What is the Optimal Monetary Policy Response to Trump Tariffs 2.0?

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Abstract

Central banks around the world are grappling with the question of how to respond to the mix of inflationary and output implications of a new round of Trump tariffs. This question is compounded by the fact that the new round of tariffs impact a broader range of goods, some focusing on final consumption goods rather than on materials such as aluminum and steel as in tariffs of the previous Trump administration. This paper studies the optimal monetary stabilization of tariffs using a New Keynesian model enriched with elements from the trade literature, including global value chains in production, and comparative advantage between multiple traded sectors that differ in terms of market structure and price rigidity. We find that the optimal monetary response is expansionary, supporting activity and producer prices at the expense of generating short-run headline inflation. The prescription of monetary expansion applies broadly, both for tariffs aimed at differentiated consumption goods and for non-differentiated goods, but with distinct motivations in each case.

Keywords: tariff shock, tariff war, optimal monetary policy, comparative advantage, production chains
JEL classification: F4

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1. Introduction

As the Trump administration launches a new round of tariffs (Trump tariffs 2.0), central banks around the world are grappling with the question of how to respond. The question is often complicated by the fact that central bank objectives of stabilizing inflation and stabilizing employment and output can conflict in the presence of tariff shocks. This question is further complicated by the fact that the new round of tariffs impact a broader range of goods, focusing more on differentiated final consumption goods rather than on less differentiated materials such as aluminum and steel as in tariffs in the previous Trump administration. In fact, some recent tariffs explicitly exclude commodities such as petroleum.

This paper studies the Ramsey optimal monetary stabilization of tariff shocks using a two-country New Keynesian model enriched with elements from the trade literature, including global value chains in production and multiple traded sectors that differ in terms of market structure and price rigidity. This analysis is an extension of Bergin and Corsetti (2023), which was the first paper in the literature to study the question of optimal monetary policy response to tariff shocks, and which was the first to claim that expansion may be the optimal policy response to a tariff war even though it may worsen headline inflation. This point has been taken up further by other academics and some policy analysts.[1] The present paper extends the analysis to consider the effects of tariffs on the comparative advantage between two traded sectors. One sector produces differentiated goods, which are typically associated with monopolistic competition, price markups, and rigidities in price setting. The other sector produces non-differentiated goods, associated with higher elasticities of substitution, perfect competition and flexible prices. As a result of these differences in market structure and price stickiness, tariffs imposed on these two sectors imply distinct macro dynamics, and the two sectors react differently to a monetary policy response. Ramsey optimal monetary policy utilizes these distinctions to help manage the broader range of implications of surprise tariff shocks.

The analysis of this paper is well suited to the question facing emerging markets targeted or potentially targeted by Trump tariffs. First, the analysis takes the perspective of the country targeted of the tariff as the home country, rather than the perspective of the

[1] See in particular Bianchi and Coulibaly (2024), and Donnan et al. (2025).

U.S., which is more typical in the existing literature. Second, since many emerging markets are exporters of primary commodities in addition to differentiated goods, tariffs and the monetary policy response can affect a country's comparative advantage between these two sectors, with potential implications for growth and development.

Our overall conclusion is that the optimal monetary response to tariffs is expansionary, supporting activity and producer prices at the expense of generating short-run headline inflation. This prescription of monetary expansion applies broadly, both for tariffs aimed at differentiated and non-differentiated goods, but with very different motivations in each of these two cases. Given monopolistic competition and price stickiness typically characterizing differentiated goods, the objective of monetary policy is to use currency depreciation to help offset the effects of tariffs on relative prices between home and foreign goods, and thereby counteract the impact of tariffs on aggregate GDP as well as sectoral reallocation. In the case of non-differentiated goods, while currency undervaluation cannot affect the relative prices of nondifferentiated goods across countries in the absence of price stickiness, optimal monetary policy can raise welfare by manipulating the price of differentiated goods relative to non-differentiated goods within a country, to hasten the reallocation toward the differentiated goods needed to compensate for the loss of non-differentiated output. In this case, monetary policy promotes welfare by amplifying reallocation induced by the tariff rather than offsetting it. We find that the role for optimal policy becomes limited if the country imposing the tariffs has the advantage of a currency dominant in the invoicing of global trade.

More specifically, we find that tariffs imposed on a country's exports of differentiated goods lowers home GDP, but even more dramatically lowers production specifically in the differentiated sector, and instead raises production in the non-differentiated sector. Domestic welfare is lowered through multiple dimensions, including loss of efficiency gains associated with differentiated goods. Optimal monetary policy response to a foreign tariff on home differentiated exports is strongly expansionary, lowering interest rates and causing a currency depreciation. The fall in the currency value has the potential to help offset a substantial portion of the change in relative price imposed by the tariff. This policy stabilizes production, but at the cost of inducing domestic

inflation. The welfare loss of inadequate monetary policy depends on the elasticity of substitution between the two sectors.

In the case of tariffs on non-differentiated goods, while the impact on home overall GDP is very similar to the case with a tariff on differentiated goods, the sectoral reallocation induced by the tariff is precisely the opposite, with the tariff shifting home production and exports away from non-differentiated goods toward differentiated goods. The rise in differentiated production, however, does not take place immediately, but takes time due to slow adjustment of sticky differentiated goods prices. While the monetary policy has no effect on the fall in home production of non-differentiated goods, a monetary expansion and currency deprecation can raise home production of differentiated goods. As noted above, this rise in differentiated production would takes please in any case gradually over time as prices adjust, but the monetary expansion and currency depreciation serves to bring this process forward in time. We conclude that the optimal monitory response to this tariff on non-differentiated goods and differentiated goods are both expansionary, but with distinct motivations.

Analysis extends to more general environments, such as when the trading relationship among the two countries is characterized by the foreign currency being dominant in the invoicing of international trade. This scenario undercuts the effectives of the monetary policy response: with home export prices sticky in the currency of the foreign buyer, exchange rate fluctuations have little impact on the relative prices and cannot effectively offset the tariff. We also study symmetric trade wars, in which the home country retaliates with tariffs of its own. The conclusion of an optimal monetary expansion continues to hold, even when applied symmetrically by both countries so that exchange rates no longer play a role.

There is a growing literature studying the macroeconomic effects of tariffs. Most of this research has been conducted in the context of real trade models, or monetary models with at best a stylized monetary side.[2] Some contributions use monetary models with standard monetary policy rules in the background, but these do not derive optimal policy or

[2] See for example Bloom, et al. (2019), Born et al. (2019), Breinlich et al. (2017), Caliendo et al. (2017), Davies and Studnicka (2018), Dhingra et al. (2017), Sampson (2017), Steinberg (2019), and Van Reenen (2016).

focus on the monetary response. Barattieri et al. (2021) and Erceg et al. (2018) study whether trade policies can potentially serve as effective tools of macroeconomic stimulus in environments with nominal frictions. Caldara et al. (2018) investigates the macroeconomic implications of trade policy uncertainty. Linde and Pescatori (2019) study the degree to which endogenous exchange rate movements work to offset the macroeconomic effects of tariffs and export subsidies. These papers share with our work the specification of a monetary economy, but focus on the effects and/or design of tariff policies in a macroeconomic environment where monetary policy operates according to a standard Taylor rule in the background. In contrast, we focus on the design of the welfare-optimizing monetary policy response of a central bank faced by exogenous tariff shocks, and characterize how the optimal policy differs from the Taylor rule benchmark.

Closer to us is Auray et al. (2020), which shares our focus on the interaction of tariff policy with alternative monetary policies, including cooperative optimal policy. Specifically, they address the question of how alternative monetary policies affect an endogenous, strategic tariff policy. This runs in the opposite direction of our question, the choice of optimal monetary policy in the face of an exogenous tariff policy. The question we ask is directly motivated by the need to design an effective monetary response to trade policy initiatives best viewed as exogenous shocks, either imposed by a foreign country over which central banks have no control, or reflecting an unexpected shift in the political agenda of the domestic government.

Yet closer to us is Bianchi and Coulibaly (2024), which also studies optimal monetary policy responses to tariffs in a New Keynesian model, and also finds expansion to be optimal. Our model environment differs in considering a variety of trade model features, including firm entry and multiple traded sectors, with the associated implications for comparative advantage.

The paper proceeds as follows. The next section describes the model environment and calibration. Section 3 uses impulse responses to compare the macroeconomic effects of various specifications of tariffs to the two sectors, and uses stochastic simulations to compute the optimal monetary policy response and welfare implications of each. Section four considers extensions to more general environments. Section 5 summarizes conclusions and policy implications.

2. Model

The theoretical framework builds upon the framework of Bergin and Corsetti (2023), augmented with two traded sectors as in the model of Bergin and Corsetti (2020). The model features two countries, home and foreign, each of which produce two types of tradable goods. The first type of good comes in differentiated varieties produced under monopolistic competition, where firm entry requires a sunk investment, and prices are subject to nominal rigidities. The second type of good is modeled according to the standard specification in real business cycle models, assuming perfect substitutability among producers within a country, but imperfect substitutability across countries. In the text to follow, we present the households' and firms' problems as well as the monetary and fiscal policy rules from the vantage point of the home economy, with the understanding that similar expressions and considerations apply to the foreign economy—foreign variables are denoted with a "*".

2.1. Goods consumption demand and price indexes

In the benchmark version of the model, households consume goods produced in both sectors, and of both domestic and foreign origin. The differentiated goods come in many varieties, produced by a time-varying number of monopolistically competitive firms in the home and foreign country, n_t and n_t^* respectively, each producing a single variety. Each variety is an imperfect substitute for any other variety in this sector, either of home or foreign origin, with elasticity ϕ. The non-differentiated goods come in a home and foreign version, which are imperfect substitutes with elasticity η. However, within each country, all goods in this sector are perfectly substitutable with each other, and are produced in a perfectly competitive environment. We will refer to the differentiated sector as "manufacturing," and denote this sector with a *D*; we will denote the non-differentiated sector with a *N*.

Tariffs are specified as ad-valorem duties imposed at the dock. They directly enter the relative prices observed by consumers, and which enter the demand equations. Tariff revenue is collected by the government of the importing country and rebated to domestic consumers, thus canceling out in the consolidated national budget constraint.

The overall consumption index is specified as follows:

$$C_t \equiv \left(\theta^{\frac{1}{\xi}} C_{D,t}^{\frac{\xi-1}{\xi}} + (1-\theta)^{\frac{1}{\xi}} C_{N,t}^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}},$$

where

$$C_{D,t} \equiv \left(\int_0^{n_t} c_t(h)^{\frac{\phi-1}{\phi}} dh + \int_0^{n_t^*} c_t(f)^{\frac{\phi-1}{\phi}} df \right)^{\frac{\phi}{\phi-1}}$$

is the index over the endogenous number of home and foreign varieties of the differentiated manufacturing good, $c_t(h)$ and $c_t(f)$, and

$$C_{N,t} \equiv \left(\nu^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + (1-\nu)^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

is the index over goods differentiated only by country of origin, $C_{H,t}$ and $C_{F,t}$ with $\nu \in [0,1]$ accounting for the weight on domestic goods. The corresponding welfare-based consumption price index is

$$P_t = \left(\theta P_{D,t}^{1-\xi} + (1-\theta)\left(P_{N,t}\right)^{1-\xi} \right)^{\frac{1}{1-\xi}}, \tag{1}$$

where

$$P_{D,t} = \left(n_t p_t(h)^{1-\phi} + n_t^* \left(p_t(f) T_{D,t} \right)^{1-\phi} \right)^{\frac{1}{1-\phi}} \tag{2}$$

is the index over the prices of all varieties of home and foreign manufacturing goods, $p_t(h)$ and $p_t(f)$, and

$$P_{N,t} = \left(\nu P_{H,t}^{1-\eta} + (1-\nu)\left(P_{F,t} T_{N,t}\right)^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{3}$$

is the index over the prices of home and foreign non-differentiated goods. In these indexes, $T_{D,t}$ represents the quantity of 1 plus the ad valorem tariff rate imposed by the home country on imports of foreign differentiated goods, and $T_{N,t}$ represents the quantity of 1 plus the ad-valorem tariff rate imposed by the home country on imports of foreign non-differentiated goods. In reporting results, we will distinguish between the "ex-tariff" price determined by an exporter, $p_t(f)$, and the "tariff-inclusive" price, $p_t(f) T_{D,t}$, paid by an importer.

The relative demand functions for domestic residents implied from our specification of preferences are listed below:

$$C_{D,t} = \theta \left(P_{D,t} / P_t \right)^{-\xi} C_t \tag{4}$$

$$C_{N,t} = C_{D,t} = (1-\theta)\left(P_{N,t} / P_t \right)^{-\xi} C_t \tag{5}$$

$$c_t(h) = \left(p_t(h) / P_{D,t} \right)^{-\phi} C_{D,t} \tag{6}$$

$$c_t(f) = \left(p_t(f) T_{D,t} / P_{D,t} \right)^{-\phi} C_{D,t} \tag{7}$$

$$C_{H,t} = \nu \left(P_{H,t} / P_{N,t} \right)^{-\eta} C_{N,t} \tag{8}$$

$$C_{F,t} = (1-\nu)\left(P_{F,t} T_{N,t} / P_{N,t} \right)^{-\eta} C_{N,t} \tag{9}$$

Note that demand functions for imports (Eqs. (7) and (9)) depend upon the tariff-inclusive price.

2.2 Home households' problem

The representative home household derives utility from consumption (C_t), and from holding real money balances (M_t/P_t); it suffers disutility from labor (l_t). The household budget consists of labor income from working at the nominal wage rate W_t; profits rebated from home firms denoted with $\left(\Pi_t \right)$ in real terms and defined below, as well as interest income on bonds in home currency ($i_{t-1}B_{H,t-1}$) and foreign currency ($i_{t-1}^{*}B_{F,t-1}$), where e_t is the nominal exchange rate in units of home currency per foreign. Income is net of lump-sum taxes (T_t), used for monetary transfers and to rebate tariff payments on imports. It is assumed that consumers do not internalize the effects of their consumption decisions on government tariff rebates.

Household optimization for the home country may be written:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t, l_t, \frac{M_t}{P_t} \right)$$

where utility is defined by

$$U_t = \frac{1}{1-\sigma} C_t^{1-\sigma} + \ln \frac{M_t}{P_t} - \frac{1}{1+\psi} l_t^{1+\psi} ,$$

subject to the budget constraint:

$$P_t C_t + \left(M_t - M_{t-1} \right) + \left(B_{Ht} - B_{Ht-1} \right) + e_t \left(B_{Ft} - B_{Ft-1} \right) = W_t l_t + \Pi_t + i_{t-1} B_{Ht-1} + i_{t-1}^{*} B_{Ft-1} - P_t AC_{Bt} - T_t .$$

In the utility function, the parameter σ denotes risk aversion and ψ is the inverse of the Frisch elasticity. The constraint includes a small cost to holding foreign bonds

$$AC_{Bt} = \frac{\psi_B \left(e_t B_{Ft}\right)^2}{2P_t p_{Ht} y_{Ht}},$$

scaled by ψ_B, which is a common device to assure long run stationarity in the net foreign asset position, and resolve indeterminacy in the composition of the home bond portfolio. The bond adjustment cost is a composite of goods that mirrors the consumption index, with analogous demand conditions to Eqs. (4)-(9).

Defining $\mu_t = P_t C_t^{\sigma}$, household optimization implies an intertemporal Euler equation:

$$\frac{1}{\mu_t} = \beta\left(1+i_t\right) E_t\left[\frac{1}{\mu_{t+1}}\right] \tag{1}$$

a labor supply condition:

$$W_t = l_t^{\psi} \mu_t \tag{11}$$

a money demand condition:

$$M_t = \mu_t \left(\frac{1+i_t}{i_t}\right), \tag{12}$$

and a home interest rate parity condition:

$$\mathrm{E_t}\left[\frac{\mu_t}{\mu_{t+1}}\frac{e_{t+1}}{e_t}\left(1+\mathrm{i}_t^*\right)\left(1+\psi_B\left(\frac{e_t B_{ft}}{p_{Ht} y_{Ht}}\right)\right)\right] = \mathrm{E_t}\left[\frac{\mu_t}{\mu_{t+1}}\left(1+\mathrm{i_t}\right)\right]. \tag{13}$$

The problem and first order conditions for the foreign household are analogous.

2.3 Home firm problem and entry condition in the differentiated goods sector

In the manufacturing sector, the production of each differentiated variety follows

$$y_t(h) = \alpha_D \left[G_t(h)\right]^{\zeta} \left[l_t(h)\right]^{1-\zeta}, \tag{14}$$

where α_D is productivity specific to the production of differentiated goods but common to all firms within that sector, $l_t(h)$ is the labor employed by firm h, and $G_t(h)$ is a composite of differentiated goods used by firm h as an intermediate input. $G_t(h)$ is specified as an index of home and foreign differentiated varieties that mirrors the consumption index specific to differentiated goods ($C_{D,t}$). If we sum across firms, $G_t = n_t G_t(h)$ represents

economy-wide demand for differentiated goods as intermediate inputs. Given that the index is the same as for consumption, this implies demands for differentiated goods varieties, $d_{G,t}(h)$ and $d_{G,t}(f)$, analogous to Eqs. (6)–(7).[3]

Differentiated goods firms set prices $p_t(h)$ subject to an adjustment cost:

$$AC_{P,t}(h) = \frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)^2 \frac{p_t(h)\, y_t(h)}{P_t}, \tag{15}$$

where ψ_P is a calibrated parameter governing the degree of price stickiness. For the sake of tractability, we follow Bilbiie et al. (2008) in assuming that new entrants inherit from the price history of incumbents the same price adjustment cost, and so make the same price setting decision.[4]

There is free entry in the sector, but, once active, firms are subject to an exogenous death shock. Since all differentiated goods producers operating at any given time face the same exogenous probability of exit δ, a fraction δ of them exogenously stop operating each period. The number of firms active in the differentiated sector, n_t, at the beginning of each period evolves according to:

$$n_{t+1} = (1-\delta)(n_t + ne_t), \tag{16}$$

where ne_t denotes new entrants.

To set up a firm, managers incur a one-time sunk cost, K_t, and production starts with a one-period lag. This cost is not constant but varies reflecting an entry congestion externality, represented as an adjustment cost that is a function of the number of new firms:

$$K_t = \left(\frac{ne_t}{ne_{t-1}}\right)^{\lambda} \overline{K}, \tag{17}$$

where $\overline{K}$ indicates the steady state level of entry cost, and the parameter λ indicates how much the entry cost rises with an increase in entry activity. The congestion externality plays a similar role as the adjustment cost for capital standard in business cycle models, which moderates the response of investment to match dynamics in data. In a similar vein, we calibrate the adjustment cost parameter, λ, to match data on the dynamics of new firm

[3] See section 1 of the online appendix for the demand equations not listed here.

[4] The price index for adjustment cost is identical to the overall consumption price index, implying demands analogous to those for consumption in Eqs. (4)-(9). See section 1 of the online appendix for the demand equations not listed here.

entry.[5] The demands for varieties for use as entry investment, $d_{K,t}(h)$ and $d_{K,t}(f)$, are determined analogously to demands for consumption of differentiated goods.

We now can specify total demand facing a domestic differentiated goods firm:

$$d_t(h) = c_t(h) + d_{G,t}(h) + d_{K,t}(h) + d_{AC,P,t}(h) + d_{AC,B,t}(h) \tag{18}$$

which includes the demand for consumption ($c_t(h)$) by households, and the demand by firms for intermediate inputs ($d_{G,t}(h)$), investment (the sunk entry costs) ($d_{K,t}(h)$), and goods absorbed as adjustment costs for prices ($d_{AC,P,t}(h)$) and bonds holding costs ($d_{AC,B,t}(h)$). There is an analogous demand from abroad $d_t^*(h)$. We assume iceberg trade costs τ_D for exports, so that market clearing for a firm's variety is:

$$y_t(h) = d_t(h) + (1+\tau_D) d_t^*(h), \tag{19}$$

Firm profits are computed as:

$$\pi_t(h) = p_t(h) d_t(h) + e_t p_t^*(h) d_t^*(h) - mc_t y_t(h) - P_t AC_{p,t}(h). \tag{20}$$

where $mc_t = \zeta^{-\zeta}(1-\zeta)^{\zeta-1} P_{D,t}{}^{\zeta} W_t^{1-\zeta} / \alpha_D$ is marginal cost.

Thus the value function of firms that enter the market in period *t* may be represented as the discounted sum of profits of domestic sales and export sales:

$$v_t(h) = E_t \left\{ \sum_{s=0}^{\infty} \left(\beta(1-\delta)\right)^s \frac{\mu_{t+s}}{\mu_t} \pi_{t+s}(h) \right\},$$

where we assume firms use the discount factor of the representative household, who owns the firm, to value future profits. With free entry, new producers will invest until the point that a firm's value equals the entry sunk cost:

$$v_t(h) = P_{D,t} K_t. \tag{21}$$

By solving for cost minimization we can express the relative demand for labor and intermediates as a function of their relative costs:

$$\frac{P_{D,t} G_t(h)}{W_t l_t(h)} = \frac{\zeta}{1-\zeta}. \tag{22}$$

Managers optimally set prices by maximizing the firm value subject to all the constraints specified above. The price setting equation:

[5] The value of steady state entry cost $\overline{K}$ has no effect on the dynamics of the model, and so will be normalized to unity.

$$p_t(h)=\frac{\phi}{\phi-1}mc_t+\frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)}-1\right)^2 p_t(h)-\psi_P\frac{1}{\phi-1}\left(\frac{p_t(h)}{p_{t-1}(h)}-1\right)\frac{p_t(h)^2}{p_{t-1}(h)}$$
$$+\frac{\psi_P}{\phi-1}E_t\left[\beta\frac{\Omega_{t+1}}{\Omega_t}\left(\frac{p_{t+1}(h)}{p_t(h)}-1\right)\frac{p_{t+1}(h)^2}{p_t(h)}\right] \tag{23}$$

expresses the optimal pricing as a function of the stochastically discounted demand faced by producers of domestic differentiated goods,

$$\Omega_t=\left[\left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi}\left(C_{D,t}+G_t+ne_t(1-\theta_K)K_t+AC_{P,D,t}+AC_{B,D,t}\right)\right.$$
$$\left.+\left(\frac{(1+\tau_D)T^*_{D,t}p_t(h)}{e_tP^*_{D,t}}\right)^{-\phi}(1+\tau_D)\left(C^*_{D,t}+G^*_t+ne^*_t(1-\theta_K)K^*_t+AC^*_{P,D,t}+AC^*_{B,D,t}\right)\right]\Big/\mu_t .$$

This sums the demand arising from consumption, use as intermediate inputs, sunk entry cost, price adjustment costs, and bond holding costs.

Under the assumption that firms preset prices in own currency, i.e., assuming producer currency pricing, the good price in foreign currency moves one-to-one with the exchange rate, net of trade costs:

$$p^*_t(h)=(1+\tau_D)p_t(h)/e_t, \tag{24}$$

where recall the nominal exchange rate, *e*, measures home currency units per foreign.

Note that, since households own firms, they receive firm profits but also finance the creation of new firms. In the household budget, the net income from firms may be written:

$$\Pi_t=n_t\pi_t(h)-ne_tv_t(h).$$

In reporting our quantitative results, we will refer to the overall home gross production of differentiated goods defined as: $y_{D,t}=n_ty_t(h)$.

2.4 Home firm problem in the undifferentiated goods sector

In the second sector firms are assumed to be perfectly competitive in producing a good differentiated only by country of origin. The production function for the home non-differentiated good is linear in labor:

$$y_{H,t}=\alpha_N l_{H,t}, \tag{25}$$

where α_N is productivity specific to this country and sector. It follows that the price of the homogeneous goods in the home market is equal to marginal costs:

$$p_{H,t} = W_t / \alpha_N . \tag{26}$$

An iceberg trade cost specific to the non-differentiated sector implies prices of the home good abroad are

$$p^*_{H,t} = p_{H,t}\left(1+\tau_N\right)/e_t . \tag{27}$$

Analogous conditions apply to the foreign non-differentiated sector.

2.5 Monetary policy

To compute the cooperative Ramsey allocation, we posit that the monetary authority maximizes aggregate welfare of both countries:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{1}{2}\left(\frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\psi} l_t^{1+\psi} \right) + \frac{1}{2}\left(\frac{1}{1-\sigma} C_t^{*1-\sigma} - \frac{1}{1+\psi} l_t^{*1+\psi} \right) \right)$$

under the constraints of the economy defined above. As common in the literature, we write the Ramsey problem by introducing additional co-state variables, which track the value of the planner committing to a policy plan.

For comparison, we also study three alternative nominal specifications. In the first one, we assume flexible prices and wages, so to characterize the natural allocation. In the second, we model monetary policy positing a constant money growth rule:

$$\frac{M_t}{M_{t-1}} = \upsilon , \tag{28}$$

which we label the 'no (stabilization) policy' case. In the last one, with replace the above with a Taylor rule of the form

$$1 + i_t = \left(1 + i_{t-1}\right)^{\gamma_i} \left[\left(1+\bar{i}\right)\left(\frac{p_t(h)}{p_{t-1}(h)} \right)^{\gamma_P} \left(\frac{Y_t}{\bar{Y}} \right)^{\gamma_Y} \right]^{1-\gamma_i} , \tag{29}$$

where terms with overbars are steady-state values. In this rule, inflation is defined in terms of differentiated goods producer prices, while Y_t is a measure of GDP defined net of intermediates as:[6]

[6] For computational simplicity, the Taylor rule is specified in terms of deviations of GDP from its steady state value, which is distinct from the output gap.

$$Y_t = \left((1+n_t)^{(-1/(1-\sigma))} \int_0^{n_t} p_t(h) y_t(h) dh - P_{D,t} G_t + p_{H,t} y_{H,t} \right) / P_t \,. \tag{30}$$

Across these different specifications of monetary policy, we will abstract from public consumption expenditure, so that the government uses seigniorage revenues and taxes to finance transfers, assumed to be lump sum. Government transfers are also used to rebate to consumers the tariff duties paid to the government by consumers and firms on imported goods. The government budget constraint thus is specified as follows:

$$T_t = \left(M_{t-1} - M_t\right) + \left(T_{D,t} - 1\right) n^*_{t-1} d_t(f) + \left(T_{N,t} - 1\right)\left(C_{F,t} + AC_{P,F,t} + AC_{B,F,t}\right). \tag{31}$$

2.6 Shocks process and equilibrium definition

Shocks are assumed to follow joint log normal distributions:

$$\begin{bmatrix} \log T_{D,t} - \log \overline{T_D} \\ \log T^*_{D,t} - \log \overline{T^*_D} \\ \log T_{N,t} - \log \overline{T_N} \\ \log T^*_{N,t} - \log \overline{T^*_N} \end{bmatrix} = \rho_T \begin{bmatrix} \log T_{D,t-1} - \log \overline{T_D} \\ \log T^*_{D,t-1} - \log \overline{T^*_D} \\ \log T_{N,t-1} - \log \overline{T_N} \\ \log T^*_{N,t-1} - \log \overline{T^*_N} \end{bmatrix} + \varepsilon_{Tt}$$

with autoregressive coefficient matrix ρ_T, and the covariance matrix $E\left[\varepsilon_{Tt}\varepsilon'_{Tt}\right]$.

To conserve space, the market clearing conditions to close the model are reported in section 2 of the appendix. A competitive equilibrium in our world economy is defined along the usual lines, as a set of processes for quantities and prices in the home and foreign country satisfying: (i) the household and firms optimality conditions; (ii) the market clearing conditions for each good and asset, including money; (iii) the resource constraints—whose specification can be easily derived from the above and is omitted to save space.

2.7 Welfare computation

We report the effects on welfare of a given policy regime configuration relative to the Ramsey allocation. The change in welfare customarily is computed in terms of consumption units that households would be willing to forgo to continue under the Ramsey policy regime. We posit identical initial conditions across different monetary policy

regimes using the Ramsey allocation, and we include transition dynamics in the computation to avoid spurious welfare reversals.[7]

2.8 Model calibration

Where possible, parameter values are taken from standard values in the literature. Risk aversion is set at $\sigma = 2$; labor supply elasticity is set at $1/\psi = 1.9$ following Hall (2009). Consistent with a quarterly frequency, $\beta = 0.99$.

The price stickiness parameter is set at ψ_p =49, a value which implies in simulations of a productivity shock that approximately half the firms resetting price during the first year. [8] The firm death rate is set at δ =0.025. The mean sunk cost of entry is normalized to the value $\overline{K}$ =1, and the adjustment cost parameter for new firm entry, λ , is taken from Bergin and Corsetti (2020). The share of intermediates in differentiated goods production follows Bergin and Corsetti (2020) to a modest value of ζ =1/3.

To choose parameters for the differentiated and non-differentiated sectors we draw on Rauch (1999). We we choose θ so that differentiated goods represent 55 percent of U.S. trade in value: ($\theta = 0.61$). We assume the two countries are of equal size with no exogenous home bias, $\nu = 0.5$, but allow trade costs to determine home bias ratios. To set the elasticities of substitution within the differentiated and non-differentiated sectors we draw on the estimates by Broda and Weinstein (2006), classified by sectors based on Rauch (1999). The Broda and Weinstein (2006) estimate of the elasticity of substitution between differentiated goods varieties is ϕ =5.2 (the sample period is 1972-1988). The corresponding elasticity of substitution for non-differentiated commodities is η = 15.3. We initially adopt a Cobb-Douglas specification for the aggregator function combining the two

[7] We adopt the methodology created by Giovanni Lombardo and used in Coenen et al. (2010), available from https://www.dropbox.com/s/q0e9i0fw6uziz8b/OPDSGE.zip?dl=0.

[8] As is well understood, a log-linearized Calvo price-setting model implies a stochastic difference equation for inflation of the form $\pi_t = \beta E_t \pi_{t+1} + \lambda mc_t$, where *mc* is the firm's real marginal cost of production, and where $\lambda = (1-q)(1-\beta q)/q$, with q is the constant probability that a firm must keep its price unchanged in any given period. The Rotemberg adjustment cost model used here gives a similar log-linearized difference equation for inflation, but with $\lambda = (\phi - 1)/\kappa$. Under our parameterization, a Calvo probability of q = 0.5 implies an adjustment cost parameter of ψ_P = 49.

sectors ($\xi \to 1$), but sensitivity analysis will report results for alternative calibrations of this parameter.

To set trade costs, we calibrate τ_D so that exports represent 26% of GDP, as is the average in World Bank national accounts data for OECD countries from 2000-2017.[9] This requires a value of τ_D =0.44.[10] This is somewhat larger than the value of 0.25 used for trade costs in Obstfeld and Rogoff, (2001), but it is small compared to some trade estimates, such as 1.7 suggested by Anderson and van Wincoop 2004, and adopted by Epifani and Gancia (2017). We follow the standard assumption of trade models that the homogeneous good is traded frictionlessly (τ_N =0).

Calibration of policy parameters for the historical monetary policy Taylor rule are taken from Coenen, et al. (2010): γ_i =0.7, γ_p =1.7, γ_Y =0.1.

The process for tariff shocks is calibrated with a mean value of 1.02 (2 percentage point mean tariff rate) to match U.S. tariff data in Barattieri et al. (2021). The autoregressive parameter is set to 0.56, estimated from Barattieri et al. (2021).[11] The standard deviation of 6 percentage points is taken from Caldara et al. (2020), chosen to capture tariff increases that have been threatened on imports from China and on imports of autos and motor-vehicle parts in 2018-2019.

3. Benchmark scenario: foreign tariff on home differentiated exports

Consider a tariff shock imposed by the foreign country on its imports of differentiated goods exported from the home country. Figure 1 reports impulse responses showing the macroeconomic effects on a selection of variables under different policy regimes, contrasting the Ramsey optimal policy (solid line), "Taylor rule" (dotted line), and "no-policy" (dashed line), where the latter is obtained by imposing a constant money growth rule.

[9] See https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS?locations=OE.
[10] To coincide with standard accounting definitions, differentiated goods used as intermediates are included in the measure of exports, and excluded in the measure of GDP, as is appropriate.
[11] We do not adopt the standard deviation of shocks estimated in Barattieri et al (2021), as these estimates are based on a sample from normal times with low volatility in tariffs compared to the more recent period of Brexit and Trump tariffs.

3.1 Transmission under suboptimal policy

Consider first the case of money policy that does not respond to the tariff, but maintains a constant rate of money growth (dashed lines in Figure 1). At first look, our impulse responses resonate with the headline case for protection in policy debates. A foreign tariff results in a foreign trade surplus (home trade deficit). While the effect of the tariff on home GDP is distinctly contractionary, foreign GDP rises (by a smaller magnitude than the fall in home GDP). Looking deeper into the transmission of the tariff, however, the headline case for protection is not strong. As discussed by Erceg et al. (2018), the GDP in the country that imposes the tariff (the foreign country in our experiment) may rise or fall, depending upon whether the fall in consumption demand due to intertemporal incentives is dominated by the rise in export demand due to the expenditure switching effect of relative prices. In our benchmark calibration the expenditure switching effect dominates.[12] In our context, output also reflects investment demand associated with the creation of new firms. The tariff has an undesired contractionary effect on firm entry in the foreign economy, while it favors entry in the home economy.

In response to a unilateral tariff on home differentiated exports, the home exchange rate depreciates slightly.[13] Observe that, in the no policy response scenario, the rate of depreciation is not large enough to offset the impact of the tariff on the relative price of home exports to home imports. This is in violation of the well-known "Lerner symmetry" result, predicting perfect offset. Linde and Pescatori (2019) have pointed out that, in its stronger form, Lerner symmetry fails in many macroeconomic contexts, depending on the structure of financial markets and nominal rigidities.

The tariff lowers inflation in the home country, due to the fall in economic activity, and an associated fall in the wage rate. Inflation rises in the foreign country, due higher costs for imported intermediates.

The effect on activity at the aggregate level discussed above masks a large sectoral reallocation. The percentage fall in the production of differentiated goods in the home

[12] In our calibration the trade elasticity is somewhat higher than typical, since it is pinned down by the elasticity of substitution between any two varieties, be they home or foreign varieties. Experiments not pictured indicate that if we reduce this elasticity of substitution slightly, from 5.2 to 4, the expenditure switching effect abates enough that the response of the foreign GDP to the tariff is negative.

[13] The small magnitude of the currency movement makes it difficult to detect depreciation in Figure 4, given the scaling used in this figure

country is three times the percentage fall in GDP. This sectoral contraction is matched by a rise in home production of non-differentiated goods of a similar magnitude. In the foreign country, sectoral productions mirror this adjustment, moving in the opposite direction.

We turn next to the case of a standard Taylor rule (dotted line in Figure 1). The calibrated Taylor rule calls for a modest monetary expansion in the home country, lowering interest rate and inducing currency depreciation. This monetary expansion is sufficient to eliminate the deflation in the home country observed above, but it is too small to have significant effect moderating the fall in output or sectoral reallocation. The dynamics of production overall and in the two sectors remain very similar to under the fixed monetary growth rule. The foreign Taylor rule raises rates slightly, in response to the rise in its own inflation; this policy works in the direction of supporting the depreciation of home currency and partly offset the effects of the tariff.

3.2 Transmission under optimal policy

In Figure 1, economic dynamics under the optimal (cooperative) policy are depicted with a solid (red) line. The home policy expansion now is much stronger, calling for a substantial cut in home interest rate. This stronger expansion induces a larger currency deprecation that offsets half of the rise in home terms of trade observed in the "no-policy" case. The policy thus offsets more than half of the fall in home GDP and more than two thirds of the sectoral reallocation. However, the strong monetary policy implies more than an offset of the home county's deflation arising from the tariff; it induces positive inflation instead. The policy in the foreign country serves to further support home policy in countering the effects of the tariff, as a foreign monetary contraction aims to reduce the rise in foreign inflation.

The optimal rate of exchange rate depreciation is not sufficient to fully restore home GDP to the pre-tariff level, especially over time (more so, if the persistence of the tariff shock exceeds that of price stickiness). On the other hand, the required cut in home interest rate tends to over-stimulate home consumption---and cause a significant aggravation of overall inflation in the home country.

We note that a monetary policy expansion has the potential to manipulate two relative prices. The first is the relative price between the home and the foreign

differentiated goods; the second is the relative price between differentiated goods, which have sticky prices, and non-differentiated goods, which have flexible prices. Balancing different margins, the home optimal monetary policy again calls for a deeper interest rate cut than implied by the Taylor rule, so to reduce the tariff-induced loss in both comparative advantage and aggregate production.

3.3 Welfare implications

Table 2 reports welfare loss of adopting a suboptimal policy (Taylor Rule) relative to the Ramsey optimal policy, measured in units of steady state consumption. To compute these implications, we conduct a stochastic simulation of the model in which unilateral tariff shocks are mean zero (shocks include both hikes and cuts in tariff rates), and can impact either country (home and foreign tariffs are equally likely and are uncorrelated across countries).[14] Given that either country can in principle experience a tariff shock, implications for unconditional moments and welfare are symmetric, and the values in the table apply equally to both countries. Relative to the optimal policy, the welfare loss under a Taylor rule for the benchmark case discussed above is 0.105 percentage points of steady state consumption (column (1)). A modest value is typical of welfare calculation of business cycles. The table also reports unconditional means of variables, showing that the loss in welfare is associated with a fall in the level consumption while at the same time raising the mean level of employment (and hence lowering leisure). This loss is associated with a loss of efficiency arising from a large percentage fall in the number of firms and goods varieties.

Column (2) of the table shows that the welfare loss rises somewhat (to 0.14%) if there is greater substitutability between the two sectors (phi $\phi = 1.4$ rather than 1.0).

4. Extensions to alternative tariff specifications and environments

4.1 Tariff on non-differentiated sector

Figure 2 plots responses for a home tariff focused on foreign exports of the non-differentiated good (rather than the differentiated good). Under the no-policy case, the impact on home GDP is very similar to the case with a tariff on differentiated goods in Figure 1. But the sectoral reallocation induced by the tariff is precisely the opposite, with

[14] Perturbation solution methods require that shocks be mean zero.

the tariff shifting home production and exports away from non-differentiated goods toward differentiated goods.

The rise in differentiated production, however does not take place immediately, but takes time due to slow adjustment of sticky differentiated goods prices. Differentiated goods producers would like to lower prices to reflect the fall in wages and production costs, but sticky prices delay this process. This delayed rise in differentiated production is further amplified by the fact that it takes time for new firm entry into the sector, which rises gradually and persistently after the tariff.

Interestingly, the direction of optimal policy is expansionary, as in case of the tariff on differentiated exports. But the magnitude and the motivation are distinct in this case. The interest rate cut is an order of magnitude smaller in Figure 2 than in Figure 1. Further, the effect is not to offset the effect of the tariff: the rise in GDP is about the same under optimal monetary policy, and the sectoral reallocation is even larger. While the monetary policy has no effect on the fall in home production of non-differentiated goods, it does raise home production of differentiated goods. As noted above, this rise in differentiated production would take place in any case over time as prices adjust, but the monetary expansion and currency depreciation serves to bring this process forward in time. Given that monetary policy is unable to offset the effect of a tariff on cross-country relative prices of non-differentiated goods since they have flexible prices, the best it can do is to facilitate the rise in differentiated production that would occur under flexible prices. Monetary expansion accomplishes this objective by inducing a fall in the relative price of home differentiated goods relative to non-differentiated goods (via a rise in flexible non-differentiated prices). We conclude that the optimal monetary responses to a tariff on non-differentiated goods and a tariff on differentiated goods both are expansionary, but with quite different motivations.

The Taylor rule in the case of this tariff implies an interest rate cut quite similar to that of the optimal policy, and likewise implies similar dynamics of macro variables. As the optimal policy stimulus was seen above to be small in magnitude, it is more similar in this case to the degree of expansion mandated by the Taylor rule aimed at stabilizing inflation in face for the deflationary effects of the tariff.

Column (6) of Table 1 shows that the welfare benefits of the optimal policy are commensurately smaller for a tariff on non-differentiated goods, about half the size of the gains from optimal policy in the case of a tariff on differentiated goods.

4.2 Dominant Currency

A distinctive feature of a trade war with the United States is that the dollar is commonly used as an international currency of invoicing for trade. It has become common in the literature to consider a case in which prices of all exported goods are sticky in dollar units, regardless of the trading countries. Our model can represent this case by assuming that the home exports are sticky in the currency of the buyer (local currency pricing) rather than the producer currency, as assumed in the benchmark model. (See the Appendix 3 for details of the specification.)

Figure 3 shows that if the home country must set prices in dollars, this severely limits its ability to use monetary policy to counter a U.S. tariff on its exports. We first note that the dynamics under the no-policy case are almost the same as under the benchmark case in Figure 1. This is because tariffs impact consumer prices regardless of the currency of invoicing. We next note that although the home country employs a significant monetary stimulus, lowering interest rate and depreciating the currency, this policy has minimal effect on the dynamics on the trade flows or other macro aggregates. This is because the currency depreciation does not affect the price observed by U.S. consumers, so the full effect of the tariff still is felt.

The asymmetry in price stickiness also puts the home country at a disadvantage in terms of the welfare implications of tariffs. As shown columns (3) and (4) of Table 2, home welfare is lower than foreign even when home and foreign tariffs are imposed in a symmetric manner.[15]

4.3 Nontraded goods

The literature that studies inter-sectoral reallocation from tariffs typically assumes that the second sector produces goods that are not internationally traded---an instance is

[15] Appendix Figure 1 shows the additional case when local currency pricing (LCP) is applied symmetrically to both home and foreign countries. Monetary policy in either country has almost no effect on trade flows.

Caliendo et al. (2017). For comparison, we modify our model by assuming that the non-differentiated sector produces non-tradables ($\nu = 1$). Simulation results are reported in Appendix Figure 2. The economic transmission is very different: there is no shift in comparative advantage, in contrast with the benchmark case in Figure 1. The effect on the non-differentiated sector is an order of magnitude smaller if these are not traded internationally. Optimal policy still calls for expansion at home, with a domestic currency depreciation. The welfare loss associated with a Taylor rule relative to the optimal policy is 0.135%, similar to the benchmark two-sector case discussed above.

4.4 Symmetric tariff war

It is a distinct possibility that central banks will be called upon to deal with a situation in which the home country reciprocates U.S. tariffs with tariffs of its own in a symmetric tariff war. Figure 5 shows the case of symmetric tariff hikes imposed on the differentiated goods exports of both countries. The fall in home aggregate economic activity is similar to the benchmark case in Figure 1, but the fall now applies to the foreign country (U.S.) as well. In addition, the contraction in activity is largely driven by the fall in differentiated goods production. The production of non-differentiated goods actually rises somewhat, but not enough to compensate for the fall in overall output coming from the differentiated sector. In a symmetric tariff war, there is no shift in comparative advantage across countries---rather, the tariff distortions result in a shift in the sectoral composition of output at a global level.

The optimal monetary policy stance is expansionary in both countries, despite the inflationary impact of the tariff. Hence it is strongly at odds with the Taylor rule mandating a contraction. Given that a symmetric tariff war cannot be remedied by a currency depreciation, the optimal policy aims at resolving the distortion created by the tariff between differentiated and non-differentiated prices within each country. An expansionary monetary stance mitigates the contraction in the differentiated good sector, driving up overall aggregate demand as well as the prices of non-differentiated goods, which are flexible.[16]

[16] Appendix Figure 3 show the case of a symmetric trade war where firms in both countries set export prices in local currency (LCP stickiness). Monetary policy has minimal impact on trade flows.

Table 2 (see column 7) suggests that the welfare loss of a symmetric tariff war is lower than for tariffs that are not coincident (comparing column (5) to (1)). This can be attributed to the fact that a symmetric tariff does not imply a large asymmetric sectoral reallocation across countries associated with a shift in comparative advantage, as found in the case of a unilateral tariff in the analysis above.

Column (8) shows a similarly diminished welfare loss is associated with a symmetric tariff war launched on exports of non-differentiated goods of both countries. See Appendix Figure 4 for impulse responses in this case.

5. Conclusion

Central banks around the world are grappling with the question of how to respond to the mix of inflation and output implications of a new round of Trump tariffs. This question is compounded by the fact that the new round of tariffs impact a broader range of goods, some focusing on final consumption goods rather than on materials such as aluminum and steel as in tariffs of the previous Trump administration. Using a New Keynesian model enriched with elements from the trade literature, including global value chains in production, and comparative advantage between multiple traded sectors that differ in terms of market structure and price rigidity, we find that the optimal monetary response is expansionary, supporting activity and producer prices at the expense of aggravating short-run headline inflation. This prescription of monetary expansion applies broadly, both for tariffs aimed at differentiated consumption goods with sticky prices and for non-differentiated commodities with flexible prices, but with very distinct motivations in each case.

In the case of tariffs targeting differentiated final consumption goods, typically characterized with monopolistic competition and price stickiness, the objective of monetary policy is to use currency depreciation to help offset the effects of tariffs on relative prices between home and foreign goods. It thereby can counteract the impact of tariffs on aggregate GDP and sectoral reallocation. In the case of non-differentiated goods, while currency undervaluation cannot affect the relative prices of nondifferentiated goods across countries in the absence of price stickiness, optimal monetary policy can raise welfare by manipulating the price of differentiated goods relative to non-differentiated goods within a

country, to hasten the reallocation toward the differentiated goods needed to compensate for the loss of non-differentiated output. In this case, monetary policy promotes welfare by amplifying reallocation induced by the tariff rather than offsetting it. However, we find that the role for optimal policy becomes limited if the country imposing the tariffs has the advantage of a currency dominant in the invoicing of global trade.

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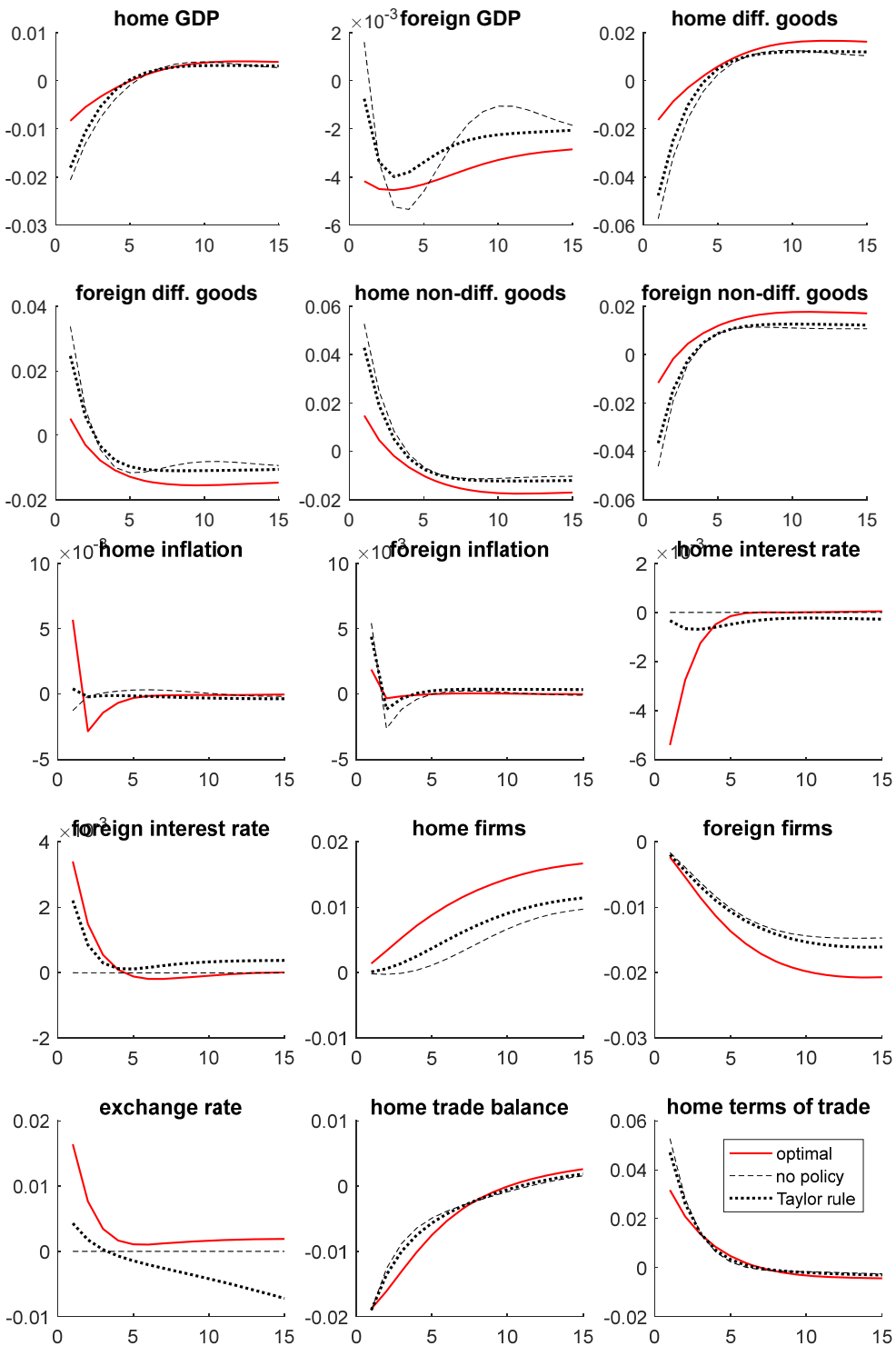
Table 1. Benchmark Parameter Values

Preferences	
Risk aversion	$\sigma = 2$
Time preference	β =0.99
Labor supply elasticity	$1/\psi = 1.9$
Differentiated goods share	$\theta = 1, \quad 0.61$
Non-differentiated goods home bias	$\nu = 0.5$
Differentiated goods elasticity	ϕ = 5.2
Non-differentiated goods elasticity	$\eta = 15.3$
Substitution between sectors	$\xi = 1$
Technology	
Firm death rate	$\delta = 0.1$
Price stickiness	$\psi_P = 49$
Intermediate input share	$\varsigma = 1/3$
Differentiated goods trade cost	τ_D =0.44
Non-differentiated goods trade cost	τ_N =0
Mean sunk entry cost	$\overline{K} = 1$
Firm entry adjustment cost	$\lambda = 0.10$
Bond holding cost	ψ_B =1xe-6
Tariff means	$\overline{T_D} = \overline{T_N} = 1.02$

Table 2. Moments of variables and welfare:
Comparing Taylor Rule policy to Ramsey

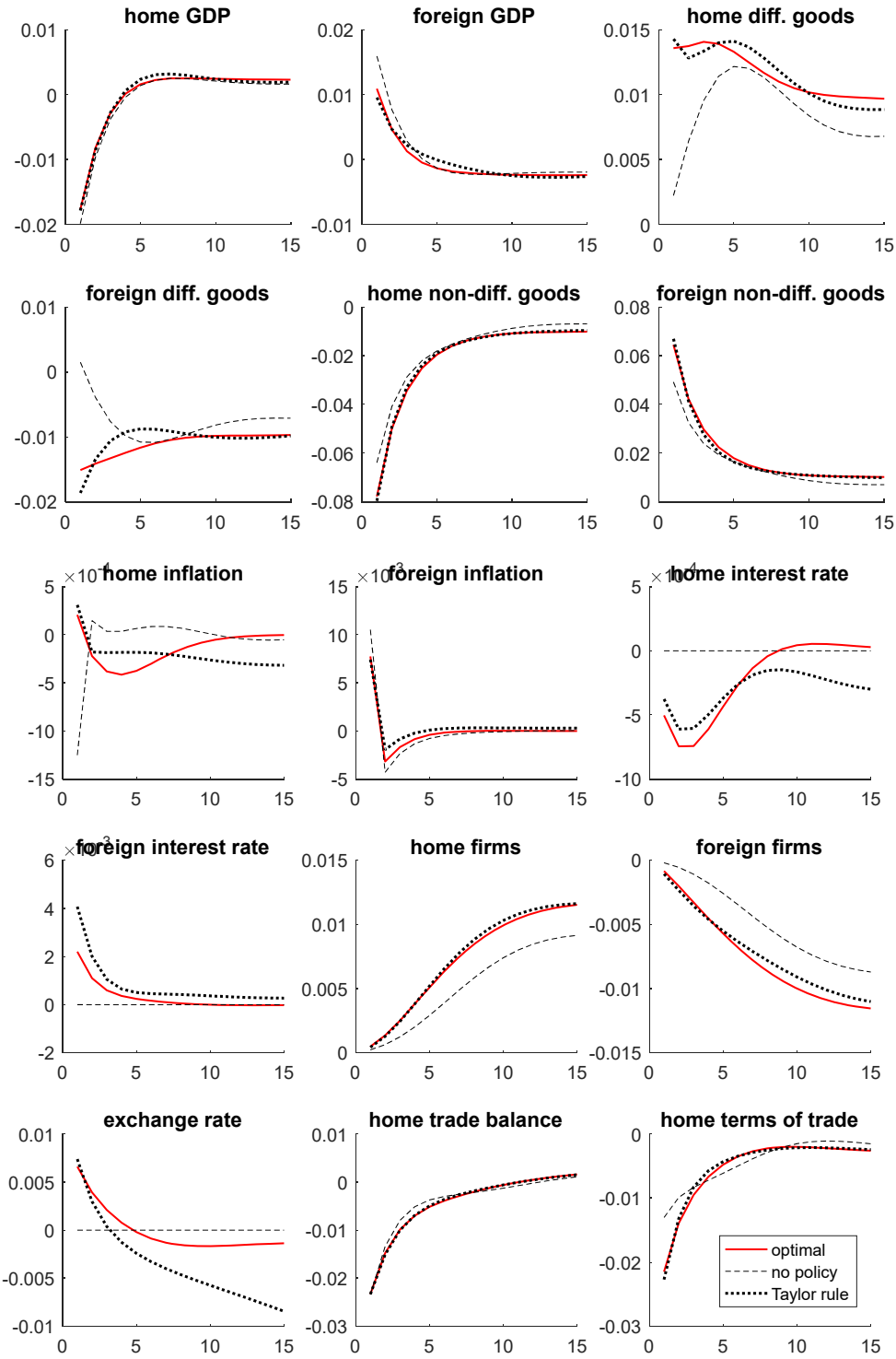
	tariff on differentiated goods					non-differentiated goods	
	independent shock				common shock	independent	common
	benchmark	substitutes	dominant currency		benchmark	benchmark	benchmark
			home	foreign			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
standard deviations in percent (difference from Ramsey case)							
GDP	0.01	-0.99	0.17	-0.16	0.65	-0.03	0.24
employment	-0.01	-0.71	0.00	-0.07	0.44	0.00	0.18
consumption	-0.34	-0.71	-0.23	-0.31	0.10	-0.02	-0.02
firm entry investment	-9.64	-2.37	-6.50	-8.78	4.23	-0.31	2.89
number of firms	-3.81	-2.40	-2.95	-3.23	0.50	-0.22	0.21
inflation	-0.15	1.05	-0.28	0.31	-0.34	-0.05	-0.09
real exch. rate	-0.99	-1.61	-0.82	-0.82	0.00	-0.03	0.00
unconditional means of variables (percent change from Ramsey case)							
GDP	0.082	0.865	0.049	-5.463	0.013	0.011	0.003
employment	0.052	0.532	-0.032	0.113	0.007	0.019	0.008
consumption	-0.037	-0.709	0.037	-0.100	0.000	-0.022	-0.010
firm entry investment	-0.479	-6.484	0.263	-0.999	-0.008	-0.162	-0.077
number of firms	-0.479	-6.484	0.263	-0.999	-0.008	-0.162	-0.077
Welfare (percent change from Ramsey case, conditional, in consumption units):							
	-0.105	-0.139	0.098	-0.265	-0.023	-0.052	-0.032

Figure 1. Impulse responses to a rise in foreign tariff on home differentiated exports



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Figure 2. Impulse responses to a rise in foreign tariff on home non-differentiated exports



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Table 3. Impulse responses to a rise in foreign tariff on home differentiated exports, foreign currency dominant

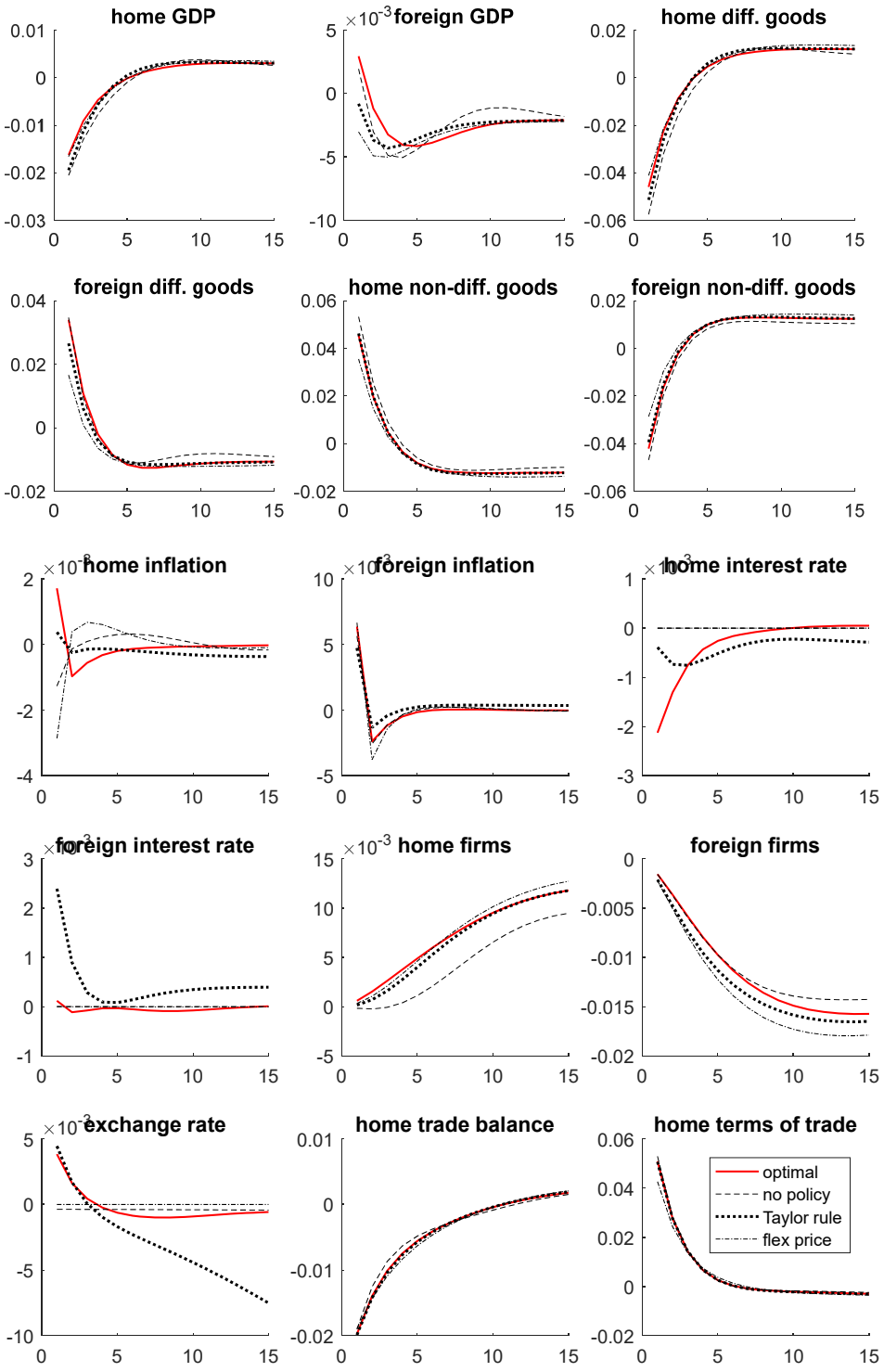
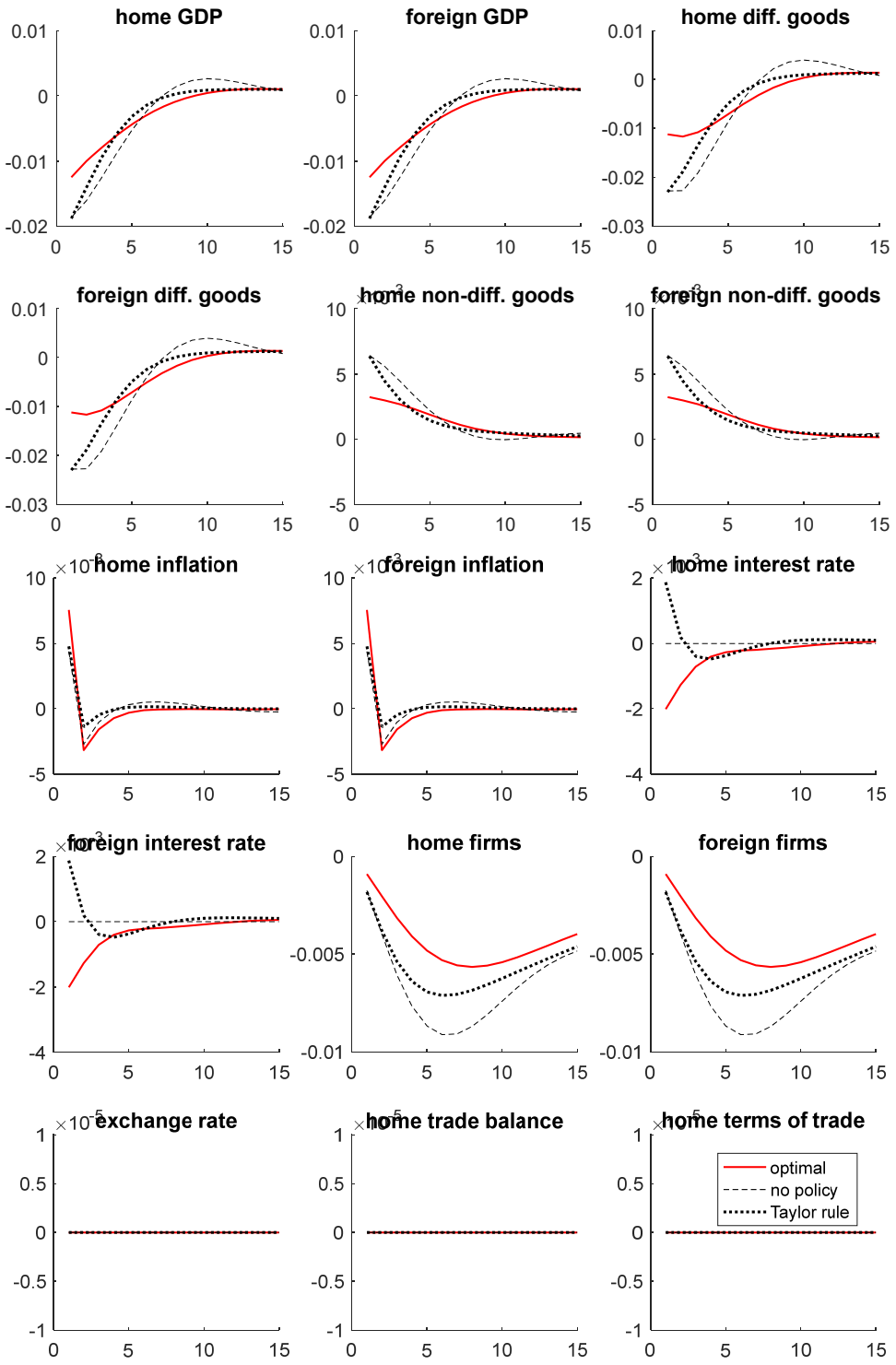


Figure 4. Impulse responses to a rise in tariff on differentiated goods in both countries



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Appendix

For
"What is the Optimal Monetary Policy Response to Trump Tariffs 2.0?"

by
Paul R. Bergin
and
Giancarlo Corsetti

1. Demand equations not listed in text

The composition of expenditure on adjustment costs, both for prices and bond holding, follows the same preferences as for consumption, and the associated demands mirror Eqs. (4)-(9). Adjustment costs for bond holding are as follows:

$$AC_{B,D,t} = \theta P_t AC_{B,t} / P_{D,t}$$

$$AC_{B,N,t} = (1-\theta) P_t AC_{B,t} / P_{N,t}$$

$$d_{AC,B,t}(h) = \left(p_t(h) / P_{D,t} \right)^{-\phi} AC_{B,D,t}$$

$$d_{AC,B,t}(f) = \left(p_t(f) T_{D,t} / P_{D,t} \right)^{-\phi} AC_{B,D,t}$$

$$AC_{B,H,t} = \nu \left(P_{H,t} / P_{N,t} \right)^{-\eta} AC_{B,N,t}$$

$$AC_{B,F,t} = (1-\nu) \left(P_{F,t} T_{N,t} / P_{N,t} \right)^{-\eta} AC_{B,N,t} .$$

The economy-wide demand for goods arising from price adjustment costs sums across the demand arising among *n* home firms: $AC_{P,t} = n_t AC_{P,t}(h)$. This is allocated as follows:

$$AC_{P,D,t} = \theta P_t AC_{P,t} / P_{D,t}$$

$$AC_{P,N,t} = (1-\theta) P_t AC_{P,t} / P_{N,t}$$

$$d_{AC,P,t}(h) = \left(p_t(h) / P_{D,t} \right)^{-\phi} AC_{P,D,t}$$

$$d_{AC,P,t}(f) = \left(p_t(f) T_{D,t} / P_{D,t} \right)^{-\phi} AC_{P,D,t}$$

$$AC_{P,H,t} = \nu \left(P_{H,t} / P_{N,t} \right)^{-\eta} AC_{P,N,t}$$

$$AC_{P,F,t} = (1-\nu) \left(P_{F,t} T_{N,t} / P_{N,t} \right)^{-\eta} AC_{P,N,t} .$$

The demand for differentiated goods for use as intermediates in production mirrors Eqs. (6)-(7), as follows:

$$d_{G,t}(h)=\left(p_t(h)/P_{D,t}\right)^{-\phi}G_t$$

$$d_{G,t}(f)=\left(p_t(f)T_{D,t}/P_{D,t}\right)^{-\phi}G_t.$$

The demand for differentiated goods for use in the sunk entry investment of new firms mirrors Eqs. (6)-(7), as follows:

$$d_{K,t}(h)=\left(p_t(h)/P_{D,t}\right)^{-\phi}ne_tK_t$$

$$d_{K,t}(f)=\left(p_t(f)T_{D,t}/P_{D,t}\right)^{-\phi}ne_tK_t.$$

2. Market clearing conditions not listed in the text

Market clearing for the non-differentiated goods market requires:

$$y_{H,t}=C_{H,t}+AC_{P,H,t}+AC_{B,H,t}+\left(1+\tau_N\right)\left(C^*_{H,t}+AC^*_{P,H,t}+AC^*_{B,H,t}\right)$$

$$y_{F,t}=\left(1+\tau^*_N\right)\left(C_{F,t}+AC_{P,F,t}+AC_{B,F,t}\right)+C^*_{F,t}+AC^*_{P,F,t}+AC^*_{B,F,t}.$$

The market clearing condition for the manufacturing goods market is given in Eq. (19) in the main text.

Labor market clearing requires:

$$\int_0^{n_t} l_t(h)dh+l_{H,t}=l_t.$$

Bond market clearing requires:

$$B_{Ht}+B^*_{Ht}=0$$

$$B_{Ft}+B^*_{Ft}=0.$$

Balance of payments requires:

$$\int_0^{n_t} p^*_t(h)\left(d^*_t(h)\right)dh-\int_0^{n^*_t} p_t(f)\left(d_t(f)\right)df+P^*_{Ht}\left(C^*_{H,t}+AC^*_{P,H,t}+AC^*_{B,H,t}\right)$$
$$-P_{F,t}\left(C_{F,t}+AC_{P,F,t}+AC_{B,F,t}\right)-i_{t-1}B^*_{H,t-1}+e_ti^*_{t-1}B_{F,t-1}=\left(B^*_{H,t}-B^*_{H,t-1}\right)+e_t\left(B_{F,t}-B_{F,t-1}\right).$$

3. Price-setting equations assuming stickiness in the local currency

Under the assumption that home firms set separate prices in the two markets, in units of domestic currency for sale in the domestic market, and in units of foreign currency for sale in the foreign market, the price setting equation (Eqn. 23) is replaced by the following:

$$p_t(h) = \frac{\phi}{\phi-1} mc_t + \frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)^2 p_t(h) - \psi_P \frac{1}{\phi-1}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)\frac{p_t(h)^2}{p_{t-1}(h)}$$
$$+ \frac{\beta\psi_P}{\phi-1} E_t\left[\frac{\mu_t}{\mu_{t+1}}\frac{\Omega_{H,t+1}}{\Omega_{H,t}}\left(\frac{p_{t+1}(h)}{p_t(h)} - 1\right)\frac{p_{t+1}(h)^{2-\phi}}{p_t(h)^{1-\phi}}\right]$$

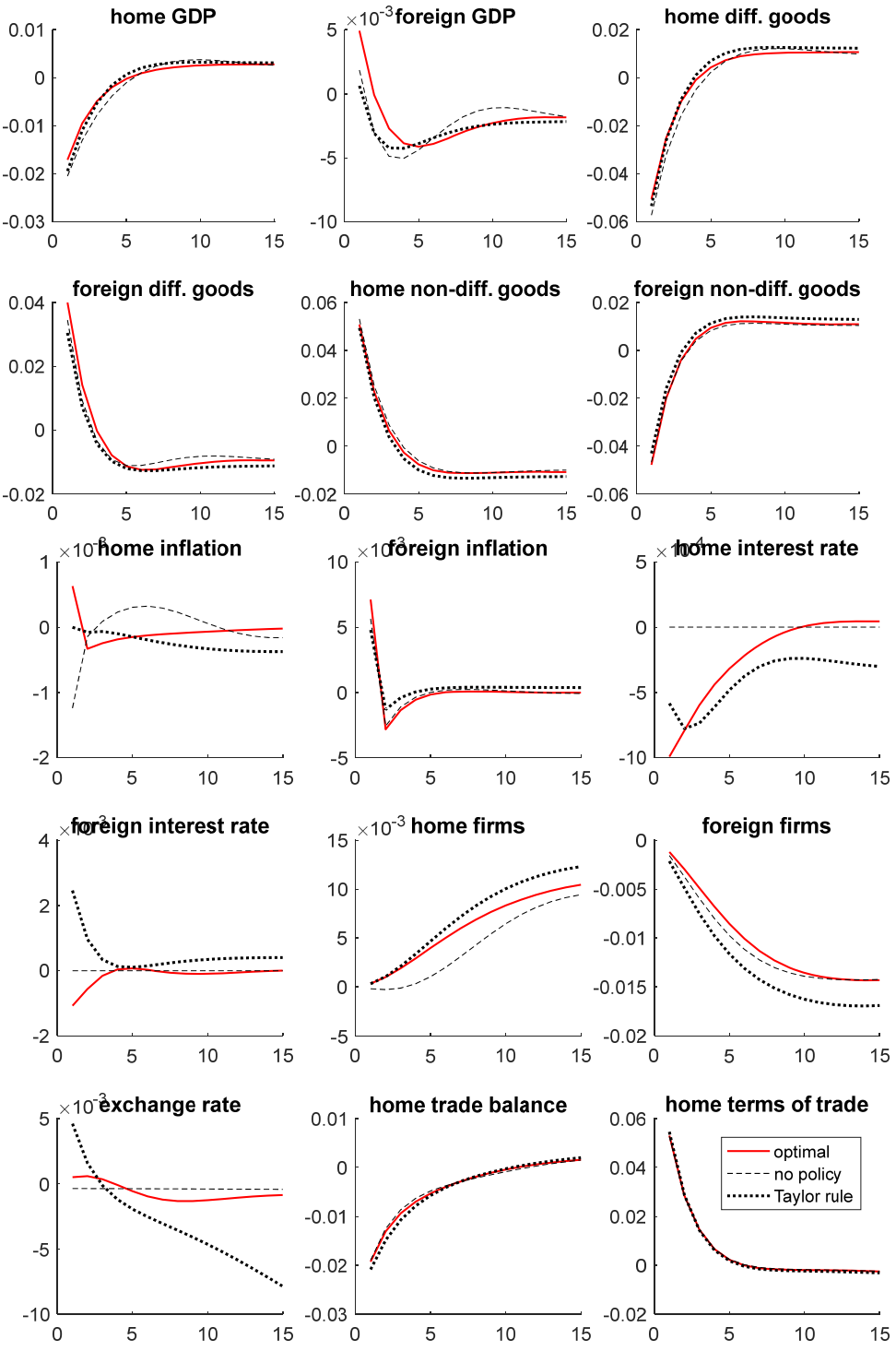
and

$$p_t^*(h) = \frac{\phi}{\phi-1}\frac{mc_t(1+\tau_{Dt})}{e_t} + \frac{\psi_P(1+\tau_{Dt})}{2}\left(\frac{p_t^*(h)}{p_{t-1}^*(h)} - 1\right)^2 p_t^*(h) - \frac{1}{\phi-1}\psi_P(1+\tau_t)\left(\frac{p_t^*(h)}{p_{t-1}^*(h)} - 1\right)\frac{p_t^*(h)^2}{p_{t-1}^*(h)}$$
$$+ \beta\frac{\psi_P}{\phi-1} E_t\left[\frac{\mu_t}{\mu_{t+1}}\frac{\Omega_{H,t+1}^*}{\Omega_{H,t}^*}\left((1+\tau_{Dt+1})\left(\frac{p_{t+1}^*(h)}{p_t^*(h)} - 1\right)\frac{e_{t+1}}{e_t}\frac{p_{t+1}^*(h)^{2-\phi}}{p_t^*(h)^{1-\phi}}\right)\right]$$

where $\Omega_{H,s} = \left(\frac{p_s(h)}{P_{D,s}}\right)^{-\phi}\left(C_{D,s} + G_s + ne_s(1-\theta_K)K_s + AC_{P,D,s} + AC_{B,D,s}\right)\frac{1}{\mu_s}$, and

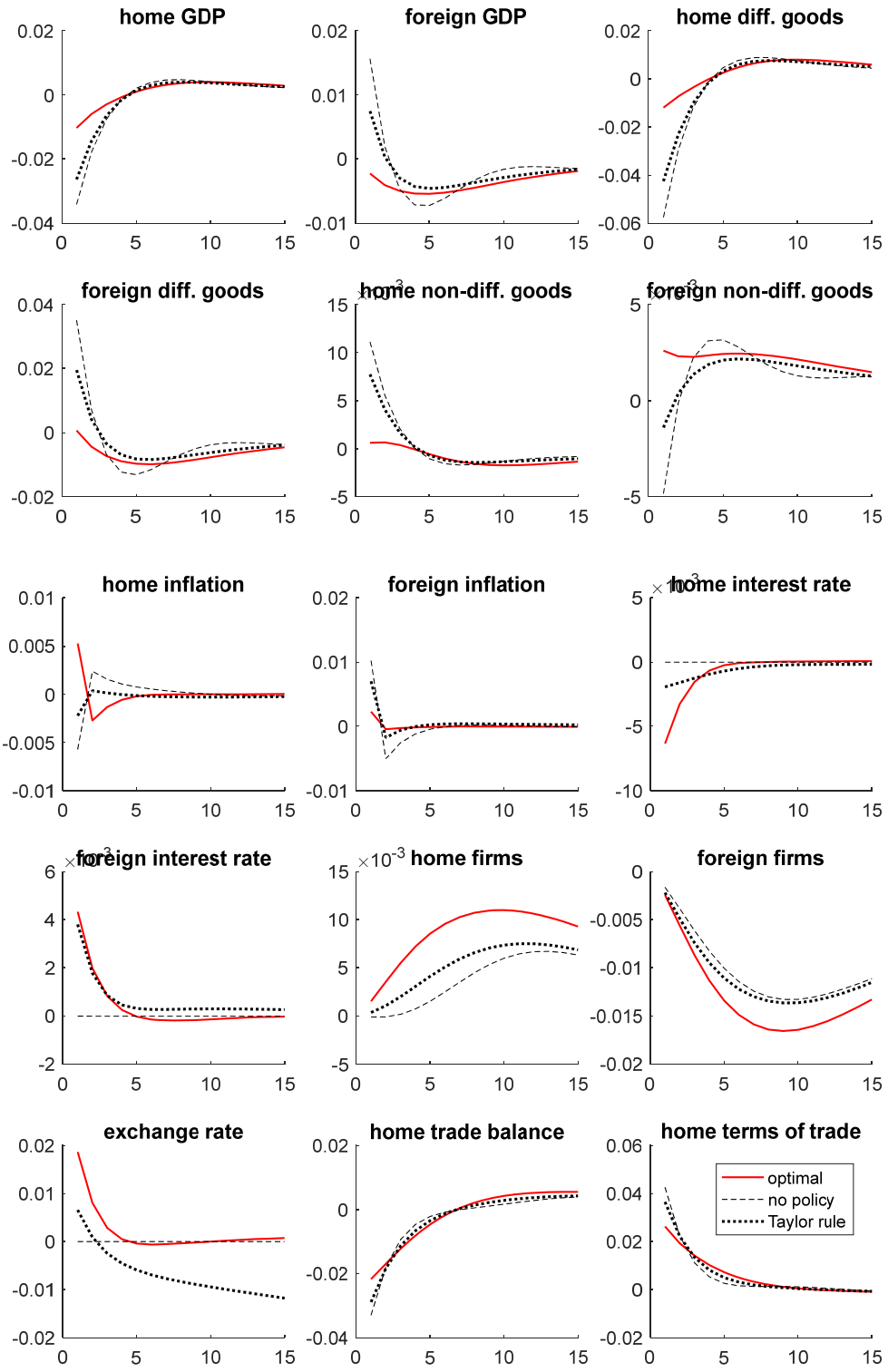
$$\Omega_{H,s}^* = \left(\frac{(1+\tau_D)p_s(h)}{e_s P^*_{D,s}}\right)^{-\phi}(1+\tau_D)\left(C^*_{D,s} + G_s^* + ne_s^*(1-\theta_K)K^*_s + AC^*_{P,D,s} + AC^*_{B,D,s}\right)\frac{1}{\mu_s}.$$

Appendix Figure 1. Impulse responses to a rise in foreign tariff on home differentiated exports, LCP in both countries

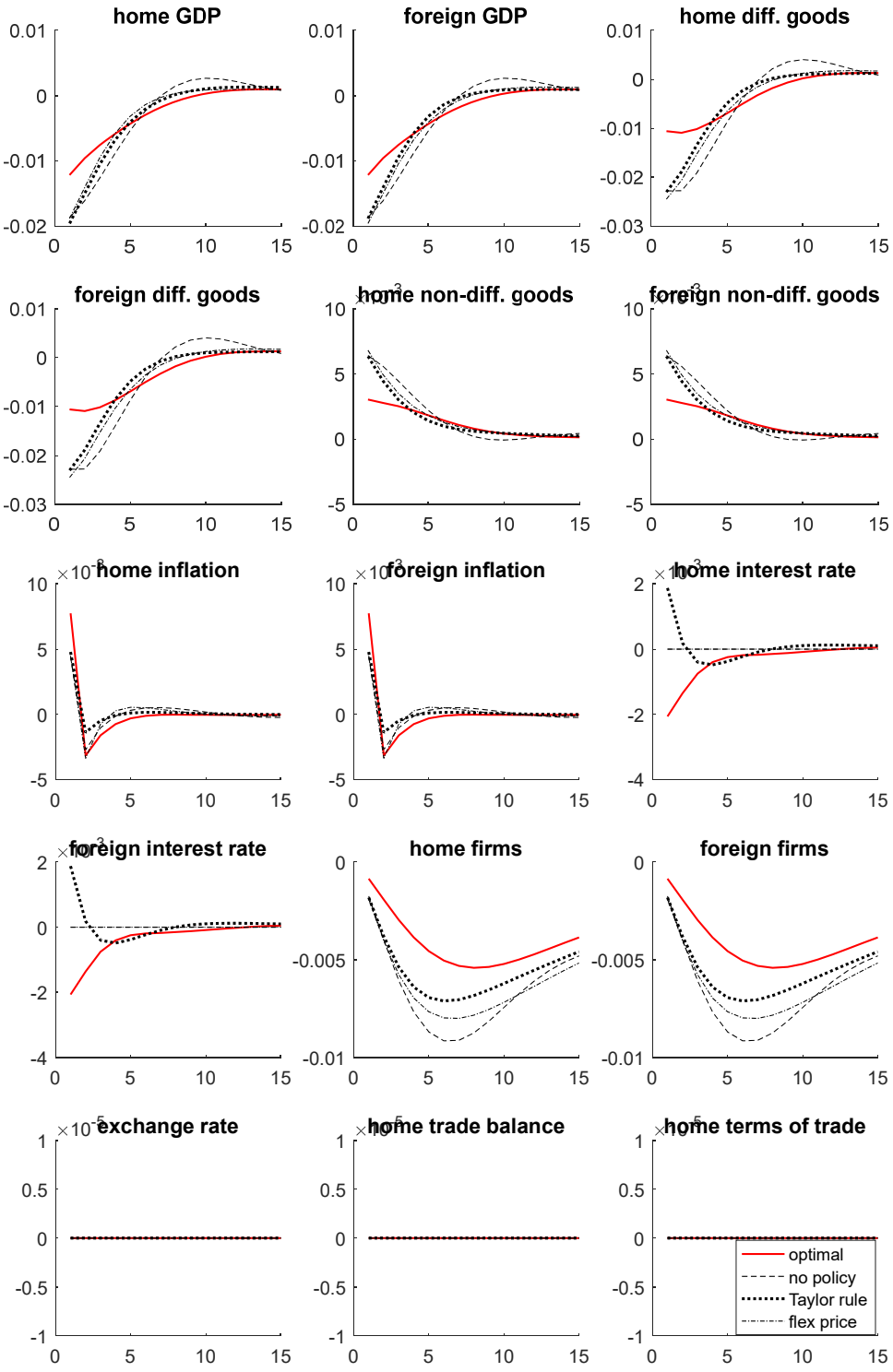


Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

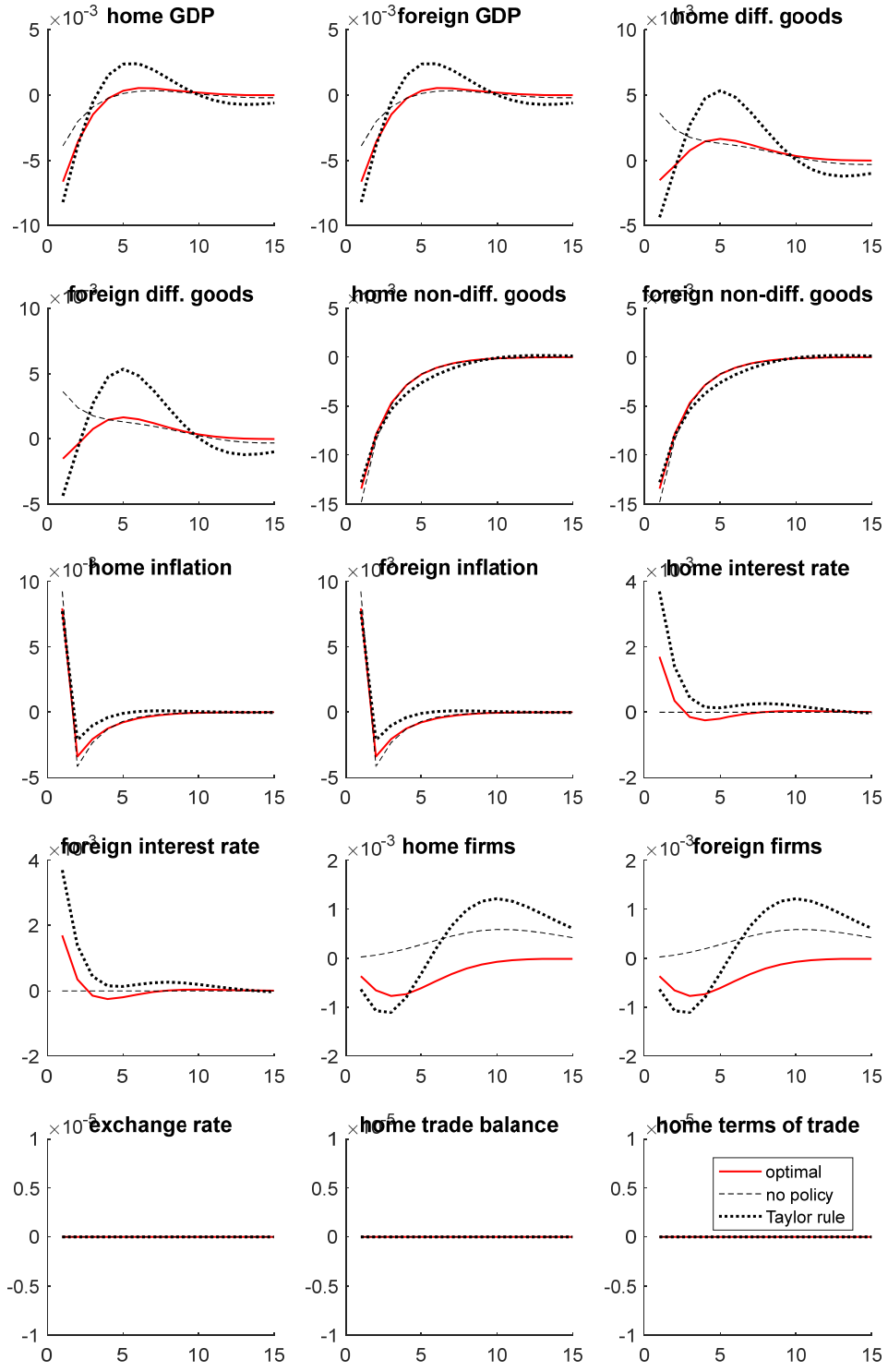
Appendix Figure 2. Impulse responses to a rise in foreign tariff on home differentiated exports, with a nontraded non-differentiated sector



Appendix Figure 3. Impulse responses to a rise in tariff on differentiated exports in both countries, Local Currency Pricing (LCP) for both countries



Appendix Figure 4. Impulse responses to a rise in tariff on non-differentiated exports in both countries



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).