BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

The macroeconomic effects of import tariffs on the euro area: a model-based assessment

by Anna Bartocci, Alessandro Cantelmo, Pietro Cova, Alessandro Notarpietro and Massimiliano Pisani

September 2025

Number 960

BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

The macroeconomic effects of import tariffs on the euro area: a model-based assessment

by Anna Bartocci, Alessandro Cantelmo, Pietro Cova, Alessandro Notarpietro and Massimiliano Pisani

Number 960 – September 2025

The series Occasional Papers *presents studies and documents on issues pertaining to the institutional tasks of the Bank of Italy and the Eurosystem. The* Occasional Papers *appear alongside the* Working Papers *series which are specifically aimed at providing original contributions to economic research.*

The Occasional Papers *include studies conducted within the Bank of Italy, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong.*

The series is available online at www.bancaditalia.it .

ISSN 1972-6643 (online)

Designed by the Printing and Publishing Division of the Bank of Italy

THE MACROECONOMIC EFFECTS OF IMPORT TARIFFS ON THE EURO AREA: A MODEL-BASED ASSESSMENT

by Anna Bartocci*, Alessandro Cantelmo*, Pietro Cova*,
Alessandro Notarpietro* and Massimiliano Pisani*

Abstract

We use a multi-country New Keynesian model of the global economy to assess the macroeconomic effects on the euro area (EA) of an increase in tariffs on U.S. (US) imports, either unilaterally or with retaliatory tariffs by the EA, China (CH) and the rest of the world (RW). Our results are as follows. First, EA output decreases to a larger extent (slightly more than 1% at the trough) under the retaliation scenario than under that of an increase in US tariffs with no retaliation (0.5%). The additional decrease is due to the drop in domestic aggregate demand, only partially offset by the increase in exports to CH. Second, an increase in global trade policy uncertainty reduces aggregate demand and, thus, has recessionary and disinflationary effects on the EA and global economies (EA GDP falls by 1%). We also consider a portfolio rebalancing towards financial assets issued by the EA, CH, the RW. This would induce a depreciation of the US dollar and (modest) expansionary and disinflationary effects on countries other than the US.

JEL Classification: C54, E52, F13, F41.

Keywords: tariffs, euro area, economic activity, inflation, DSGE models.

DOI: 10.32057/0.QEF.2025.960

---

* Bank of Italy, Economic Outlook and Monetary Policy Directorate. The views expressed in this paper are those of the authors alone and should not be attributed to the Bank of Italy or the Eurosystem. All errors are of the authors. Correspondence: anna.bartocci@bancaditalia.it, alessandro.cantelmo@bancaditalia.it, pietro.cova@bancaditalia.it, alessandro.notarpietro@bancaditalia.it, massimiliano.pisani@bancaditalia.it.

1 Introduction[1]

The increase in tariffs on imports by the United States (US henceforth) and the possible retaliation by trade partners have revived the debate on the international macroeconomic effects of tariffs. The issue is particularly important for the euro area (EA), which is a relatively open economy.

This paper evaluates the macroeconomic impact on the EA of tariff imposition by simulating a multi-country model of the global economy. The model is New Keynesian. It features short-run nominal price (and wage) rigidities and a non-trivial stabilization role for the central bank. In each country the central bank sets the monetary policy rate according to a Taylor rule in response to (after-tariff) headline inflation and output fluctuations. The model is calibrated to the EA as a whole (that is, the EA is not modeled as a monetary union), the US, China (CH), and a fourth residual region representing the rest of the world (RW).

We run the following scenarios. In the first one, the US imposes an *ad-valorem* tariff on CH, EA, and RW goods (other than energy) used for (domestic) consumption and investment purposes. The rise is temporary and lasts four years. In the second scenario there is retaliation, that is, CH, EA, and RW impose tariffs on imports of US goods. Specifically, in the first scenario it is assumed that the US imposes a 45pp tariff increase on imports of CH goods and a 9pp increase on both EA and RW products. The second scenario considers the full retaliation by CH, EA, and RW, that impose tariffs on US products (CH raises tariffs by 45pp, EA and RW by 9pp). Thus, we exclude any increase in tariffs on bilateral trade flows among EA, CH, and RW.

In addition to the direct effect of tariffs, consistent with the observed increase in trade policy uncertainty stemming from the announcements of higher tariffs by the US administration, we also evaluate the impact of higher trade uncertainty by simulating an exogenous decline of private investment. The fall is computed by assuming a shock to the trade policy uncertainty, as measured by the Trade Policy Uncertainty index (TPU) and on the basis of the response of investment to TPU shocks estimated in Caldara et al. (2020). Moreover, consistent with the un-

[1]We thank Fabio Busetti, Michele Caivano, Dario Caldara, Giuseppe Ferrero, Alessandro Secchi, Stefano Neri, and participants at the ECB Working Group on Econometric Modelling for useful discussions.

certainty on the US policy outlook that has followed the tariff announcements, we also simulate that the US dollar depreciates in nominal terms vis-à-vis other currencies because international investors rebalance their portfolios towards financial assets issued by EA, CH, and RW. Finally, the scenario of retaliation is newly run to conduct a robustness analysis on key parameters, such as the intratemporal elasticity of substitution among tradable goods and the nominal exchange rate pass-through (ERPT) into the prices of US exports.

The main results are the following. First, EA output decreases to a larger extent under retaliation (slightly more than 1% at the trough) than under unilateral increase in US tariffs (0.5%). The additional decrease is due to the drop in domestic aggregate demand, only partially offset by the increase in exports toward CH. Second, the increase in TPU reduces global demand and has recessionary and disinflationary effects on the EA and global economies (EA GDP falls by 1%). Third, a portfolio rebalancing by international investors towards financial assets issued by EA, CH, RW would induce a depreciation of the US dollar and have (modest) expansionary and disinflationary effects on these countries. Finally, results on retaliation are robust to changes in values of intratemporal elasticity of substitution between tradables and of the ERPT.

The paper is related to the literature on the macroeconomic effects of protectionism and tariffs. Conteduca et al. (2025) use a multi-country, multi-sector model to analyze the welfare effects of US tariff increases, and obtain macroeconomic impacts from unilateral US tariff increases, particularly for the euro area, that are broadly in line with ours. Auclert et al. (2025) use an open-economy New Keynesian model to show that temporary tariffs cause a recession whenever the import elasticity is below an openness-weighted average of the export elasticity and the intertemporal substitution elasticity - a condition arguably satisfied in practice. Moreover, unilateral tariffs tend to improve the trade balance, but when other countries retaliate the trade balance worsens and the recession deepens. McKibbin and Noland (2025) use a multi-country, multi-sector computable-general-equilibrium model to simulate the effects of US tariffs. The imposition of a 25 percent tariff on all goods from Mexico and Canada would slow growth and accelerate inflation in all three countries. Bianchi and Coulibaly (2025), within an open-economy New Keynesian model, show that the optimal monetary policy response in a country that imposes tariffs is expansionary, with inflation rising above and beyond the direct effects of tariffs. This result holds regardless of whether tariffs apply to consumption goods or intermediate inputs, whether the shock is temporary or permanent, and whether tariffs address other distortions. Bergin and Corsetti (2023) use a New Keynesian model enriched with global value chains and firm dynamics to show that the optimal monetary responses, coordinated across countries, to tariffs are expansionary. The responses support activity and producer prices at the expense of aggravating short-run headline inflation, contrary to the prescription of the standard Taylor rule. This holds all the more when the home currency is dominant in pricing of international trade. Jacquinot et al. (2022) simulate a New Keynesian multi-country model of the world economy to assess the macroeconomic effects of US tariffs imposed on one country in the EA and the RW. The model is augmented with an endogenous effective lower bound (ELB) on the monetary policy rate of the EA and country-specific labor markets with search-and-matching frictions. According to the reported results, tariffs produce recessionary effects in each country. If the ELB binds, then the tariff has recessionary effects on the whole EA, even if it is imposed on only one EA country and the RW. Cova et al. (2020) evaluate the macroeconomic impact on the EA of the imposition of tariffs by simulating a multi-country New Keynesian model featuring the ELB on the EA monetary policy rate. The bilateral tariff dispute between the US and CH has positive spillovers on the EA economy, because of favorable trade-rerouting effects. Simultaneous tariff increases between the US and CH and between the US and EA have negative effects on EA GDP and (before-tariff) inflation. The effects are magnified if the ELB binds in the EA. Bolt et al. (2019) analyze the effects of the US-CH trade dispute and show that, while both countries would lose from a tariff war, the EA may benefit from trade rerouting in the short run, if it does not get involved in the conflict. Lindé and Pescatori (2019) quantify the macroeconomic costs of trade tariffs and find that they can be substantial, with permanently lower income and trade volumes. However, a fully symmetric retaliation to a unilaterally imposed border adjustment tax can prevent any sizable adverse real or nominal effects. Faruqee et al. (2008) analyze the effects of tariffs in a model of the global economy. According to their estimates, a generalized 10% hike against Emerging Asia improves the US current account balance as a share of GDP by a mere 0.1 percentage point. The effect disappears after about two years, and in the absence of further adjustment in net saving, it may even revert sign. Similar effects hold in the RW. Moro and Nispi Landi (2024) set up a multi-country New Keynesian model to study the effects of a geoeconomic fragmentation shock, modeled as an increase in the tax rates on goods, commodities, and bonds purchased from rival countries. Fragmentation predominantly affects the China-aligned bloc and the US allies, with these countries experiencing larger declines in production and consumption. In contrast, the US is relatively shielded from the shock because of their limited exposure to the rival bloc. Pisani and Vergara Caffarelli (2018) evaluate the macroeconomics effects of tariffs implied by the Brexit on the United Kingdom (UK) and the EA. The imposition of tariffs reduces UK exports and economic activity by a non-negligible amount. The macroeconomic costs for the UK are reduced if it decides unilaterally not to increase tariffs on imports from the EA and to reduce those on imports from the RW. Different from all these contributions, we assess the impact of US tariffs and retaliation (to US tariff) on EA (and global) macroeconomic conditions, in particular with reference to the response of the central bank. Moreover, we also take into account possible indirect macroeconomic effects of the increase in tariffs, associated with the rise in TPU.

The paper is organized as following. The next section briefly describes the model. Section 3 illustrates the simulated scenarios. Section 4 presents and discusses the results. Section 5 concludes.

2 Main model features

We initially provide an overview of the model. Thereafter, we describe tariffs and their impact on aggregate demand, inflation, and monetary policy. Finally, we report the calibration of model.

2.1 Model setup

We develop a four-country model of the world economy, calibrated to EA, US, CH, and RW. We assume that internationally traded goods can be subject to the imposition of import tariffs.

In each bloc there are Ricardian and Hand-To-Mouth (HTM) households. The first type of household maximizes a standard intertemporal problem subject to her budget constraint. The second type consumes her available wage income in every period. Her labor supply is the same as the one chosen by the Ricardian one.

Consumption and investment are final nontradable goods produced by local firms under perfect competition. The consumption good is a basket of several nested bundles. There is a distinction between energy and non-energy goods. Non-energy goods are intermediate nontradable and tradable goods. The intermediate tradable good is in turn a basket of domestic and imported goods. The investment basket includes non-fuel intermediate goods only.

Following Corsetti et al. (2008), in each country there is a local distribution sector intensive in local nontradables. Firms in the distribution sector act under perfect competition. They produce distribution services using intermediate nontradables according to a Leontief technology. The distribution sector introduces a wedge between the wholesale and the retail price. It implies that the ERPT to retail prices is lower than the ERPT at the border (wholesale price), consistent with empirical evidence.

Intermediate nontradable goods are produced by firms under monopolistic competition according to a constant-elasticity-of-substitution (CES) technology in labor, capital, and fuel. A similar production function holds for the production of intermediate tradable goods. Firms in the intermediate tradable and nontradable sectors are price-setters. The market power implies that each firm optimally sets the nominal price of the produced good in the currency of the destination market charging a mark-up over marginal costs, taking into account local demand conditions, nominal price rigidities, the distribution sector, and tariffs.

The fuel bundle is a homogeneous good produced by domestic firms under perfect competition using crude oil as the only input of a linear production function. Firms buy crude oil in the world market, transform it at no cost into fuel and then sell it domestically to households and firms producing non-fuel intermediate goods. The price of crude oil is set in US dollars in the world market. Thus, it is the same in every bloc once corrected for nominal exchange rate fluctuations (the law of one price holds for the crude oil price, that is, there is no international price discrimination). The global oil supply is assumed to be exogenous and constant at its baseline level. It is assumed to be owned by RW and US, consistent with empirical evidence.

As for financial markets, there is a riskless one-period bond denominated in local currency that is traded within each bloc other than the US. Moreover, a riskless bond denominated in US dollars is traded internationally. As such, an uncovered interest parity holds for each region other than the US, which links the differential between domestic and US monetary policy rates to the expected nominal exchange rate depreciation of the domestic currency vis-à-vis the US dollar.

As for monetary policy, the central bank in each bloc sets the monetary policy rate according to a standard Taylor-type rule, by reacting to changes in after-tariff headline inflation and real activity. To capture inertia in the conduct of monetary policy, it is assumed that in each period the monetary policy rate also reacts to its value in the previous period in a gradual way.

In each region tariffs enter the budget constraint of the public sector jointly with other taxes and public expenditures. A (standard) fiscal rules stabilizes public debt in the medium term by systematically dictating changes in lump-sum taxes paid by Ricardian households.

Finally, the model includes nominal and real frictions useful to reproduce the gradual adjustment observed in the data in response to typical business cycle shocks. Specifically, habit in consumption, sticky nominal prices and wages, nominal price and wage indexation, adjustment costs on investment in physical capital.[2]

2.2 Firms

In what follows, we report the relevant equations for the transmission of the tariff shock in the EA. Similar equations hold for other blocs. We initially describe the sectors producing final and intermediate goods and their interaction with the tariffs. Subsequently, we illustrate the monetary policy rule.

2.2.1 Final goods

Firms in the final goods sector produce three different types of goods under perfect competition. One type is used for private consumption, the other for investment, and the further one for public sector consumption.

The generic firm x produces the private consumption bundle according to a CES function of

[2]Nominal wage- and price-settings are subject to quadratic adjustment costs similar to Rotemberg (1982). In particular, there is double (weighted) indexation to previous-period inflation rate and to the central bank inflation target.

non-fuel $C_{V,t}$ and fuel $FU_{C,t}$ bundles:

$$C_t(x) = \left[(1 - a_{FU,C})^{\frac{1}{\rho}} C_{V,t}(x)^{\frac{\rho-1}{\rho}} + a_{FU,C}^{\frac{1}{\rho}} FU_{C,t}(x)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, \tag{1}$$

where $a_{FU,C}$ $(0 < a_{FU,C} < 1)$ is the share of fuel in the bundle and $\rho > 0$ measures the elasticity of substitution between non-fuel and fuel consumption.

The private non-fuel consumption bundle, $C_{V,t}$, is produced according to a CES function of intermediate tradable and nontradable goods, $C_{T,t}$ and $C_{N,t}$, respectively:

$$C_{V,t}(x) = \left[a_{T,C}^{\frac{1}{\eta}} C_{T,t}(x)^{\frac{\eta-1}{\eta}} + (1 - a_{T,C})^{\frac{1}{\eta}} C_{N,t}(x)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{2}$$

where the parameter $a_{T,C}$ $(0 < a_{T,C} < 1)$ is the weight of tradable goods in the consumption bundle and $\eta > 0$ is the elasticity of substitution between tradable and nontradable goods.

The basket of tradable goods $C_{T,t}$ is

$$\begin{aligned} C_{T,t}(x) = [& a_{EA,C}^{\frac{1}{\eta_T}} C_{EA,t}(x)^{\frac{\eta_T-1}{\eta_T}} + a_{US,C}^{\frac{1}{\eta_T}} C_{US,t}(x)^{\frac{\eta_T-1}{\eta_T}} + a_{CH,C}^{\frac{1}{\eta_T}} C_{CH,t}(x)^{\frac{\eta_T-1}{\eta_T}} \\ & + (1 - a_{EA,C} - a_{US,C} - a_{CH,C})^{\frac{1}{\eta_T}} C_{RW,t}(x)^{\frac{\eta_T-1}{\eta_T}}]^{\frac{\eta_T}{\eta_T-1}}, \end{aligned} \tag{3}$$

where the parameters $a_{EA,C}, a_{US,C}, a_{CH,C}$ $(0 < a_{EA,C}, a_{US,C}, a_{CH,C} < 1,\ a_{EA,C} + a_{US,C} + a_{CH,C} < 1\ )$ are respectively the weights of EA, US, and CH goods in the bundle, $C_{EA,t}$, $C_{US,t}$, and $C_{CH,t}$, respectively. The variable $C_{RW,t}$ represents the bundle of RW goods. The parameter $\eta_T > 0$ is the elasticity of substitution among tradable goods.

The consumption good C_{EA} is a composite basket of a continuum of differentiated intermediate goods, each supplied by a different EA firm h. It is produced according to the following function:

$$C_{EA,t}(x) = \left[\int_0^{n^{EA}} C_{EA,t}(x,h)^{\frac{\theta_T-1}{\theta_T}} dh \right]^{\frac{\theta_T}{\theta_T-1}}, \tag{4}$$

where $\theta_T > 1$ is the elasticity of substitution among EA brands. The parameter n^{EA} is the size of the EA economy $(0 < n^{EA} < 1$, the size of the world is normalized to 1).[3] Similar bundles

[3]We assume that the size of each country is equal to the number of households and to the number of firms within each sector.

hold for other tradable and nontradable goods.

The investment bundle is similar to the consumption bundle, Eq. 1, except for the absence of fuel. In turn, the production of the investment good is isomorphic to that to consumption, Eq. 2. For the public consumption basket, we assume it is fully biased towards (domestic) intermediate nontradable goods.

Consumption deflators. The implied overall consumption (headline) deflator is

$$P_{C,t} = \left[\left(1 - a_{FU,C}\right) P_{V,t}^{1-\rho} + a_{FU,C} P_{FU,t}^{1-\rho} \right]^{\frac{1}{1-\rho}}, \tag{5}$$

where $P_{FU,t}$ is the fuel price deflator and $P_{V,t}$ the deflator of the non-fuel component, equal to

$$P_{V,t} = \left[a_{T,C} P_{TC,t}^{1-\eta} + \left(1 - a_{T,C}\right) P_{N,t}^{1-\eta} \right]^{\frac{1}{1-\eta}}, \tag{6}$$

where $P_{TC,t}$ and $P_{N,t}$ are the prices of the bundles of intermediate tradable and nontradable goods and services, respectively.

The deflator of the non-fuel tradable consumption basket, $P_{TC,t}$, is

$$P_{TC,t} = \left[a_{EA,C} P_{EA,t}^{1-\eta_T} + a_{US,C} P_{US,t}^{1-\eta_T} + a_{CH,C} P_{CH,t}^{1-\eta_T} + \left(1 - a_{EA,C} - a_{US,C} - a_{CH,C}\right) P_{RW,t}^{1-\eta_T} \right]^{\frac{1}{1-\eta_T}}, \tag{7}$$

where $P_{EA,t}$, $P_{US,t}$, $P_{CH,t}$, and $P_{RW,t}$ are the consumer prices of EA, US, CH, and RW tradable goods, respectively.

The (EA) consumer price of the generic US good is

$$P_{US,t} = \bar{P}_{US,t} \left(1 + \tau_{EA,US,t}\right) + \eta^{distr} P_{N,t}, \tag{8}$$

where $\tau_{EA,US,t} > 0$ is the *ad-valorem* tariff the EA applies on the generic imported US good and $\bar{P}_{US,t}$ is the border (before-tariff) nominal price of the imported good, set and sticky in euros. The term $\eta^{distr} > 0$ is a parameter and is due to the assumption of distribution services intensive in local intermediate nontradable goods and services. Distribution services introduce a wedge between the border (i.e., wholesale) price and the consumer (i.e., retail) price of the tradable good. Similar equations hold in other regions and for other (domestic and imported) tradable goods. Thus, higher tariffs at the border would, *ceteris paribus*, increase imported inflation and, thus, overall (i.e., headline) consumer price inflation. In equilibrium the magnitude of the increase would depend upon many factors, in particular the price-setting decisions of firms operating in the intermediate tradable goods and the monetary policy response. Similar equations (including those on tariffs) hold for the investment deflator, but for the fuel component (which is absent in the investment bundle).

2.2.2 Intermediate goods

The production function for the generic EA intermediate tradable good h is:[4]

$$Y_{H,t}(h) = \left[(1 - a_{FU_H})^{\frac{1}{\xi_Y}} V_{H,t}(h)^{\frac{\xi_Y - 1}{\xi_Y}} + a_{FU_H}^{\frac{1}{\xi_Y}} (FU_{H,t}(h))^{\frac{\xi_Y - 1}{\xi_Y}} \right]^{\frac{\xi_Y}{\xi_Y - 1}}, \tag{9}$$

where the variable $FU_{H,t}(h)$ represents fuel, bought from the domestic fuel sector, the variable $V_{H,t}(h)$ is value added input, the parameter a_{FU_H} $(0 < a_{FU_H} < 1)$ is the weight of fuel in the production, and the parameter $\xi_Y > 0$ measures the elasticity of substitution between value added and fuel.

The value added input of the generic EA intermediate tradable good h is:

$$V_{H,t}(h) = \left[(1 - a_{L_H})^{\frac{1}{\xi}} K_{H,t}(h)^{\frac{\xi - 1}{\xi}} + a_{L_H}^{\frac{1}{\xi}} L_{H,t}(h)^{\frac{\xi - 1}{\xi}} \right]^{\frac{\xi}{\xi - 1}}, \tag{10}$$

where the variable $K_{H,t}(h)$ is the end-of-period t physical capital, that firms rent from domestic (Ricardian) households in a competitive market, and $L_{H,t}(h)$ is labor, supplied by domestic households. The parameter $\xi > 0$ measures the elasticity of substitution between capital and labor. The parameter a_{HL} $(0 < a_{L_H} < 1)$ is the weight of labor in the production.

The variable $L_H(h)$ is a composite of a continuum of differentiated labor inputs, each supplied by a different domestic household j under monopolistic competition. In the case of the EA, the

[4] A similar equation holds for the generic firm in the intermediate nontradable sector.

bundle is

$$L_{H,t}(h) = \left[\int_0^{n^{EA}} L_{H,t}(h,j)^{\frac{\theta_L - 1}{\theta_L}} dj \right]^{\frac{\theta_L}{\theta_L - 1}}, \tag{11}$$

where $\theta_L > 1$ is the elasticity of substitution among labor varieties. The assumption of monopolistic supply allows us to have nominal wage rigidity in the model.

The generic firm in the intermediate tradable sector minimizes its production costs by optimally choosing the amount of inputs given the above technology constraints and the corresponding prices (the gross nominal rental rate of capital R_t^K, the nominal wage rate W_t, the price of fuel $P_{FU,t}$).

Moreover, the firm sets prices in each (domestic and foreign) destination market in local currency, taking into account local demand conditions and the presence of a local distribution sector. We introduce nominal price rigidities by assuming that the firm pays market-specific quadratic costs for adjusting before-tariff nominal prices.[5]

Thus, when setting the before-tariff optimal price, the firm takes into account that tariffs could affect relative prices and, thus, demand for the produced good. Specifically, and consistent with the definitions of the bundles and deflators reported above, the following consumption demand equation for the generic US brand i holds in the EA:

$$C_{US,t}(i) = a_{US,C} a_{TC} (1 - a_{FU_C}) \left(\frac{P_{US,t}(i)}{P_{US,t}} \right)^{-\theta_T} \left(\frac{P_{US,t}}{P_{TC,t}} \right)^{-\eta_T} \left(\frac{P_{TC,t}}{P_{V,t}} \right)^{-\eta} \left(\frac{P_{V,t}}{P_{C,t}} \right)^{-\rho} C_t, \tag{12}$$

where prices are inclusive of tariff and distribution services (a similar equation holds for the investment demand). *Ceteris paribus*, an increase in the tariff on the US good would raise its price inclusive of tariff, according to Eq. 8, inducing consumers to substitute other goods for the US ones, to an extent pinned down by the elasticities of substitution, in particular the elasticity η_T.

2.3 The central bank

In each bloc the central bank controls the monetary policy rate according to a standard Taylor rule, which implies that the policy rate reacts to the (after-tariff) consumer price (headline)

[5]See Rotemberg (1982).

inflation. Moreover, the central bank reacts to real output growth.

In the case of the EA central bank, the gross monetary policy rate R is set according to the rule:

$$\left(\frac{R_t}{\overline{R}}\right) = \left(\frac{R_{t-1}}{\overline{R}}\right)^{\phi_R} \left(\frac{\Pi_{C,t}}{\overline{\Pi}_C}\right)^{(1-\phi_R)\phi_\Pi} \left(\frac{RGDP_t}{RGDP_{t-1}}\right)^{(1-\phi_R)\phi_{gY}}, \tag{13}$$

where $\overline{R}$ is the steady-state gross monetary policy rate, $\Pi_{C,t} \equiv P_{C,t}/P_{C,t-1}$ is the (after-tariff) gross inflation rate, $\overline{\Pi}_C$ is the long-run steady-state inflation target, and $RGDP_t$ the EA gross domestic product in real terms (i.e., evaluated at constant, before-tariff, prices), the terms ϕ_R, ϕ_Π, and ϕ_{gY} are parameters ($0 < \phi_R < 1$, $\phi_\Pi > 1$). Thus, it is assumed that the central bank raises the monetary policy rate if the increase in tariff induces, in equilibrium, an increase in the after-tariff inflation rate.

2.4 Calibration

The model is calibrated at quarterly frequency. Table 1 shows the great ratios for the four regions. Table 2 reports the trade matrix. The parameters are calibrated to match these quantities and in line with the existing literature.[6] Tables 3 to 6 report the implied (quarterly) calibration. Table 3 shows the preference and technology parameters. Preferences are the same across households of different regions. The intertemporal elasticity of substitution is set equal to 1.0, the habit parameter to 0.7, and the inverse of the Frisch elasticity to 1.5. The elasticity of substitution among tradable goods other than oil is 1.5. For the investment basket, the elasticity of substitution between domestic and imported goods is the same as that of the consumption basket. The elasticity of substitution between tradables and nontradables is set to 0.8. The parameter η^{distr} of the distribution sector in Eq. 8 is set to 1.2.

In the production function the elasticity of substitution between fuel and value added is set to 0.8, while that between capital and labor is set to 1. As such, oil and other inputs are hardly substitutable. The weight of fuel in the production function of intermediate goods is set to 0.02 for both tradables and nontradables. For the consumption basket, the elasticity of substitution between fuel and other goods is equal to 0.4. We further assume a depreciation rate of physical capital of 0.025, consistently with an annual depreciation rate of 10%. The weight of domestic

[6]See Gomes et al. (2010), Pesenti (2008), and Warne et al. (2008).

tradable goods in the consumption and investment tradable baskets is different across countries, to match multilateral import-to-GDP ratios. We then set the weights of bilateral imports other than oil to match the trade matrix, reported in Table 2.

Table 4 reports real and nominal rigidities. For real rigidities, parameters regulating the adjustment costs on investment changes are set to 4.5 in all countries. For nominal rigidities, we set the adjustment costs for wages to 300; for prices of domestic and imported tradable goods, to 120; for prices of nontradable goods, to 400. The price and wage indexation parameters are set to 0.75. Table 5 shows price and wage markup values. We identify the intermediate nontradable and tradable sectors in the model with the (nontradable) services and manufacturing sectors in the data, respectively. In each region the markups in the nontradable sector and in the labor market are assumed to be higher than that in the tradable sector.

Table 6 reports the parameters of the monetary policy rules (see Eq. 13). The monetary policy rate reacts to the its lagged value (the corresponding parameter is set to 0.85), inflation (1.6) and output growth (0.1).

The chosen calibration allows us to get a response of EA GDP and inflation to a domestic monetary policy shock in line with other models of the EA.[7] Given that the initial level of tariffs does not affect our results, for simplicity we set steady- state tariffs to zero in each region.

3 Scenarios

We simulate the following scenarios, on the basis of the information on tariff increases available on mid-February 2025. In the first scenario it is assumed that the US imposes 45pp tariff increase on imports of CH goods and by 9pp on both EA and RW products. The second scenario considers the full retaliation by CH, EA, and RW, that impose tariffs on US products (CH raises tariffs by 45pp, EA and RW by 9pp). Thus, we exclude any increase in tariffs on bilateral trade flows among EA, CH, and RW.

The model does not distinguish between goods and services. Given that tariffs are likely to be imposed on goods only, we rescale the size of the tariff imposed by country x on (total)

[7]See Gomes et al. (2010) and Warne et al. (2008).

imports from a country y by the share of imported goods (from country y) over total imports (from country y). The implied tariff shocks are as follows: US imposes rises in the tariff on imports from EA, CH, and RW equal to 15.3pp, 42.3pp, 6.8pp, respectively. EA, CH, and RW impose tariffs on imports from US equal to 8.7pp, 30.6pp, 5.5pp, respectively.

In the simulations the increases in the tariff rates are sudden and transitory. They last for 4 years (16 quarters) and, from quarter 17, permanently return to the steady-state level. Tariff revenues are rebated in a lump-sum way to domestic households.

We also run a scenario in which we impose an exogenous decline of private investment, motivated by the increase in trade policy uncertainty stemming from the announcements of higher tariffs by the US administration. The fall in investment is computed by assuming a shock to the trade policy uncertainty, as measured by the Trade policy uncertainty index (TPU) and on the basis of the response of investment to TPU shocks estimated in Caldara et al. (2020). We calibrate the shock based on the observed spike in the TPU index by Caldara et al. (2020) in the last quarter of 2024 when trade tensions heightened (the TPU in 2024Q4 increased by almost 130 percentage points relative to 2024Q3). Specifically, we feed the model with eight-quarter negative investment-specific shocks that simultaneously affect all countries, starting from the initial period of the simulation, and that determine a 5% drop in private investments at the trough in every region.[8]

Moreover, consistent with the uncertainty on the US policy outlook and the multilateral depreciation of the US dollar observed after the multiple US tariff announcements, we feed the model with negative risk-premium shocks on US dollar-denominated bonds issued by EA, CH, and RW over the first 20 quarters. The reduction in risk premia captures, in a stylized way, international investors that rebalance their portfolios towards financial assets issued by EA, CH, and RW. It induces – via the uncovered interest parity (UIP) conditions holding for EA, CH, and RW Ricardian households – a sharp multilateral depreciation of the US dollar, lasting for slightly more than 20 quarters.[9]

[8] Caldara et al. (2020) estimate that a 2-standard-deviation shock to the TPU (equivalent to a 45-percentage-point increase that lasts about 12 quarters) generates a 2% fall in private investment. The increase in the TPU observed in the last quarter of 2024 is almost threefold the shock simulated by Caldara et al. (2020). We therefore calibrate the effects on private investment in each country accordingly.

[9] As previously illustrated, in the model there is one bond internationally traded among the four regions, denominated in US dollars, paying the US monetary policy rate possibly augmented by an exogenous risk premium.

Finally, we run a robustness analysis on the values of two key parameters for the transmission of tariff shocks, that is, the intratemporal elasticity of substitution among tradable goods other than oil and the ERPT into US export prices.

All scenarios are run under the assumption of perfect foresight. Households and firms perfectly anticipate future tariff values, investment-specific shocks in the TPU scenario, and risk-premium shocks in the case of the depreciation of the US dollar. Thus, the whole path of shocks surprises households and firms only in the initial period of the simulations.

4 Results

4.1 US unilateral tariff increase

We assume that US imposes tariff increases on imports of goods from EA, CH, and RW equal to 15.3pp, 42.3pp, 6.8pp, respectively. EA, CH, and RW do not retaliate.

Fig. 1 shows responses of the US dollar nominal bilateral exchange rates, import prices, and headline inflation rate. The US dollar appreciates vis-à-vis all the other currencies, consistent with the increase in the US monetary policy rate (see below). The appreciation only partially offsets the negative impact of the US tariff on the price-competitiveness of goods exported to US. Before-tariff border prices of US imports, invoiced in US dollar, slightly decrease, as firms exporting to the US absorb, to some extent, the increase in tariff by reducing their markup. The increase in the retail price of the imported goods is, to some extent, limited by its distribution (nontradable) service component (see Eq. 8), whose price remains broadly constant in the short run. Headline inflation increases in the initial period, because of the higher tariffs. Before-tariff inflation (right-hand axis), instead, decreases, because of the lower US aggregate demand. From the second quarter on before- and after-tariff inflation coincide and show values slightly below the baseline in the first two years.

Fig. 2 reports responses of the US main macroeconomic variables. US bilateral imports decrease, consistent with the higher tariffs. Imports of CH goods decrease to a larger extent, because US raises tariffs on CH goods relatively more. US GDP persistently decreases (3.5% at the trough), because the higher tariffs make consumption and investment more expensive, inducing households and firms to reduce their spending.[10] The decline in aggregate demand is amplified by the monetary policy tightening, in response to the increase in inflation (see Taylor rule, Eq. 13). As said, the higher monetary policy rate also favors the appreciation of US dollar. The latter negatively affects US exports, that persistently decrease. Labor persistently drops. The increase in nominal wages, relatively large in the very short run because of the indexation to previous-period after-tariff inflation, is not large enough to offset the increase in nominal prices at consumer level, that is, the wage in real terms declines.

Fig. 3 presents international macroeconomic spillovers. Lower exports to the US negatively affect economic activity in EA, CH, and RW. Trade among EA, CH, and RW offsets the drop in exports to US only partially. Thus, EA, CH, and RW multilateral exports drop. In particular, EA and RW exports to CH slightly decrease, consistent with the depreciation of the CH currency and the larger reduction in CH aggregate demand. The CH currency's multilateral depreciation and the larger drop in CH aggregate demand and economic activity than in EA and RW are due to the higher drop in CH exports to US, because of the larger increase in US tariffs on CH goods.[11] Investment (in the initial quarters) and labor drop, consistently with the lower production. Inflation rates decrease, inducing the central banks to reduce the (corresponding) monetary policy rates. The decrease in the international US dollar-invoiced price of oil, associated with the fall in global demand, contributes to reduce headline inflation in each region, by lowering the nominal price, invoiced in local currency, of the energy component of the consumption bundle (the price of US energy decreases less than the international price of oil because of the US distribution margin of energy products, that partially increases with the increase in tariffs; in the other regions, prices of oil and energy in local currency also reflect changes in the nominal exchange rate vis-à-vis the US dollar).

Overall, the increase in US tariffs reduces US production (3.5% at the trough), following the drop in domestic (aggregate) demand for consumption and investment. The US tariffs negatively affect economic activity and inflation in EA, RW, and, to a larger extent because of the relatively higher increase in the corresponding tariff, CH (EA GDP falls by 0.5% at the trough). Trade-

[10] US HTM households' consumption decreases to a larger extent than Ricardian households', because HTM households do not have access to financial markets to smooth consumption and their source of income is only labor. Responses are available upon request.

[11] The CH currency depreciates to a larger extent vis-à-vis the US dollar and, because the cross-parity condition across nominal exchange rates holds, also vis-à-vis the EA and RW currencies.

rerouting among countries other than US offsets only to a limited extent lower exports to the US.

4.2 Retaliation to US tariffs

We now assume that EA, CH, and RW retaliate to US tariffs by raising tariffs only on US goods (they do not raise tariffs on each other's tradables). As in the case of US unilateral tariff increase, reported in the Section 4, US imposes increases in the tariff on imports from EA, CH, and RW equal to 15.3pp, 42.3pp, 6.8pp, respectively. EA, CH, and RW retaliate by imposing tariffs on imports from US equal to 8.7pp, 30.6pp, 5.5pp, respectively.

Fig. 4 contains responses of US (multilateral) exports and EA, CH, RW main macroeconomic variables. Relative to the case of tariffs raised only by the US (black continuous line), under retaliaton the US multilateral exports, as expected, drop to a larger extent (red-dash line). US GDP decreases relatively more. US headline inflation does not greatly change across the two scenarios. The US central bank raises the monetary policy rate to a lesser extent, mitigating the drop in consumption and investment. Labor decreases to a larger extent, consistent with the larger drop in US production.

Higher tariffs make US goods more expensive, favoring the increase in EA, CH, and RW headline inflation rates. In each region the increase in headline inflation is rather mechanical and very short-lived, because it is due to the increase in the tariff in the first period. Subsequently, after- and before-tariff coincide and fluctuate very closely to the baseline level. In particular, the inflation rate of the consumption's energy component falls slightly more under retaliation, because of the lower global demand for oil, contributing to limit the rise in headline inflation. Central banks raise the monetary policy rates, instead of decreasing them as in the no-retaliation case, because of the increase in after-tariff headline inflation in the initial period.

Fig. 5 shows responses of the trade variables. Under retaliation, US exports further drop towards all destinations. The drop in EA, CH, and RW aggregate demands reduces (bilateral) imports from each other, more than offsetting the positive substitution effects associated with the imposition of tariffs on US goods. Only EA and RW exports to CH increase. The reason is the larger substitution effect in favor of EA and RW goods, due to the larger increase in CH tariff on US goods. EA, CH, and RW exports to the US decrease slightly more for two reasons. First, the US dollar appreciates vis-à-vis the other currencies to a less extent, inducing a lower drop in the (before-tariff) border price of US imports (not reported to save on space). Second, as said, US economic activity, income and, through it, aggregate demand, are negatively affected by the drop in US exports.

Overall, retaliation further reduces global aggregate demand, with additional negative effects on international trade and economic activity in all countries, including in the EA. Economic activity contracts – as it does without retaliation – but the contemporaneous surge in after-tariff inflation provides the central bank with a (potentially) non-trivial stabilization trade-off. However, headline inflation rises only on impact and in a rather mechanical way because of the tariff increase.

4.3 Increase in trade policy uncertainty

The (multiple) announcements of US tariff and retaliatory measures by US trade partners have widely increased uncertainty. The TPU index spiked in correspondence of these announcements. To capture the (possible) negative impact of large trade policy uncertainty on aggregate demand, we impose an exogenous decline in global investment in physical capital, that falls by around 5% at the trough in every region. We feed the model with eight-quarter negative investment-specific shocks that simultaneously affect all countries, starting from the initial period of the simulation. To isolate this indirect effect of higher tariffs, via the increase in uncertainty, we do not simulate the direct impact of higher tariffs on prices.[12]

Fig. 6 reports responses of the main variables. The global reduction in private investments induces a fall in global aggregate demand. Economic activity and inflation decrease worldwide, including in EA (whose GDP falls by 1%). Lower oil prices contribute to decreasing headline inflation. In every region the central bank reduces the monetary policy rate to stabilize inflation and economic activity. In CH real GDP and inflation decrease to a larger extent than in other regions, because investment is a relatively large component of CH aggregate demand. Thus, the CH central bank reduces the policy rate relatively more than other central banks do. The

[12]The calibration of the monetary policy rule is the same as in the benchmark case, with the inflation weight in the Taylor rule equal to 1.6.

exchange rates do not greatly change among one another, given that the shock affects countries in a similar way.

Overall, tariff announcements, by (possibly) inducing an increase in TPU, have global recessionary and disinflationary effects. The effects on TPU would add to the direct effects of tariffs on the prices of imports. The overall effects of tariffs on global (and EA) economic activity would be recessionary. The direct (after-tariff) inflationary effect of higher tariffs, that materializes (only) in the initial period, could be at least partially offset by the disinflationary effects of the higher uncertainty.

4.4 International financial portfolios' rebalancing

Consistent with the uncertainty on the US policy outlook and the multilateral depreciation of the US dollar observed after the multiple US tariff announcements, we feed the model with negative risk-premium shocks on US dollar-denominated bonds issued by EA, CH, and RW over the first 20 quarters. The reduction in risk premia for these regions captures, in a stylized way, international financial investors that rebalance their portfolios towards financial assets issued by EA, CH, and RW. It induces – via the uncovered interest parity (UIP) conditions holding for EA, CH, and RW Ricardian households – a sharp multilateral depreciation of the US dollar, lasting for slightly more than 20 quarters.

Fig. 7 shows the responses of the main variables. The US dollar depreciation leads to an increase in US inflation via higher import prices, which further spurs an increase in the monetary policy rate via the US Taylor rule. The more restrictive monetary policy conditions worsen US macroeconomic conditions, with falls in US consumption and investment. Interestingly, there is a large improvement in both US gross and net exports, favored by the improvement in price-competitiveness of US goods and the drop in US aggregate demand. To the opposite, the relative improvement in their international financial conditions induces EA, CH, and RW to reduce their net foreign asset positions (assumed to be zero in steady state). Macroeconomic outcomes mirror those for the US, with improvements in consumption and investment and a drop in headline inflation. The latter is due to the lower import prices, in particular the price of energy, favored by the strong appreciation of the EA, CH, and RW currencies vis-à-vis the US dollar, as the international price of oil is invoiced in US dollars. GDP expands the most in CH, because of the increase in investment, whose weight in CH aggregate demand is relatively large.

Overall, tariff announcements, by (possibly) inducing an international portfolio rebalancing and a multilateral nominal depreciation of the US dollar, may have expansionary and disinflationary effects in countries other than the US.

4.5 Robustness

4.5.1 Higher elasticity of substitution

We newly simulate the retaliation scenario under the assumption of higher elasticity of substitution among tradables. We set it to 4.5 instead of 1.5 as in the benchmark calibration.

Fig. 8 shows responses of bilateral and multilateral exports. Relative to the benchmark case (black continuous line), under high elasticity (red-dashed lines) US exports decrease relatively more, because, for a given tariff increase, households and firms in EA, CH, and RW find it less difficult to substitute other tradables for US ones. Similarly, all exports to US decline more, because for US households and firms it is easier to substitute domestic tradables for imported ones. Bilateral exports among EA, CH, and RW increase relatively more. Overall, CH multilateral exports decrease relatively more, while EA and RW multilateral exports decrease less (the improvement is relatively small).

Fig. 9 reports US and EA main macroeconomic variables. Relative to the benchmark case, the drop in US GDP does not greatly change, because both US exports and imports further decrease by similar amounts. GDP falls to a lower extent in EA, CH, and RW. The lower output loss is due to the increased demand for domestic tradables and non-US tradables, that can be easily substituted for US ones. Headline inflation and monetary policy rate do not greatly change across the two scenarios. In EA and RW the monetary policy rate decreases less, because the central bank stabilizes the economic activity, which improves in relative terms. In CH the central bank reduces the monetary policy rate slightly more, because inflation increases slightly less on impact, consistent with the smaller depreciation of the CH currency vis-à-vis the US dollar (under high elasticity all currencies depreciate to a less extent vis-à-vis the US dollar).[13]

[13]Under high elasticity, an increase in US tariffs without retaliation would induce the US GDP to slightly

Overall, under retaliation the impact of higher tariffs on economic activity and aggregate demand is negative also under the assumption of relatively high elasticity of substitution among tradables, confirming the results obtained under relatively low elasticity.

4.5.2 Higher exchange rate pass-through into US export prices

Nominal prices of exported goods are set and sticky in the currency of the destination country (local currency pricing). We newly simulate the retaliation scenario assuming that the exchange rate pass-through (ERPT) into US export prices is relatively high at the border by setting the corresponding nominal rigidities to low values (that is, the corresponding Rotemberg parameters κ are set to 1.2 instead of 120 as in the benchmark calibration).

Fig. 10 contains the responses of exports. Relative to the benchmark case of low ERPT, US exports decrease to a larger extent, because the appreciation of the US dollar is quickly passed-through into US export prices, that increase to a larger extent in the currency of the destination market. Other countries' exports are not affected. In some cases there is a rather mild relative improvement, associated with the larger loss in price-competitiveness of US exports.

Fig. 11 reports the responses of the main macroeconomic variables. Overall, they do not greatly change across the two cases. The inflation rate in EA and RW increases slightly more on impact, because of the larger depreciation of their currencies vis-à-vis the US dollar, that raises imported inflation. Following the initial larger increase in inflation, the EA and RW central banks raise the monetary policy rate slightly more on impact.

Overall, the stagflationary impact of higher tariffs is robust to the assumption of high ERPT into US export prices.

5 Concluding remarks

We have simulated a multi-country model of the global economy to evaluate the macroeconomic effects on the EA of an increase in US tariffs on imports, either unilaterally or accompanied by

increase on impact, instead of decreasing as under the benchmark calibration. However, after the initial period, the US output falls, because of the lower aggregate demand, similar to what happens under the benchmark calibration. International spillovers would be recessionary and disinflationary, but slightly smaller than in the benchmark case.

retaliatory tariffs adopted by EA, CH, and RW. EA output decreases to a larger extent under retaliation than under the US unilateral increase in tariffs. The additional decrease is due to the drop in domestic aggregate demand, offset by the increase in exports toward CH only to a rather limited extent. Trade rerouting can mitigate the drop in EA output only to a limited extent. The increase in TPU, associated with the introduction of tariffs, has modest recessionary and disinflationary effects on the EA economy. A portfolio rebalancing towards financial assets issued by EA, CH, RW would induce a depreciation of the US dollar and expansionary and disinflationary effects on these countries.

Our contribution can be extended along several dimensions. First, the EA can be modeled as a monetary union. The effects on output and inflation would depend on the relevance of international (both intra- and extra-EA) trade of EA countries. Second, financial frictions, by affecting the capability of households and firms to borrow and lend, could amplify the transmission of tariff shocks. Third, the role of employment and wage dynamics for the propagation of the shock can be assessed by introducing in the model a labor market featuring search-and-matching frictions. We leave these issues for future research.

References

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub, "The Macroeconomics of Tariff Shocks," Working Paper Series 33726, NBER April 2025.

Bergin, Paul and Giancarlo Corsetti, "The Macroeconomic Stabilization Of Tariff Shocks: What Is The Optimal Monetary Response?," *Journal of International Economics*, July 2023, *143*, 1–25.

Bianchi, Javier and Louphou Coulibaly, "The Optimal Monetary Policy Response to Tariffs," Working Paper Series 33560, NBER March 2025.

Bolt, Wilko, Kostas Mavromatis, and Sweder van Wijnbergen, "The Global Macroeconomics of a Trade War. The EAGLE model on the US-China trade conflict," DNB Working Papers 623, Netherlands Central Bank, Research Department February 2019.

Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo, "The economic effects of trade policy uncertainty," *Journal of Monetary Economics*, 2020, *109*, 38–59.

Conteduca, Francesco Paolo, Michele Mancini, and Alessandro Borin, "Roaring tariffs: The global impact of the 2025 US trade war," article, VoxEU.org, May 2025.

Corsetti, Giancarlo, Luca Dedola, and Sylvain Leduc, "High exchange-rate volatility and low pass-through," *Journal of Monetary Economics*, September 2008, *55* (6), 1113–1128.

Cova, Pietro, Alessandro Notarpietro, and Massimiliano Pisani, "Protectionism and the effective lower bound in the euro area," Temi di discussione (Economic working papers) 1286, Bank of Italy, Economic Research and International Relations Area July 2020.

Faruqee, Hamid, Douglas Laxton, Dirk Muir, and Paolo Pesenti, "Would protectionism defuse global imbalances and spur economic activity? A scenario analysis," *Journal of Economic Dynamics and Control*, August 2008, *32* (8), 2651–2689.

Gomes, Sandra, Pascal Jacquinot, and Massimiliano Pisani, "The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area," Working Paper Series 1195, European Central Bank May 2010.

Jacquinot, Pascal, Matija Lozej, and Massimiliano Pisani, "Macroeconomic effects of tariffs shocks: The role of the effective lower bound and the labour market," *Journal of International Money and Finance*, 2022, *120* (C).

Lindé, Jesper and Andrea Pescatori, "The macroeconomic effects of trade tariffs: Revisiting the Lerner symmetry result," *Journal of International Money and Finance*, 2019, *95* (C), 52–69.

McKibbin, Warwick and Marcus Noland, "Trump's threatened tariffs projected to damage economies of US, Canada, Mexico, and China?," Real time economics, Peterson Institute for International Economics January 2025.

Moro, Alessandro and Valerio Nispi Landi, "FraNK: fragmentation in the NK model," Temi di discussione (Economic working papers) 1475, Bank of Italy, Economic Research and International Relations Area December 2024.

Pesenti, Paolo, "The Global Economy Model: Theoretical Framework," *IMF Staff Papers*, June 2008, *55* (2), 243–284.

Pisani, Massimiliano and Filippo Vergara Caffarelli, "What will Brexit mean for the British and euro-area economies? A model-based assessment of trade regimes," Temi di discussione (Economic working papers) 1163, Bank of Italy, Economic Research and International Relations Area January 2018.

Rotemberg, Julio J., "Monopolistic Price Adjustment and Aggregate Output," *Review of Economic Studies*, October 1982, *49* (4), 517–31.

Warne, Anders, Günter Coenen, and Kai Christoffel, "The new area-wide model of the euro area: a micro-founded open-economy model for forecasting and policy analysis," Working Paper Series 944, European Central Bank October 2008.

Table 1: Great ratios (% of GDP)

	EA	US	CH	RW
Private consumption	60.2	60.4	36.5	61.5
of which: HTM consumption	6.02	7.9	6.1	7.4
Investment	19.8	19.6	43.5	18.5
Public consumption	20.0	20.0	20.0	20.0
Imports	25.5	12.4	16.7	15.4
Consumption goods	15.4	8.2	9.0	12.0
Investment goods	7.8	4.1	4.5	5.9
Oil (net imports)	2.3	0.1	3.2	−2.5
Distribution margin	0.18	0.26	0.13	0.35
Share of world GDP	16.5	22.8	19.3	41.3

Note: EA=euro area; US=United States; CH=China; RW=Rest of the world.

Table 2: International linkages (% of GDP, tradables different from oil)

	EA	US	CH	RW
Imported consumption goods from				
EA	...	1.5	1.4	5.2
US	2.5	...	0.8	3.1
CH	2.0	1.3	...	3.7
RW	10.9	5.4	6.8	...
Imported investment goods from				
EA	...	0.8	0.7	2.6
US	1.3	...	0.4	1.5
CH	1.0	0.6	...	1.8
RW	5.5	2.7	3.4	...

Note: EA=euro area; US=United States; CH=China; RW=Rest of the world.

Table 3: Households and firms behavior

	EA	US	CH	RW
Households				
Subjective discount factor β	0.9996	0.9996	0.9996	0.9996
Intertemporal elasticity of substitution $1/\sigma$	1.00	1.00	1.00	1.00
Habit persistence ζ	0.70	0.70	0.70	0.70
Inverse of the labor Frisch elasticity τ	1.50	1.50	1.50	1.50
Distribution margin η^{distr}	1.2	1.2	1.2	1.2
Population share of HTM n^{rot}	40	40	40	40
Final consumption goods				
Substitution btw fuel and other goods ρ	0.40	0.40	0.40	0.40
Substitution btw domestic and imp. goods η_T	1.5	1.5	1.5	1.5
Substitution btw tradables and nontrad. η	0.80	0.80	0.80	0.80
Bias toward fuel $a_{FU,C}$	0.05	0.05	0.1	0.1
Bias toward tradable goods $a_{T,C}$	0.50	0.40	0.60	0.60
Bias toward domestic tradable goods a_C	0.27	0.47	0.41	0.32
Final investment goods				
Substitution btw domestic and imp. goods $\eta_{T,I}$	1.5	1.5	1.5	1.5
Substitution btw tradables and nontrad. η_I	0.80	0.80	0.80	0.80
Bias toward tradable goods $a_{T,I}$	0.70	0.60	0.70	0.70
Bias toward domestic goods a_I	0.29	0.48	0.80	0.16
Intermediate tradable goods				
Substitution btw value added and fuel $\xi_{Y,T}$	0.80	0.80	0.80	0.80
Substitution btw labor and capital ξ_T	1.00	1.00	1.00	1.00
Bias toward fuel a_{FU}	0.02	0.02	0.02	0.02
Bias toward capital $(1 - a_L)$	0.50	0.40	0.40	0.40
Intermediate nontradable goods				
Substitution btw value added and fuel $\xi_{Y,N}$	0.80	0.80	0.80	0.80
Substitution btw labor and capital ξ_N	1.00	1.00	1.00	1.00
Bias toward fuel a_{FU_N}	0.02	0.02	0.02	0.02
Bias toward capital $(1 - a_{L_N})$	0.4	0.36	0.36	0.36
Fuel distribution margin η^{FU}	1.3	0.3	0.3	0.3
Depreciation rate of capital δ	0.025	0.025	0.025	0.025

Note: EA=euro area; US=United States; CH=China; RW=Rest of the world.
In each region the corresponding parameter is set equal to the reported value.
HTM households' population share in % of country's population.

Table 4: Real and nominal rigidities

Real rigidities	
Investment adjustment ϕ_I	4.50
Net foreign asset adjustment costs	
ϕ_{b1}, ϕ_{b2}	0.01,0.01
Nominal adjustment costs	
Households	
Wage stickiness κ_W	300
Tradable goods	
Price stickiness (domestically produced goods) κ	120
Price stickiness (imported goods) κ	120
Nontradable goods	
Price stickiness κ_N	400
Indexation	
Prices a_P	0.75
Wages a_W	0.75

Note: in each region the corresponding parameter is set equal to the reported value.
US do not have adj. costs on net foreign asset position.

Table 5: Gross price and wage markups

Tradables price markup θ_T	1.20
Nontradables price markup θ_N	1.33
Wage markup θ_W	1.30

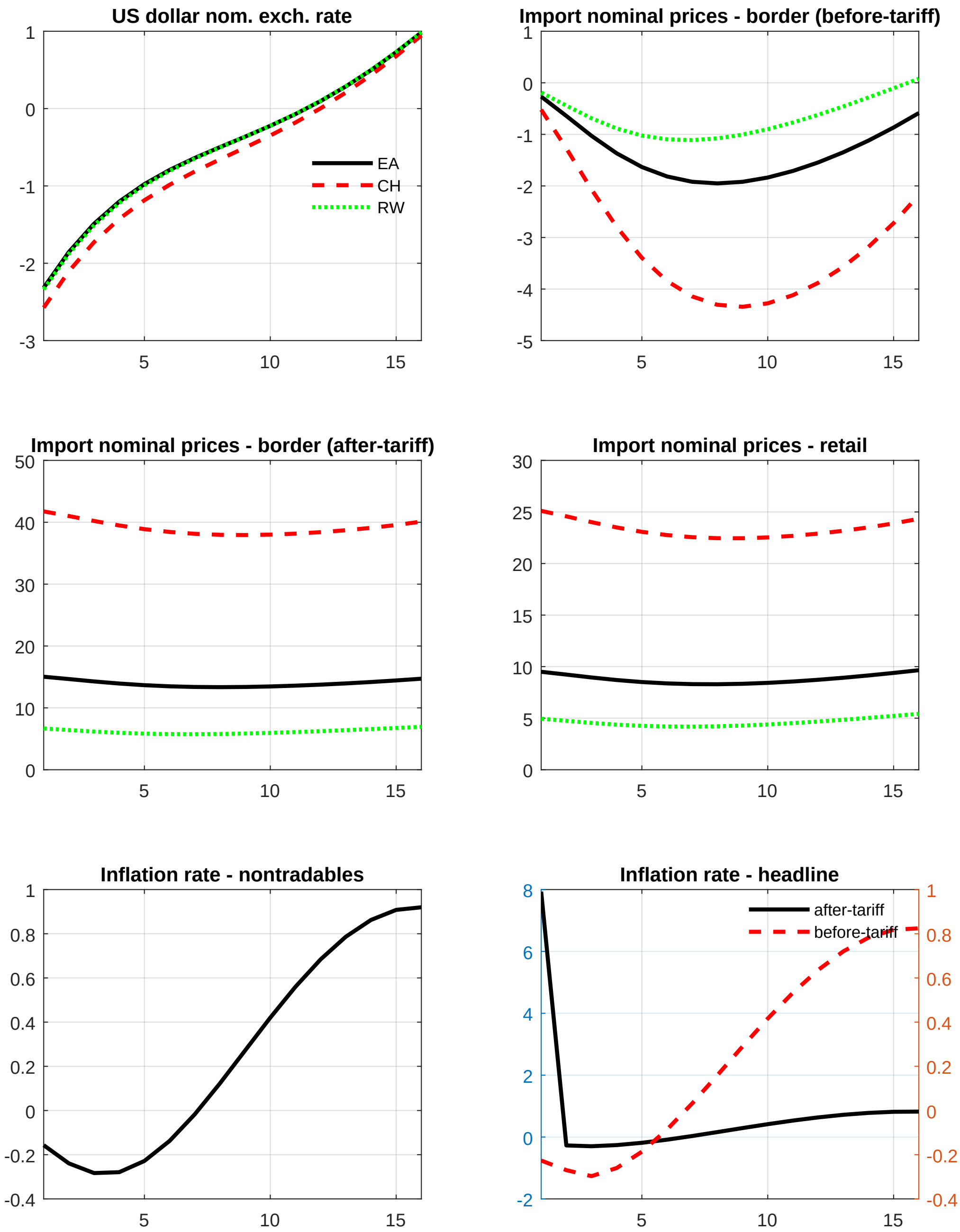
Note: in each region the corresponding parameter is set equal to the reported value.

Table 6: Monetary policy rule

Interest rate inertia ϕ_R	0.85
Interest rate response to inflation gap ϕ_Π	1.60
Interest rate response to output growth ϕ_{gY}	0.10

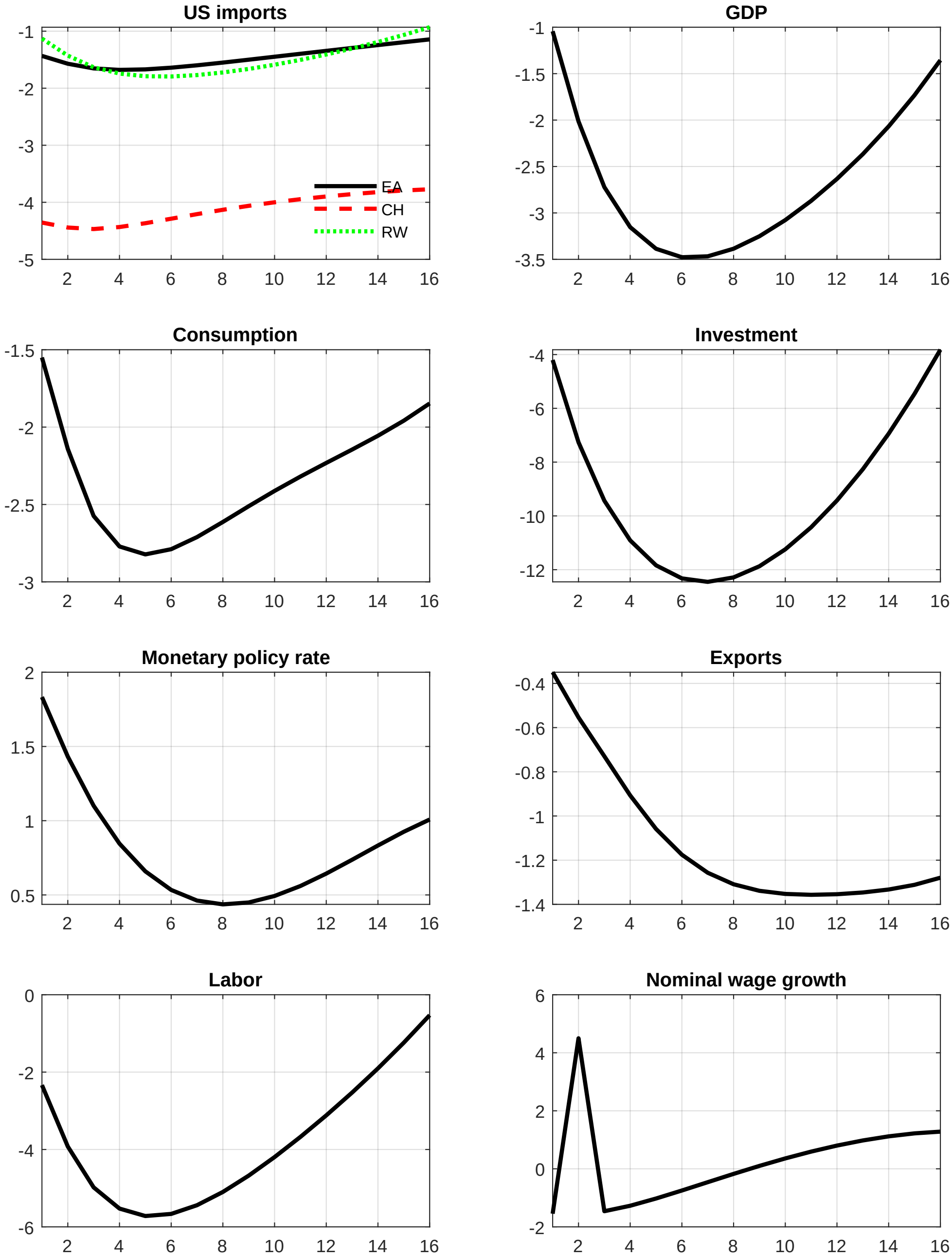
Note: in each region the corresponding parameter is set equal to the reported value.

Figure 1: Increase in US tariffs: US dollar exchange rate, import prices, and inflation.



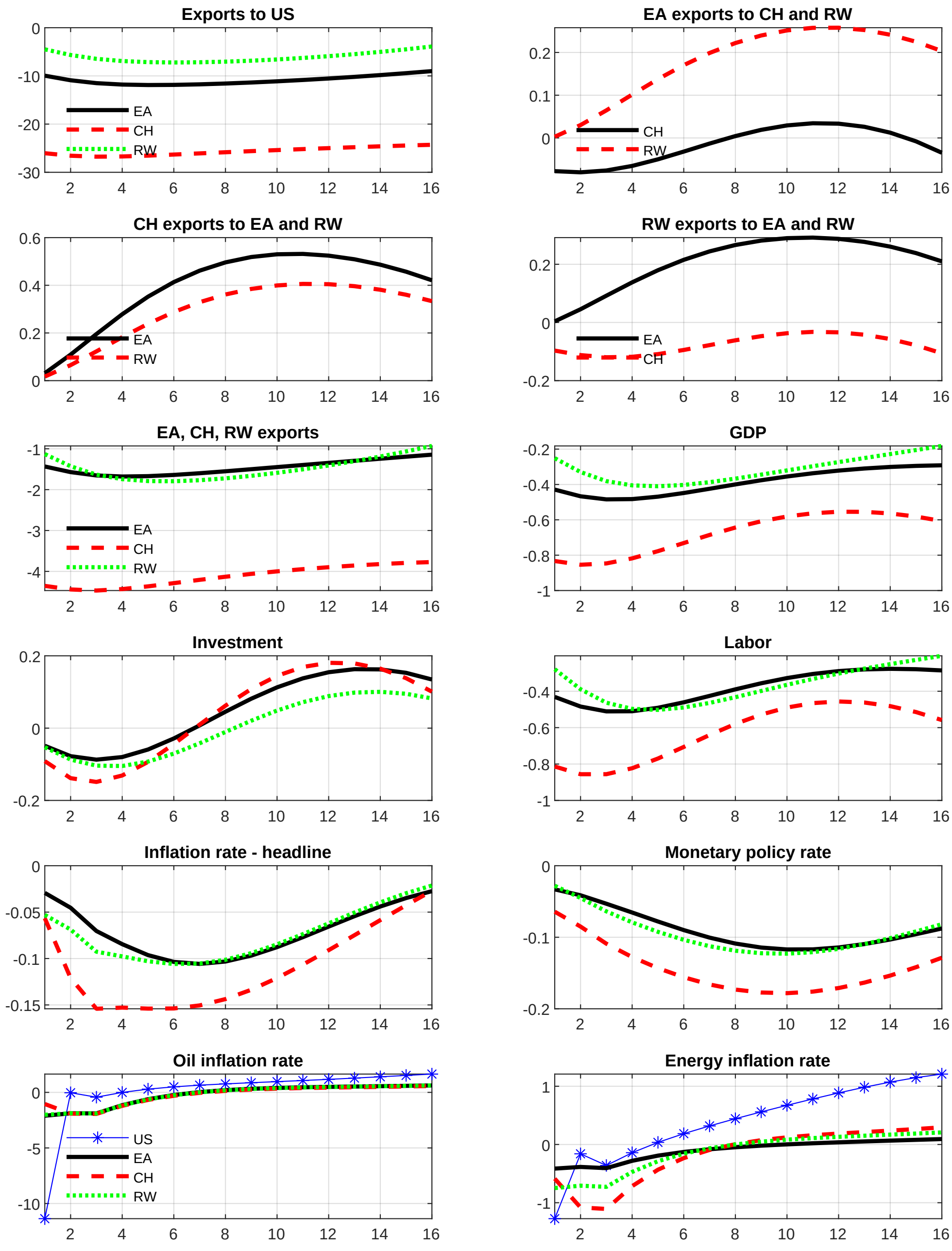
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; inflation rate: annualized pp deviations; before-tariff inflation: right-hand axis; exchange rate: bilateral, nominal terms, + (-) = depreciation (appreciation) of the US dollar.

Figure 2: Increase in US tariffs: US macroeconomic variables.



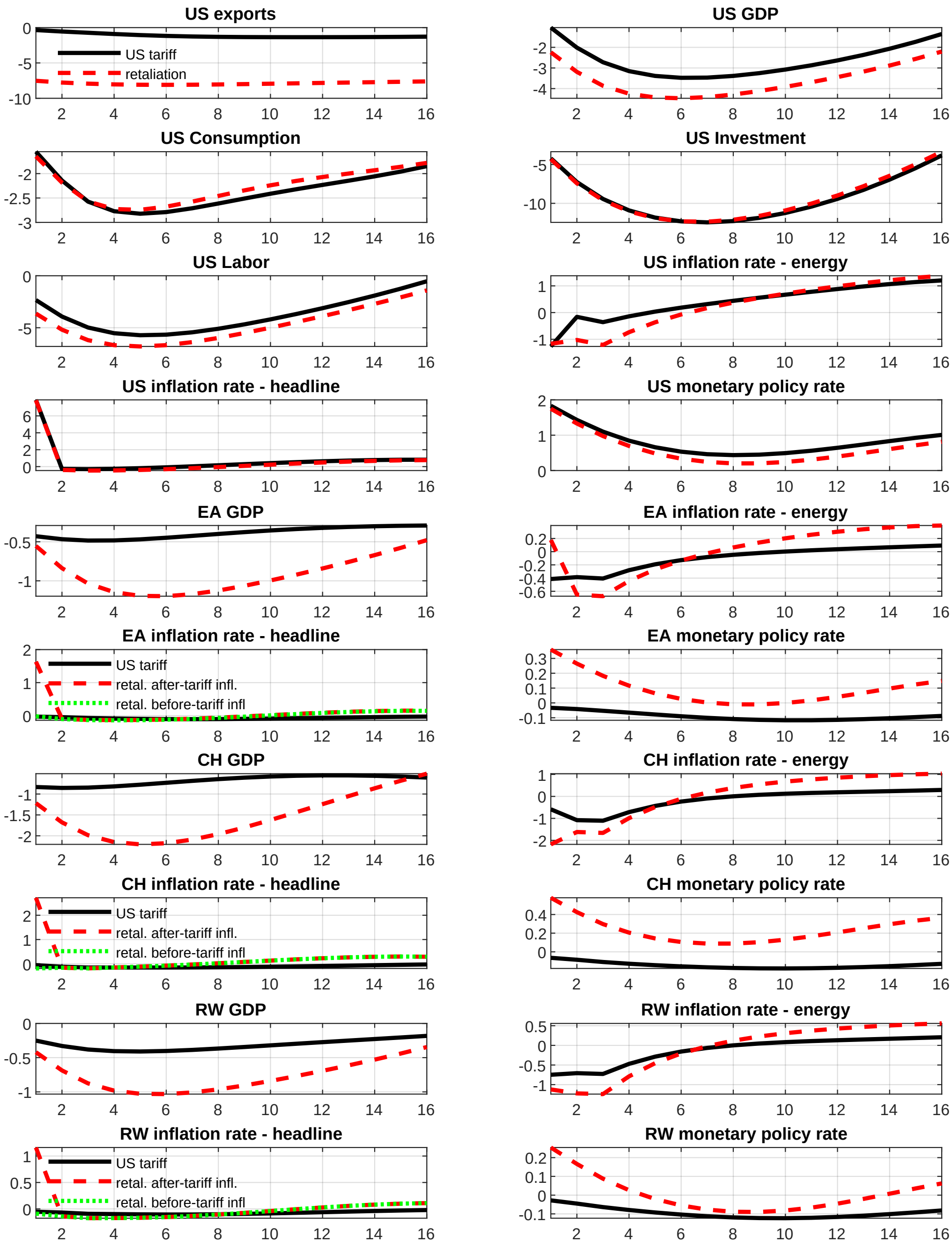
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; monetary policy rate and nominal wage growth: annualized pp deviations; GDP and its components: real terms (constant, steady-state, prices).

Figure 3: Increase in US tariffs: international spillovers.



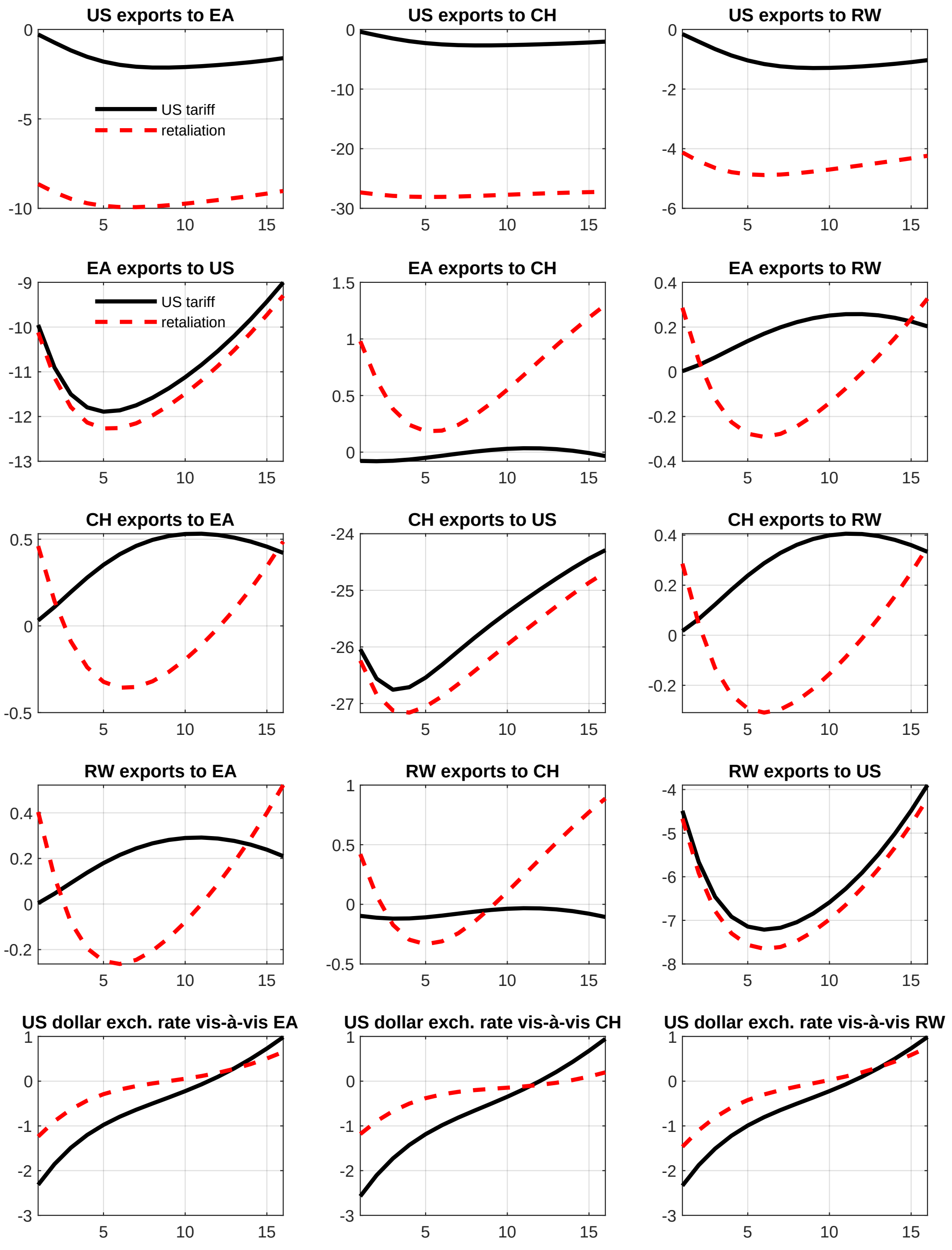
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; GDP, exports, and investment: real terms (constant, steady-state, prices); monetary policy rate and inflation rate: annualized pp deviations.

Figure 4: Retaliation: main macroeconomic variables.



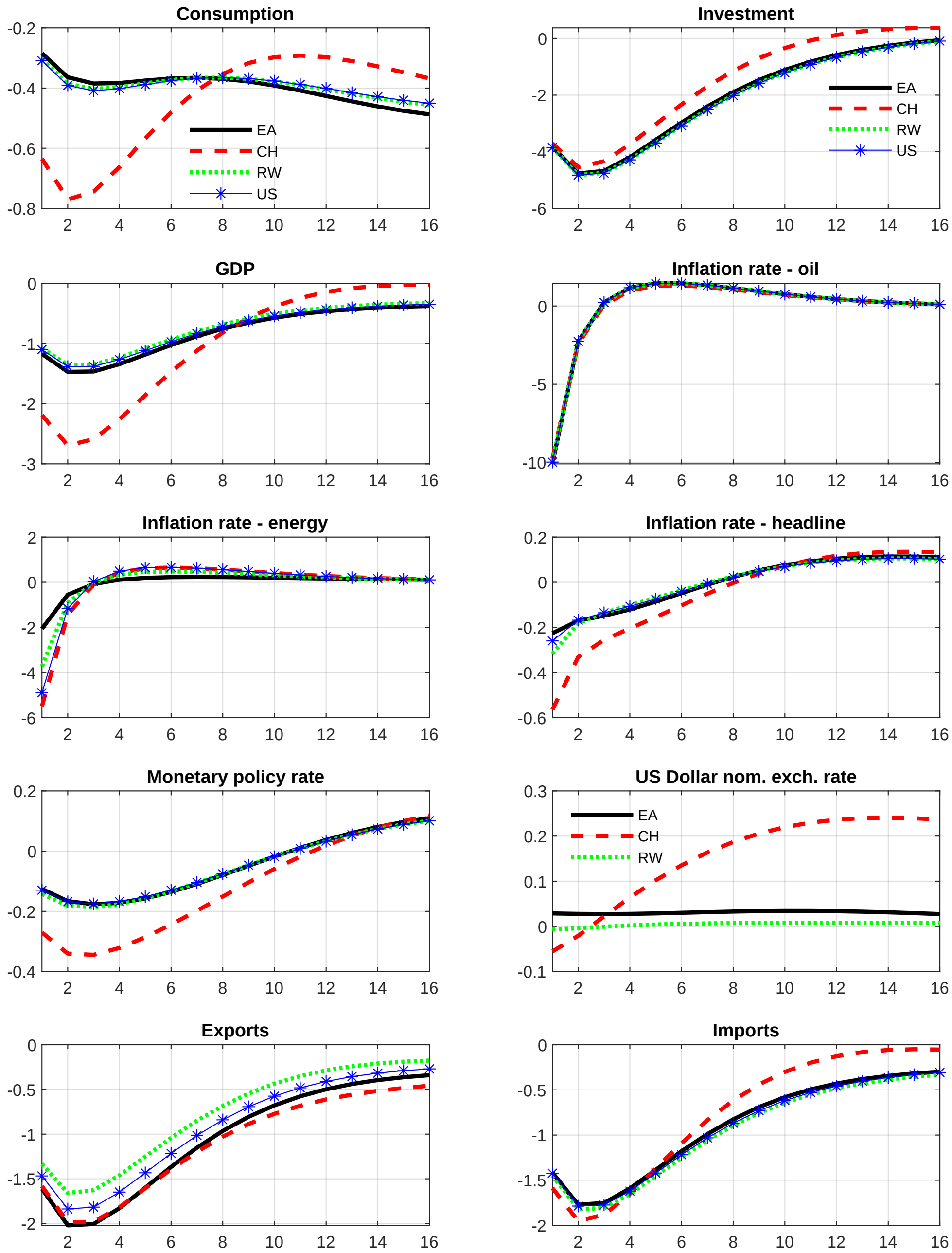
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; exports, GDP, consumption and investment: real terms (constant, steady-state, prices); monetary policy rate and inflation rate: annualized pp deviations.

Figure 5: Retaliation: trade variables.



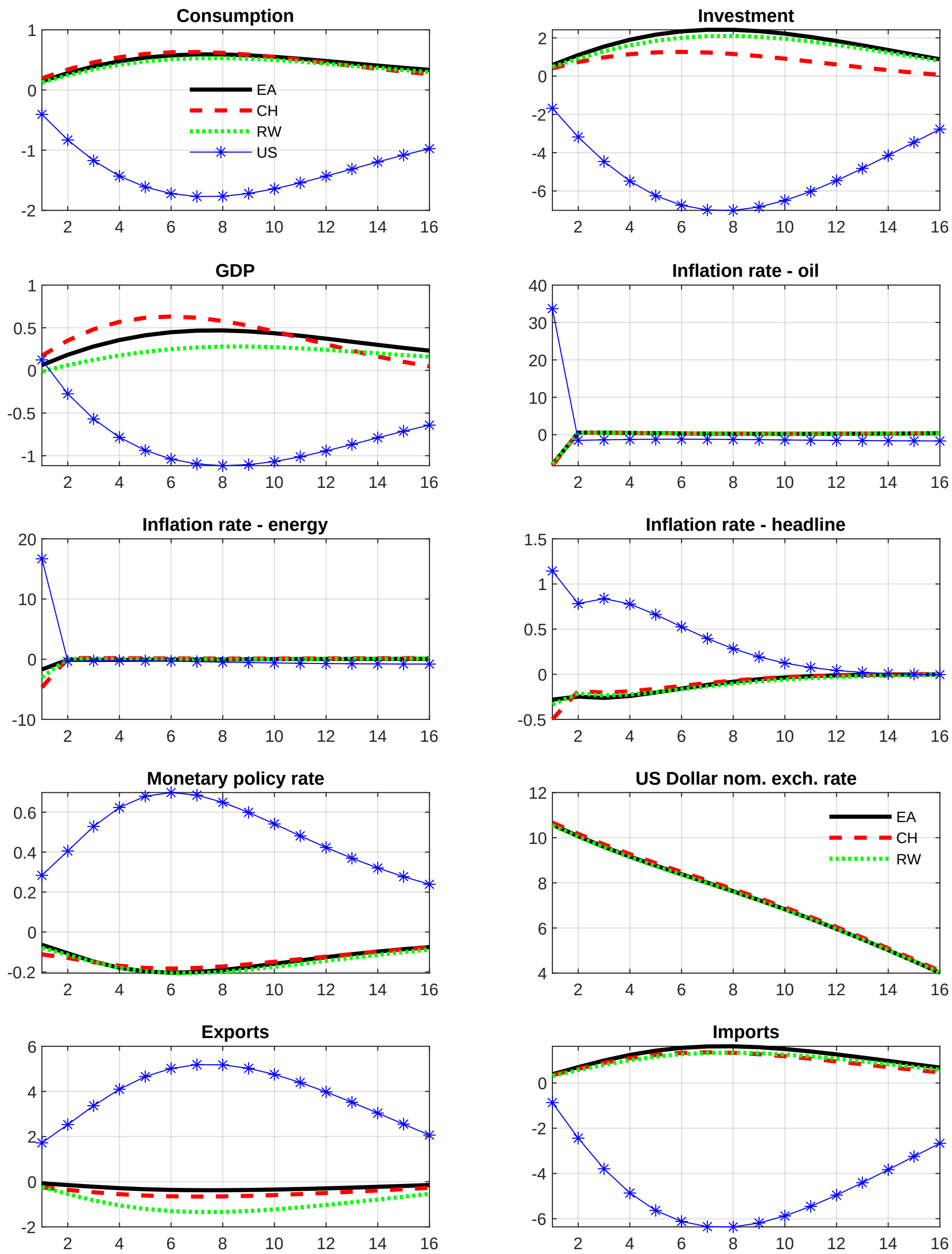
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; exports: real terms (constant, steady-state, prices); exchange rate: nominal terms, + (-) = depreciation (appreciation) of the US dollar.

Figure 6: Rise in TPU: macroeconomic variables.



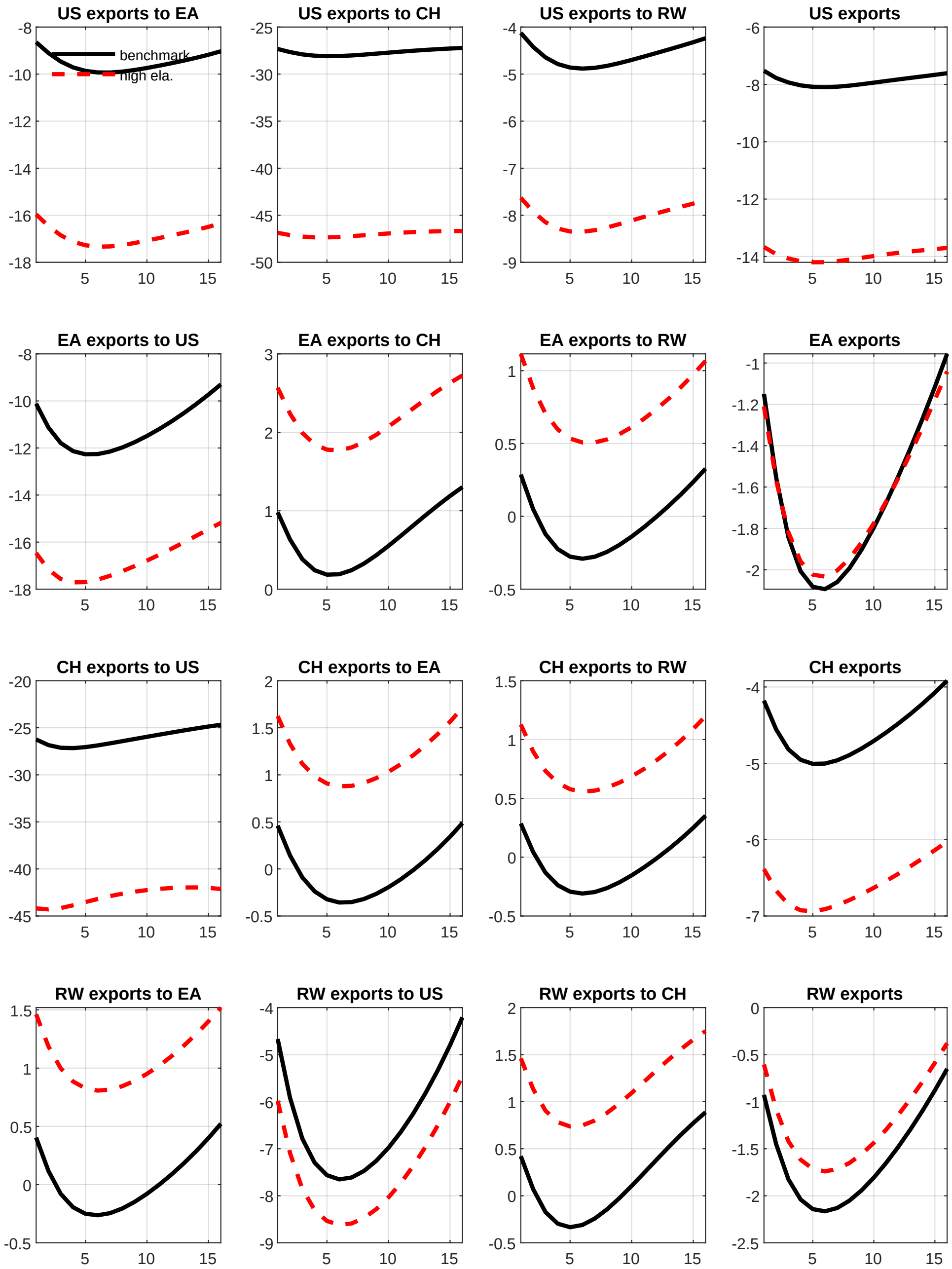
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; GDP and its components: real terms (constant, steady-state, prices); inflation rate and monetary policy rate: annualized pp deviations; exchange rate: bilateral, nominal terms, + (-) = depreciation (appreciation) of the US dollar.

Figure 7: Portfolio rebalancing: macroeconomic variables.



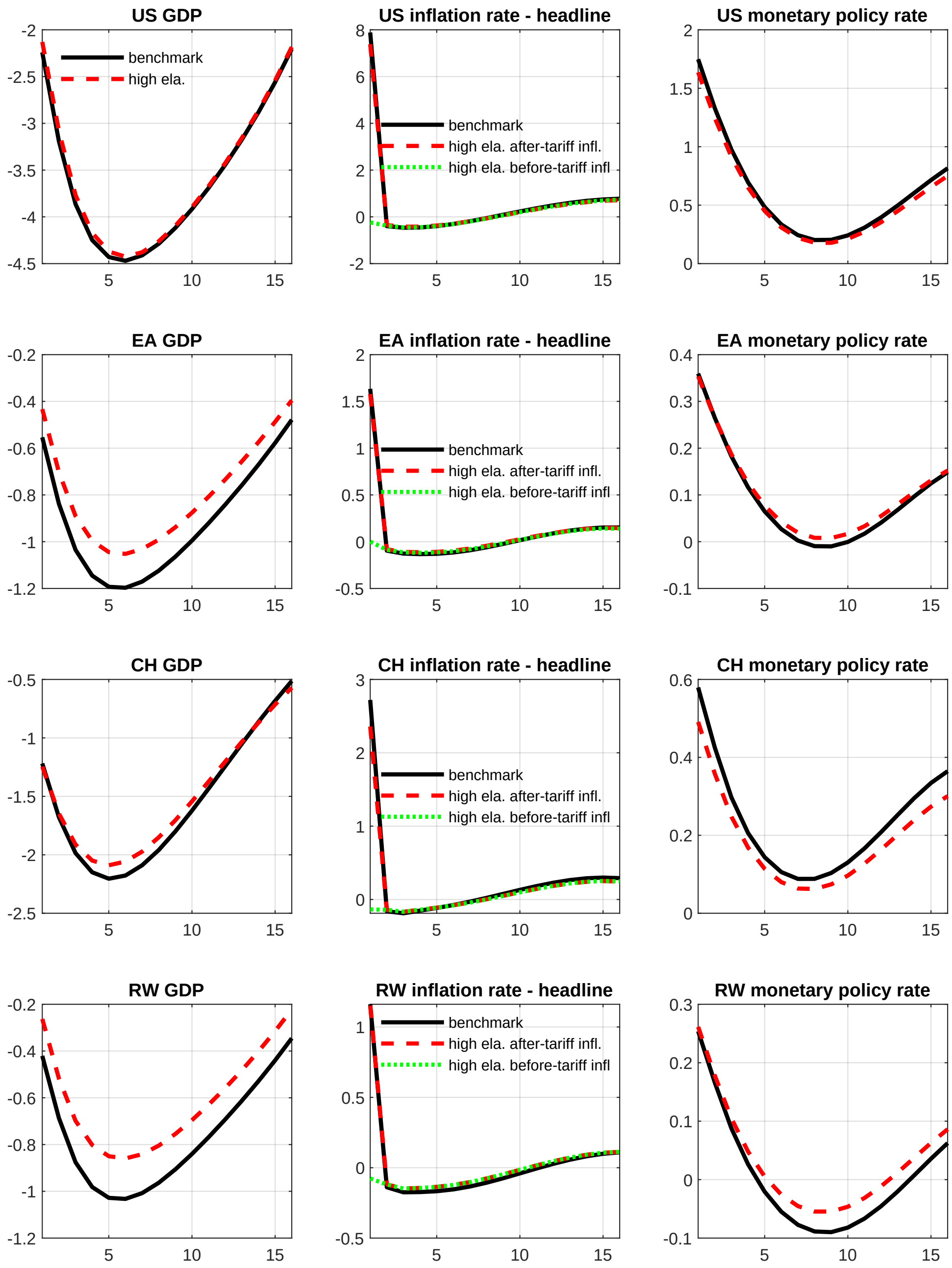
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; GDP and its components: real terms (constant, steady-state, prices); inflation rate and monetary policy rate: annualized pp deviations; exchange rate: bilateral, in nominal terms, + (-) = depreciation (appreciation) of the US dollar.

Figure 8: Retaliation under high elasticity: bilateral and multilateral exports.



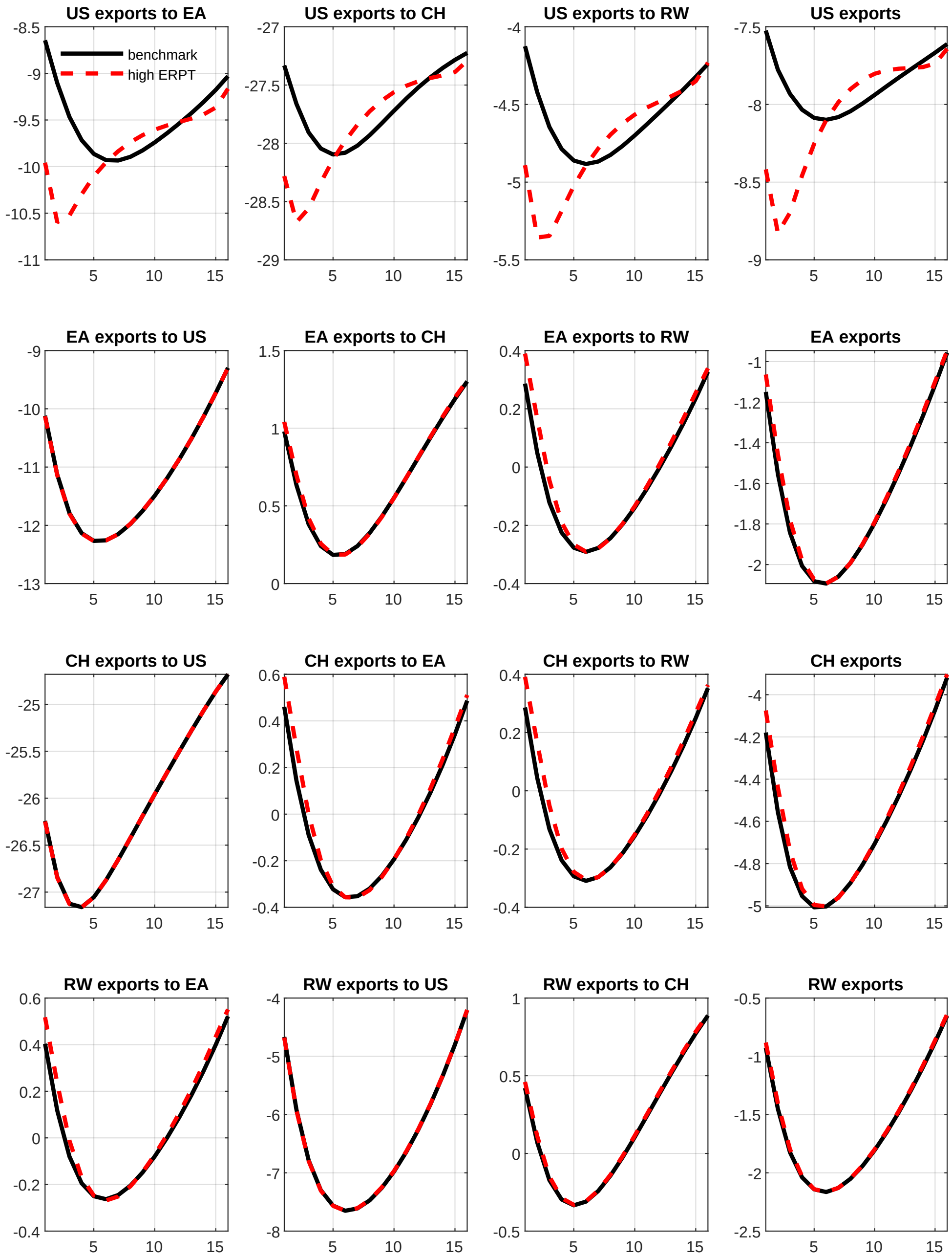
Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; exports: real terms (constant, steady-state, prices).

Figure 9: Retaliation under high elasticity: main macroeconomic variables.



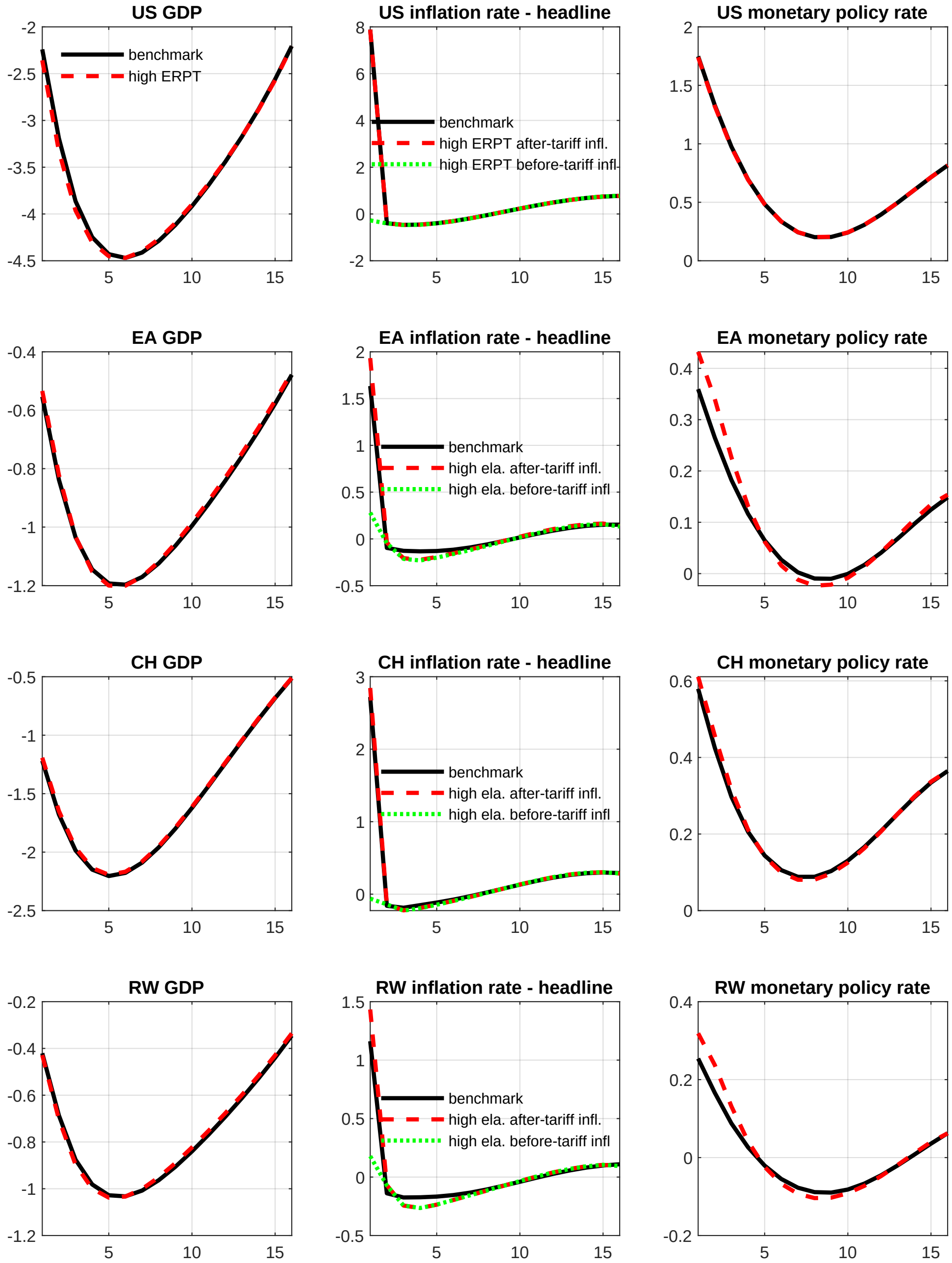
Notes: quarters on the horizontal axis; on the vertical axis, GDP: real terms (constant, steady-state, prices), % deviations from the baseline; monetary policy rate and inflation rate: annualized pp deviations.

Figure 10: Retaliation under high ERPT into US export prices: exports.



Notes: quarters on the horizontal axis; on the vertical axis, % deviations from the baseline; exports: real terms (constant, steady-state, prices).

Figure 11: Retaliation under high ERPT into US export prices: main macroeconomic variables.



Notes: quarters on the horizontal axis; on the vertical axis, GDP: real terms (constant, steady-state, prices), % deviations from the baseline; monetary policy rate and inflation rate: annualized pp deviations.