In addition, and in line with the closed economy case, discounting dampens the effects of real interest rate changes occurring further into the future, helping mitigate the output part of the FGP.

The effect of behavioral discounting on the initial response of output to current and future real interest rate changes is depicted in the first row of Figure 5.1, where we follow the presentation strategy from Section 4.3. The chart clearly shows that behavioral discounting allows for a decay of FG efficiency (as a function of its horizon), both in open and closed economies.

The differences between the open and closed economy cases can be traced back to the endogenous net foreign asset response, i.e., the second line of Equation (5.2) (which is absent in the closed economy case, in which $B^*_t \equiv 0$). Following a pattern similar to the one described before, a longer FG horizon leads to greater accumulation of net foreign assets, which tends to depress output. The latter follows from the fact that the term in the square brackets is typically positive. Overall, and in line with Figure 5.1, the rate of decay is faster in an open economy, which actually also holds absent discounting. Crucially, however, in the fully rational case, FG remains very efficient over very long horizons as the blue line does not go down to zero, but rather asymptotes at around 0.5, consistent with studies confirming the presence of the FGP also in rational expectations open economy models.

[16] See Bodenstein (2010) for a discussion of the consequences of low trade elasticity.

FIGURE 5.1. **Effects of Forward Guidance: Open vs Closed Economy**




**Note:** This figure shows the normalized initial response of output and inflation as a function of forward guidance horizon. The left panel represents the open economy with UIP premium of 0.01 and the right panel represents the closed economy.

5.2. **Inflation.** We now turn to the reaction of inflation, which is depicted in the second row of Figure 5.1. It is clear that, for this variable, the FGP is much less pronounced in an open economy, even without discounting. The reasons why may not appear immediately obvious, particularly as domestic inflation is the discounted sum of future marginal cost, and all its three endogenous components depend on the future path of real interest rates. In an open economy, however, inflation also depends on import prices, which are heavily influenced by the exchange rate.

After some algebra, where we drop terms independent of monetary policy and invoke the small open economy assumption that allows us to treat foreign rates as exogenous, we can characterize the relationship between inflation and domestic real rates as follows[17]

$$\hat{\pi}_t \approx -\frac{\kappa a}{\beta(1-m)}\mathbb{E}_t \sum_{T=t}^{\infty} \left[m^{T-t+1} - (\beta m)^{T-t+1}\right] \hat{r}_T - \frac{\alpha}{1-\alpha}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T - \frac{\alpha}{1-\alpha}\hat{Q}_{t-1}, \quad (5.3)$$

[17] See Appendix B for full details of the derivation.

where we have defined

$$a \equiv \varphi\left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right) + \frac{1}{1-\alpha},$$

and where the approximation comes from omitting several terms loading on NFA, which are quantitatively very small, and which would otherwise obscure the non-monotonic relationship between forward guidance horizon $T-t$ and inflation. In the limiting case $\beta \to 1$, we arrive at

$$\hat{\pi}_t \approx \underbrace{-\kappa a \mathbb{E}_t \sum_{T=t}^{\infty} (T-t+1)\, m^{T-t} \hat{r}_T}_{\text{Domestic Marginal Cost}} \underbrace{- \frac{\alpha}{1-\alpha}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T}_{\text{Import Prices}} - \frac{\alpha}{1-\alpha}\hat{Q}_{t-1}, \tag{5.4}$$

where the first term captures effects due to marginal cost, while the other one is related to the direct effects of exchange rates on prices of imported goods.

The key implications of Equation (5.4) are perfectly consistent with the patterns documented in Figure 5.1. In a closed economy, because the marginal cost component (the only one present in this case) is a product of exponential decay and linear growth, the relationship between the effect on inflation and FG horizon is linear for the rational model ($m = 1$), and possibly non-monotonic for the behavioral model (increasing and then decreasing).[18] In an open economy, the picture is modified by the presence of the import price component, which does not grow with the FG horizon even for the rational case of $m = 1$, and decays very fast for $m < 1$, largely reflecting the strongly mitigating effect of myopia on the exchange rate FGP discussed in Section 4.3. As a consequence, the inflation component of the FGP is much less pronounced in an open economy, implying that the mitigating effect of discounting on this puzzle is also *relatively* smaller compared to the closed economy case.

## 6. International Monetary Policy Spillovers

As we shall show in this Section, our behavioral open economy model also features interesting implications for international monetary spillovers. To analyze these, we first combine the consumption Euler equation (3.2) with the resource constraint (3.7) and iterate on the outcome to arrive at

$$\hat{Y}_t = \underbrace{\alpha \hat{Y}_t^*}_{\text{Demand Channel}} + \underbrace{\eta\frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_t}_{\text{Expenditure Switching Channel}}$$
$$\underbrace{-\frac{1-\alpha}{\sigma}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T}_{\text{Endogenous Home Policy Response}} + \underbrace{(1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{B}_T^*}_{\text{Myopia “Damper”}}. \tag{6.1}$$

[18] This explains the hump shape also documented, though not accounted for, in Gabaix (2020).

The first two terms on the right hand side represent two traditional channels of international spillovers. The first one captures the positive effect of an increase in foreign output, and hence demand for the Home economy's exports. The second is associated with expenditure switching effects caused by the endogenous reaction of the real exchange rate. As the exchange rate appreciates when foreign interest rates go down, this channel acts in the opposite direction to the foreign demand channel, potentially more than offsetting the positive effects of an increase in foreign output.[19] The third term describes the effects of an endogenous response of the Home real interest rate, highlighting the fact that any meaningful evaluation of international spillovers must condition on the monetary policy reaction of the recipient country. Finally, the last term shows up only under myopia, and will typically make the response of Home output to Foreign monetary easing smaller, as the net foreign asset position deteriorates due to an exchange rate appreciation that follows foreign monetary easing.

To provide more intuition on how behavioral discounting affects the size of spillovers, and in line with the preceding observation on their conditionality, we further assume that the Home monetary authority always keeps the real interest rate constant, so that the third term in Equation (6.1) disappears and the expenditure switching channel -- represented by the reaction of the real exchange rate -- becomes exogenous to the Home economy. Iterating the foreign IS curve (3.10) forward, substituting in the outcome for foreign output, using the UIP condition (4.7) to substitute for the real exchange rate, and finally dropping the exogenous component of the risk premium (as it is independent of foreign policy) yields

$$\hat{Y}_t \approx \underbrace{-\frac{\alpha}{\sigma}\mathbb{E}_t \sum_{T=t}^{\infty} m^{*T-t} \hat{r}^*_T}_{\text{Demand Channel}} + \underbrace{\eta \frac{\alpha(2-\alpha)}{1-\alpha}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t} \hat{r}^*_T}_{\text{Expenditure Switching Channel}}, \tag{6.2}$$

where the approximation comes from omitting terms depending on the net foreign asset position, which are quantitatively small and hence immaterial for this part of our results. Clearly, for given degree of myopia abroad $m^*$, behavioral discounting in the Home economy weakens the negative impact of the expenditure switching channel, and hence contributes to positive cross-country comovement in output conditional on foreign monetary shocks.

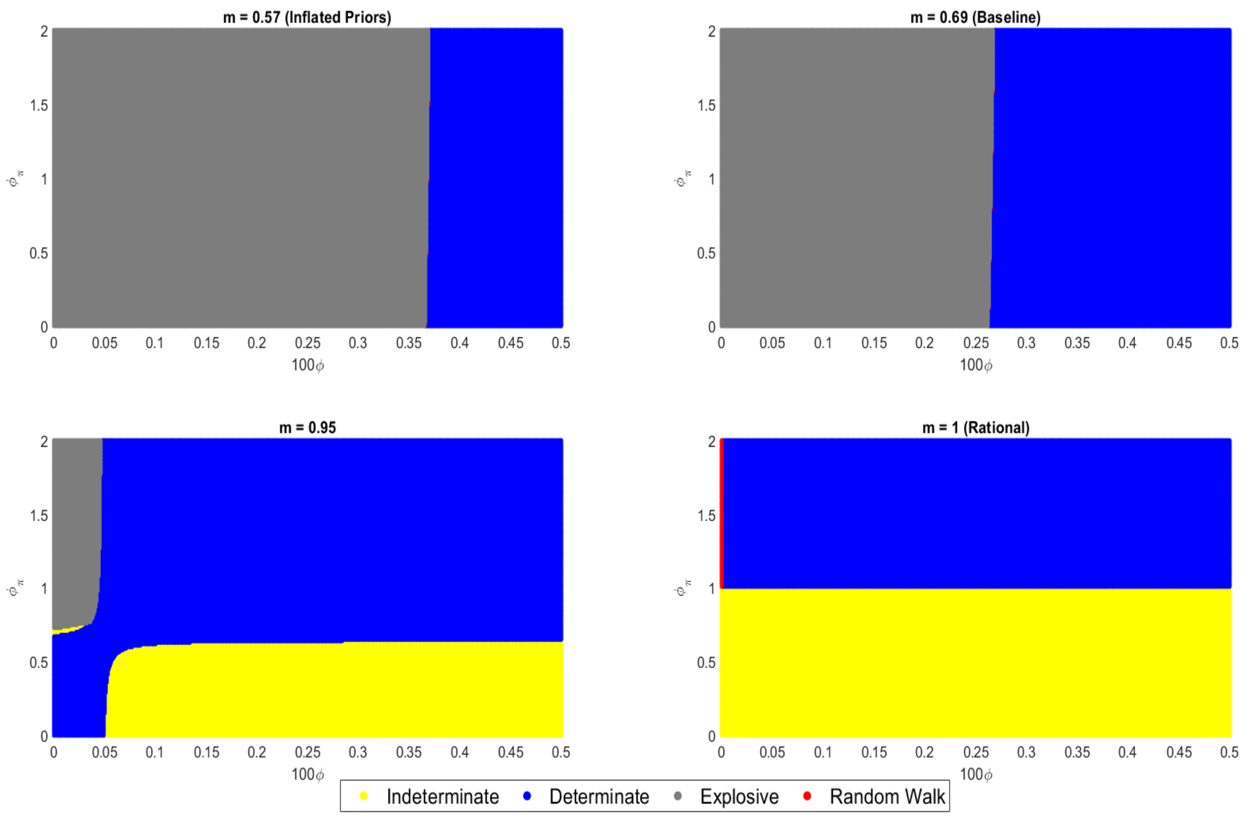
## 7. Stationarity and Determinacy

It is well understood that, in small open economy models with rational agents, the assumption of incomplete asset markets engenders stationarity issues (see also Schmitt-Grohe and

[19] Notably, for given reactions of foreign output and the real exchange rate, the relative importance of these two spillover channels does not depend on discounting.

Uribe, 2003).[20] Among several methods to induce stationarity considered in the NOEM literature, a debt-elastic risk premium on foreign bond holdings is by far the most popular (Senhadji, 2003), and in our setup it is introduced by setting $\phi > 0$. It is also well known that standard New Keynesian models can generate sunspot equilibria when the interest rate does not respond sufficiently strongly to endogenous variables. For example, if the policy rate only reacts to inflation ($\phi_y = 0$), determinacy requires it to respond more than one-for-one to deviations of inflation from target ($\phi_\pi > 1$, Taylor principle). This canonical rational expectations case is illustrated in the bottom right panel of Figure 7.1, which demonstrates, in particular, that *any* positive risk premium ensures stationarity, while satisfying the Taylor principle guarantees uniqueness.

FIGURE 7.1. **Stationarity and Determinacy Regions**




**Note:** This figure shows the type of equilibrium in the linearized version of the model for different values of behavioral discounting $m$, UIP risk premium parameter $\phi$, and monetary policy feedback to inflation $\phi_\pi$. All other parameters are set to the posterior mean in our baseline estimation, except that we set $\phi_y = 0$.

[20] The intuition is that when $m = 1$, and in the absence of a risk premium ($\phi = 0$), the Home real interest rate becomes tied to the (exogenous from the small economy's perspective) foreign real interest rate via the UIP condition 3.3. The IS curve 3.2 then implies that consumption has a unit root.

As the remaining panels reveal, things change dramatically when agents are myopic. Two effects are at play. First of all, behavioral discounting exacerbates the stationarity problem. To see why, it is instructive to inspect Equation (3.2), which clarifies that, except for the final term and if the real interest rate is effectively exogenous from the home economy's perspective, the consumption path becomes *explosive* whenever $m < 1$. While the endogenous evolution of net foreign assets associated with the final term mitigates this effect somewhat, the associated feedback turns out to be too weak to induce stationarity. As a result, and for standard parameter values adopted in our calibration, the case for an additional stationarizing mechanism (such as the debt elastic premium, $\phi > 0$) becomes stronger when agents form behavioral rather than rational expectations. In addition, and unlike in the rational case, we cannot use an arbitrarily small positive $\phi$ to achieve stationarity. Intuitively, this is because myopic agents are less sensitive to future values of the risk premium, and so the responses of their consumption to temporary income shocks are too small to prevent boundless accumulation or decumulation of assets, *unless* $\phi$ is sufficiently large. This effect is stronger for higher degrees of myopia and can be observed in Figure 7.1 by noting that the explosive area tends to expand when $m$ becomes smaller.

The second consideration – documented by Gabaix (2020) in a closed economy setup – is that behavioral discounting shrinks the indeterminacy region, so that a weaker response of the policy rate to inflation may suffice to eliminate sunspot equilibria. This effect can be clearly seen in Figure 7.1, where the area corresponding to indeterminacy decreases in line with the cognitive discounting parameter $m$. Moreover, Figure 7.1 reveals how the two considerations discussed above interact in a non-trivial way: for small degrees of discounting – such as those in lower-left panel – stability may not require a debt-elastic risk premium, but can alternatively be achieved by sufficiently deviating from the Taylor principle. As is well known from the New Keynesian literature, in that case one eigenvalue moves inside the unit circle. It thus ensures model stability by offsetting the impact of the unstable root associated with the Euler equation. This only "works" for small degrees of discounting, however, with the upper left panel of Figure 7.1 highlighting a case in which stability can *only* be achieved by setting the risk premium parameter $\phi$ sufficiently high. Nevertheless, the minimal value of $\phi$ that ensures stability is still fairly small, and the parameterization we adopt ($\phi = 0.01$) is more than sufficient even for a very high degree of myopia.

## 8. Optimal Monetary Policy

We finally discuss the implications of agents' myopia for the optimal conduct of monetary policy. To make our analysis tractable, we follow Gali and Monacelli (2005) and make several simplifying assumptions.[21] More specifically, we focus on the case of complete markets and assume the presence of an employment subsidy that neutralizes the static monopolistic distortion in production of intermediate goods. We also stick to our baseline calibration by fixing the elasticity of intertemporal substitution and price elasticity of international trade at unity. Following most of the behavioral literature, including Gabaix (2020), the welfare criterion is defined as the utility of a representative household under rational expectations. All of the above allows us to approximate the welfare loss in quadratic form as (see Appendix D for derivations)

$$\mathbb{U}_t \approx -\frac{1-\alpha}{2}\mathbb{E}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[\frac{\mu}{\kappa(\mu-1)}\hat{\pi}_{H,T}^2 + (1+\varphi)\hat{x}_T^2\right] + t.i.p., \tag{8.1}$$

where $\hat{x}_t \equiv \log(Y_t/\bar{Y}_t)$ is the output gap, defined as the log-deviation of output from its efficient level $\bar{Y}_t$, which coincides with flexible price output under rational expectations, and $t.i.p.$ stands for terms independent of policy.

Having the welfare loss approximation in quadratic form allows us to characterize the optimal policy problem to second-order, using the linearized equilibrium conditions that summarize agents' decisions as constraints. The key one is the domestic Phillips curve (3.4), which we can rewrite in output gap terms as follows

$$\hat{\pi}_{H,t} = m\beta\mathbb{E}_t\{\hat{\pi}_{H,t+1}\} + \kappa(1+\varphi)\hat{x}_t + \xi_t, \tag{8.2}$$

where we also add a standard cost-push shock $\xi_t$ to create a monetary policy tradeoff. Solving the problem under commitment (timeless perspective) results in the following optimal targeting rule

$$\hat{\pi}_{H,t} + \frac{\mu-1}{\mu}(\hat{x}_t - m\hat{x}_{t-1}) = 0, \tag{8.3}$$

and the optimal producer price level follows

$$\hat{P}_{H,t} = \frac{\mu-1}{\mu}\left[\hat{x}_t - (1-m)\sum_{T=0}^{t-1}\hat{x}_T\right], \tag{8.4}$$

where $\hat{P}_{H,t} \equiv \log(P_{H,t}/P_{H,-1}) = \log(P_{H,t})$ denotes the log-deviation of the producer price index from its initial level, with the latter normalized to unity without loss of generality.

Formulas (8.3) and (8.4) above are the same as in Gabaix (2020) and Benchimol and Bounader (2019), who however consider closed economy setups where the distinction between domestic and final consumption goods disappears. Absent cost-push shocks, it is then optimal for the central bank to perfectly stabilize producer prices as that guarantees an efficient allocation. In contrast, when cost-push shocks are present, the monetary authority

[21] By making these assumptions we essentially extend the analysis in Gali and Monacelli (2005) to the behavioral case. See De Paoli (2009) for how market incompleteness complicates formulation of optimal policy under RE.

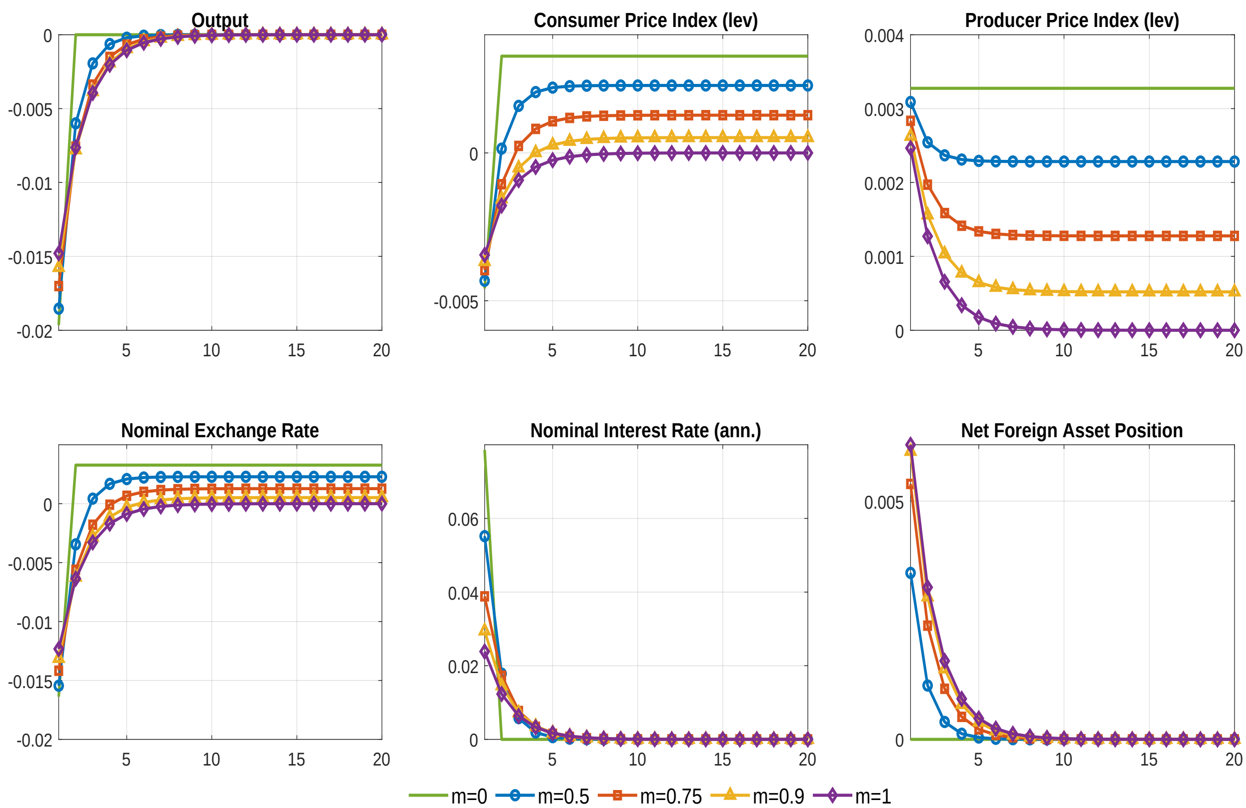
should deviate from period by period stabilization of producer prices. Importantly, and in line with optimal monetary policy analysis for closed economy behavioral models, equation (8.4) implies that, whenever $m < 1$ positive cost-push shocks (which open a negative output gap) push the price level permanently up. Expressed alternatively, the optimality of price level targeting, even in the long run, is a knife-edge result specific to the RE case of $m = 1$.

To illustrate and further study these results, Figure 8.1 plots optimal impulse responses to a positive i.i.d. cost-push shock. When agents are forward-looking and the central bank can credibly commit to future actions, it is optimal to generate a longer lasting recession even when the shock has zero persistence. This is because promising future deflation helps bring the current inflation down. This motive becomes weaker when agents (firms in this case) are myopic, and hence the optimizing policy maker exploits it less. As a result, despite tightening more and generating a deeper fall in output on impact, the outcome is a higher and permanent increase in producer prices. In this way, when agents are myopic, optimal monetary policy under commitment comes closer to the discretionary case. Indeed, in the extreme case of $m = 0$, the optimal responses to an i.i.d. cost-push shock correspond to the discretionary policy outcome: output falls below its steady state level only in the period of the shock while the price level goes up on impact and then remains flat.

These considerations have important consequences in an open economy context. Since, independently of the degree of discounting, the optimal response is to tighten monetary policy, the exchange rate appreciates on impact and then depreciates. However, while it eventually comes back to its initial level when agents are fully rational, it becomes permanently weaker when they are instead myopic, consistent with a permanent increase in the producer price level. An implication is that, when monetary policy is conducted optimally, the nominal exchange rate follows a random walk, even when all relative prices such as the terms of trade or the real exchange rate are stationary. Our results thus suggest that attempting to use the exchange rate as a nominal anchor – a potentially attractive alternative for emerging economies lacking monetary credibility (see, e.g., Frankel, 2010) – becomes considerably less appealing when agents are myopic.

We conclude by noting that optimal policy in an economy with behavioral agents makes the net foreign asset position less responsive to shocks, as can be gleaned from the last panel of Figure 8.1. Again, this feature reflects incentives of the policy maker to exploit forward-looking behavior of agents to keep consumption down for longer, which is reflected in a positive value of the net portfolio vis-a-vis the rest of the world. As explained before, this incentive is lower when agents are myopic and, in the extreme case of $m = 0$, net foreign assets do not respond at all to temporary cost-push shocks.

Figure 8.1. **Optimal Responses to a Cost-Push Shock**




**Note:** This figure shows the impulse response functions to a 0.25% i.i.d. cost-push shock. The purple and green lines indicate the extreme cases of no discounting ($m = 1$) and full discounting ($m = 0$).

## 9. Conclusions

In this paper, we have studied the implications of extending the standard open economy New Keynesian framework by adding behavioral agents á la Gabaix (2020). We have shown that the resulting model fits the data better, and also markedly improves upon its fully rational variant along several additional dimensions. First, it helps mitigate puzzles related to the uncovered interest rate parity condition in a way that is consistent with recent empirical evidence reassessing those puzzles using survey-based measures of expectations. Second, accounting for myopia decreases the efficacy of policies that rely on announcements of future actions, like "low for longer", thus rectifying a key element of the forward guidance puzzle, both for the exchange rate and inflation. Third, by decreasing the relative strength of the exchange rate channel, the behavioral open economy model can better account for international output comovement. Fourth, we have also shown that cognitive discounting has important implications for the optimal conduct of monetary policy, including calling into question the desirability of using the exchange rate as a nominal anchor.

While incorporating behavioral aspects in a consistent way is not costless, and doing so can quickly become quite involved in more complex environments, we believe that the price is worth paying as the benefits in the form of better empirical fit and more reasonable implications are significant. As our analysis suggests, this is true both when working with closed and open economy models, but, arguably, particularly so for the latter on account of the numerous anomalies which cognitive discounting helps mitigate.

## References


Adjemian, S., H. Bastani, M. Juillard, F. Karame, J. Maih, F. Mihoubi, W. Mutschler, G. Perendia, J. Pfeifer, M. Ratto, and S. Villemot (2021): "Dynare: Reference Manual Version 4," Dynare Working Papers 1, CEPREMAP. E.3

Adolfson, M., S. Laseen, J. Linde, and M. Villani (2007): "Bayesian estimation of an open economy DSGE model with incomplete pass-through," *Journal of International Economics*, 72, 481–511. 1, 3.3

Bacchetta, P., E. Mertens, and E. van Wincoop (2009): "Predictability in financial markets: What do survey expectations tell us?" *Journal of International Money and Finance*, 28, 406–426. 2

Bacchetta, P. and E. van Wincoop (2010): "Infrequent Portfolio Decisions: A Solution to the Forward Discount Puzzle," *American Economic Review*, 100, 870–904. 1, 4, 4.2, 4.2, 4.2

Bacchetta, P. and E. van Wincoop (2021): "Puzzling exchange rate dynamics and delayed portfolio adjustment," *Journal of International Economics*, 131, 103460. 1, 4.2

Benchimol, J. and L. Bounader (2019): "Optimal Monetary Policy Under Bounded Rationality," IMF Working Papers 2019/166, International Monetary Fund. 8

Benigno, G. and P. Benigno (2003): "Price stability in open economies," *The Review of Economic Studies*, 70, 743–764. 3

Bianchi, F., C. L. Ilut, and H. Saijo (2021): "Diagnostic Business Cycles," NBER Working Papers 28604, National Bureau of Economic Research, Inc. 1

Bodenstein, M. (2010): "Trade elasticity of substitution and equilibrium dynamics," *Journal of Economic Theory*, 145, 1033–1059. 16

Bordalo, P., N. Gennaioli, and A. Shleifer (2018): "Diagnostic expectations and credit cycles," *The Journal of Finance*, 73, 199–227. 1

Branch, W. A. and B. McGough (2009): "A New Keynesian Model with Heterogeneous Expectations," *Journal of Economic Dynamics and Control*, 33, 1036–1051. 1

Brock, W. A. and C. H. Hommes (1997): "A Rational Route to Randomness," *Econometrica: Journal of the Econometric Society*, 1059–1095. 1

Brzoza-Brzezina, M., P. Galinski, and K. Makarski (2025): "Monetary and fiscal policy in a two-country model with behavioral expectations," *Journal of International Money and Finance*, forthcoming. 9

Bullard, J. and K. Mitra (2002): "Learning about monetary policy rules," *Journal of Monetary Economics*, 49, 1105–1129. 1

Burnside, C., B. Han, D. Hirshleifer, and T. Y. Wang (2011): "Investor Overconfidence and the Forward Premium Puzzle," *Review of Economic Studies*, 78, 523–558. 1

Bussiere, M., M. Chinn, L. Ferrara, and J. Heipertz (2022): "The New Fama Puzzle," *IMF Economic Review*, 70, 451–486. 2

Candian, G. and P. De Leo (2021): "Imperfect Exchange Rate Expectations," Working paper, SSRN. 1

Carlstrom, C. T., T. S. Fuerst, and M. Paustian (2015): "Inflation and output in New Keynesian models with a transient interest rate peg," *Journal of Monetary Economics*, 76, 230–243. 1

Chen, K., M. Kolasa, J. Linde, H. Wang, P. Zabczyk, and J. Zhou (2023): "An Estimated DSGE Model for Integrated Policy Analysis," IMF Working Papers 2023/135, International Monetary Fund. 8

Corsetti, G. and P. Pesenti (2001): "Welfare and Macroeconomic Interdependence," *The Quarterly Journal of Economics*, 116, 421–445. 3

De Grauwe, P. (2011): "Animal Spirits and Monetary Policy," *Economic theory*, 47, 423–457. 1

De Long, J. B., A. Shleifer, L. H. Summers, and R. J. Waldmann (1990): "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, 98, 703–738. 1

De Paoli, B. (2009): "Monetary Policy under Alternative Asset Market Structures: The Case of a Small Open Economy," *Journal of Money, Credit and Banking*, 41, 1301–1330. 21

Du, Q., S. Eusepi, and B. Preston (2021): "Non-rational Beliefs in an Open Economy," *Review of Economic Dynamics*, 41, 174–204. 1

Engel, C. (2016): "Exchange Rates, Interest Rates, and the Risk Premium," *American Economic Review*, 106, 436–474. 1, 4, 4.2, 4.2

Evans, G. W. and S. Honkapohja (2001): *Learning and expectations in macroeconomics*, Princeton University Press. 1

Fama, E. F. (1984): "Forward and spot exchange rates," *Journal of Monetary Economics*, 14, 319–338. 1, 4, 4.1, 4.1

Frankel, J. (2010): "Monetary Policy in Emerging Markets," in *Handbook of Monetary Economics*, ed. by B. M. Friedman and M. Woodford, Elsevier, vol. 3 of *Handbook of Monetary Economics*, chap. 25, 1439–1520. 8

Froot, K. A. and J. A. Frankel (1989): "Forward Discount Bias: Is it an Exchange Risk Premium?" *The Quarterly Journal of Economics*, 104, 139–161. 2

Fuhrer, J. C. and G. D. Rudebusch (2004): "Estimating the Euler equation for output," *Journal of Monetary Economics*, 51, 1133–1153. 9

Gabaix, X. (2020): "A Behavioral New Keynesian Model," *American Economic Review*, 110, 2271–2327. (document), 1, 2.3, 3.1, 3.2, 6, 3.3, 4.3, 18, 7, 8, 8, 9

Gabaix, X. and M. Maggiori (2015): “International Liquidity and Exchange Rate Dynamics,” *The Quarterly Journal of Economics*, 130, 1369–1420. 1, 5, 8

Galí, J. (2015): *Monetary Policy, Inflation, and the Business Cycle: an Introduction to the New Keynesian Framework and its Applications*, Princeton University Press. A.4

——— (2020): “Uncovered Interest Parity, Forward Guidance and the Exchange Rate,” *Journal of Money, Credit and Banking*, 52, 465–496. 1, 4, 4.3

Gali, J. and T. Monacelli (2005): “Monetary Policy and Exchange Rate Volatility in a Small Open Economy,” *Review of Economic Studies*, 72, 707–734. 3, 3.3, 8, 21, D.1, D.1

Giannoni, M., C. Patterson, and M. Del Negro (2015): “The Forward Guidance Puzzle,” 2015 Meeting Papers 1529, Society for Economic Dynamics. 1

Gopinath, G., E. Boz, C. Casas, F. J. Diez, P.-O. Gourinchas, and M. Plagborg-Moller (2020): “Dominant Currency Paradigm,” *American Economic Review*, 110, 677–719. 1

Gourinchas, P.-O. and A. Tornell (2004): “Exchange rate puzzles and distorted beliefs,” *Journal of International Economics*, 64, 303–333. 1

Gust, C., E. Herbst, and J. D. Lopez-Salido (2021): “Short-term Planning, Monetary Policy, and Macroeconomic Persistence,” *American Economic Journal: Macroeconomics*. 1

——— (2022): “Short-term Planning, Monetary Policy, and Macroeconomic Persistence,” *American Economic Journal: Macroeconomics*, 14, 174–209. 9

Ilabaca, F., G. Meggiorini, and F. Milani (2020): “Bounded rationality, monetary policy, and macroeconomic stability,” *Economics Letters*, 186, 108522. 9

Ilut, C. (2012): “Ambiguity Aversion: Implications for the Uncovered Interest Rate Parity Puzzle,” *American Economic Journal: Macroeconomics*, 4, 33–65. 1

Itskhoki, O. and D. Mukhin (2021): “Exchange rate disconnect in general equilibrium,” *Journal of Political Economy*, 129, 2183–2232. 1, 5, 4, 4.3

Jeanne, O. and A. K. Rose (2002): “Noise Trading and Exchange Rate Regimes,” *The Quarterly Journal of Economics*, 117, 537–569. 1

Justiniano, A. and B. Preston (2010): “Monetary policy and uncertainty in an empirical small open-economy model,” *Journal of Applied Econometrics*, 25, 93–128. 1, 3.3

Kalemli-Ozcan, S. and L. Varela (2021): “Five Facts about the UIP Premium,” NBER Working Papers 28923, National Bureau of Economic Research, Inc. 1

Kollmann, R. (2002): “Monetary policy rules in the open economy: effects on welfare and business cycles,” *Journal of Monetary Economics*, 49, 989–1015. 3

McKay, A., E. Nakamura, and J. Steinsson (2016): “The power of forward guidance revisited,” *American Economic Review*, 106, 3133–58. 1

Müller, G. J., M. Wolf, and T. Hettig (2024): "Delayed Overshooting: The Case for Information Rigidities," *American Economic Journal: Macroeconomics*, 16, 310–342. 1

Na, S. and Y. Xie (2023): "A Behavioral New Keynesian Model of a Small Open Economy under Limited Foresight," Tech. rep. 1

Obstfeld, M. and K. Rogoff (2001): "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" in *NBER Macroeconomics Annual 2000, Volume 15*, National Bureau of Economic Research, Inc, NBER Chapters, 339–412. 1

Preston, B. (2005): "Learning about Monetary Policy Rules when Long-Horizon Expectations Matter," *International Journal of Central Banking*, 1. 1

Ratto, M. (2008): "Analysing DSGE Models with Global Sensitivity Analysis," *Computational Economics*, 31, 115–139. 11

Schmitt-Grohé, S. and M. Uribe (2001): "Stabilization policy and the costs of dollarization," *Journal of Money, Credit and Banking*, 482–509. 3

Schmitt-Grohe, S. and M. Uribe (2003): "Closing small open economy models," *Journal of International Economics*, 61, 163–185. 4, 7

Senhadji, A. S. (2003): "External Shocks and Debt Accumulation in a Small Open Economy," *Review of Economic Dynamics*, 6, 207–239. 7

Valchev, R. (2020): "Bond Convenience Yields and Exchange Rate Dynamics," *American Economic Journal: Macroeconomics*, 12, 124–166. 1

Woodford, M. (2003): *Interest and Prices. Foundations of a Theory of Monetary Policy*, Princeton University Press. A.5, C, D.1

——— (2013): "Macroeconomic Analysis Without the Rational Expectations Hypothesis," *Annual Review of Economics*, 5, 303–346. 2.3

——— (2019): "Monetary Policy Analysis when Planning Horizons are Finite," *NBER Macroeconomics Annual*, 33, 1–50. 9

Wu, J. C. and F. D. Xia (2016): "Measuring the macroeconomic impact of monetary policy at the zero lower bound," *Journal of Money, Credit and Banking*, 48, 253–291. E.1

# Appendices

## Appendix A. Key Derivations

In this Appendix we present the key steps necessary to derive the linearized equilibrium conditions of a small open economy version of our model. Unless indicated otherwise, we use the variable transformations defined in Section 3.

A.1. **Household Budget Constraint and Optimality Conditions.** Linearizing the budget constraint (2.3) yields

$$\hat{B}_t^{*,h} + \hat{B}_t^h = \beta^{-1}\left(\hat{B}_{t-1}^{*,h} + \hat{B}_{t-1}^h + \mu^{-1}(\hat{W}_t + \hat{N}_t^h) + \hat{D}_t - \hat{C}_t^h\right), \tag{A.1}$$

where $\hat{D}_t \equiv (D_t - D)/Y$, and where we used the assumption of zero steady state assets ($B^* = B = 0$), as well as the result that the steady state labor share is the inverse of the (gross) product markup $\mu$.

Given the household's utility function (2.1) and budget constraint (2.3), the optimization problem yields the following linearized Euler equations associated with Home and Foreign bond holdings

$$\hat{C}_t^h = \hat{\mathbb{E}}_t\hat{C}_{t+1}^h - \frac{1}{\sigma}\hat{\mathbb{E}}_t\left\{\hat{i}_t - \hat{\pi}_{t+1}\right\}, \tag{A.2}$$

$$\hat{C}_t^h = \hat{\mathbb{E}}_t\hat{C}_{t+1}^h - \frac{1}{\sigma}\hat{\mathbb{E}}_t\left\{\hat{i}_t^* - \hat{\pi}_{t+1}^* + \hat{Q}_{t+1} - \hat{Q}_t - \phi\hat{B}_t^* + \varrho_t\right\}, \tag{A.3}$$

where $\phi = \Phi'(0,0)$, and the intratemporal labor supply condition is

$$\hat{W}_t = \sigma\hat{C}_t^h + \varphi\hat{N}_t^h. \tag{A.4}$$

Combining equations (A.2) and (A.3) results in

$$\hat{\mathbb{E}}_t\left\{\hat{i}_t - \hat{\pi}_{t+1}\right\} = \hat{\mathbb{E}}_t\left\{\hat{i}_t^* - \hat{\pi}_{t+1}^* + \hat{Q}_{t+1} - \hat{Q}_t - \phi\hat{B}_t^* + \varrho_t\right\}. \tag{A.5}$$

Since this equation features expectations in aggregate variables that are beyond the control of an individual agent, and which are expressed as deviations from their respective steady state values, we can use the behavioral discounting formula (3.1) for $k = 0, 1$ to write

$$\hat{i}_t - m\mathbb{E}_t\left\{\hat{\pi}_{t+1}\right\} = \hat{i}_t^* - m\mathbb{E}_t\left\{\hat{\pi}_{t+1}^* - \hat{Q}_{t+1}\right\} - \hat{Q}_t - \phi\hat{B}_t^* + \varrho_t, \tag{A.6}$$

which is the UIP condition (3.3) in the main text.

A.2. **Deriving the Individual Consumption Function.** Let us iterate the linearized budget constraint forward and use the standard transversality condition to write

$$\hat{B}^{*,h}_{t-1} + \hat{B}^{h}_{t-1} = \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left( \hat{C}^h_T - \mu^{-1}(\hat{W}_T + \hat{N}^h_T) + \hat{D}_T \right). \tag{A.7}$$

Note that by multiplying the Euler equation (A.2) by $\beta$ and iterating forward we obtain

$$\hat{C}^h_t = (1-\beta)\hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \hat{C}^h_T - \frac{\beta}{\sigma}\hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left( \hat{i}_T - \hat{\pi}_{T+1} \right). \tag{A.8}$$

Combining the two and rearranging yields

$$\hat{C}^h_t = (1-\beta)\left(\hat{B}^{*,h}_{t-1} + \hat{B}^h_{t-1}\right) + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[ (1-\beta)\left( \frac{1}{\mu}(\hat{W}_T + \hat{N}^h_T) + \hat{D}_T \right) - \frac{\beta}{\sigma}\left( \hat{i}_T - \hat{\pi}_{T+1} \right) \right]. \tag{A.9}$$

We can now use the equilibrium condition (A.4) to eliminate individual labor supply

$$\hat{C}^h_t = (1-\beta)\left(\hat{B}^{*,h}_{t-1} + \hat{B}^h_{t-1}\right) + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[ (1-\beta)\left( \frac{\varphi+1}{\mu\varphi}\hat{W}_T - \frac{\sigma}{\mu\varphi}\hat{C}^h_T + \hat{D}_T \right) - \frac{\beta}{\sigma}\left( \hat{i}_T - \hat{\pi}_{T+1} \right) \right], \tag{A.10}$$

and again exploit Equation (A.8) to finally obtain

$$\left(1 + \frac{\sigma}{\mu\varphi}\right)\hat{C}^h_t = (1-\beta)\left(\hat{B}^{*,h}_{t-1} + \hat{B}^h_{t-1}\right) + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[ (1-\beta)\left( \frac{\varphi+1}{\mu\varphi}\hat{W}_T + \hat{D}_T \right) - \frac{\beta}{\sigma}\left(1 + \frac{\sigma}{\mu\varphi}\right)\left( \hat{i}_T - \hat{\pi}_{T+1} \right) \right]. \tag{A.11}$$

The equation above is the individual consumption function that incorporates labor supply choice.

A.3. **Deriving the IS Curve.** Since Equation (A.11) features expectations only about aggregate variables, we can apply to it the behavioral discounting formula (3.1) for $k = 0, 1, 2, ....$

$$\left(1 + \frac{\sigma}{\mu\varphi}\right)\hat{C}^h_t = (1-\beta)\left(\hat{B}^{*,h}_{t-1} + \hat{B}^h_{t-1}\right) + \mathbb{E}_t \sum_{T=t}^{\infty} (\beta m)^{T-t} \left[ (1-\beta)\left( \frac{\varphi+1}{\mu\varphi}\hat{W}_T + \hat{D}_T \right) - \frac{\beta}{\sigma}\left(1 + \frac{\sigma}{\mu\varphi}\right)\left( \hat{i}_T - m\hat{\pi}_{T+1} \right) \right], \tag{A.12}$$

so that it now uses the rational expectations operator rather than the subjective one. Since we no longer need to make a distinction between macroeconomic aggregates and individual choices, we can drop indexing consumption and assets by $h$ and use the Home bond market clearing condition $B_t = 0$. After some algebra, we can write Equation (A.12) recursively

$$\left(1+\frac{\sigma}{\mu\varphi}\right)\hat{C}_t = (1-\beta)\left(\hat{B}^*_{t-1}+\hat{B}_{t-1}-m\beta\hat{B}^*_t-m\beta\hat{B}_t\right)+(1-\beta)\left(\frac{\varphi+1}{\mu\varphi}\hat{W}_t+\hat{D}_t\right)$$
$$-\frac{\beta}{\sigma}\left(1+\frac{\sigma}{\mu\varphi}\right)\left(\hat{i}_t-m\mathbb{E}_t\hat{\pi}_{t+1}\right)+m\beta\left(1+\frac{\sigma}{\mu\varphi}\right)\mathbb{E}_{t+1}\hat{C}_{t+1}. \quad \text{(A.13)}$$

Now we can use the budget constraint (A.1) and the Home currency bond market clearing condition $B_t = 0$ to obtain

$$\left(\beta+\frac{\sigma}{\mu\varphi}\right)\hat{C}_t = (1-\beta)(1-m)\beta\hat{B}^*_t+\frac{1-\beta}{\mu}\left(\frac{1}{\varphi}\hat{W}_t-\hat{N}_t\right)$$
$$-\frac{\beta}{\sigma}\left(1+\frac{\sigma}{\mu\varphi}\right)\left(\hat{i}_t-m\mathbb{E}_t\hat{\pi}_{t+1}\right)+m\beta\left(1+\frac{\sigma}{\mu\varphi}\right)\mathbb{E}_{t+1}\hat{C}_{t+1}. \quad \text{(A.14)}$$

Finally, using the optimal labor supply condition (A.4) results in

$$\hat{C}_t = m\mathbb{E}_t\hat{C}_{t+1}-\frac{1}{\sigma}\left(\hat{i}_t-m\mathbb{E}_t\hat{\pi}_{t+1}\right)+(1-m)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}^*_t, \quad \text{(A.15)}$$

which is the aggregate IS curve (3.2) in the main text.

A.4. **Deriving the Phillips Curve.** Aggregation of intermediate inputs into final goods according to Dixit-Stiglitz formulas (2.4) yields the following isoelastic demand condition

$$Y^f_{H,t}+Y^{*,f}_{H,t} = \left(\frac{P^f_{H,t}}{P_{H,t}}\right)^{\frac{\mu}{1-\mu}}\left[Y_{H,t}+Y^*_{H,t}\right], \quad \text{(A.16)}$$

where the aggregate price indices are

$$P_{H,t} = \left[\int_0^1\left(P^f_{H,t}\right)^{\frac{1}{1-\mu}}\mathrm{d}f\right]^{1-\mu}, \qquad \text{and} \qquad P^*_{H,t} = \left[\int_0^1\left(P^{*,f}_{H,t}\right)^{\frac{1}{1-\mu}}\mathrm{d}f\right]^{1-\mu}, \quad \text{(A.17)}$$

and where we used the law of one price $P^f_{H,t} = \varepsilon_t P^{*,f}_{H,t}$, which also implies $P_{H,t} = \varepsilon_t P^*_{H,t}$. Using the demand conditions (A.16) and production technology (2.5) allows us to rewrite the firm problem consistent with maximization of (2.6) as

$$\max_{P^f_{H,t}}\hat{\mathbb{E}}_t\sum_{T=t}^{\infty}\theta^{T-t}\Lambda_{t,T}\left[P^f_{H,t}-P_T\frac{W_T}{z_t}\right]\left(\frac{P^f_{H,t}}{P_{H,T}}\right)^{\frac{\mu}{1-\mu}}\left[Y_{H,T}+Y^*_{H,T}\right]. \quad \text{(A.18)}$$

The first order condition is

$$\hat{\mathbb{E}}_t\sum_{T=t}^{\infty}\theta^{T-t}\Lambda_{t,T}\left[P^f_{H,t}-\mu P_T MC_T\right]\left(\frac{P^f_{H,t}}{P_{H,T}}\right)^{\frac{\mu}{1-\mu}}\left[Y_{H,T}+Y^*_{H,T}\right]=0, \quad \text{(A.19)}$$

where $MC_t \equiv (W_tP_t)/(P_{H,t}z_t)$ is the real marginal cost deflated by the producer price index.

As in a textbook closed economy case (see e.g. Galí, 2015), linearizing around the zero inflation steady state yields

$$\hat{P}^{\diamond}_{H,t} = (1-\beta\theta)\sum_{T=t}^{\infty}(\beta\theta)^{T-t}\hat{\mathbb{E}}_t\left\{\hat{\pi}_{H,t+1} + ... + \hat{\pi}_{H,T} + \hat{MC}_T\right\}, \tag{A.20}$$

where $\hat{P}^{\diamond}_{H,t} \equiv \log(P^{f}_{H,t}/P_{H,t})$, $\hat{MC}_t \equiv \log(MC_t/MC)$, $\hat{\pi}_{H,t} \equiv \log(P_{H,t}/P_{H,t-1})$ and where we used the result that all reoptimizing firms choose the same price to drop the $f$ superscript. Since the subjective expectation operator now concerns only variables beyond individual firm control and all of them are expressed as deviations from steady state, we can apply the discounting formula (3.1) to obtain

$$\hat{P}^{\diamond}_{H,t} = (1-\beta\theta)\sum_{T=t}^{\infty}(\beta\theta)^{T-t}\mathbb{E}_t\left\{m\hat{\pi}_{H,t+1} + ... + m^{T-t}\hat{\pi}_{H,T} + m^{T-t}\hat{MC}_T\right\}. \tag{A.21}$$

After some algebra, this can be written recursively as

$$\hat{P}^{\diamond}_{H,t} - \beta\theta m\mathbb{E}_t\hat{P}^{\diamond}_{H,t+1} = (1-\beta\theta)\hat{MC}_t + \beta\theta m\mathbb{E}_t\left\{\hat{\pi}_{H,t+1}\right\}. \tag{A.22}$$

Note that the definition of the price index (A.17) implies

$$\hat{\pi}_{H,t} = (1-\theta)(\hat{P}^{\diamond}_{H,t} + \hat{\pi}_{H,t}) = \frac{1-\theta}{\theta}\hat{P}^{\diamond}_{H,t}. \tag{A.23}$$

Combining this with Equation (A.22) and rearranging yields

$$\hat{\pi}_{H,t} = m\beta\mathbb{E}_t\left\{\hat{\pi}_{H,t+1}\right\} + \frac{(1-\beta\theta)(1-\theta)}{\theta}\hat{MC}_t, \tag{A.24}$$

which is Equation (3.4) in the main text.

A.5. **Deriving the Marginal Cost Equation.** The optimal composition of the consumption basket (2.2) implies the following formula for the aggregate price index $P_t$

$$P_t = \left[(1-\alpha)\left(P_{H,t}\right)^{1-\eta} + \alpha\left(P_{F,t}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{A.25}$$

which leads to

$$\hat{P}_{H,t} = -\frac{\alpha}{1-\alpha}\hat{P}_{F,t} = -\frac{\alpha}{1-\alpha}\hat{Q}_t, \tag{A.26}$$

where $\hat{P}_{H,t} = \log(P_{H,t}/P_t)$ , $\hat{P}_{F,t} = \log(P_{F,t}/P_t)$, and where the last equality follows from the definition of the real exchange rate $Q_t = \varepsilon_t P^*_t$ and the small open economy version of producer currency pricing $P_{F,t} = \varepsilon_t P^*_t$.

Combining labor market clearing condition (2.9), with the firm-level production function (2.5), and the firm's demand conditions (A.16) yields

$$N_t = \frac{Y_{H,t} + Y^*_{H,t}}{z_t}\Delta_t, \tag{A.27}$$

where

$$\Delta_t \equiv \int_0^1 \left( \frac{P^f_{H,t}}{P_{H,t}} \right)^{\frac{\mu}{1-\mu}} \mathrm{d}f \tag{A.28}$$

is a measure of price dispersion. Defining aggregate output as the sum of domestic production and exports results in the following aggregate production function

$$Y_t \equiv Y_{H,t} + Y^*_{H,t} = \frac{z_t}{\Delta_t} N_t, \tag{A.29}$$

the linearized version of which is

$$\hat{Y}_t = \hat{z}_t + \hat{N}_t - \hat{\Delta}_t. \tag{A.30}$$

Given the problem of firms, their marginal cost deflated by producer prices is

$$\hat{MC}_t = \hat{W}_t - \hat{P}_{H,t} - \hat{z}_t, \tag{A.31}$$

where $\hat{P}_{H,t} = \log(P_{H,t}/P_t)$. Using Equation (A.26) to substitute in for $\hat{P}_{H,t}$, labor supply condition (A.4) to eliminate $\hat{W}_t$, Equation (A.30) to eliminate $\hat{N}_t$, and the well-known result that price dispersion is of second order (see, e.g., Woodford, 2003) yields

$$\hat{MC}_t = \sigma \hat{C}_t + \varphi \hat{Y}_t + \frac{\alpha}{1-\alpha} \hat{Q}_t - (1+\varphi)\hat{z}_t, \tag{A.32}$$

which is Equation (3.5) in the main text.

A.6. **Deriving the Goods Market Clearing Condition.** Our definition of aggregate output (A.29) together with market clearing conditions (2.10) imply

$$Y_t = C_{H,t} + \frac{1-\zeta}{\zeta} C^*_{H,t}. \tag{A.33}$$

Plugging in for the optimal composition of the consumption basket then results in

$$Y_t = (1-\alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} C_t + \frac{1-\zeta}{\zeta} \alpha^* \left( \frac{P^*_{H,t}}{P^*_t} \right)^{-\eta} C^*_t. \tag{A.34}$$

The small open economy assumption and producer currency pricing imply $C^*_t = Y^*_t$ and $P^*_{H,t} = P_{H,t}/\varepsilon_t$. This allows us to write

$$Y_t = (1-\alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} C_t + \frac{1-\zeta}{\zeta} \alpha^* \left( \frac{P_{H,t}}{P_t Q_t} \right)^{-\eta} Y^*_t. \tag{A.35}$$

Linearization then yields

$$\hat{Y}_t = (1-\alpha)\hat{C}_t - (1-\alpha)\eta \hat{P}_{H,t} + \alpha \hat{Y}^*_t - \alpha\eta(\hat{P}_{H,t} - \hat{Q}_t). \tag{A.36}$$

Using Equation (A.26) to eliminate $\hat{P}_{H,t}$ and rearranging terms results in

$$\hat{Y}_t = (1-\alpha)\hat{C}_t + \alpha\hat{Y}_t^* + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_t, \tag{A.37}$$

which is equation (3.7) in the main text.

## Appendix B. Additional Derivations

B.1. **Deriving Equation** (5.1)**.** Eliminating consumption from Equation (3.2) using the resource constraint (3.7) results in

$$\hat{Y}_t = m\mathbb{E}_t\hat{Y}_{t+1} + \alpha\left(\hat{Y}_t^* - m\mathbb{E}_t\hat{Y}_{t+1}^*\right) + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\left(\hat{Q}_t - m\mathbb{E}_t\hat{Q}_{t+1}\right) - \frac{1-\alpha}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right) + (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}_t^*, \tag{B.1}$$

and exploiting the UIP condition (3.3) then yields

$$\hat{Y}_t = m\mathbb{E}_t\hat{Y}_{t+1} + \alpha\left(\hat{Y}_t^* - m\mathbb{E}_t\hat{Y}_{t+1}^*\right) + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\left(\hat{i}_t^* - \phi\hat{B}_t^* + \varrho_t - m\mathbb{E}_t\left\{\hat{\pi}_{t+1}^*\right\} - \hat{i}_t + m\mathbb{E}_t\left\{\hat{\pi}_{t+1}\right\}\right) - \frac{1-\alpha}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right) + (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}_t^*. \tag{B.2}$$

When considering the effects of Home monetary policy, we can drop the exogenous risk premium and foreign variables (also exogenous on account of the small open economy assumption). By rearranging and using the definition of the ex ante real interest rate $\hat{r}_t \equiv \hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}$ we then arrive at

$$\hat{Y}_t = m\mathbb{E}_t\hat{Y}_{t+1} - \left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right)\hat{r}_t - \left[\eta\frac{\alpha(2-\alpha)}{1-\alpha}\phi - (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\right]\hat{B}_t^*, \tag{B.3}$$

which is Equation (5.1) in the main text.

B.2. **Deriving Equations** (5.3) **and** (5.4)**.** By combining equations (3.4) and (3.5), and iterating forward on the outcome, we obtain

$$\hat{\pi}_{H,t} = \kappa\mathbb{E}_t\sum_{T=t}^{\infty}(\beta m)^{T-t}\left(\sigma\hat{C}_T + \varphi\hat{Y}_T + \frac{\alpha}{1-\alpha}\hat{Q}_T - \hat{z}_t\right), \tag{B.4}$$

Note that each of the three endogenous variables defining real marginal cost (last bracket above) can be expressed as a function of the current and expected future real interest rates, see in particular equations (4.8), (5.2) and (4.7). Ignoring terms associated with the net foreign asset position (as they are small), omitting productivity shocks (as we focus on the effects of domestic monetary policy), and consistently dropping foreign variables (on account of the the small open economy assumption) allows us to write

$$\sigma \hat{C}_t + \varphi \hat{Y}_t + \frac{\alpha}{1-\alpha}\hat{Q}_t \approx -a\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T, \tag{B.5}$$

where $a \equiv \varphi\left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right) + \frac{1}{1-\alpha}$. Plugging this into Equation (B.4) yields

$$\begin{aligned}\hat{\pi}_{H,t} &\approx -\kappa a \mathbb{E}_t\left[\hat{r}_t + m\left(1+\beta\right)\hat{r}_{t+1} + ... + m^n\left(1+\beta+...+\beta^n\right)\hat{r}_{t+n} + ...\right] \\ &= -\kappa a \mathbb{E}_t \sum_{T=t}^{\infty} \frac{m^{T-t+1} - \left(\beta m\right)^{T-t+1}}{m(1-\beta)}\hat{r}_T. \end{aligned} \tag{B.6}$$

Recall that CPI inflation is given by Equation (3.6). Exploiting relationships (B.6) and (4.7), and again ignoring terms related to net foreign assets, yields

$$\hat{\pi}_t \approx -\frac{\kappa a}{m(1-\beta)}\mathbb{E}_t \sum_{T=t}^{\infty}\left[m^{T-t+1} - \left(\beta m\right)^{T-t+1}\right]\hat{r}_T - \frac{\alpha}{1-\alpha}\mathbb{E}_t\sum_{T=t}^{\infty} m^{T-t}\hat{r}_T - \frac{\alpha}{1-\alpha}\hat{Q}_{t-1}, \tag{B.7}$$

which is Equation (5.3) in the main text.

In the limit $\beta \to 1$ we also have $M \to m$, and Equation (B.6) becomes

$$\hat{\pi}_{H,t} = -\kappa a \mathbb{E}_t\left[\hat{r}_t + 2m\hat{r}_{t+1} + ... + (n+1)m^n\hat{r}_{t+n} + \ldots\right], \tag{B.8}$$

which plugged into the definition of CPI (3.6) results in

$$\hat{\pi}_t = -\kappa a \mathbb{E}_t \sum_{T=t}^{\infty}\left(T-t+1\right)m^{T-t}\hat{r}_T - \frac{\alpha}{1-\alpha}\mathbb{E}_t\sum_{T=t}^{\infty} m^{T-t}\hat{r}_T - \frac{\alpha}{1-\alpha}\hat{Q}_{t-1}, \tag{B.9}$$

which is Equation (5.4) in the text.

Finally, the relative weight of the penultimate component in the formula above is

$$\frac{\frac{\alpha}{1-\alpha}}{\varphi\left(\frac{1-\alpha}{\sigma} + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\right) + \frac{1}{1-\alpha}} = \frac{1}{\varphi(\eta - \sigma^{-1})\left(2-\alpha\right) + \left(\frac{\varphi}{\sigma} + 1\right)\alpha^{-1}},$$

and so it is clearly increasing in the economy's openness $\alpha$.

B.3. **Deriving Equation** (6.1) **and** (6.2)**.** Let us rearrange the output IS curve (B.1) as follows

$$\begin{aligned}\hat{Y}_t - \alpha\hat{Y}_t^* - \eta\frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_t = m\mathbb{E}_t &\left\{\hat{Y}_{t+1} + \alpha\hat{Y}_{t+1}^* + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_{t+1}\right\} \\ &- \frac{1-\alpha}{\sigma}\mathbb{E}_t\sum_{T=t}^{\infty} m^{T-t}\hat{r}_T + (1-m)(1-\alpha)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}_t^*. \end{aligned} \tag{B.10}$$

Iterating this forward yields

$$\hat{Y}_t = \alpha \hat{Y}_t^* + \eta \frac{\alpha(2-\alpha)}{1-\alpha}\hat{Q}_t - \frac{1-\alpha}{\sigma}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T + (1-m)(1-\alpha)\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{B}_T^*, \quad \text{(B.11)}$$

which is Equation (6.1) in the main text.

To derive Equation (6.2), we iterate forward on the foreign IS curve (3.10) while allowing the degree of myopia abroad $m^*$ to be possibly different from that in the home economy $m$, use the outcome to substitute for $\hat{Y}_t^*$ above, and further exploit Equation 4.7 to substitute for $\hat{Q}_t$. After omitting the terms associated with net foreign assets and the exogenous component of the risk premium, assuming a constant real interest rate in the Home economy $\hat{r}_t = 0$, and rearranging we arrive at

$$\hat{Y}_t \approx -\frac{\alpha}{\sigma}\mathbb{E}_t \sum_{T=t}^{\infty} m^{*T-t}\hat{r}_T^* + \eta \frac{\alpha(2-\alpha)}{1-\alpha}\mathbb{E}_t \sum_{T=t}^{\infty} m^{T-t}\hat{r}_T^*, \quad \text{(B.12)}$$

which is Equation (6.2) in the main text.

## Appendix C. Complete Markets Case

When markets are complete, the budget constraint (2.3) can be rewritten as

$$C_t^h + \hat{\mathbb{E}}_t q_{t,t+1} A_{t+1}^h = A_t^h + W_t N_t^h + D_t, \quad \text{(C.1)}$$

where $A_t^h$ is the real stochastic payoff of a portfolio of Arrow-Debreu securities purchased by household $h$ at time $t-1$ and $q_{t,t+1}$ is the pricing kernel so that $\hat{\mathbb{E}}_t q_{t,t+1} A_{t+1}^h$ is the period-$t$ price of a random payment $A_{t+1}^h$ that occurs in period $t+1$ (see e.g. Woodford (2003) for a discussion). In a behavioral model like ours, $q_{t,t+1}$ can be interpreted as the price of a contingent claim that pays one unit of good in some state at time $t+1$, divided by the *subjective* probability of occurrence of that state given information at time $t$.

It then immediately follows that in the steady state we have $q = (1+r)^{-1} = \beta$. Linearizing around the zero asset holdings equilibrium yields

$$\hat{\mathbb{E}}_t \hat{A}_{t+1}^h = \beta^{-1}\left(\hat{A}_t^h + \mu^{-1}(\hat{W}_t + \hat{N}_t^h) + \hat{D}_t - \hat{C}_t^h\right). \quad \text{(C.2)}$$

Optimization by households still implies the same household-level Euler equation (A.2) and intratemporal optimality condition (A.4). This allows us to proceed exactly as in Appendix (A.2) to obtain an individual consumption function that is similar to equation (A.11), and which features expectations about aggregate variables only

$$\left(1+\frac{\sigma}{\mu\varphi}\right)\hat{C}_t^h = (1-\beta)\hat{A}_t^h$$
$$+\hat{\mathbb{E}}_t\sum_{T=t}^{\infty}\beta^{T-t}\left[(1-\beta)\left(\frac{\varphi+1}{\mu\varphi}\hat{W}_T+\hat{D}_T\right)-\frac{\beta}{\sigma}\left(1+\frac{\sigma}{\mu\varphi}\right)\left(\hat{i}_T-\hat{\pi}_{T+1}\right)\right]. \quad \text{(C.3)}$$

The remaining derivations follows those presented in Appendix (A.3), except that we now need to apply behavioral discounting to the expected payoff of the aggregate portfolio of Arrow-Debreu securities $\hat{\mathbb{E}}_t\hat{A}_{t+1} = m\mathbb{E}_t\hat{A}_{t+1}$. This is the key step that makes a difference compared to the incomplete markets case, in which only risk-free bonds exist and so there is no uncertainty on the one-period asset return. As a result, we finally arrive at

$$\hat{C}_t = m\mathbb{E}_t\hat{C}_{t+1} - \frac{1}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right), \quad \text{(C.4)}$$

which is equation (4.10) in the main text and which, unlike its incomplete markets version (3.2), does not feature the country's net foreign assets position.

## Appendix D. Optimal Monetary Policy

D.1. **Deriving a Welfare Loss Function.** The goal of the social planner is to maximize

$$\mathbb{U}_t = \mathbb{E}_t\sum_{T=t}^{\infty}\beta^{T-t}\left[\frac{(C_T)^{1-\sigma}}{1-\sigma} - \frac{(N_T)^{1+\varphi}}{1+\varphi})\right], \quad \text{(D.1)}$$

which differs from an individual household's objective (2.1) in that it uses rational instead of behavioral expectations. Denoting period utility (term in the square bracket) by $u_t$, its second order Taylor expansion around the steady state is

$$u_t \approx u + u_C C\left(\hat{C}_t + \frac{1-\sigma}{2}\hat{C}_t^2\right) + u_N N\left(\hat{N}_t + \frac{1+\varphi}{2}\hat{N}_t^2\right), \quad \text{(D.2)}$$

where $u_C$ and $u_N$ are the steady state partial derivatives of $u$ with respect to consumption and labor. As shown by Gali and Monacelli (2005)), optimal steady state allocation for a small open economy that takes world output and consumption as given implies $-\frac{u_N}{u_C} = (1-\alpha)\frac{C}{N}$, which allows us to write

$$\frac{u_t-u}{u_C C} \approx \left(\hat{C}_t + \frac{1-\sigma}{2}\hat{C}_t^2\right) - (1-\alpha)\left(\hat{N}_t + \frac{1+\varphi}{2}\hat{N}_t^2\right). \quad \text{(D.3)}$$

When markets are complete so that the risk sharing condition (4.9) holds, the market clearing (3.7) condition can be rewritten as

$$\hat{Y}_t = (1-\alpha)\hat{C}_t + \alpha\hat{Y}_t^* + \eta\frac{\alpha(2-\alpha)}{1-\alpha}\sigma\left(\hat{C}_t - \hat{C}_t^*\right), \quad \text{(D.4)}$$

which simplifies to

$$\hat{C}_t = (1-\alpha)\hat{Y}_t + \alpha \hat{Y}_t^*, \tag{D.5}$$

when $\sigma = \eta = 1$, which we will use henceforth, and where we also use the small open economy implication $C_t^* = Y_t^*$. This allows us to rewrite Equation (D.3) as

$$\frac{u_t - u}{u_C C} \approx (1-\alpha)\left(\hat{Y}_t - \hat{N}_t - \frac{1+\varphi}{2}\hat{N}_t^2\right) + t.i.p., \tag{D.6}$$

where $t.i.p.$ stands for terms independent of policy.

Let us now use the aggregate production function (A.30) to eliminate $\hat{N}_t$

$$\frac{u_t - u}{u_C C} \approx -\frac{1-\alpha}{2}\left(2\hat{\Delta}_t + (1+\varphi)\left(\hat{Y}_t - \hat{z}_t\right)^2\right) + t.i.p., \tag{D.7}$$

where we again exploited the fact that price dispersion $\Delta_t$ is of second order. Note that, when markets are complete so that Equations (4.9) and (D.5) hold, the real marginal cost formula (3.5) can be rewritten as

$$\hat{MC}_t = (1+\varphi)(\hat{Y}_t - \hat{z}_t), \tag{D.8}$$

which implies that flexible price output is proportional to productivity, i.e., we have that

$$\frac{u_t - u}{u_C C} \approx -\frac{1-\alpha}{2}\left(2\hat{\Delta}_t + (1+\varphi)\hat{x}_t^2\right) + t.i.p., \tag{D.9}$$

where $\hat{x}_t \equiv \log(Y_t/\bar{Y}_t)$ is the output gap.

As the last step, we can use Lemma 1 and 2 in Gali and Monacelli (2005), originally proved by Woodford (2003)

$$\sum_{T=t}^{\infty} \beta^{T-t}\hat{\Delta}_T = \frac{\mu}{2(\mu-1)}\sum_{T=t}^{\infty}\beta^{T-t}\mathbb{V}\mathrm{ar}\hat{P}_{H,T}^f = \frac{\mu}{2\kappa(\mu-1)}\sum_{T=t}^{\infty}\beta^{T-t}\hat{\pi}_{H,T}^2, \tag{D.10}$$

where $\mathbb{V}\mathrm{ar}\hat{P}_{H,t}^f$ is the cross-sectional variance of relative prices charged by Home producers. As a result, we finally arrive at

$$\mathbb{U}_t \approx -\frac{1-\alpha}{2}\mathbb{E}_t\sum_{T=t}^{\infty}\beta^{T-t}\left[\frac{\mu}{\kappa(\mu-1)}\hat{\pi}_{H,T}^2 + (1+\varphi)\hat{x}_T^2\right] + t.i.p., \tag{D.11}$$

which is Equation (8.1) in the main text.

D.2. **Optimal Stabilization.** The optimization problem is to minimize the welfare loss function (8.1), subject to (8.2). The Lagrangian for this problem is

$$\mathbb{E}_t\sum_{T=t}^{\infty}\beta^{T-t}\left[\frac{\mu}{\kappa(\mu-1)}\hat{\pi}_{H,T}^2 + (1+\varphi)\hat{x}_T^2 + \delta_T\left(\hat{\pi}_{H,T} - m\beta\hat{\pi}_{H,T+1} - \kappa(1+\varphi)\hat{x}_T - \xi_T\right)\right] \tag{D.12}$$

and the associated first-order conditions under commitment are

$$2\hat{x}_t - \kappa\delta_t = 0, \tag{D.13}$$

$$\frac{2\mu}{\kappa(\mu-1)}\hat{\pi}_{H,t} + \delta_t - m\delta_{t-1} = 0. \tag{D.14}$$

Combining these two equations results in

$$\hat{\pi}_{H,t} + \frac{\mu-1}{\mu}(\hat{x}_t - m\hat{x}_{t-1}) = 0, \tag{D.15}$$

which is the formulation reported in the main text.

## Appendix E. Bayesian Estimation Results

E.1. **Data.** The domestic block of our model is represented by Canada and the foreign block, which is essentially a closed economy, is represented by the US. For these two countries, the estimation uses quarterly data on output, inflation and interest rates, as well as the bilateral exchange rate. All time series are taken from the Federal Reserve Economic Data (FRED) and transformed as follows:

(1) Per-Capita Real Output Growth ($y_t^{obs}$): We use the real GDP series labeled as NGDPRSAXDCCAQ and quarterly population estimates 17-10-0009-01 (formerly CANSIM 051-0005)

$$y_t^{obs} = 100\left[\ln\left(\frac{\text{GDP}_t}{\text{Pop}_t}\right) - \ln\left(\frac{\text{GDP}_{t-1}}{\text{Pop}_{t-1}}\right)\right] \tag{E.1}$$

(2) Inflation ($\pi_t^{obs}$): GDP deflator CANGDPDEFQISMEI

$$\pi_t^{obs} = 100\ln\left[\frac{\text{Def}_t}{\text{Def}_{t-1}}\right] \tag{E.2}$$

(3) Interest Rate ($i_t^{obs}$): 3-Month rate IR3TIB01CAM156N

$$i_t^{obs} = \frac{R_t}{4} \tag{E.3}$$

(4) Foreign Per-Capita Real Output Growth ($y_t^{obs,*}$): We take real GDP GDPC1 and population level CNP16OV

$$y_t^{obs,*} = 100\left[\ln\left(\frac{\text{GDP}_t^*}{\text{Pop}_t^*}\right) - \ln\left(\frac{\text{GDP}_{t-1}^*}{\text{Pop}_{t-1}^*}\right)\right] \tag{E.4}$$

(5) Foreign Inflation ($\pi_t^{obs,*}$): Implicit price deflator GDPDEF

$$\pi_t^{obs,*} = 100\ln\left[\frac{\text{Def}_t^*}{\text{Def}_{t-1}^*}\right] \tag{E.5}$$

(6) Foreign Interest Rate ($r_t^{obs,*}$): Effective federal fund rate FEDFUNDS

$$r_t^{obs,*} = \frac{R_t^*}{4} \tag{E.6}$$

(7) Exchange Rate ($e_t^{obs}$): Canadian Dollar to US Dollar Exchange Rate CCUSMA02CAQ618N

$$\Delta e_t^{obs} = 100 \ln \left[ \frac{\text{RER}_t}{\text{RER}_{t-1}} \right] \tag{E.7}$$

The measurement equations linking the data to the model variables are

$$y_t^{obs,*} = \hat{Y}_t^* - \hat{Y}_{t-1}^* + y^* \tag{E.8}$$
$$\pi_t^{obs,*} = \hat{\pi}_t^* + \pi^* \tag{E.9}$$
$$i_t^{obs,*} = \hat{i}_t^* + \pi^* + r^* \tag{E.10}$$
$$y_t^{obs} = \hat{Y}_t - \hat{Y}_{t-1} + y \tag{E.11}$$
$$\pi_t^{obs} = \hat{\pi}_{H,t} + \pi \tag{E.12}$$
$$i_t^{obs} = \hat{i}_t + \pi + r \tag{E.13}$$
$$e_t^{obs} = Q_t - Q_{t-1} + \hat{\pi}_t + \pi - \hat{\pi}_t^* - \pi^* \tag{E.14}$$

so that, rather than demeaning data prior to estimation, we use intercepts $y$, $\pi$, $r$, $y^*$, $\pi^*$, $r^*$ to capture the trend growth rate of output, average inflation, and the average real interest rate.

Our baseline sample runs from 1972:Q1 to 2007:Q4. However, for robustness, we also estimate the model over the periods 1982:Q2–2007:Q4 and 1972:Q1–2019:Q4. In the latter case, which captures the period when the US policy rate was constrained by the zero lower bound and asset purchase programs were conducted, we replace the interest rate with the shadow rate estimated by Wu and Xia (2016).

E.2. **Shocks.** To estimate a model with seven observable variables using full information methods, we need to allow for at least seven stochastic shocks. Three of them are already included in the model equations and they affect domestic and foreign monetary policy ($\nu_t$ and $\nu_t^*$) and international risk premium ($\varrho_t$). Following the DSGE literature, for each country we additionally include shocks to household intertemporal preferences ($g_t$ and $g_t^*$) and to firm cost ($\xi_t$ and $\xi_t^*$). Preference shocks are introduced as shifters in the subjective discount factor $\beta$, resulting in the following modification of the IS curve (3.2)

$$\hat{C}_t = m\mathbb{E}_t\hat{C}_{t+1} - \frac{1}{\sigma}\left(\hat{i}_t - m\mathbb{E}_t\hat{\pi}_{t+1}\right) + (1-m)\frac{1-\beta}{1+\frac{\sigma}{\mu\varphi}}\hat{B}_t^* + g_t - m\mathbb{E}_t\hat{g}_{t+1}. \tag{E.15}$$

The cost shocks are modelled as exogenous shifts in firms' market power $\mu$ and modify the Phillips curve (3.4) as follows

$$\hat{\pi}_{H,t} = m\beta\mathbb{E}_t\{\hat{\pi}_{H,t+1}\} + \kappa\hat{MC}_t + \xi_t. \tag{E.16}$$

All shocks are defined as independent AR(1) processes, except for the monetary policy shocks that we assume to be white noise.

E.3. **Estimation Results.** Table E.1 presents the characteristics of the prior and posterior distributions for structural parameters and constants in the measurement equations while estimated shock properties are presented in Table E.2. The Markov Chain Monte Carlo (MCMC) jump size in the Metropolis-Hastings algorithm is scaled to ensure a target acceptance rate of around 30 percent. We use 250,000 draws and burn the initial 150,000, with convergence of the MCMC chains verified using diagnostic tests based on trace plots and potential scale reduction factors. Estimation is conducted using Dynare 4.6.4 (Adjemian et al., 2021). We report the estimates obtained for the baseline sample 1972:Q2–2007:Q4. The results for the other two samples (1982:Q2–2007:Q4 and 1972:Q1–2019:Q4) are similar and available upon request.

E.4. **Robustness Check: Less Informative Priors.** Tables E.3 and E.4 present the estimation results of the behavioral model, in which we assume that the standard deviations of the prior distributions are 50% bigger than in the baseline variant.

## Table E.1. **Estimation: Structural Parameters**

| Parameter | Description | Prior | | | Poster.: Rational | | Poster.: Baseline | |
|---|---|---|---|---|---|---|---|---|
| | | Dist. | Mean | SD | Mean | [5, 95] | Mean | [5, 95] |
| $m$ | Cognitive Discounting | B | 0.80 | 0.070 | | | 0.68 | [0.54, 0.83] |
| $\phi_\pi$ | H Taylor Rule, Inflation | N | 1.50 | 0.50 | 2.58 | [2.06, 3.14] | 1.26 | [0.83, 1.67] |
| $\phi_\pi^*$ | F Taylor Rule, Inflation | N | 1.50 | 0.50 | 2.16 | [1.82, 2.52] | 1.50 | [1.02, 1.94] |
| $\phi_y$ | H Taylor Rule, Output | N | 0.125 | 0.13 | 0.33 | [0.21, 0.44] | 0.37 | [0.25, 0.49] |
| $\phi_y^*$ | F Taylor Rule, Output | N | 0.125 | 0.13 | 0.14 | [0.07, 0.22] | 0.18 | [0.06, 0.28] |
| $\rho$ | H Interest Rate Smooth | B | 0.90 | 0.05 | 0.87 | [0.84, 0.89] | 0.86 | [0.82, 0.89] |
| $\rho^*$ | F Interest Rate Smooth | B | 0.90 | 0.05 | 0.74 | [0.70, 0.79] | 0.81 | [0.74, 0.88] |
| $\theta$ | Calvo Probability | B | 0.875 | 0.05 | 0.88 | [0.85, 0.92] | 0.95 | [0.93, 0.97] |
| $\varphi$ | Inverse Frisch Elasticity | G | 3.00 | 0.25 | 2.97 | [2.60, 3.33] | 2.97 | [2.56, 3.37] |
| $\sigma$ | Intertemp. El. of Subst. | N | 1.00 | 0.20 | 1.74 | [1.52, 1.95] | 1.64 | [1.39, 1.89] |
| $\eta$ | Trade Elasticity | G | 1.00 | 0.05 | 0.84 | [0.78, 0.90] | 0.80 | [0.73, 0.86] |
| $r$ | SS H Real Rate | N | 0.50 | 0.25 | 0.18 | [-0.18, 0.54] | 0.29 | [-0.08, 0.67] |
| $r^*$ | SS F Real Rate | N | 0.50 | 0.25 | 0.65 | [0.44, 0.85] | 0.68 | [0.42, 0.92] |
| $\pi$ | SS H Inflation | N | 1.00 | 0.25 | 1.02 | [0.71, 1.32] | 1.05 | [0.83, 1.27] |
| $\pi^*$ | SS F Inflation | N | 1.00 | 0.25 | 0.97 | [0.72, 1.24] | 0.94 | [0.70, 1.18] |
| $y$ | SS H Output Growth | N | 0.50 | 0.25 | 0.36 | [0.33, 0.39] | 0.40 | [0.38, 0.42] |
| $y^*$ | SS F Output Growth | N | 0.50 | 0.25 | 0.41 | [0.38, 0.44] | 0.44 | [0.42, 0.46] |

**Note:** B stands for Beta, G stands for Gamma and N stands for Normal distribution. H and F indicates Home and Foreign, respectively. SS denotes the steady state and SD the standard deviation.

Table E.2. **Estimation: Shocks**

| Parameter | Description | Prior | | | Poster.: Rational | | Poster.: Baseline | |
|---|---|---|---|---|---|---|---|---|
| | | Dist. | Mean | SD | Mean | [5, 95] | Mean | [5, 95] |
| $\rho_g$ | AR H Preference | B | 0.70 | 0.10 | 0.95 | [0.93, 0.97] | 0.96 | [0.95, 0.98] |
| $\rho_g^*$ | AR F Preference | B | 0.70 | 0.10 | 0.83 | [0.78, 0.87] | 0.90 | [0.86, 0.94] |
| $\rho_\xi$ | AR H Cost-Push | B | 0.70 | 0.10 | 0.87 | [0.74, 0.98] | 0.65 | [0.55, 0.70] |
| $\rho_\xi^*$ | AR F Cost-Push | B | 0.70 | 0.10 | 0.94 | [0.89, 0.98] | 0.89 | [0.84, 0.93] |
| $\rho_\varrho$ | AR Risk Premium | B | 0.70 | 0.10 | 0.98 | [0.97, 0.99] | 0.96 | [0.94, 0.98] |
| $\sigma_\nu$ | SD H Monetary Policy | IG | 0.25 | Inf | 0.39 | [0.33, 0.44] | 0.31 | [0.27, 0.34] |
| $\sigma_{\nu*}$ | SD F Monetary Policy | IG | 0.25 | Inf | 0.41 | [0.36, 0.45] | 0.37 | [0.33, 0.40] |
| $\sigma_g$ | SD H Preference | IG | 0.25 | Inf | 11.08 | [7.90, 13.9] | 3.99 | [3.19, 4.76] |
| $\sigma_{g*}$ | SD F Preference | IG | 0.25 | Inf | 2.70 | [2.07, 3.22] | 1.82 | [1.48, 2.20] |
| $\sigma_\xi$ | SD H Cost-Push | IG | 0.25 | Inf | 0.21 | [0.16, 0.26] | 0.37 | [0.29, 0.44] |
| $\sigma_{\xi*}$ | SD F Cost-Push | IG | 0.25 | Inf | 0.08 | [0.05, 0.11] | 0.10 | [0.07, 0.14] |
| $\sigma_\varrho$ | SD Risk Premium | IG | 0.25 | Inf | 0.29 | [0.26, 0.33] | 0.65 | [0.45, 0.83] |

**Note:** B stands for Beta and IG stands for Inverted Gamma distribution. AR indicates AR(1) coefficient and SD the standard deviation of innovation. H and F denote Home and Foreign, respectively.

Table E.3. **Estimation with Inflated Priors: Structural Parameters**

| Parameter | Description | Prior | | | Posterior | |
|---|---|---|---|---|---|---|
| | | Dist. | Mean | SD | Mean | [5, 95] |
| $m$ | Cognitive Discounting | B | 0.80 | 0.10 | 0.62 | [0.37, 0.81] |
| $\phi_\pi$ | H Taylor Rule, Inflation | N | 1.50 | 0.75 | 1.24 | [0.75, 1.71] |
| $\phi_\pi^*$ | F Taylor Rule, Inflation | N | 1.50 | 0.75 | 1.44 | [0.92, 1.96] |
| $\phi_y$ | H Taylor Rule, Output | N | 0.125 | 0.195 | 0.34 | [0.20, 0.46] |
| $\phi_y^*$ | F Taylor Rule, Output | N | 0.125 | 0.195 | 0.15 | [0.02, 0.28] |
| $\rho$ | H Interest Rate Smooth | B | 0.90 | 0.075 | 0.86 | [0.81, 0.90] |
| $\rho^*$ | F Interest Rate Smooth | B | 0.90 | 0.075 | 0.82 | [0.73, 0.91] |
| $\theta$ | Calvo Probability | B | 0.875 | 0.075 | 0.96 | [0.93, 0.98] |
| $\varphi$ | Inverse Frisch Elasticity | G | 3.00 | 0.375 | 2.87 | [2.28, 3.44] |
| $\sigma$ | Intertemp. El. of Subst. | G | 1.00 | 0.30 | 2.04 | [1.66, 2.41] |
| $\eta$ | Trade Elasticity | G | 1.00 | 0.075 | 0.64 | [0.59, 0.69] |
| $r$ | SS H Real Rate | N | 0.50 | 0.325 | 0.17 | [-0.31, 0.66] |
| $r^*$ | SS F Real Rate | N | 0.50 | 0.325 | 0.74 | [0.35, 1.12] |
| $\pi$ | SS H Inflation | N | 1.00 | 0.325 | 1.09 | [0.84, 1.35] |
| $\pi^*$ | SS F Inflation | N | 1.00 | 0.325 | 0.92 | [0.59, 1.26] |
| $y$ | SS H Output Growth | N | 0.50 | 0.325 | 0.40 | [0.37, 0.43] |
| $y^*$ | SS F Output Growth | N | 0.50 | 0.325 | 0.43 | [0.40, 0.46] |

**Note:** B stands for Beta, G stands for Gamma and N stands for Normal distribution. H and F indicates Home and Foreign, respectively. SS denotes the steady state and SD the standard deviation.

Table E.4. **Estimation with Inflated Priors: Shocks**

| Parameter | Description | Prior | | | Posterior | |
|---|---|---|---|---|---|---|
| | | Dist. | Mean | SD | Mean | [5, 95] |
| $\rho_g$ | AR H Preference | B | 0.70 | 0.15 | 0.98 | [0.96, 0.99] |
| $\rho_g^*$ | AR F Preference | B | 0.70 | 0.15 | 0.94 | [0.90, 0.98] |
| $\rho_\xi$ | AR H Cost-Push | B | 0.70 | 0.15 | 0.67 | [0.56, 0.78] |
| $\rho_\xi^*$ | AR F Cost-Push | B | 0.70 | 0.15 | 0.91 | [0.86, 0.96] |
| $\rho_\varrho$ | AR Risk Premium | B | 0.70 | 0.15 | 0.97 | [0.95, 0.99] |
| $\sigma_\nu$ | SD H Monetary Policy | IG | 0.25 | Inf | 0.30 | [0.27, 0.34] |
| $\sigma_{\nu*}$ | SD F Monetary Policy | IG | 0.25 | Inf | 0.36 | [0.32, 0.40] |
| $\sigma_g$ | SD H Preference | IG | 0.25 | Inf | 4.20 | [3.21, 5.12] |
| $\sigma_{g*}$ | SD F Preference | IG | 0.25 | Inf | 2.04 | [1.60, 2.49] |
| $\sigma_\xi$ | SD H Cost-Push | IG | 0.25 | Inf | 0.39 | [0.29, 0.49] |
| $\sigma_{\xi*}$ | SD F Cost-Push | IG | 0.25 | Inf | 0.11 | [0.07, 0.16] |
| $\sigma_\varrho$ | SD Risk Premium | IG | 0.25 | Inf | 0.69 | [0.43, 0.96] |

**Note:** B stands for Beta and IG stands for Inverted Gamma distribution. AR indicates AR(1) coefficient and SD the standard deviation of innovation. H and F denote Home and Foreign, respectively.