Invoicing Currency and Optimal Policies in a Global Liquidity Trap[*]

Jongsoo Kim[†] Suk Joon Kim[‡] Sangheon Ahn[§] Kwang Hwan Kim[¶]

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Abstract

We study how international pricing regimes influence optimal monetary-fiscal policy during global liquidity traps. Using the two-country New Keynesian model, we find that high exchange rate pass-through induces the less affected economy to raise interest rates, stabilizing relative prices but suppressing global demand. Low pass-through instead leads to sustained low rates to support global demand. Fiscal policy complements monetary policy limitations: high pass-through warrants global spending expansion, while low pass-through requires asymmetric spending in the more affected country.

Key Words: Zero lower bound, Nominal rigidities, Optimal monetary policy, Invoicing currency
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[†]School of Economics, Yonsei University, jskim0915@yonsei.ac.kr
[‡]Department of Economics, New York University, sk10040@nyu.edu
[§]Department of Economics, University of Texas at Austin, heonahn@utexas.edu
[¶]School of Economics, Yonsei University. Email: kimkh01@yonsei.ac.kr

1 Introduction

Should policymakers care about which currency is used in international trade when designing optimal monetary and fiscal policy? The international pricing regime fundamentally shapes how exchange rate movements affect relative prices, trade flows, and ultimately, macroeconomic adjustment across countries, as demonstrated in the seminal work by Gopinath et al. (2020). While extensive research shows how different pricing regimes shape optimal policies during normal times (Corsetti et al. (2011), Engel (2011) and Egorov and Mukhin (2023)), their role during global liquidity traps, when interest rates hit zero lower bound (hereafter, ZLB), remains largely unexplored. This gap in our understanding has become increasingly consequential as major economies face recurring encounters with the ZLB, while remaining deeply interconnected through international trade. In this paper, we show that the invoicing currency regime fundamentally alters both (i) how adverse shock transmits across countries at the liquidity trap and (ii) the optimal mix of monetary and fiscal policy.

To this end, we build a two-country New Keynesian model where one economy (Home) is hit by a large negative demand shock that drives its natural interest rate below zero. While not directly affected by the shock, the Foreign economy experiences spillovers through trade linkages and exchange rate movements. Within this framework, we examine two distinct pricing regimes: producer currency pricing (PCP) and local currency pricing (LCP). Under PCP, firms set export prices in their own currency, leading to complete exchange rate pass-through (hereafter, ERPT) as import prices fully adjust to exchange rate movements. Under LCP, firms instead price exports in the destination country's currency, resulting in incomplete pass-through due to sticky local currency prices. Within this framework, we characterize optimal cooperative discretionary policies—following the tradition of Cook and Devereux (2013) and Cho et al. (2023b)—and show how these distinct pricing regimes fundamentally reshape both shock transmission and the optimal monetary-fiscal policy mix during liquidity traps.

Our transmission analysis reveals a crucial insight: the stabilizing properties of ERPT depend critically on shock severity, creating a fundamental trade-off for policymakers. We establish this by first examining scenarios where central banks mechanically follow their natural interest rate paths, isolating the pure transmission effects of each pricing regime. For moderate shocks that push only the Home economy to the ZLB, PCP's complete pass-through acts as an effective automatic stabilizer. Home's currency depreciates, triggering immediate price adjustments that redirect global demand toward Home goods and cushion the downturn. LCP's sluggish pass-through weakens this beneficial channel, resulting in a deeper recession for the Home economy.

This relationship inverts completely for severe shocks that drive both countries to the ZLB. Intense deflationary pressures create a positive real interest rate differential that causes Home's currency to appreciate rather than depreciate—a perverse outcome that worsens the downturn. Under PCP, rapid price adjustment amplifies this destabilizing effect by making Home goods immediately less competitive globally. Under LCP, however, sticky export prices provide natural insulation against these adverse exchange rate movements, automatically limiting the damage.

Building on these transmission differences, we find that the distinct patterns create very different optimal monetary policy strategies. Since the Home economy remains constrained at the ZLB, the key policy differences emerge in how the Foreign economy should respond. The central finding is that Foreign maintains substantially higher interest rates under PCP than under LCP, with this divergence increasing with shock severity. This difference stems from how effectively each pricing regime allows Foreign to influence economic outcomes through exchange rate channels. Under PCP, complete pass-through makes exchange rate management a powerful policy tool across all shock scenarios. Foreign optimally raises interest rates to engineer favorable exchange rate movements through uncovered interest parity—depreciating Home's currency during moderate shocks to boost competitiveness, or countering perverse appreciation during severe shocks to limit damage. This strategy proves effective because rapid price changes amplify expenditure-switching effects, though it comes at the cost of suppressing global demand, particularly when aggressive rate hikes are needed to combat severe deflationary episodes.

Under LCP, the same exchange rate strategy becomes far less potent regardless of shock severity. Limited pass-through means that even substantial interest rate changes produce only muted effects on relative prices and trade flows. Recognizing this constraint, Foreign shifts strategy entirely—prioritizing support for global aggregate demand through lower interest rates while accepting reduced ability to directly address relative imbalances. This approach proves particularly advantageous during severe shocks, where LCP's sticky prices provide built-in insulation against perverse exchange rate movements, enabling Foreign to maintain a consistently accommodative policy focused on global demand support without worrying about amplifying exchange rate distortions.

Building on this monetary policy analysis, we show how fiscal policy systematically complements monetary policy's regime-specific focus and constraints. Under LCP, monetary policy's emphasis on supporting global demand through low interest rates leaves relative distortions inadequately addressed. Fiscal policy fills this gap by concentrating intervention in Home to manage cross-country imbalances that monetary policy cannot effectively target due to limited pass-through. This complementary relationship manifests differently under PCP, where monetary policy's focus on managing relative prices through higher Foreign rates creates a global demand shortfall that fiscal policy must address through synchronized expansion across both countries.

Finally, we analyze how optimal policy responses vary with trade openness—a dimension particularly relevant as countries reassess global integration strategies. A key finding emerges: the sensitivity of optimal policy to trade integration depends critically on the underlying pricing regime. Under PCP, Foreign's optimal monetary policy is highly sensitive to the degree of trade openness. Foreign's interest rate increases and the need for fiscal coordination peak at intermediate openness levels, precisely where most advanced economies currently operate. This occurs because intermediate openness creates a "sweet spot" where exchange rate movements generate substantial expenditure-switching effects while simultaneously creating severe cross-country distortions that require aggressive policy responses. In stark contrast, under LCP, the optimal policy remains largely insensitive to variations in trade openness. Sticky export prices dampen the exchange rate transmission mechanism regardless of integration levels, allowing Foreign to maintain a consistently accommodative policy focused on global demand support. These findings reveal that the consequences of changing trade relationships for crisis management depend not just on the degree of integration, but fundamentally on the currency invoicing patterns that govern how exchange rate movements transmit across borders.

Related Literature. This paper contributes to the literature on optimal cooperative monetary policies in open economies (Faia and Monacelli, 2008; Corsetti and Pesenti, 2001; Benigno and Benigno, 2003; Engel, 2011; Groll and Monacelli, 2020; Auray et al., 2024). In particular, our paper is closest to the literature when an open economy faces significant demand shocks that lead to the ZLB. In this context, Fujiwara et al. (2013) shows that the optimal monetary policy in one country should respond to the macroeconomic conditions of other countries. Cook and Devereux (2013) analyze the optimal monetary policy under discretion as we do and argue that the less affected country should raise the interest rate in order to ameliorate the recession in the more affected country, but only under the PCP setting. Cook and Devereux (2016) further establish that monetary unions can outperform flexible exchange rate regimes in such scenarios by preventing adverse relative price responses and reducing macroeconomic volatility. More recently, Cho et al. (2025) examine the optimal inflation target in an open economy with a ZLB constraint, calibrating their analysis to the Euro area. Our paper makes two distinct contributions to this literature. First, unlike previous studies that focus primarily on monetary policy at the ZLB, we provide a comprehensive analysis of how monetary and fiscal policies should optimally coordinate during liquidity traps in open economies.[1] Second, this paper provides the first systematic analysis of how different international pricing regimes fundamentally reshape both the transmission of ZLB episodes and the optimal policy responses.

Our paper also relates to the rich literature on international price-setting regimes and their macroeconomic implications. The importance of currency invoicing for relative price dynamics and international policy transmission is emphasized by Obstfeld and Rogoff (2000) and Engel (2003), with recent empirical evidence provided by Boz et al. (2017). While the classical framework assumes PCP following Dornbusch (1976), the evidence of low ERPT leads to the development of LCP models, as in Bacchetta and van Wincoop (2000) and Chari et al. (2002). While these different pricing regimes have been shown to matter for various aspects of international macroeconomics, their implications during global liquidity traps remain largely unexplored. Our paper addresses this gap by showing how different pricing regimes fundamentally reshape both the international transmission of shock and optimal policy responses.

The rest of the paper is structured as follows. Section 2 constructs our two-country New Keynesian model, distinguishing between PCP and LCP pricing to capture varying ERPT. Section 3 analyzes how pricing regimes affect demand shock transmission at the ZLB, highlighting key differences between small and large shocks. Section 4 explores optimal monetary policy design, examining how ERPT affects the trade-off between global and relative stabilization. Section 5 examines the optimal monetary-fiscal policy mix, showing how fiscal policy complements monetary policy's regime-specific constraints. Section 6 analyzes how these optimal policy patterns vary with trade openness and demonstrates the robustness of our findings across different parameter specifications. Section 7 concludes.

2 Environment

We build on a standard two-country New Keynesian model (Corsetti et al. (2011)) with two distinct currency pricing regimes: Producer Currency Pricing (PCP) and Local Currency Pricing (LCP).

[1] Cook and Devereux (2019) examine optimal fiscal policy under liquidity trap, but in the context of a currency union. Bhattarai and Egorov (2016) study optimal monetary and fiscal policy at ZLB, but under small open economy and PCP framework. In contrast, we focus on flexible exchange rate regimes and how optimal policy depends crucially on currency invoicing assumptions. Our work also connects to literature exploring fiscal policy's role when monetary policy becomes constrained. Adao et al. (2009), Farhi et al. (2014), and Chen et al. (2021) show how tax and tariff policies can generate exchange rate depreciation. We extend this literature by analyzing optimal fiscal policy under liquidity traps across various pricing regimes.

The world consists of two equal-sized countries, Home and Foreign. For brevity, we focus on describing the Home country's decision problems, with Foreign variables denoted by asterisks (*). The Foreign country's problems can be defined symmetrically.

2.1 Households

The representative household in the Home country maximizes their utility function:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \{U(C_t; Z_t) + V(N_t) + J(G_t)\} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(Z_t \frac{C_t^{1-\rho}}{1-\rho} - \frac{N_t^{1+\eta}}{1+\eta} + \Psi \frac{G_t^{1-\rho}}{1-\rho} \right),$$

subject to the budget constraint:

$$P_t C_t + \sum_{h^{t+1}} q_t(h^{t+1}) \mathcal{B}_{t+1} + B_{H,t+1} \leq \mathcal{B}_t + (1+R_t) B_{H,t} + W_t N_t + D_t + \tau_t$$

where C_t denotes the home consumption basket priced at P_t, N_t denotes the labor supply with nominal wage W_t, and G_t denotes the home government spending. β is the discount factor, ρ is the inverse of the intertemporal elasticity of substitution, η is the inverse Frisch elasticity, and Ψ is the preference parameter for government spending. $\mathcal{B}_{t+1}$ is the holdings of state-contingent securities, priced at $q_t(h^{t+1})$, paying off one unit of domestic currency when state h^{t+1} is realized at time $t+1$. $B_{H,t}$ is the domestic nominal bond, yielding a net yield of R_t at the beginning of period t. τ_t is the lump-sum taxes. D_t denotes the accrued profit from monopolistically competitive firms. Z_t represents the demand shock that follows the lognormal AR(1) process:

$$z_t = \rho_z z_{t-1} + \epsilon_t^z \qquad \text{with} \qquad \epsilon_t^z \overset{iid}{\sim} \mathcal{N}(0, \sigma_z^2)$$

where $z_t \equiv \log Z_t$.

The consumption basket of Home is a composite index of domestic and imported goods:

$$C_t = \left[\nu^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + (1-\nu)^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}},$$

where $\nu \in [\frac{1}{2}, 1]$ is the weight of domestically produced goods in the consumption basket, which we refer to as the degree of home bias. $\theta > 0$ is the trade elasticity of substitution between domestic and foreign goods. $C_{H,t}$ and $C_{F,t}$ are consumption bundles of imperfectly substitutable varieties with the elasticity of substitution being θ:

$$C_{H,t} = \left[2^{\frac{1}{\theta}} \int_0^{1/2} C_{H,t}(i)^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}} \quad \text{and} \quad C_{F,t} = \left[2^{\frac{1}{\theta}} \int_{1/2}^{1} C_{F,t}(i)^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}},$$

where the demand for each variety is given by:

$$C_{H,t}(i) = 2\left(\frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\theta} C_{H,t} \quad \text{and} \quad C_{F,t}(i) = 2\left(\frac{P_{F,t}(i)}{P_{F,t}} \right)^{-\theta} C_{F,t}.$$

$P_{j,t}(i)$ is the price of good i produced in country $j \in \{H, F\}$, quoted in the Home currency. The price index of composite consumption $C_{H,t}$ and $C_{F,t}$ is:

$$P_{H,t} = \left[2 \int_0^{1/2} P_{H,t}(i)^{1-\sigma} \, di\right]^{\frac{1}{1-\sigma}} \quad \text{and} \quad P_{F,t} = \left[2 \int_{1/2}^{1} P_{F,t}(i)^{1-\sigma} \, di\right]^{\frac{1}{1-\sigma}},$$

while Home's consumer price index is given by:

$$P_t = \left[\nu P_{H,t}^{1-\theta} + (1-\nu) P_{F,t}^{1-\theta}\right]^{\frac{1}{1-\theta}},$$

Household optimization yields the following consumption Euler equation:

$$\frac{U_C(C_t, \xi_t)}{P_t} = \beta(1+R_t)\mathbb{E}_t \frac{U_C(C_{t+1}, \xi_{t+1})}{P_{t+1}}, \tag{1}$$

Complete international risk-sharing implies:

$$Q_t Z_t C_t^{-\rho} = Z_t^* (C_t^*)^{-\rho} \tag{2}$$

which links consumption patterns across countries through movements in the real exchange rate Q_t and country-specific demand shocks.

2.2 Firms

In the Home country, each firm i employs domestic labor $N_t(i)$ to produce a differentiated good according to a simple linear production function:

$$Y_{H,t}(i) = N_t(i).$$

Firms follow Calvo (1983) pricing, with a fraction $(1-\alpha)$ of firms choosing the optimal reset prices. We assume appropriate subsidies are in place to ensure efficient steady-state allocation. The optimal price-setting problem differs crucially across pricing regimes:

For PCP , firm i chooses a single optimal price $P_{H,t}^o$ for both domestic and export markets[2]:

$$\max_{P_{H,t}^o} \mathbb{E}_t \sum_{k=0}^{\infty} (\beta\alpha)^k \Lambda_{t+k} \left[P_{H,t}^o \left\{C_{H,t+k}(i) + C_{H,t+k}^*(i) + G_{t+k}(i)\right\} - W_{t+k} N_{t+k}(i)\right]. \tag{3}$$

For LCP , firm i set separate prices for domestic ($P_{H,t}^o$) and export ($P_{H,t}^{*,o}$) markets:

$$\max_{P_{H,t}^o, P_{H,t}^{*,o}} \mathbb{E}_t \sum_{k=0}^{\infty} (\beta\alpha)^k \Lambda_{t+k} \left[P_{H,t}^o \{C_{H,t+k}(i) + G_{t+k}(i)\} + S_{t+k} P_{H,t}^{*,o} C_{H,t+k}^*(i) - W_{t+k} N_{t+k}(i)\right], \tag{4}$$

[2]Given the symmetric equilibrium where all adjusting firms face identical problems, we can drop the index i from the optimal price.

where $\Lambda_{t+k} = \frac{U_C(C_{t+k},\xi_{t+k})}{P_{t+k}} \frac{P_t}{U_C(C_t,\xi_t)}$ represents the stochastic discount factor and S_{t+k} is the nominal exchange rate defined as units of domestic currency per unit of foreign currency. These optimal prices then aggregate according to regime-specific laws of motion:

$$\begin{aligned}
\textbf{\textit{PCP:}} \qquad & P_{H,t} = \left[(1-\alpha)(P^o_{H,t})^{1-\sigma} + \alpha P^{1-\sigma}_{H,t-1}\right]^{\frac{1}{1-\sigma}}, \\
\textbf{\textit{LCP:}} \qquad & P_{H,t} = \left[(1-\alpha)(P^o_{H,t})^{1-\sigma} + \alpha P^{1-\sigma}_{H,t-1}\right]^{\frac{1}{1-\sigma}}, \\
& P^*_{H,t} = \left[(1-\alpha)(P^{*,o}_{H,t})^{1-\sigma} + \alpha (P^*_{H,t-1})^{1-\sigma}\right]^{\frac{1}{1-\sigma}}.
\end{aligned}$$

2.3 International Relative Prices

A key element in understanding international price dynamics is the internal relative price, which measures how expensive imported goods are compared to domestic goods in each country. For the Home country, this is defined as $T_t = \frac{P_{F,t}}{P_{H,t}}$ (the price of Foreign imported goods relative to domestically produced Home goods), while for the Foreign country it is $T^*_t = \frac{P^*_{H,t}}{P^*_{F,t}}$ (the price of Home imported goods relative to domestically produced Foreign goods), playing a crucial role in determining consumption patterns and trade flows between countries.

Under PCP, firms set their export prices in their own currency. This creates a direct link between exchange rate movements and relative prices in both markets. When the exchange rate changes, export prices adjust immediately in the destination market's currency. This leads to a simple reciprocal relationship between Home and Foreign relative prices: $T_t = \frac{1}{T^*_t}$. A Home currency depreciation simultaneously increases T_t and decreases T^*_t, reflecting how Foreign goods become relatively more expensive in Home while Home goods become relatively cheaper in Foreign.

Under LCP, firms set their export prices in the destination market's currency. The reciprocal relationship $T_t = \frac{1}{T^*_t}$ persists, but relative prices adjust more slowly to exchange rate movements since export prices are preset in the destination currency. When exchange rates move, the prices of identical goods can diverge across countries, creating currency misalignment measured by $m_t = \left(\frac{S_t P^*_{H,t}}{P_{H,t}} \frac{S_t P^*_{F,t}}{P_{F,t}}\right)^{\frac{1}{2}}$. This misalignment captures how sticky local currency pricing temporarily prevents price equalization across borders.

2.4 Market Clearing

The market clearing condition for Home goods balances total production with domestic consumption, exports, and government spending:

$$Y_{H,t} = \nu \left(\frac{P_{H,t}}{P_t}\right)^{-\theta} C_t + (1-\nu) \left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\theta} C^*_t + G_t, \tag{5}$$

where $Y_{H,t} = \left[2^{\frac{1}{\sigma}} \int_0^{1/2} Y_{H,t}(i)^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}}$ is aggregate home output.

2.5 Linearized Equilibrium and Welfare Objectives

We characterize the log-linearized equilibrium conditions that constrain optimal policy design. For any variable X_t, we define $\hat{X}_t \equiv \log(X_t/X)$ as deviations from steady state and $\tilde{X}_t \equiv \log(X_t/X_t^{fb})$ as gaps from the efficient allocation. The efficient benchmark features flexible prices, perfect competition, and optimal fiscal policy satisfying $V'(N_t) = J'(G_t)$.[3]

Following Engel (2011) and Cook and Devereux (2013), we decompose variables into world averages $\hat{X}_t^W = \frac{\hat{X}_t + \hat{X}_t^*}{2}$ and relative differences $\hat{X}_t^R = \frac{\hat{X}_t - \hat{X}_t^*}{2}$. This decomposition isolates how pricing regimes affect international transmission mechanisms. For clarity, we only show key equations here. Complete model derivations, including detailed household and firm optimization, the full linearized system, and welfare function derivations, are provided in the online appendix.

Demand block: World output gaps evolve identically under both pricing regimes:

$$\frac{1}{c_y}\left(\tilde{Y}_t^W - E_t\tilde{Y}_{t+1}^W\right) - \frac{1-c_y}{c_y}\left(\tilde{G}_t^W - E_t\tilde{G}_{t+1}^W\right) = -\frac{1}{\rho}\left(\frac{\hat{R}_t + \hat{R}_t^*}{2} - E_t\hat{\pi}_{t+1}^W - \hat{R}_{ppi,t}^{W,nat}\right), \quad (6)$$

where c_y is the steady-state consumption-to-output ratio and $\hat{R}_{ppi,t}^{W,nat}$ denotes world natural rates defined as $\hat{R}_{ppi,t}^{W,nat} \equiv \frac{\hat{R}_{ppi,t}^{fb} + \hat{R}_{ppi,t}^{fb,*}}{2}$. $\hat{R}_{ppi,t}^{fb}$ and $\hat{R}_{ppi,t}^{fb,*}$ are PPI-based real interest rates that prevail in the economy without nominal rigidity.

Relative dynamics diverge across regimes. Under PCP, complete pass-through creates direct policy transmission:

$$\frac{1}{c_yD}\left(\tilde{Y}_t^R - E_t\tilde{Y}_{t+1}^R\right) - \frac{(1-c_y)}{c_yD}\left(\tilde{G}_t^R - E_t\tilde{G}_{t+1}^R\right) = -\frac{1}{\rho}\left(\frac{\hat{R}_t - \hat{R}_t^*}{2} - E_t\hat{\pi}_{t+1}^R - \hat{R}_{ppi,t}^{R,nat}\right), \quad (7)$$

where $D = (2\nu-1)^2 + 4\rho\theta\nu(1-\nu)$ captures international linkage strength. Similar to the case of world IS curve, $\hat{R}_{ppi,t}^{R,nat}$ denotes the relative natural rate defined as $\hat{R}_{ppi,t}^{R,nat} \equiv \frac{\hat{R}_{ppi,t}^{fb} - \hat{R}_{ppi,t}^{fb,*}}{2}$.

Under LCP, sticky export prices generate currency misalignment effects:

$$\begin{aligned}\frac{2\nu-1}{c_yD}\left(\tilde{Y}_t^R - E_t\tilde{Y}_{t+1}^R\right) - \frac{(2\nu-1)(1-c_y)}{c_yD}\left(\tilde{G}_t^R - E_t\tilde{G}_{t+1}^R\right) + \frac{2\nu(1-\nu)\theta}{D}\left(\hat{m}_t - E_t\hat{m}_{t+1}\right) \\ = -\frac{1}{\rho}\left(\frac{\hat{R}_t - \hat{R}_t^*}{2} - E_t\hat{\pi}_{cpi,t+1}^R - \hat{R}_{cpi,t}^{R,nat}\right). \quad (8)\end{aligned}$$

[3] Steady-state subsidies eliminate monopolistic distortions, ensuring $X = X^{fb}$.

The currency misalignment term $\hat{m}_t$ captures deviations from the law of one price, creating additional history dependence absent under PCP. $\hat{R}^{R,nat}_{cpi,t}$ stands for the relative CPI-based real interest rate that prevails in the economy with flexible prices.

Supply block: World inflation dynamics remain identical across regimes:

$$\hat{\pi}^W_t = \kappa \left(\left(\frac{\rho}{c_y} + \eta \right) \tilde{Y}^W_t - \frac{\rho (1 - c_y)}{c_y} \tilde{G}^W_t \right) + \beta E_t \hat{\pi}^W_{t+1}, \tag{9}$$

where $\kappa = \frac{(1-\alpha\beta)(1-\alpha)}{\alpha}$ represents the Phillips curve slope.

Relative inflation dynamics differ by regime. Under PCP, we focus on producer price inflation:

$$\hat{\pi}^R_{ppi,t} = \kappa \left(\left(\frac{\rho}{c_y D} + \eta \right) \tilde{Y}^R_t - \frac{\rho (1 - c_y)}{c_y D} \tilde{G}^R_t \right) + \beta E_t \hat{\pi}^R_{ppi,t+1}. \tag{10}$$

Under LCP, consumer price inflation incorporates misalignment effects:

$$\hat{\pi}^R_{cpi,t} = \kappa \left((2\nu - 1) \left(\frac{\rho}{c_y D} + \eta \right) \tilde{Y}^R_t - (2\nu - 1) \frac{\rho (1 - c_y)}{c_y D} \tilde{G}^R_t + \frac{D - (2\nu - 1)^2}{2D} \hat{m}_t \right) + \beta E_t \hat{\pi}^R_{cpi,t+1}. \tag{11}$$

Similar to the demand block, currency misalignment influences relative CPI dynamics under LCP. Specifically, when the Home currency depreciates ($m_t > 0$), incomplete ERPT makes imported goods relatively less expensive at Home, stimulating consumption compared to a scenario of complete pass-through. This wealth effect, in turn, reduces labor supply compared to PCP in Home, contributing to a higher cross-country CPI inflation differential.

In the case of LCP, two additional equations constitute the set of linear constraints for the optimal policy problem.

$$\tilde{Y}^R_t = \frac{c_y D}{2\rho} \tilde{T}_t + \frac{c_y (2\nu - 1)}{2\rho} \hat{m}_t + (1 - c_y) \tilde{G}^R_t \tag{12}$$

$$\Delta \hat{T}_t = \beta E_t \Delta \hat{T}_{t+1} - \kappa \left(\tilde{T}_t + 2\eta \tilde{Y}^R_t \right) \tag{13}$$

The first equation dictates how the relative price gap, misalignment, and the relative government spending gap affect the cross-country output gap differential. Relatively cheaper home-produced goods ($\tilde{T}_t > 0$), positive misalignment ($\hat{m}_t > 0$), and more aggressive fiscal expansion at Home ($\tilde{G}^R_t > 0$) contribute to the widening output gap between the two countries by increasing demand for Home goods. The second equation describes the sluggish movement of the relative price due to incomplete ERPT. Unlike in the case of PCP, export prices do not immediately adjust to exchange rate fluctuations but instead display inertia, following the second-order difference equation.

For the final remark, one notable feature for both pricing regimes is that the global dimension of the model can be fully characterized by the World IS curve (6) and World NKPC (9). These equations determine the paths of world output gap ($\tilde{Y}_t^W$) and inflation ($\hat{\pi}_t^W$). Thus, when countries implement identical policy paths $\left(\{\hat{R}_t^W\}_{t=0}^{\infty}, \{\hat{G}_t^W\}_{t=0}^{\infty}\right)$, world economic outcomes are identical across two symmetric pricing regimes. Hence, the extent to which export prices reflect exchange rate movements only affects cross-country differential in output gap and inflation while keeping world variables intact.

Welfare objectives Our cooperative policy analysis maximizes joint welfare:

$$W = E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(Z_t \frac{C_t^{1-\rho}}{1-\rho} - \frac{N_t^{1+\eta}}{1+\eta} + \Psi \frac{G_t^{1-\rho}}{1-\rho} \right) + \frac{1}{2} \left(Z_t^* \frac{(C_t^*)^{1-\rho}}{1-\rho} - \frac{(N_t^*)^{1+\eta}}{1+\eta} + \Psi \frac{(G_t^*)^{1-\rho}}{1-\rho} \right) \right]$$

Under discretionary policy, the social planner minimizes a quadratic loss function derived from second-order approximation around the efficient allocation (detailed in the online appendix).

The loss function structure varies by regime: PCP targets producer price inflation and output gaps, while LCP features an additional currency misalignment term that captures inefficient deviations from the law of one price arising under incomplete pass-through.

2.6 Calibration

Parameter	Value	Description
ρ	1	Inverse of the elasticity of intertemporal substitution
β	0.9963	Discount factor
η	1	Inverse of Frisch elasticity of labor supply
ν	0.8	Home bias (degree of trade openness)
σ	5	Elasticity of substitution between differentiated goods
θ	2	Elasticity of substitution between goods across countries
Ψ	0.25	Preference parameter for government spending
α	0.85	Calvo parameter
ρ_z	0.9	Shock persistence

Table 1: Baseline Calibration

We calibrate $\beta = 0.9963$ (1.5% annual real rate), $\eta = 1$, $\alpha = 0.85$, and $\sigma = 5$ (25% steady-state markup) following Cook and Devereux (2013). Following Cho et al. (2023a), we set $\rho = 1$ and $\theta = 2$, implying Edgeworth substitutability between international goods. The government spending weight $\Psi = 0.25$ yields consumption-to-output ratio $c_y = 0.8$. Shock persistence $\rho_z = 0.9$ and home bias $\nu = 0.8$ complete our baseline. The online appendix demonstrates robustness across alternative parameter specifications.

2.7 Solution Method

We characterize optimal cooperative discretionary policies using a Markov-perfect Stackelberg-Nash equilibrium where the social planner acts as Stackelberg leader. Under PCP, this yields a static optimization problem each period. Under LCP, endogenous state variables from sticky export prices create a dynamic optimization problem requiring careful treatment of occasionally binding zero lower bound constraints, which we solve using the piecewise linear method of Harrison and Waldron (2021).

3 ERPT and Demand Shock Transmission

In this section, we explore how varying degrees of ERPT yield different macroeconomic outcomes during demand-driven ZLB episodes. To obtain sharp economic intuition, we compare two canonical pricing regimes: producer currency pricing (PCP), where ERPT is complete, and local currency pricing (LCP), where pass-through is incomplete due to sticky export prices. Our analysis reveals that the stabilizing properties of ERPT depend crucially on shock size and the binding of the ZLB constraint.

3.1 Characterizing Demand Shocks: Small versus Large

A key finding of our analysis is that the transmission of demand shocks through exchange rates operates differently depending on shock size. When the ZLB is not binding, a negative demand shock in the home economy leads to a depreciation of the home currency, regardless of its magnitude. This occurs because the home real interest rate falls below the foreign rate, and the uncovered interest parity (UIP) condition implies currency depreciation. This standard mechanism continues to operate even when the ZLB binds, provided the deflationary pressures are modest. However, the exchange rate dynamics fundamentally change when a large shock drives the economy to bind at the ZLB. Intense deflationary pressures ($E_t\hat{\pi}_{t+1} < 0$) may cause the home currency to appreciate, as the home real interest rate rises above the foreign rate (Cook and Devereux (2013)). As the direction of exchange rate movements under the ZLB is influenced by the magnitude of the shock, we categorize demand shocks into two types to examine the role of ERPT in each scenario separately.

The criterion determining the severity of the ZLB is an impact response of the natural interest rate, the real interest rate that prevails in a flexible price economy. A 'small shock' pushes only the home country's natural rate below zero in a fully open economy ($\nu = 0.5$), while keeping

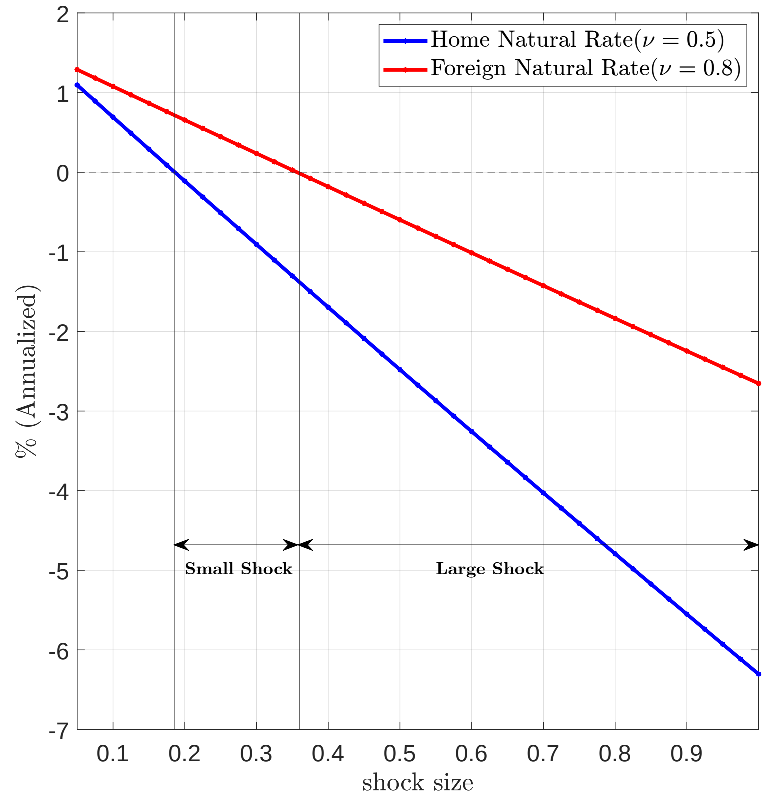

Figure 1: Small Shock vs Large Shock

Note: Interest rates are expressed as annualized rates, calculated as $R_t^4 - 1$. This same annualization formula is applied to all interest rate impulse responses shown in the figures below.

the foreign rate positive under baseline home bias (ν = 0.8). Under such shocks, only the Home country faces a binding ZLB when monetary policy follows the natural rate.

A 'large shock', in contrast, drives both countries' natural rates negative under baseline home bias, creating a global liquidity trap when monetary policy follows the natural rate. Figure 1 illustrates this classification under our baseline parameters (Table 1), showing that small shocks fall between 0.18 and 0.36 in magnitude. For our analysis, we use representative values of 0.3 and 0.6 for small and large shocks, respectively.

3.2 Demand Shock Transmission: PCP vs LCP

Using the definition of shocks in the previous section, we investigate how varying degrees of ERPT change the dynamics of macroeconomic variables at the ZLB. As the main purpose of this experiment is to reveal the intrinsic difference between two pricing regimes, we aim to have monetary authorities in each country follow their respective natural interest rate paths. However, directly setting policy rates equal to natural rates can lead to multiple equilibria, as noted in Section 4.3.1.1

of Galí (2015). To address this issue, we adopt a policy rule where interest rates respond to both the natural rate and deviations in inflation and consumption gap.[4] Following the IRF matching approach of Christiano et al. (2005), we choose the coefficients ϕ_π and ϕ_c to minimize the distance between the natural rate path and the actual nominal rate path:

$$\hat{R}_t = \max\left\{-\log\left(\frac{1}{\beta}\right), \hat{R}^{fb}_{ppi,t} + \phi_\pi \pi_{H,t} + \phi_c \tilde{C}_t\right\},$$
$$\hat{R}^*_t = \max\left\{-\log\left(\frac{1}{\beta}\right), \hat{R}^{fb,*}_{ppi,t} + \phi_\pi \pi^*_{F,t} + \phi_c \tilde{C}^*_t\right\}.$$

Additionally, to isolate the effects of pricing regimes on demand shock transmission, we set government spending in each country to follow their flexible-price counterparts:

$$\hat{G}_t = \hat{G}^{fb}_t \qquad\qquad \hat{G}^*_t = \hat{G}^{*,fb}_t$$

This framework aims to ensure identical policy paths across pricing regimes. As discussed in Section 2.5 , for identical policy paths, the global variables should theoretically remain unchanged across PCP and LCP regimes. While our IRF matching approach does not achieve exactly identical paths due to small numerical optimization errors, the resulting world variables remain very close across pricing regimes. Therefore, any meaningful differences in the relative variables can be attributed to the underlying transmission mechanisms (ERPT) affecting the distribution of adjustment between countries.

Small Shock. Figure 2 illustrates the dynamics of world and relative variables when a small shock hits the Home country. By design, both economies' nominal interest rates track their natural rate paths closely through IRF matching, leading to nearly identical trajectories in world output gap and inflation (panels 1 and 2). However, significant differences emerge in relative variables, most notably in the output gap (panel 3): the relative output gap falls more sharply under LCP than PCP, indicating that incomplete pass-through amplifies the Home country's share of the recession. This asymmetry stems from the sluggish adjustment of internal relative prices under LCP, which hampers Home's ability to benefit from exchange rate movements.

During mild ZLB episodes, home currency depreciation serves as an automatic stabilizer by making home exports cheaper and imports more expensive. This relative price adjustment redirects global demand toward home-produced goods, cushioning Home's recession. However, the effectiveness of this stabilization channel depends crucially on the degree of ERPT. Under PCP, rapid price adjustment allows this channel to work efficiently, protecting Home from a severe

[4] We chose the combination that leads to the minimum distance from the natural interest rate path.

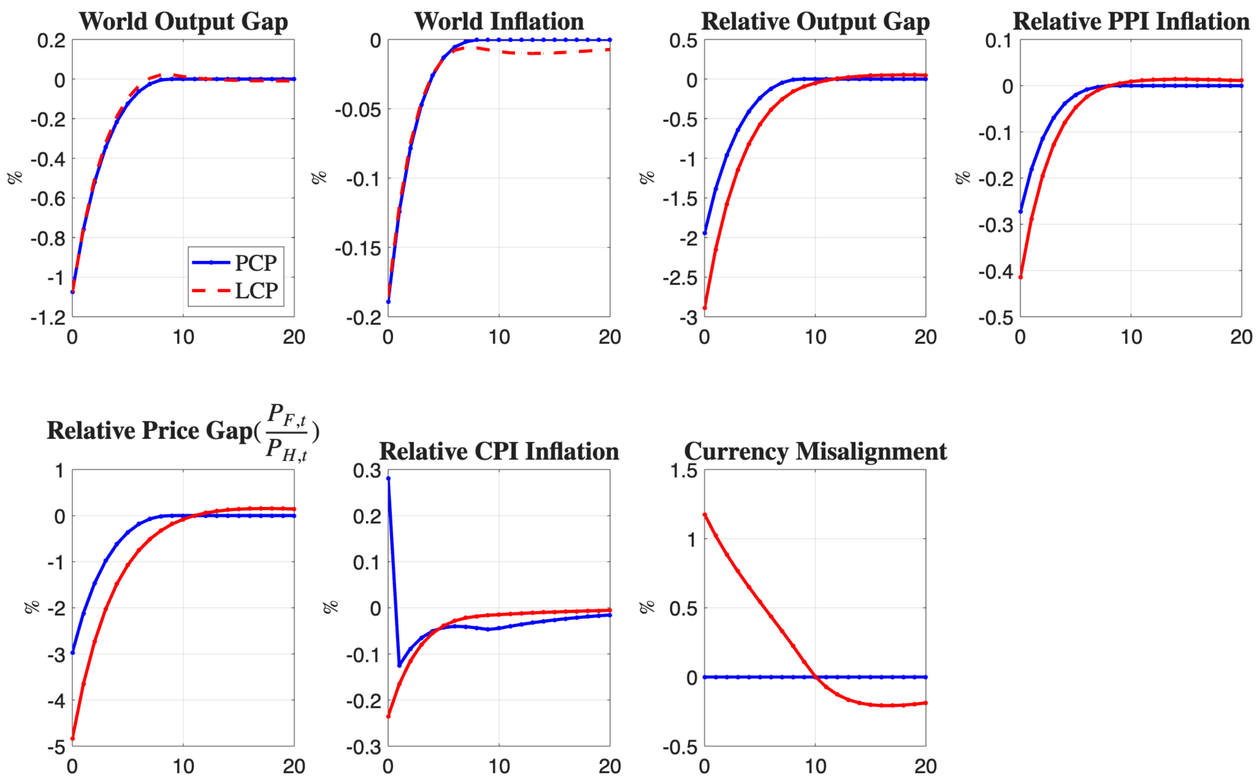

Figure 2: Impulse Response (Small Shock)

downturn. In contrast, under LCP, relative prices adjust more sluggishly (panel 5), weakening this natural stabilizing mechanism and deepening the recession despite identical policy rates.

Currency misalignment represents another key difference between PCP and LCP dynamics (Figure 2 panel 7). This misalignment, reflecting deviations from the law of one price, arises because sticky export prices under LCP prevent full adjustment to exchange rate changes. When Home's currency depreciates, export and import prices adjust less than they would under PCP due to sticky export price-setting, leading to lower relative CPI inflation and distorted consumption patterns: Home consumes more while Foreign consumes less compared to PCP. This higher Home consumption exacerbates the relative output decline by reducing labor supply through the wealth effect. Moreover, sticky export prices distort markups in export markets, affecting firms' labor demand. Thus, minimizing currency misalignment becomes an additional policy objective under LCP, unlike under PCP where such misalignment does not occur.

Large Shock. Figure 3 displays the impulse response of world and relative macro variables when a large shock strikes the Home economy. In this extreme ZLB episode, the Home economy faces significant deflationary pressures, leading to a positive interest rate differential ($r_t - r_t^* > 0$). Combined with the UIP condition, the home currency appreciates, in contrast to what occurs under a small shock.

This reversal in exchange rate movement reshapes the relative performance of PCP and LCP economies. The relative output gap (Figure 3 panel 3) contracts less severely under LCP than it does under PCP. The economic intuition behind this phenomenon is that the deviation from complete pass-through under LCP provides a natural insulation against the “perverse" effects of exchange rate movements.

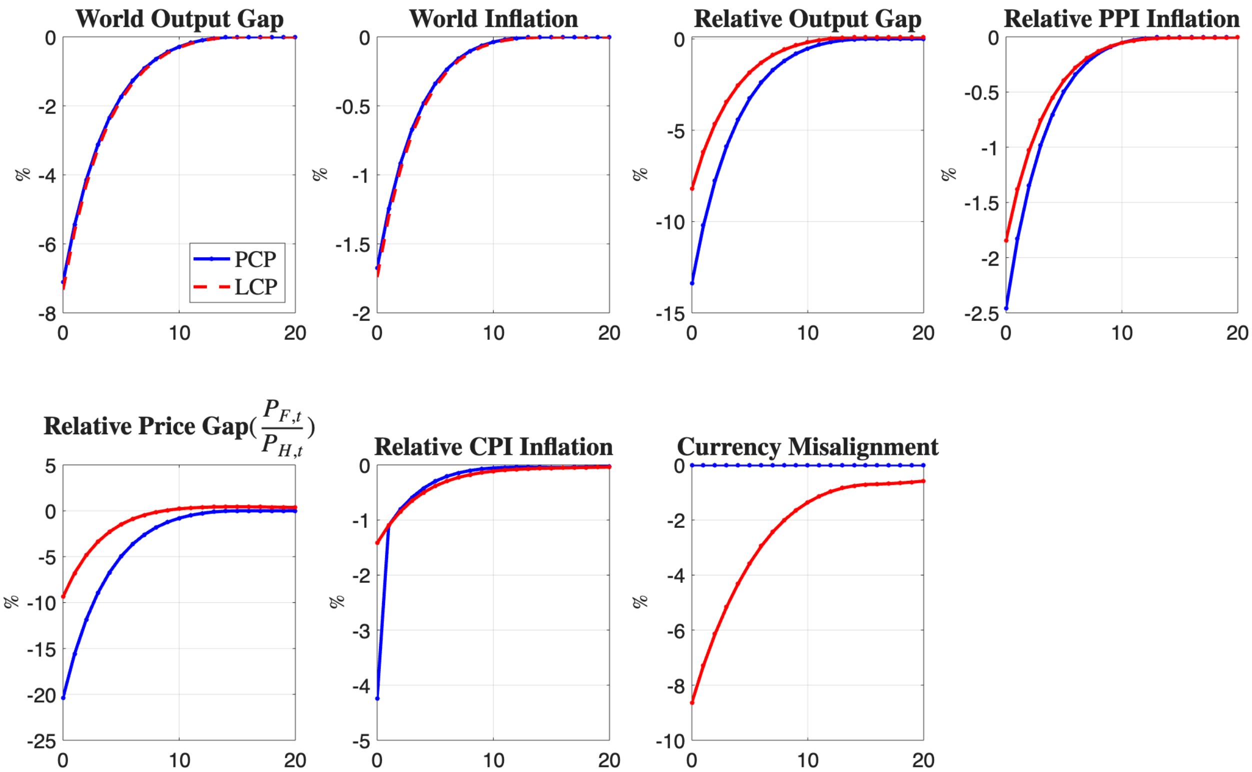

Figure 3: Impulse Response (Large Shock)

Unlike small shock scenarios where currency depreciation helps stabilize Home’s economy, appreciation under large shocks has destabilizing effects: it makes home exports more expensive and foreign imports cheaper. Hence, this expenditure-switching away from home-produced goods deepens Home’s recession. Again, the severity of this destabilizing mechanism depends critically on the degree of ERPT. With complete pass-through under PCP, Home experiences the maximal adverse effect from currency appreciation since internal relative prices in both countries instantly reflect the exchange rate movements. However, when ERPT is incomplete under LCP, internal relative prices are only partially influenced by currency appreciation due to inertia generated by sticky export prices. Hence, expenditure-switching toward foreign goods is limited, and recession in the home country becomes less severe than under PCP.

This analysis reveals a fundamental state dependence in how pricing regimes affect macroeconomic stability. Under small shocks, PCP's rapid price adjustment helps stabilize the economy through beneficial expenditure-switching. However, this same price flexibility becomes a cost under large shocks by amplifying the adverse effect of perverse exchange rate movements. In contrast, while LCP's price stickiness impairs adjustment to small shocks, it provides valuable insulation against large ones. These findings carry important implications for optimal policy design: policy effectiveness depends crucially on both the pricing regime and shock size—themes we further explore in the next section.

4 Optimal Monetary Policy Under PCP and LCP

This section analyzes the design of the optimal cooperative policy under discretion for both PCP and LCP pricing regimes. One limitation in comparing the optimal policy is the presence of an endogenous state variable under LCP, restricting complete analytical characterization. Hence, we present simulation-based results using benchmark shock sizes and verify in section 7 that the main conclusions hold across a wide range of parameters. The policy instruments include the nominal interest rates (R_t, R_t^*) and government spending (G_t, G_t^*) in each country. Our analysis proceeds in two steps. First, we examine optimal monetary policy alone, keeping fiscal policy passive at its flexible price level. Then, in the next section, we characterize the optimal mix of monetary and fiscal policies when all instruments are used to maximize world welfare.

Small Shock. Figure 4 compares optimal monetary policy responses and welfare-relevant variables under PCP and LCP when a small shock hits the Home country. While Home's policy rates follow similar paths under both regimes (panel 1), a striking difference emerges in Foreign's behavior: Foreign pursues substantially tighter policy under PCP than it does under LCP (panel 2).

The divergence in monetary policy design can be attributed to two key factors: (1) differing stabilization objectives and (2) the extent of exchange rate pass-through on internal relative prices. As observed in equation (14), under PCP with passive fiscal policy, the stabilizing objectives of the social planner are average and relative output gap and PPI inflation between the two countries.

$$2\left\{\mathcal{L}_t^{W,PCP} - \mathcal{L}_t^{fb}\right\} = -\left(\frac{\rho}{c_y}+\eta\right)\left(\tilde{Y}_t^W\right)^2 - \left(\frac{\rho}{c_y D}+\eta\right)\left(\tilde{Y}_t^R\right)^2 - \frac{\sigma}{\kappa}\left((\hat{\pi}_{ppi,t}^W)^2 + (\hat{\pi}_{ppi,t}^R)^2\right) \tag{14}$$

Under PCP, the social planner achieves maximal welfare by engineering the more favorable relative prices (terms-of-trade) for the home economy. Complete exchange rate pass-through makes this relative-focused strategy effective. When Foreign raises rates, the resulting home currency

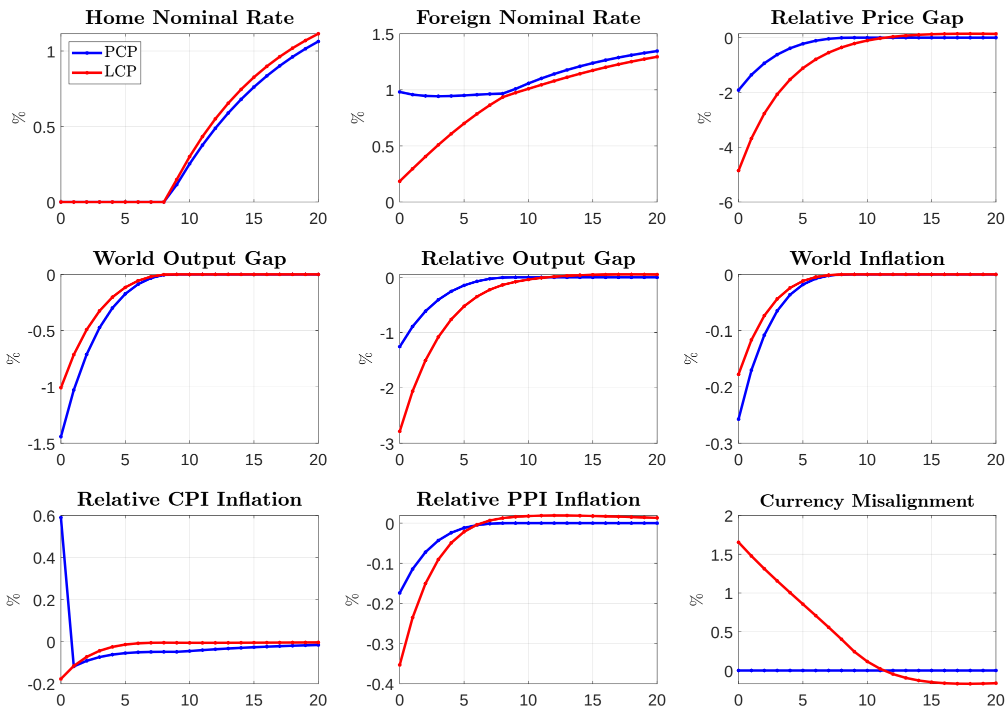

Figure 4: Optimal Monetary Policy (Small Shock)

depreciation immediately affects relative prices, generating strong expenditure-switching toward home-produced goods. This mechanism helps stabilize both the relative output gap (Figure 4 panel 5) and inflation (panel 8). While higher Foreign rates do suppress global demand through intertemporal substitution (panels 4 and 6), the benefits of correcting relative imbalances outweigh these costs when pass-through is complete.

Under LCP, the welfare objective of the social planner becomes more complex compared to the PCP. Since sticky export prices incur misallocation of labor in export markets and distort the relative consumption between two countries, the social planner tries to stabilize CPI inflation and currency misalignment instead of PPI inflation as observed in equation (15).

$$2\left\{\mathcal{L}_t^{W,LCP} - \mathcal{L}_t^{fb}\right\} = -\left(\frac{\rho}{c_y}+\eta\right)\left(\tilde{Y}_t^W\right)^2 - \left(\frac{\rho}{c_y D}+\eta\right)\left(\tilde{Y}_t^R\right)^2 - \frac{c_y\nu(1-\nu)\theta}{D}\hat{m}_t^2$$
$$-\frac{\sigma}{\kappa}\left(\left(\hat{\pi}_t^W\right)^2 + \left(\hat{\pi}_{cpi,t}^R\right)^2 - 2(1-\nu)(1-c_y)\hat{\pi}_{cpi,t}^R\Delta\hat{T}_t + \left(c_y(2\nu-1)+(1-\nu)\right)(1-\nu)\left(\Delta\hat{T}_t\right)^2\right) \tag{15}$$

Sticky export prices introduce another channel through which the optimal monetary policy design under LCP diverges from PCP: the social planner's reduced ability to influence the relative output gap. Relative prices exhibit inertia under LCP, in contrast to the purely forward-looking behavior under PCP. This sluggishness limits the policy's ability to influence relative variables through exchange rate movements, forcing a greater emphasis on managing global variables.

Moreover, the currency misalignment channel plays a key role in shaping LCP's optimal policy response. Unlike PCP where misalignment does not occur, any policy action that alters the exchange rate under LCP affect the degree of misalignment. In the case of small shocks, raising Foreign interest rates would further depreciate the Home currency, exacerbating misalignment and its associated welfare costs.

As a result, the social planner under LCP pursues a very different strategy compared to PCP: maintaining lower Foreign interest rates to simultaneously support global demand and limit currency misalignment, even though this provides less help for relative adjustment. This trade-off is evident in Figure 4: Foreign's more accommodative stance (panel 2) helps limit the decline in world output gap (panel 4) compared to PCP. This reflects a fundamental shift in policy priorities - when ERPT is weak, attempting to correct relative gaps through aggressive rate hikes becomes less effective, making global demand stabilization through lower world interest rates the more efficient policy choice.

Large Shock. Figure 5 presents the outcomes of optimal monetary policy in response to a large negative demand shock in the Home country. The most dramatic difference appears in Foreign's interest rate policy (Figure 5 panel 2): under PCP, Foreign raises rates above steady state, while under LCP, it maintains zero rates for eight periods.

When a large demand shock meets the ZLB, strong deflationary pressures create a positive real interest rate gap, leading to an appreciation of the home currency. As outlined in Section 3, under PCP, this perverse exchange rate movement intensifies the recession by redirecting expenditure away from home goods, further distorting the relative output gap (Panel 5). Hence, the objective of optimal monetary policy is to mitigate the home currency appreciation by lowering the relative interest rate gap between the two economies. This is achieved by substantially increasing the foreign nominal interest rate, albeit at the expense of suppressing global demand (Figure 5 panels 4 and 6). Again, this optimal policy design leverages the strong expenditure-switching mechanism driven by the tight connection between exchange rates and internal relative prices.

Under LCP, limited ERPT shifts optimal policy toward global stabilization. While Foreign's aggressive rate hikes effectively manage relative variables under PCP, they become counterproductive under LCP - significantly depressing global demand while achieving minimal improvement in relative imbalances. The need for active relative stabilization is further reduced by sticky export prices, which act as natural insulators against adverse exchange rate movements, automatically moderating both relative output gaps and price distortions (Figure 5 panels 3, 5, and 8).

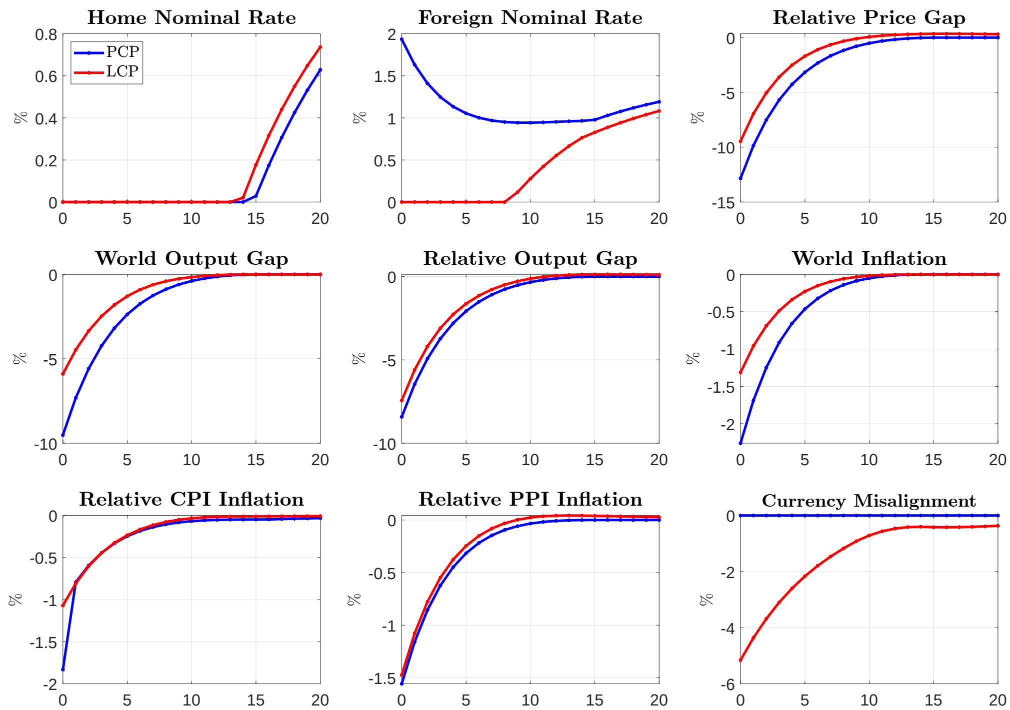

Figure 5: Optimal Monetary Policy (Large Shock)

With this built-in stabilization of relative variables, the social planner focuses on boosting global demand through lower foreign (and thus lower world) interest rates. This strategy involves a key trade-off: maintaining low rates helps support global demand but allows home currency appreciation to persist, worsening currency misalignment (panel 9). The social planner must therefore carefully calibrate the duration of Foreign's zero-rate policy, balancing global demand support against the costs of prolonged exchange rate distortions and cross-country consumption imbalances.

This pattern reveals how ERPT fundamentally shapes Foreign's optimal monetary policy. Under complete pass-through (PCP), Foreign prioritizes exchange rate management through higher rates to facilitate expenditure-switching, accepting weaker global demand as the cost. When pass-through is limited (LCP), these priorities reverse - Foreign focuses on supporting global variables through lower rates, even at the expense of larger cross-country imbalances. This relationship further intensifies under large shock, where exchange rate moves perversely. This shift in objectives from relative adjustment (PCP) to global stabilization (LCP) demonstrates how firms' pricing decisions reshape both monetary policy transmission and optimal responses during liquidity trap episodes.

5 Optimal Monetary and Fiscal Policy Mix

In the previous section, we explored how and why optimal monetary policy varies across different pricing regimes while keeping fiscal policy to a passive rule. Now, we explore the optimal coordination of monetary and fiscal policies, considering government spending as an additional instrument to counteract the effects of a negative demand shock. The prominent channel through which government spending combats the recession is the New-Keynesian demand effect. An increase in government spending beyond the flexible price level ($\tilde{G}_t > 0$) reduces markups by boosting labor demand. When the policy rate in one country is constrained by the ZLB, the New Keynesian demand effect of government spending can complement the limitations of monetary policy, helping to mitigate declines in output and inflation. However, active fiscal intervention also incurs a cost by distorting the marginal rate of substitution between leisure and government spending from its optimal level. Balancing this trade-off, the optimal fiscal response will be designed to address the most severe distortions that monetary policy alone cannot fully take care of. Indeed, our analysis reveals that fiscal policy systematically addresses the distortions that monetary policy cannot due to latter's regime-specific constraints.

Small Shock. Figure 6 illustrates the optimal fiscal policy responses for both types of shocks, revealing how fiscal policy complements monetary policy's focus under each pricing regime. Under PCP, monetary policy prioritizes correcting relative imbalances through higher Foreign interest rates. While this monetary strategy effectively addresses cross-country imbalances, it inevitably puts downward pressure on global demand and triggers a recession in the Foreign economy. To compensate for these contractionary effects, fiscal policy focuses on supporting global demand through synchronized increases in government spending across both countries (Figure 6, panels 1 and 2). Although this fiscal intervention improves welfare through both global and relative channels, its primary contribution comes from boosting global demand. Figure 7 quantifies these improvements by contrasting the difference between scenarios with and without fiscal intervention. As panels 1 and 3 demonstrate, the expansionary fiscal policy raises the world output gap and inflation by approximately 0.5% and 0.04% respectively. Hence, such policy directly addresses the global demand shortfall created by monetary policy's focus on relative stability.

Under LCP, the complementary relationship reverses, as the red line in Panels 1 and 2 of Figure 6 shows. With monetary policy focused on supporting global demand through low world interest rates (due to limited ERPT), fiscal policy primarily addresses the resulting relative imbalances. This manifests in an asymmetric fiscal response: Less worldwide expansion in government spend-

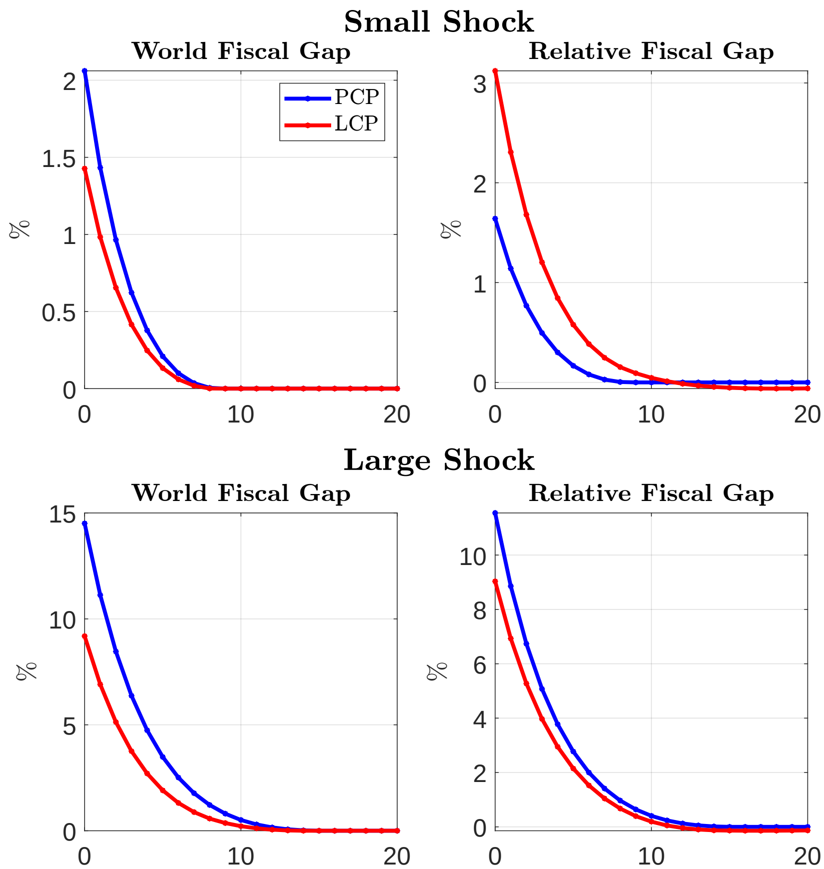

Figure 6: Optimal Fiscal Policy

ing (Panel 1) but more relative expansion in Home than under PCP (Panel 2). Figure 7 confirms this complementary role - the largest improvements appear in relative variables, with fiscal policy reducing the relative output gap and CPI inflation by 0.6% and 0.03% respectively (panels 2 and 4). This asymmetric fiscal intervention directly targets the distortions that arise when monetary policy's accommodative stance, while successful in boosting global demand, creates inefficient cross-country imbalances.

Table 2 quantifies these complementary relationships through welfare decomposition. Under PCP, welfare gains (0.0964) originate from improvements in world variables, reflecting fiscal policy's focus on supporting global demand while monetary policy handles relative adjustment. Under LCP, higher total welfare gains (0.1271) are achieved through improvements in relative variables, though this requires larger welfare losses from relative government spending (-0.0475 under LCP vs -0.0114 under PCP) to compensate for monetary policy's limited effectiveness in managing cross-country imbalances. This welfare analysis confirms how fiscal policy systematically addresses the areas where monetary policy's regime-specific focus creates gaps in stabiliza-

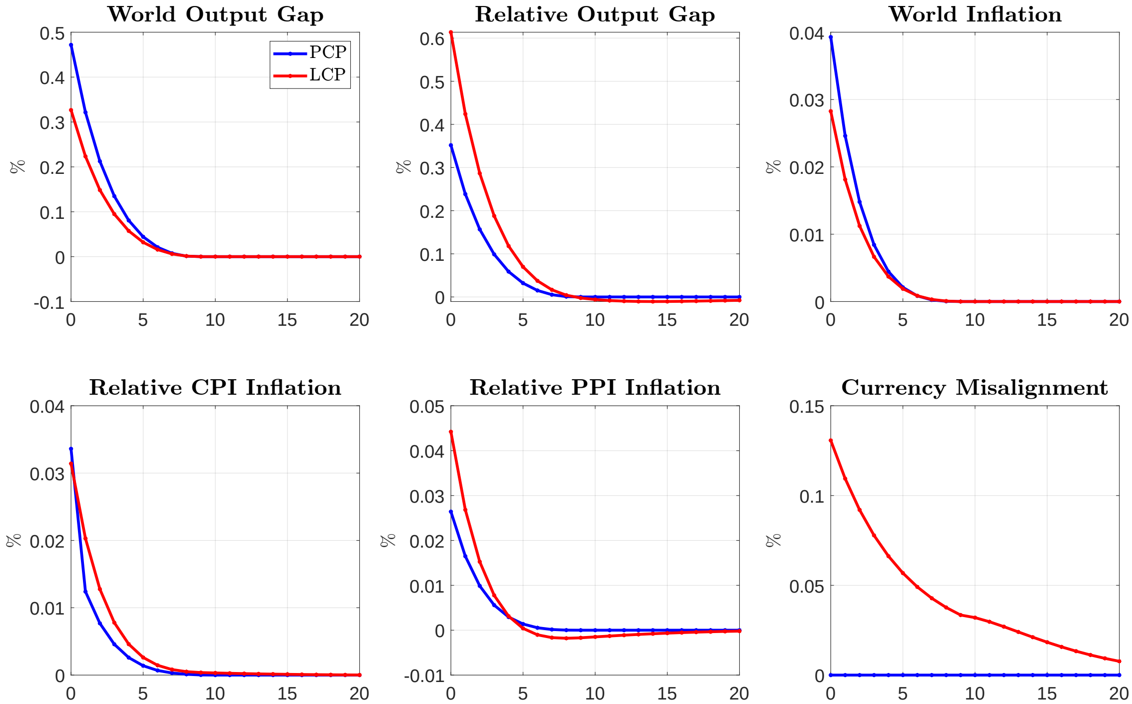

Figure 7: Gains from Optimal Fiscal Policy (Small Shock)

Note: Each panel shows the difference in impulse responses between scenarios with optimal fiscal policy and those with passive fiscal policy

tion.

Large Shock. Under large shocks, the complementary relationship between monetary and fiscal policy significantly intensifies, especially when perverse exchange rate movements emerge at the ZLB. The optimal fiscal policy responses for large shocks under both pricing regimes are presented in the lower panels of Figure 6.

Under PCP, monetary policy prioritizes managing relative distortions by raising Foreign rates to counter perverse appreciation. However, this focus on relative stability through high rates significantly contracts global demand - which is much larger than in the small shock case. As a result, fiscal policy must expand beyond its small-shock role of primarily supporting global demand to address both objectives: it must boost the diminished aggregate demand while also helping correct relative distortions that monetary policy cannot fully manage due to the ZLB. This is visible in the optimal policy responses shown in Figure 6: substantial fiscal expansions are required in both world and relative terms. Furthermore, the effectiveness of this dual-objective fiscal intervention is evident in Figure 8, which shows the difference in impulse responses between

Terms	Small Shock PCP	Small Shock LCP	Large Shock PCP	Large Shock LCP
$\tilde{Y}_t^W$	0.0476	0.0230	3.0480	1.0224
$\tilde{Y}_t^R$	0.0246	0.1060	1.6681	0.9061
$\tilde{G}_t^W$	-0.0195	-0.0092	-1.2266	-0.4642
$\tilde{G}_t^R$	-0.0114	-0.0475	-0.7168	-0.4378
$\tilde{Y}_t^W \tilde{G}_t^W$	-0.0191	-0.0091	-0.9796	-0.3893
$\tilde{Y}_t^R \tilde{G}_t^R$	-0.0086	-0.0447	-0.4559	-0.3568
$\hat{m}_t$	N/A	-0.0025	N/A	0.0417
$\hat{\pi}_t^W$	0.0569	0.0284	7.4739	1.9236
$\hat{\pi}_t^R$	0.0257	0.0314	3.5095	1.0356
$\Delta\hat{T}_t$	N/A	0.0424	N/A	0.3290
$\hat{\pi}_t^R \Delta\hat{T}_t$	N/A	0.0088	N/A	0.1120
Total	0.0964	0.1271	12.321	3.7224

Table 2: Welfare Gain Accounting

Note: Each component measures the welfare gain attributable to using optimal fiscal policy. Specifically, each is derived as the difference between welfare components under the fully optimal monetary and fiscal policy mix (R, R^*, G, G^*) and those under a regime where only optimal monetary policy (R, R^*) is implemented. The relative inflation term corresponds to relative PPI inflation under PCP and CPI inflation LCP. To enhance interpretability, all values are scaled by a factor of 100.

scenarios with optimal fiscal policy and those with passive fiscal policy. Under PCP, the fiscal policy achieves roughly twice the improvement in global variables (panels 1 and 3) and 50% larger gains in relative variables (panels 2, 4, and 5) compared to LCP.

Under LCP, this complementary dynamic shifts fundamentally. Since sticky export prices naturally moderate exchange rate effects, monetary policy can maintain its focus on supporting global demand through low rates without creating severe relative distortions. This built-in insulation against perverse exchange rate movements reduces the need for both monetary and fiscal intervention, resulting in substantially reduced fiscal stimulus requirements relative to PCP, as evidenced by smaller gaps in both global and relative fiscal spending (Figure 6 lower panels). The magnitude of fiscal expansions in the world and relative terms is about 25% smaller than the level required under PCP. Since monetary policy can effectively support global demand without creating severe relative distortions, fiscal policy can focus more narrowly on providing targeted support primarily in the Home economy.

The column labeled large shock in Table 2 reveals how these different complementary patterns translate into gains. PCP achieves substantially higher total welfare gains (12.321 vs 3.7224), but requires roughly triple the fiscal intervention costs. This reflects PCP's expanded fiscal role: larger interventions are needed to compensate for monetary policy's acute trade-off between relative

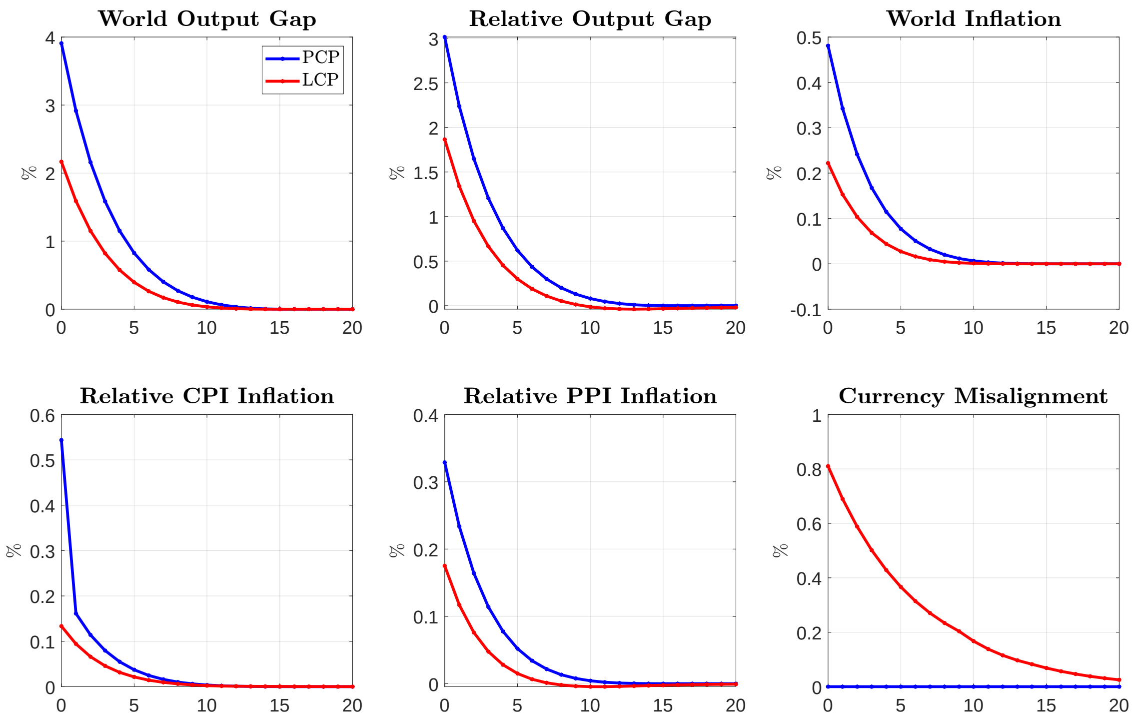

Figure 8: Gains from Optimal Fiscal Policy (Large Shock)

Note: Each panel shows the difference in impulse responses between scenarios with optimal fiscal policy and those with passive fiscal policy

stability and global demand when high pass-through amplifies exchange rate distortions. Under LCP, both welfare gains and fiscal costs remain modest since low ERPT naturally help monetary policy avoid this difficult trade-off, reducing the need for compensatory fiscal action.

In summary, the optimal design of fiscal policy fundamentally differs across pricing regimes based on its complementary role to monetary policy. Under small shocks, PCP monetary policy's focus on relative stability through exchange rates leaves gaps in global demand that fiscal policy must fill through synchronized expansion. Under LCP, monetary policy's focus shifts to supporting global demand, requiring fiscal policy to instead address resulting relative imbalances through asymmetric interventions. This complementary relationship intensifies under large shocks: PCP requires aggressive fiscal stimulus in both countries to address the severe trade-offs created by monetary policy's fight against perverse exchange rate effects, while LCP's natural insulation against these exchange rate distortions allows for more moderate, targeted fiscal support. These patterns demonstrate how firms' pricing decisions fundamentally shape not just the transmission of shocks but the entire optimal policy mix between monetary and fiscal policies.

6 Trade Openness and Optimal Policy

The effectiveness of monetary and fiscal policy coordination depends crucially on trade integration between countries (Cook and Devereux, 2013). Our analysis thus far has demonstrated how pricing regimes fundamentally shape optimal policy responses under baseline trade integration. We now examine how these relationships evolve across different levels of economic integration between countries. While the core mechanisms identified earlier - monetary policy's regime-specific focus and fiscal policy's complementary role - remain operational, their relative strength varies systematically with trade openness, leading to distinct optimal policy mixes.

6.1 Optimal Monetary Policy

Figure 9 maps the optimal monetary policy choices of Foreign across trade openness levels (ν) and shock magnitudes (σ_z). Given that Home's interest rate remains at zero across all parameter combinations, we focus on analyzing Foreign's policy responses.

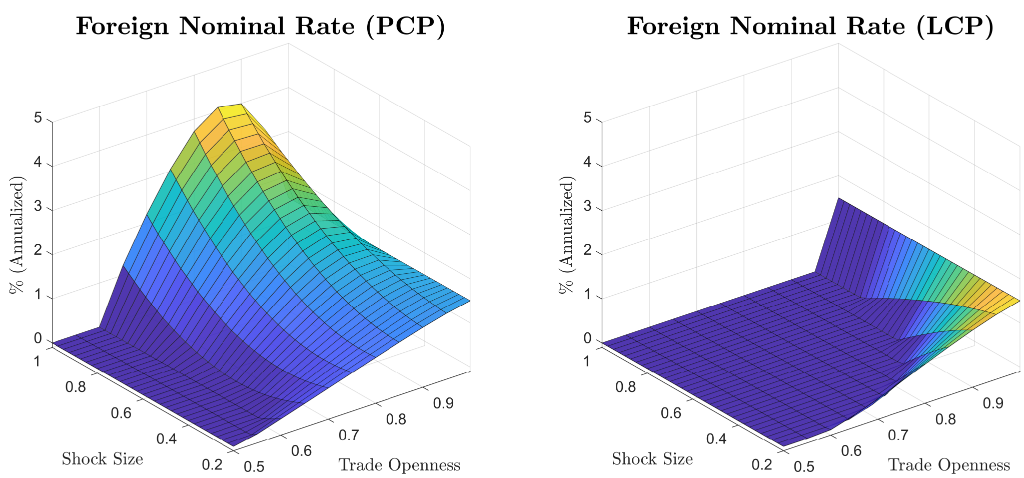

Figure 9: Trade Openness and Optimal Monetary Policy

Figure 9 reveals a striking contrast in how trade openness affects optimal policy across pricing regimes. The left panel shows that under PCP, Foreign's optimal interest rate is highly sensitive to the degree of trade openness—rates vary substantially across integration levels, peaking sharply at intermediate openness around $\nu \approx 0.8$. While Foreign's policy rate under PCP takes positive values across most parameter configurations (except at perfect trade integration, $\nu = 0.5$), the right panel tells a completely different story: under LCP, optimal policy remains remarkably insensitive to trade openness, with Foreign maintaining zero or near-zero rates across virtually the entire integration spectrum. Moreover, the interest rate differential between PCP and LCP increases with shock size and displays an inverse U-shaped pattern with respect to trade openness.

This systematic difference in policy stances reflects the distinct transmission channels operating under each regime, as established in Sections 3 and 4. Under PCP, monetary policy aims to manage relative price distortions through exchange rate channels, requiring higher Foreign rates. Under LCP, with dampened ERPT, policy instead prioritizes stimulating global demand through lower rates. These divergent objectives become more pronounced with shock size, particularly when large shocks trigger home currency appreciation. In these cases, PCP requires aggressive rate hikes to counter severe relative distortions, while LCP's natural insulation from exchange rate movements allows Foreign to maintain accommodative policy.

The relationship between trade openness and optimal policy rates reveals distinct patterns across pricing regimes. Under PCP, Foreign's rate decisions reflect two competing forces. As home bias increases (lower trade openness), the adverse home demand shock becomes more concentrated in the Home economy, widening real interest rate differentials between countries. This triggers stronger home currency appreciation and more intense expenditure-switching effects, which Foreign counteracts by raising rates. However, this policy mechanism loses potency as economies approach complete closure ($\nu \to 1$), since countries mainly consume domestic goods. These opposing forces create a "sweet spot" at intermediate levels of trade openness - near our baseline calibration of $\nu \approx 0.8$ - where Foreign's rate adjustments have maximum impact on relative variables.[5]

Under LCP, this sensitivity to trade openness essentially vanishes. Sticky export prices act as a persistent dampener on exchange rate transmission regardless of integration levels. In highly integrated economies, Foreign maintains zero rates because: (1) higher trade integration means imports comprise a larger share of consumption baskets, making Foreign's monetary expansion more effective at stimulating global demand, and (2) sticky export prices naturally moderate relative price distortions, allowing Foreign to focus on supporting aggregate demand. As economies become more closed, this calculus shifts only marginally—the key point is that optimal policy remains largely invariant to trade openness under LCP, in sharp contrast to PCP's high sensitivity.

These patterns carry profound implications for policy coordination. Under PCP, the high sensitivity to trade openness means countries face substantially different coordination challenges depending on their integration level. Countries at intermediate openness—where Foreign's rates

[5]For a more detailed explanation of this logic, see the discussion on pages 386-387 in Cho et al. (2023b).

peak and where most advanced economies currently sit—face the most intense policy trade-offs, with Foreign needing to raise rates aggressively precisely when global demand support is most crucial. Movement toward either greater isolation or deeper integration would actually ease these pressures. In stark contrast, under LCP, the insensitivity of optimal policy to trade openness implies that changes in global integration patterns would have minimal impact on policy coordination requirements. This fundamental difference suggests that understanding a country's invoicing currency composition is at least as important as measuring its trade openness when designing crisis response strategies.

6.2 Optimal Fiscal Policy

Building on our analysis of how fiscal policy complements monetary policy's regime-specific focus, we now examine how this complementary relationship evolves with trade openness. Figure 10 illustrates these patterns by plotting differences in world and relative government spending between PCP and LCP across varying levels of trade integration and shock sizes. Positive values indicate larger fiscal expansion under PCP, while red dotted points mark where LCP requires greater fiscal intervention.

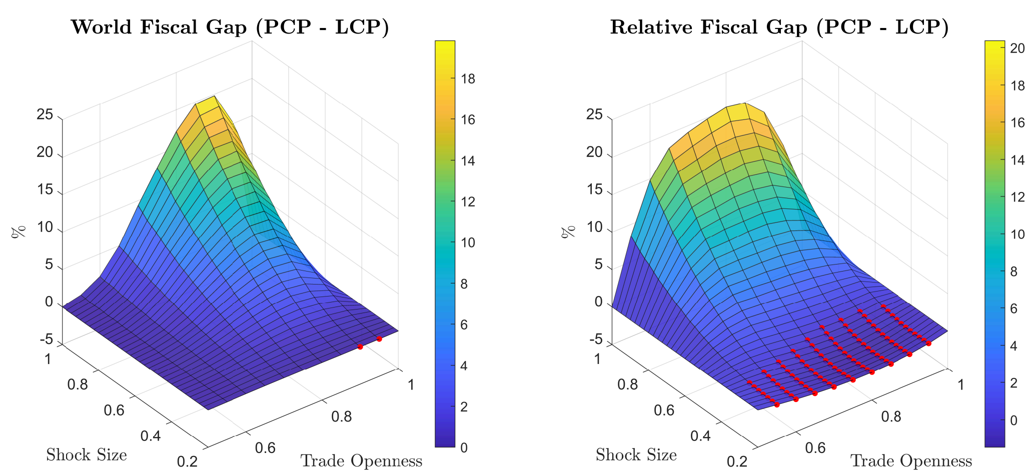

Figure 10: Trade Openness and Optimal Fiscal Policy

Note: Figure shows the period-0 difference in world and relative government spending gap between the two pricing regimes. Positive values correspond to more government spending under PCP. Red dotted points denote the parameter combinations where government spending increases less under PCP compared to LCP.

The left panel of Figure 10 displays the difference in the world fiscal gap ($\frac{\tilde{G}_t+\tilde{G}_t^*}{2}$) response between the two pricing regimes during the impact period. A notable observation is that PCP generally requires larger global fiscal expansion across most parameter combinations. This pattern directly reflects our earlier finding about monetary policy's regime-specific focus: under PCP, monetary policy's emphasis on managing relative prices through higher Foreign rates creates a global demand shortfall that fiscal policy must address. This fiscal compensation becomes more pronounced both with shock size and at intermediate levels of trade openness.

The right panel of Figure 10 depicts the difference in the relative fiscal gap ($\frac{\tilde{G}_t - \tilde{G}_t^*}{2}$) between the two pricing regimes, where a more positive value signifies a greater concentration of government spending at Home under PCP. For small shocks, LCP requires larger relative fiscal intervention (shown by red dotted points) because slower ERPT leads to sharper declines in the relative output gap and inflation. This aligns with our earlier findings about LCP's limited price adjustment hampering natural stabilization through exchange rates. However, as shock size increases, this pattern completely reverses. Under large shocks, PCP demands increasingly asymmetric fiscal expansion concentrated in Home because complete pass-through amplifies the destabilizing effects of perverse exchange rate movements, while under LCP, the natural insulation from sticky prices moderates these distortions.

Regarding trade openness, the difference in the relative fiscal gap exhibits a U-shaped pattern for small shocks and an inverted U-shaped pattern for large shocks. These patterns emerge because varying degrees of ERPT have their strongest impact on relative variables at moderate trade openness. Under small shocks, PCP's complete pass-through of currency depreciation provides natural stabilization while reducing the need for fiscal intervention. This relative fiscal need under LCP is strongest at moderate trade openness but diminishes as economies become either very open or very closed, creating the U-shaped pattern. For large shocks this relationship inverts - PCP's complete pass-through amplifies relative distortions most severely at intermediate openness and necessitates substantial home-concentrated fiscal expansion. This larger gap in relative fiscal needs between PCP and LCP generates the inverse-U shape. In sum, during ZLB episodes with large deflation, PCP requires more expansionary fiscal policy in both global and relative terms.

Figure 11 quantifies how these different fiscal policy responses translate into welfare gains. In the figure, positive values indicate larger welfare gains under PCP relative to LCP, while red dotted points mark regions where LCP generates higher welfare gains. Under small shocks, LCP generates marginally higher gains as fiscal policy must actively compensate for monetary policy's limited effectiveness in using exchange rate channels. Under large shocks, this pattern completely reverses - PCP achieves substantially larger welfare gains, peaking at intermediate openness ($\nu \approx 0.8$). This reflects the expanded role of fiscal policy under PCP: it must address both se-

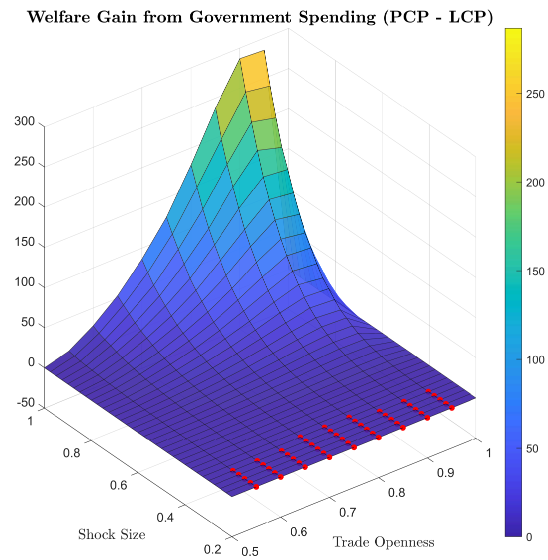

Figure 11: Trade Openness and Welfare Gain from Optimal Fiscal Policy

Note: Figure displays the gap of the additional welfare gain from using fiscal policy between PCP and LCP. A higher positive value means additional welfare gain from using fiscal policy is larger under PCP. Red dotted points denote the parameter combinations where welfare from using fiscal policy is smaller under PCP compared to LCP.

vere relative distortions from perverse exchange rate movements and weak global demand from monetary tightening, with these challenges most acute at intermediate openness. The substantial fiscal intervention needed to manage these dual problems generates larger welfare gains compared to LCP, where sticky prices naturally help monetary policy avoid such sharp trade-offs.

6.3 Robustness Checks

In Online Appendix section A.2, we show that our key findings regarding optimal monetary and fiscal policy mix remain robust across alternative parameter specifications, though with varying intensities that align with economic intuition. We examine variations in the inverse elasticity of intertemporal substitution (ρ), trade elasticity (θ), and price stickiness (α), with particular attention to the composite parameter $\rho\theta$ that governs substitutability between home and foreign goods. When goods are Edgeworth complements (low $\rho\theta$), the optimal policy differences between PCP and LCP regimes become less pronounced as households consume home and foreign goods jointly rather than substituting between them, reducing the effectiveness of exchange rate policy in managing relative prices. Conversely, reduced price stickiness ($\alpha = 0.75$) amplifies the differences between pricing regimes through the "Paradox of Flexibility," which intensifies deflationary pressures at the zero lower bound. These variations in parameter values affect the magnitude of optimal policy responses in economically intuitive ways while preserving the fundamental relationship between pricing regimes, trade integration, and optimal policy design.

7 Conclusion

This paper shows that international pricing regimes (PCP, LCP) fundamentally shape how monetary and fiscal policies should optimally respond during liquidity trap episodes. Our analysis reveals three key findings. First, the effectiveness of ERPT as a stabilization mechanism depends critically on shock size. While complete pass-through under PCP helps stabilize economies during mild recessions, it amplifies distortions when large shocks trigger perverse exchange rate movements at the ZLB. In contrast, LCP's sluggish price adjustment, while detrimental under small shocks, provides valuable insulation against large shocks.

Second, these transmission patterns directly influence optimal policy design. Under PCP, less affected countries should raise interest rates to engineer favorable exchange rate movements, though this requires aggressive synchronized fiscal expansion to offset suppressed global demand. Under LCP, monetary policy should focus on boosting aggregate demand since exchange rate channels are less effective, while fiscal policy addresses cross-country imbalances. For large shocks, these differences intensify - PCP requires substantial monetary-fiscal coordination to counter perverse exchange rate effects, while LCP's natural insulation reduces intervention needs.

Third, our analysis reveals a fundamental contrast in how trade openness affects optimal policy across pricing regimes. Under PCP, optimal policy is highly sensitive to trade integration—Foreign's interest rates and fiscal requirements vary substantially across openness levels, peaking at intermediate integration where most advanced economies operate and where policy coordination challenges are most severe. In stark contrast, under LCP, optimal policy remains remarkably insensitive to trade openness. Sticky export prices consistently dampen exchange rate transmission, allowing Foreign to maintain accommodative policy regardless of integration levels. These findings reveal that invoicing currency composition fundamentally determines whether changes in trade relationships matter for crisis management—complete pass-through regimes face vastly different coordination challenges across integration levels, while incomplete pass-through regimes experience minimal policy implications from shifting trade patterns.

While this paper focuses on optimal cooperative discretionary policy, the most promising extension would be to analyze non-cooperative policy responses under different pricing regimes.

Given the increasing prevalence of unilateral policy actions and growing tensions in international economic coordination—as evidenced by recent trade disputes, divergent pandemic responses, and strategic competition between major economies—understanding how countries optimally respond when acting independently becomes particularly relevant. Non-cooperative settings would likely reduce the policy divergences we identify between PCP and LCP regimes, as Foreign countries would be less willing to sacrifice domestic welfare by raising rates to help stabilize relative prices. Under PCP, Foreign would likely maintain lower rates when acting unilaterally, leading to outcomes closer to those we observe under LCP cooperation. Analyzing these non-cooperative equilibria would provide crucial insights into when the costs of coordination failure are highest and help identify the conditions under which international cooperation becomes most essential during global downturns.

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