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# The Macroeconomic Consequences of Import Tariffs and Trade Policy Uncertainty

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**The Macroeconomic Consequences of Import Tariffs and Trade Policy Uncertainty**
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**ABSTRACT:** We estimate the macroeconomic effects of import tariffs and trade policy uncertainty in the United States, combining theory-consistent and narrative sign restrictions in Bayesian SVARs. We find mostly adverse consequences of protectionism, in aggregate and across sectors and regions. Tariff shocks are more important than trade policy uncertainty shocks. Tariff shocks depress trade, investment, and output persistently. The general equilibrium import elasticity is –0.8. Historically, NAFTA/WTO raised output by 1-3% for twenty years. Undoing the 2018/19 measures would raise output by 4% over three years. The findings imply higher gains of trade than partial equilibrium or static trade models.

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WORKING PAPERS

# The Macroeconomic Consequences of Import Tariffs and Trade Policy Uncertainty

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# 1 Introduction

The uncertainty about US trade policy spiked around and following the 2016 presidential election. Subsequently, the US raised import tariffs substantially. For example, the average rate on Chinese goods has increased from 3% to 21% between 2018 and 2020. The return of protectionism renewed the interest among policy makers and researchers worldwide in two classic questions in international economics. What are the effects of import tariffs in large open economies? What is the effect of uncertainty about trade policy in such countries? Two long-standing strands of research address these questions by using microeconomic data, analyzing the two questions in isolation, and focusing on selected trade episodes. A macroeconomic account of the average effects of both dimensions of US trade policy over many trade events is largely missing.

This paper aims at filling the gap. We provide evidence on the effects of import tariffs and trade policy uncertainty on the US economy in general equilibrium since the 1960s. Combining two traditions in the empirical macroeconomic literature, our identification approach uses both theory and narrative information to disentangle and estimate the effects of trade policy level and uncertainty shocks. We contribute to the literature on international trade along three main dimensions.

First, the empirical trade literature is mainly based on microeconomic data. For example, Fajgelbaum et al. (2019) estimate the impact of trade impediments in partial equilibrium. Then, they embed these estimates in a structural general equilibrium model. This approach delivers sharp identification and detailed insights into the economic mechanisms. But the aggregate effects are based on potentially strong behavioral and parametric assumptions and refer only to the long run as they are based on comparative statics. We complement these insights by starting from the opposite side. We estimate the short run general equilibrium effects using a flexible empirical framework in form of a Bayesian structural vector autoregression (SVAR) with minimal assumptions. Then, we use the identified shocks to determine the disaggregated impacts across US sectors and states.

The second contribution is to estimate both dimensions of US trade policy, shifts in the level of tariffs and in the uncertainty around these, in one encompassing model. By contrast, most of the empirical trade literature analyzes them separately, treating either one as orthogonal to the other.[1] This might be problematic because tariff changes and trade policy uncertainty often go

[1] Autor et al. (2016) and Fajgelbaum and Khandelwal (2022) review the literature on the effects of tariff changes

hand in hand, as the recent US trade disputes illustrate. In addition, identifying both level and uncertainty shifts within a single model has the advantage that the implications and importance of both dimension of trade policy can be compared consistently.

The third contribution is to complement the existing estimates based on single trade events, or shorter samples, with evidence from 60 years of quarterly data, containing all the previously considered events but also longer swings in US trade policy. For example, several studies investigate the impact of China's WTO accession in 2001 (Autor et al., 2013; Handley and Limão, 2017) or of the most recent US trade conflicts (Amiti et al., 2019; Flaaen et al., 2020; Cavallo et al., 2021). Others use granular data that start in the 1990s (Barattieri and Cacciatore, 2023; Boehm et al., 2023). These studies provide valuable insights into specific episodes and trade policies. We add evidence on their average effects.

Identifying both level and uncertainty shifts in one model is challenging and the literature has not come to a conclusion. We use sign restrictions on the contemporaneous responses of the variables for identification of first and second moment shocks to trade policy. The restrictions can either come from theory (Uhlig, 2005) or from historical records (Antolín-Díaz and Rubio-Ramírez, 2018). We combine both pieces of information. For theory, we set-up a canonical two-country dynamic stochastic general equilibrium (DSGE) model featuring stochastic volatility of import tariffs. We simulate the model using prior-predictive analysis and derive theory-consistent sign patterns of the impulse responses that are robust to parameter uncertainty. We augment these predictions with narrative sign restrictions from key historical episodes of US protectionism. We estimate the Bayesian SVAR on quarterly US macroeconomic data for the 1960Q-2019Q4 period, including the latest trade disputes and earlier ones.[2] The model includes customs duties and an index of trade policy uncertainty to capture first and second moment shocks to US trade policy. We remain agnostic about the signs of the effects on policy targets like GDP or the trade balance.

Regarding our first contribution, we find that both shocks to trade policy have broad general equilibrium effects. Exogenous increases in tariffs reduce imports, exports, and investment

and Handley and Limão (2022) the literature on the impact of trade policy uncertainty. Alessandria et al. (2021) is one of the few exceptions that analyze both changes in the level and uncertainty of tariffs in one framework. They study Chinese exports to the US, using China's switch to most-favored nation status in 1980 and a structural trade model with a time-varying probability of regime switching.

[2]The sample contains, for example, the Nixon shock in 1971, Ford's tariffs on energy imports in 1975, the GATT Tokyo and Uruguay Rounds concluding in 1979 and 1994, the creation of NAFTA in 1994, and the latest tariff increases in 2018/19.

strongly and persistently. Consumer prices increase and the exchange rate appreciates. Despite the improvement of the trade balance, output falls persistently below trend because all private domestic demand components contract. We estimate a general equilibrium import elasticity of –0.2 in the short run and of –0.8 after six years. The pass-through to import prices is 0.1 upon impact and 0.5 in the medium run. Results from local projections of disaggregated data on the tariff shocks suggest that imports, exports, and investment fall in nearly all sectors. The employment effects are ambiguous. Trade policy uncertainty shocks also affect macroeconomic dynamics. They depress imports and investment. However, output is less affected because the exchange rate tends to depreciate and exports to rise, compensating the domestic demand contraction. Across sectors, investment falls, while exports mostly increase. The employment effects are again ambiguous.

As to the second contribution, we document similarities but also differences in the effects of level and uncertainty shocks to US trade policy. The impulse responses show that protectionist tariff shocks are more detrimental than trade policy uncertainty shocks. Tariff shocks depress imports *and* exports and weigh particularly on private investment. Trade policy uncertainty shocks reduce imports, too, but because they raise exports the output effects are modest. We quantify the average importance of the two shocks. Both are macroeconomically relevant but to different degrees. Tariff shocks are about twice as important. They explain close to 10% of the unexpected variation in US output, whereas trade policy uncertainty shocks account for 5%.

For the third contribution, we estimate and compare the macroeconomic effects of the many shifts in US trade policy since the 1960s. Historical decompositions show that the Nixon and Ford tariff shocks in 1971 and 1975 left only small and short scars on GDP. Against this, the swing from protection in the 1980s (vis-à-vis Japan) to free trade in the 1990s (NAFTA, GATT/WTO) had large and long-lasting positive effects: quarterly output-to-trend increased by 1-3 log points for twenty years. The modest cost was a widening of the trade deficit by 0.5 percentage points of GDP per quarter over this period. 2016 reversed the swing. We find that the return to protectionism narrowed the trade deficit at the expense of depressing GDP. The estimated output costs for 2018/19 are 2%. Going forward, a structural scenario analysis suggests that reducing tariffs and uncertainty to their pre-2016 levels would unlock a cumulative output gain of 4% over three years.

Overall, the results imply that the gains of stable free trade relations can be higher than suggested by partial equilibrium or static general equilibrium trade models once the dynamic general equilibrium effects are accounted for. Moreover, the disaggregated results indicate that the capability of trade policy to reallocate economic activity or employment across sectors or space within a country is limited. Finally, the findings also inform policy makers and researcher that they need to be more concerned about the level of tariffs than about the uncertainty surrounding these.

**Relation to literature.** The findings relate to three strands of research on the effects of trade policies. First, the traditional empirical trade literature provides evidence based on microeconomic data. As a recent example, Barattieri and Cacciatore (2023) study the impact of temporary trade barriers on production networks and find no significant effects on employment in upstream industries and negative effects in downstream sectors. Boehm et al. (2023) use exogenous changes in most favored nation tariffs and estimate trade elasticities. We complement these insights with general equilibrium estimates, given that the macroeconomic literature on trade policy in large open economies is mainly theoretical. Going back to at least Mundell (1961), Keynesian models typically predict that a rise in domestic tariffs has contractionary effects under flexible exchange rates as the terms of trade improve, savings rise, and domestic demand falls.[3] We show that these theoretical predictions and the existing microeconomic estimates bear out in aggregate data. For example, Boehm et al. (2023) find a partial equilibrium import elasticity of –2 in the long run. We obtain a general equilibrium elasticity of –0.8, indicating non-negligible substitution within imports.

Other microeconometric studies focus on the effects of the uncertainty that surrounds trade policy. Using China's accession to the World Trade Organization (WTO) in 2001 as a natural experiment, Pierce and Schott (2016) document that the associated decrease in uncertainty about import tariffs boosted bilateral trade but reduced US manufacturing employment; Handley and Limão (2017) show that it raised Chinese exports to the US and lowered US prices significantly; and Feng et al. (2017) document a similar pattern for Chinese and European firms. Conversely, Alessandria et al. (2019) highlight wait-and-see behavior of US firms before China's accession that dampened trade. Crowley et al. (2018) use data on Chinese firms and document that firms subject to higher trade policy uncertainty engage in less international trade. We complement this microeconomic evidence by showing that these effects transmit to the macro-economy. But our

[3] Chan (1978) and Krugman (1982) substantiate Mundell's findings under extensions of nominal rigidities and money markets. Eichengreen (1981, 1983) finds that the effect can shortly be expansionary before turning recessionary in a dynamic open macro portfolio balance model. While we share the theoretical foundations with this earlier literature, our focus is empirical.

results paint a more benign picture of trade policy uncertainty because of the export-boosting general equilibrium exchange rate effects. Another explanation of the lower importance at the aggregate level would be that some of the differential effects across firms or industries cancel out.

The second strand of related literature aims at estimating the effects of economic (policy) uncertainty. The standard approach is to assume exclusion restrictions between first and second moment shifts (Bloom, 2009; Baker et al., 2016; Caldara et al., 2020). However, their is little theoretical guidance for such restrictions and in practice some researchers order uncertainty first and others the level of variables. In addition to the theoretical doubts, Kilian et al. (2022) show that exclusion restrictions are empirically invalid for identifying uncertainty shocks. A few articles allow for simultaneous feedback between first and second moments (Piffer and Podstawski, 2018; Berger et al., 2020; Ludvigson et al., 2021). These propose using instruments, shock restrictions, a combination of both, or options prices to disentangle level and uncertainty shocks. They study the impact of general macroeconomic or financial uncertainty. We complement this evidence by focusing on the first and second moments of trade policy. We document that second moment shocks are macroeconomically relevant but first moment shocks are more important.[4] Moreover, we propose using sign restrictions for the identification of both shocks. As standard trade theory is silent about the signs, we build a DSGE model with stochastic volatility for that purpose.

The third strand of related literature focuses on the US-China trade relations and in particular the trade war since 2016. Amiti et al. (2019) find that the 2018 tariffs imposed by the US have reduced imports and increased prices significantly. Fajgelbaum et al. (2019) reach a similar conclusion. They find complete pass-through of tariffs on US consumer prices and estimate welfare costs for US consumers of 0.3% of GDP. Cavallo et al. (2021) document complete pass-through at the border but not to retail prices, suggesting that domestic markups have fallen. Flaaen et al. (2020) provide evidence that US import tariffs on washers raised consumer prices more than one-to-one.

We complement these insights with estimates of the average pass-through of US tariff shifts since the 1960s and with estimates of the macroeconomic consequences of two specific shifts. We find a mean degree of pass-through to import prices of 0.5, suggesting that the US has been able to affect world prices in previous trade conflicts. Furthermore, our historical decompositions suggest a more

[4] Aonther difference to the articles that look at macroeconomic or financial uncertainty is that these uncertainty measures affect domestic firms directly, whereas trade policy uncertainty is more relevant for foreign exporters.

positive assessment of the WTO than Autor et al. (2013), who document that China's accession led to many job losses in the US. While we confirm their findings with macroeconomic data, showing that the employment effects were predominantly negative, we find a sustained investment and output boom in the US in the 2000s due to a long sequence of free trade shocks. Consistent with the larger gains from free trade, our model yields larger estimates of the costs of the 2018/19 trade war. They are an order of magnitude larger than those of Fajgelbaum et al. (2019), suggesting that it is important to take into account the short run adjustment costs to shifts in trade policy that comparative statics neglect.

The remainder of the paper is structured as follows. Section 2 lays out the theoretical model. Section 3 describes the data and the empirical methodology. Section 4 presents the results. Section 5 summarizes the robustness, while Section 6 concludes.

# 2 A small model of a large open economy

We use a canonical DSGE model of a large open economy to derive general equilibrium sign restrictions for the identification of tariff shocks and trade policy uncertainty shocks. The model features nominal frictions, following the tradition of Mundell (1961), Chan (1978) and Krugman (1982), in the form of rigid producer currency pricing. It contains two countries and two goods, following Obstfeld and Rogoff (1995), and two nominal noncontingent bonds. We keep the model tractable for three reasons. First, we want to limit the number of functional and parametric assumptions to a necessary minimum. Second, many additional features of large open economy models, like home bias or local currency pricing, typically change the quantitative properties of the model, such as exchange rate volatility or cross-country correlations, but not the qualitative implications. Third, we solve the model with third-order perturbation methods many times to derive a range of impulse responses to trade policy uncertainty shocks for alternative parameter values so we need to minimize computation time.

## 2.1 Households

The model consists of two countries with a constant number of households and firms. The countries are symmetric in their structure but may differ in size. Households are indexed by $z \in [0, 1]$. We assume that househols $z \in [0, n]$ live in the domestic economy and households $z \in (n, 1]$ in the rest of the world so that $n$ measures the fraction of the domestic economy in the world economy and the global population is normalized to 1. A representative domestic household $z$ maximizes

$$E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{d_t^1 \left(C_t^1 (z)\right)^{1-\sigma}}{1-\sigma} + \frac{\chi}{1-\epsilon} \left( \frac{M_t^1 (z)}{P_t^1} \right)^{1-\epsilon} - \frac{\kappa}{1+\eta} \left( L_t^{1,S} (z) \right)^{1+\eta} \right). \tag{1}$$

$\beta \in (0, 1)$ is the discount factor, $C_t^1 (z)$ real consumption, $d_t^1$ a demand shock, $M_t^1$ nominal money, $P_t^1$ the consumption price index, $L_t^{1,S} (z)$ labor supply, and the superscript denotes country 1.

The budget constraint of household $z$ is

$$\begin{aligned} & P_t^1 C_t^1 (z) + M_t^1 (z) + T_t^1 + B_t^{1,1} (z) + S_t^{1,2} B_t^{2,1} (z) \\ = \; & M_{t-1}^1 (z) + R_{t-1}^1 B_{t-1}^{1,1} (z) + S_t^{1,2} R_{t-1}^2 B_{t-1}^{2,1} (z) \left( 1 - \frac{\psi}{2} B_{t-1}^{2,1} \right) + W_t^1 L_t^{1,S} (z) + \Pi_t^1, \end{aligned} \tag{2}$$

where $T_t^1$ are nominal tax obligations and $B_t^{1,1} (z)$ a nominal risk-free bond in domestic currency held by the domestic household and paying gross interest $R_{t-1}^1$. $S_t^{1,2}$ is the nominal exchange rate defined as the price of the foreign country's currency in terms of the home country's currency, such that an increase implies a depreciation of the domestic currency. $B_t^{2,1} (z)$ is a risk-free bond denominated in foreign currency paying the risk-free gross rate $R_{t-1}^2$. Adjusting foreign bond holdings implies a cost governed by the parameter $\psi > 0$ that induces stationarity of the model. Finally, $W_t^1$ is the nominal wage and $\Pi_t^1$ are per capita profits of the firms owed by the domestic households. We obtain the first order conditions by maximizing (1) s.t. (2) and rule out Ponzi schemes. The problem of the representative foreign household is isomorphic in structure.

### 2.2 Firms

Each country produces a homogeneous consumption good in two stages. At the upstream, firms are imperfectly competitive. They produce a variety of differentiated intermediate goods. These are used at the downstream domestically and abroad by perfectly competitive firms that produce a final good. Since upstream firms have monopoly power, output is demand determined in the short-run when prices adjust sluggishly. We assume a constant number of upstream firms, each producing exactly one intermediate good. The number of firms corresponds to the number of households in each country and firms are indexed by $z$. Firm $z \in [0,n]$ is located at home and firm $z \in (n,1]$ in the rest of the world.

### 2.2.1 Final good producers

Intermediate goods are traded internationally and combined to produce the domestic final good with the CES production function

$$Y_t^{S,1} = \left[ \int_0^n y_t^{1,1}(z)^{\frac{\theta-1}{\theta}} dz + \int_n^1 y_t^{2,1}(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}}, \tag{3}$$

with $\theta > 1$ the elasticity of substitution. $y_t^{1,1}(z)$ are intermediate goods produced and used domestically, $y_t^{2,1}(z)$ are intermediate goods produced abroad and imported; and analogously for foreign final goods producers, such that $y_t^{1,2}(z)$ are exports and $y_t^{2,1}$ imports of the home country.

The final good producer at home solves the profit maximization problem

$$\max_{y_t^{1,1}(z), y_t^{2,1}(z)} P_t^1 Y_t^{S,1} - \int_0^n p_t^1(z)\, y_t^{1,1}(z)\, dz - \int_0^n S_t^{1,2}\left(1+\tau_t^1\right) p_t^2(z)\, y_t^{2,1}(z)\, dz$$

subject to the production function (3), where $p_t^1(z)$ and $p_t^2(z)$ are the prices of the intermediate goods in producer's country currency and $\tau_t^1$ is an import tariff of home at the border, implying that the law of one price does not hold in general. The first order conditions to the maximization problem yield the demand for home and foreign intermediate good $z$:

$$y_t^{1,1}(z) = \left(\frac{p_t^1(z)}{P_t^1}\right)^{-\theta} Y_t^{S,1} \text{ and } y_t^{2,1}(z) = \left(\frac{S_t^{1,2}(1+\tau_t^1)\, p_t^2(z)}{P_t^1}\right)^{-\theta} Y_t^{S,1},$$

which depend, other things equal, negatively on the relative price of the good and positively on aggregate production, and imports depend negatively on the tariff rate. The zero profit condition implies that the price (index) of one unit of the final good equals its minimal cost of production

$$P_t^1 = \left[ \int_0^n p_t^1(z)^{1-\theta} dz + \int_n^1 \left(S_t^{1,2}\left(1+\tau_t^1\right) p_t^2(z)\right)^{1-\theta} \right]^{\frac{1}{1-\theta}}.$$

The problem of the final good producer abroad, and the consumer price index, are analogously.

### 2.2.2 Intermediate goods producers

Domestic intermediate firms produce with a linear production function using labor: $y_t^{S,1}(z) = a_t^1 L_t^{D,1}(z)$, where $a_t^1$ is a technology shock; foreign firms produce analogously. Aggregate demand for domestic intermediate good $z$ is a weighted average of domestic and foreign demand for that good: $y_t^{D,1}(z) = n y_t^{1,1}(z) + (1-n)\, y_t^{1,2}(z)$. Taking demand and the production function as given, domestic firm $z$ sets $p_t^1(z)$ to maximize profits

$$\Pi_t^1(z) = p_t^1(z)\, y_t^{D,1}(z) - W_t^1 L_t^{D,1}(z) - AC_t^1(z)$$

and takes into account a quadratic cost of price adjustment $AC_t^1(z) = \frac{\phi}{2}\left(\frac{p_t^1(z)}{p_{t-1}^1(z)} - 1\right)^2 p_t^1 y_t^1$, following Rotemberg (1982).

## 2.3 Government policy and equilibrium

We assume that trade policy is exogenous in both countries. The domestic tariff rate follows an AR(1) process with stochastic volatility:

$$\begin{aligned} \tau_t^1 &= (1-\rho)\,\tau^1 + \rho\tau_{t-1}^1 + \omega_{t-1}\varepsilon_t \\ \omega_t &= (1-\rho)\,\omega + \rho\omega_{t-1} + \mu\nu_t, \end{aligned}$$

where $\varepsilon_t$ and $\nu_t$ are *iid* standard normal innovations to the level and variance of tariffs, respectively, and variables without time-subscript denote their steady state. We refer to $\tau_t^1$ as tariff shocks and to $\omega_t$ as uncertainty shocks. Tariff proceeds are redistributed to domestic households as a lump-sum. We allow for retaliation of the foreign country in an ad-hoc form:

$$\tau_t^2 = (1-\rho)\,\tau^2 + \rho\tau_{t-1}^2 + \zeta\omega_{t-1}\varepsilon_t,$$

with $\zeta \in [0,1]$. $\zeta = 0$ is no retaliation and $\zeta = 1$ is full retaliation. Central banks in both countries keep the nominal money supply constant.[5] The equilibrium definition is standard. The

[5] Assuming a Taylor rule in both countries yields qualitatively the same results but complicates the simulation of the model for alternative parameter values as more parameter combinations yield indeterminacy/instability.

equilibirum is symmetric as households and firms each face the same problem. Goods, labor, and money markets clear, and both bonds are in zero net supply.

## 2.4 Results

We calibrate some parameters and specify distributions for others to solve the model and obtain impulse responses to tariff level and uncertainty shocks. Table 1 summarizes the choices. The frequency is quarters. We interpret country 1 as the US. We set $\beta = 1/1.01, \theta = 6, \kappa = \frac{\theta-1}{\theta}, \epsilon = 3, \chi = (1-\beta)\left(\frac{\theta-1}{\kappa\theta}\right)^{\frac{\epsilon-1}{2}}, \psi = 0.0025, \tau^1 = \tau^2 = 0$ and assume zero inflation in steady state. These are standard values. We calibrate them because they mainly affect the deterministic steady state.[6]

The remaining parameters are more important for the dynamics. We specify independent distributions, which are typically used as priors for the estimation of DSGE models. For the country size $n$, we use a beta distribution with mean 0.5 and standard deviation 0.25. We use the same distribution for the retaliation parameter $\zeta$ but with mean 0.6, reflecting that other countries typically respond with counter measures but less than one-for-one. Another important parameter for the dynamics is the persistence of the shocks $\rho$, which is central to wealth effects. We specify a fairly high autocorrelation of the shocks as a baseline, following Caldara et al. (2020), but allow for lower values as well, by using a beta distribution with mean 0.95 and standard deviation 0.025. The price adjustment cost parameter $\phi$ determines how much output is demand determined. We use a normal prior distribution with mean 60 and standard deviation 15. Finally, the preference parameters are relevant for the dynamics as they determine the labor response and the willingness of households to substitute consumption intertemporally. We allow for variation in the (inverse) Frisch labor supply elasticity $\eta$ and the coefficient of relative risk aversion $\sigma$. For both, we choose inverse gamma distributions with mean 1 and standard deviation 0.5. The calibrated and mean values yield a quarterly interest rate of 1% in steady state, an interest rate elasticity of money demand of $-0.33$, a consumption elasiticy of 0.33, and a markup over marginal cost of 20%.

We draw 10,000 parameter combinations from the distributions. For each draw, we compute the impulse responses to a tariff level shock and to a trade policy uncertainty shock. For the latter, we compute a third-order approximation with pruning, following Fernández-Villaverde et al. (2015)

[6] We set the import tariff to zero to obtain a closed-form solution for the steady state and minimize simulation time. The average effective import tariff in the US since the 1960s is 0.036, not far from our calibrated value.

| Parameter | Symbol | Value/Distribution | Mean | S.d. |
|---|---|---|---|---|
| *Calibrated* | | | | |
| Discount factor | $\beta$ | 1/1.01 | | |
| Disutility hours | $\kappa$ | 0.8333 | | |
| Elasticity money demand | $\epsilon$ | 3 | | |
| Utility money | $\chi$ | 0.0099 | | |
| Elasiticity substition goods | $\theta$ | 6 | | |
| Transaction costs bonds | $\psi$ | 0.0025 | | |
| Steady state tariff rate | $\tau^1, \tau^2$ | 0 | | |
| S.d. tariff rate shocks | $\omega^1$ | 0.01 | | |
| S.d. tariff volatility shocks | $\mu^1$ | 0.01 | | |
| *Distributions* | | | | |
| Risk aversion | $\sigma$ | Inverse gamma | 1 | 0.25 |
| Inverse Frisch Elasticity | $\eta$ | Inverse gamma | 1 | 0.25 |
| Country size | $n$ | Beta | 0.5 | 0.25 |
| Persistence tariff shocks | $\rho$ | Beta | 0.95 | 0.025 |
| Price adjustment cost | $\phi$ | Normal | 60 | 15 |
| Retaliation | $\zeta$ | Beta | 0.6 | 0.25 |

Table 1: Parameter values and distributions for quarterly frequency.

and Basu and Bundick (2017), and simulate the model for 1000 periods without shocks to obtain the stochastic steady state, that is, the ergodic mean in the absence of shocks. We discard the first 1000 periods as burn-in and feed in a trade policy uncertainty shock that doubles the standard deviation of tariff level shocks.

Figure 1 shows the responses to a shock of 1 percentage point (pp) to the level of the tariff rate of the home country over 12 quarters. The solid line refers to the point-wise median and the shaded area to the 68% credible set. The tariff rate increases persistently for more than three years. This raises the domestic price of imported goods and the consumer price level, whereas producer prices remain initially unchanged due to the price adjustment costs. Because of the consumer price level increase, the nominal exchange rate appreciates and the terms of trade improve. As foreign goods are relatively more expensive, households substitute away from them toward domestic goods. Exports fall as the exchange rate appreciates and foreign demand declines. However, as imports fall more than exports, the trade balance tends to rise. Labor and private consumption fall (not shown) because domestic households are wealthier due to the terms of trade effect and substitute more expensive goods for leisure. Output tends to decline.

Figure 2 shows the responses to a trade policy uncertainty shock that doubles the standard deviation of innovations to tariff level shocks of the home country. As uncertainty about import tariffs rises, imports fall persistently. Domestic firms have an upward pricing incentive, as in

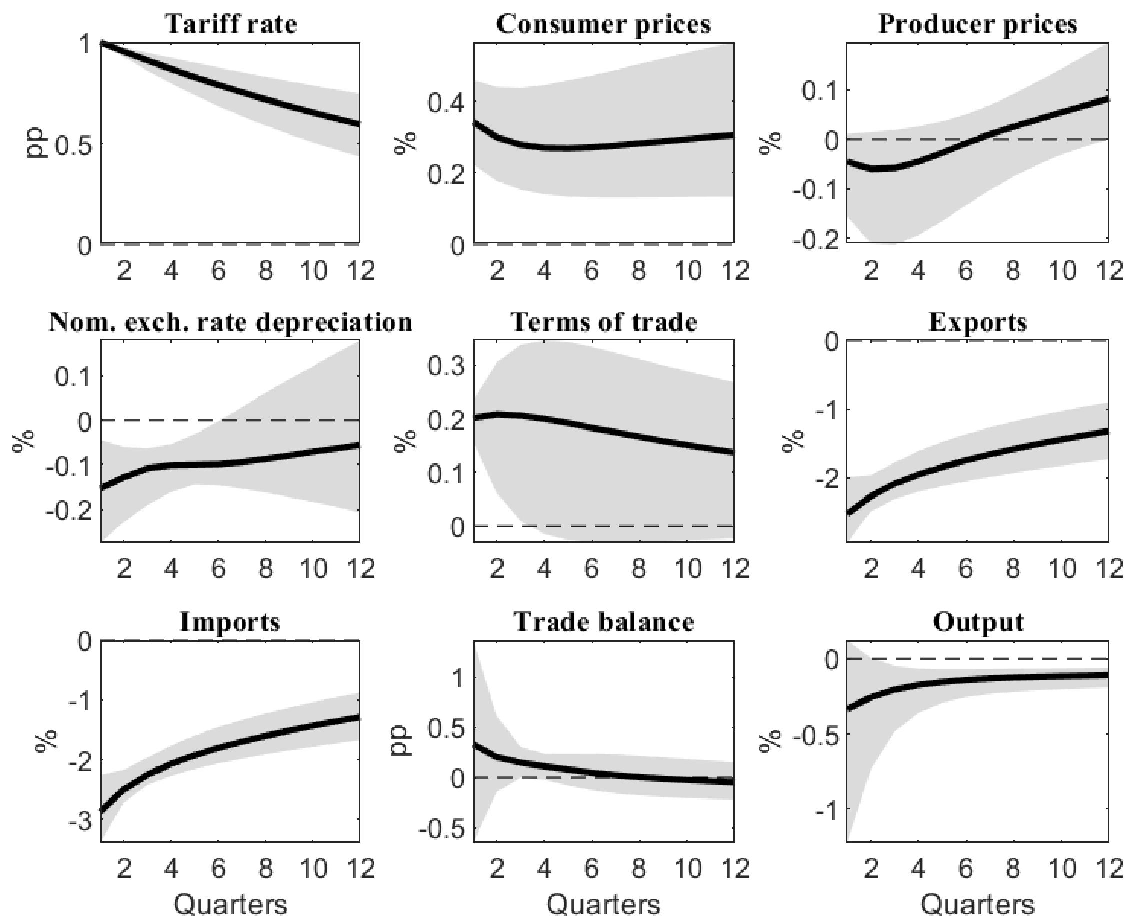



Figure 1: Impulse responses to tariff level shock. *Notes:* The figure shows the responses to a shock of 1 percentage point (pp) to the level of the tariff rate of the home country. The solid line refers to the point-wise median and the shaded area to the 68% credible set.

Fernández-Villaverde et al. (2015), and raise producer prices and markups. This feeds into consumer prices. Domestic households want to precautionary save more than foreign households, which raises demand for external assets. As domestic demand falls more than foreign demand, the nominal exchange rate tends to depreciate, exports to increase, and the trade balance to improve. The depreciation further pushes up consumer prices. Output tends to rise initially and then to fall.

The short positive output effect is a key difference to Caldara et al. (2020) who find a negative output response throughout. They assume full retaliation, which eliminates the differential demand and saving effects and depresses output in both countries. In any case, we will not use the sign of the output response for the identification of trade policy uncertainty shocks. Finally, Figures A.1

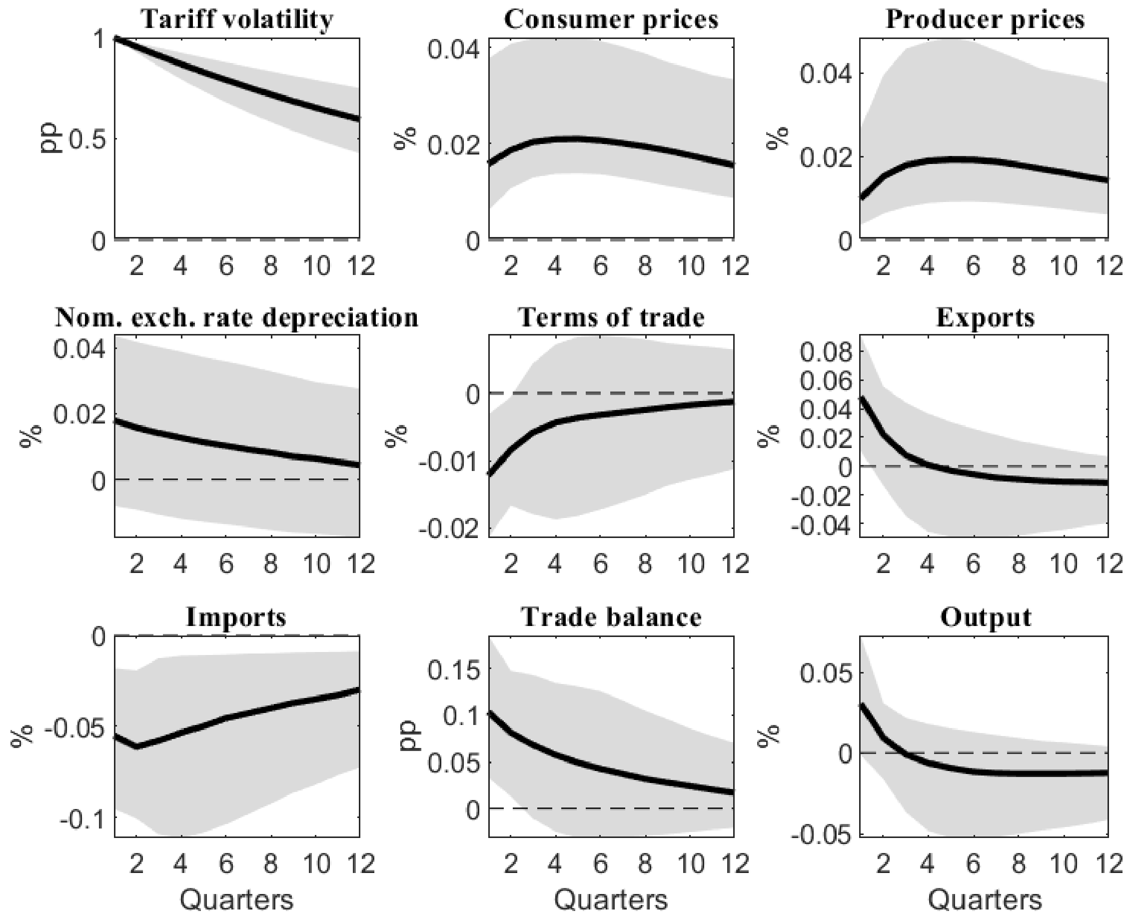



Figure 2: Impulse responses to trade policy uncertainty shock. *Notes:* The figure shows the responses to a trade policy uncertainty shock that doubles the standard deviation of innovations to tariff level shocks of the home country. The solid line refers to the point-wise median and the shaded area to the 68% credible set.

and A.2 in Online Appendix A show the robust theoretical responses to home demand shocks and home supply shocks, which we also use for identification in the next section.

# 3 Empirical strategy and data

## 3.1 Bayesian SVAR and data

We estimate a reduced form Bayesian VAR that takes the following form:

$$y_t = \nu + \sum_{i=1}^{p} A_i y_{t-i} + u_t, \tag{4}$$

where $y_t$ denotes the vector of endogenous variables, $\nu$ is a vector of intercepts, $A_i$ are regression coefficient matrices, and $u_t$ mean-zero $i.i.d.$ reduced form errors with covariance matrix $\mathbb{E}(u_t u_t') = \Sigma$.

In $y_t$, we use quarterly data on real GDP, real exports, real imports, the consumer price index, the nominal effective exchange rate, real customs duties, and trade policy uncertainty for the United States from 1960Q1 to 2019Q4. We exclude the Covid-19 pandemic. All series enter $y_t$ in log levels. Nominal variables are deflated by the consumer price index. Table A.1 provides details about the sources, data, and variable construction.

We choose these variables in accordance with the theoretical model of Section 2. Most of the variables allow disentangling tariff shocks and trade policy uncertainty shocks from each other, and from demand and supply shocks, as theory implies distinct sign patters for their responses. We use customs duties to include a measure of tariff proceeds that should increase after a positive tariff level shock. Similarly, we employ the news-based measure of trade policy uncertainty of Caldara et al. (2020) to identify shocks to that variable.[7] The inclusion of consumer prices improves the identification of supply and demand shocks for which the price responses differ. We include output as a key variable of interest. The order of the variables in $y_t$ does not matter as we do not rely on a recursive identification. We estimate (4) with $p = 4$ as we have quarterly data.

The upper panel in Figure 3 displays the evolution of US customs duties relative to GDP since 1960. The US applies tariffs on imports and customs duties are the proceeds from these taxes. Duties fluctuate between 0.15 and 0.40 percent of GDP. Until the end of the 1980s, the series is increasing, then decreases to reach a rather constant low level from the early 2000s onward. It spikes in 1971 and 1975 and at the onset of the US-China trade war in 2018. The lower panel displays the trade policy uncertainty measure of Caldara et al. (2020). It is based on occurrences of US newspaper articles which include terms related to both trade policy and uncertainty. The series shows major spikes in 1971, 1975 and 1993 although these are relatively low when compared to the period from 2016 onward when trade policy uncertainty rises markedly.

The reduced form VAR in (4) can be expressed in a structural form as

$$B_0 y_t = \vartheta + \sum_{i=1}^{p} B_i y_{t-i} + \varepsilon_t, \tag{5}$$

[7]The news-based measure from Baker et al. (2016) only starts in 1985 and the earnings calls-based measures from Caldara et al. (2020) and Hassan et al. (2019) in the 2000s.

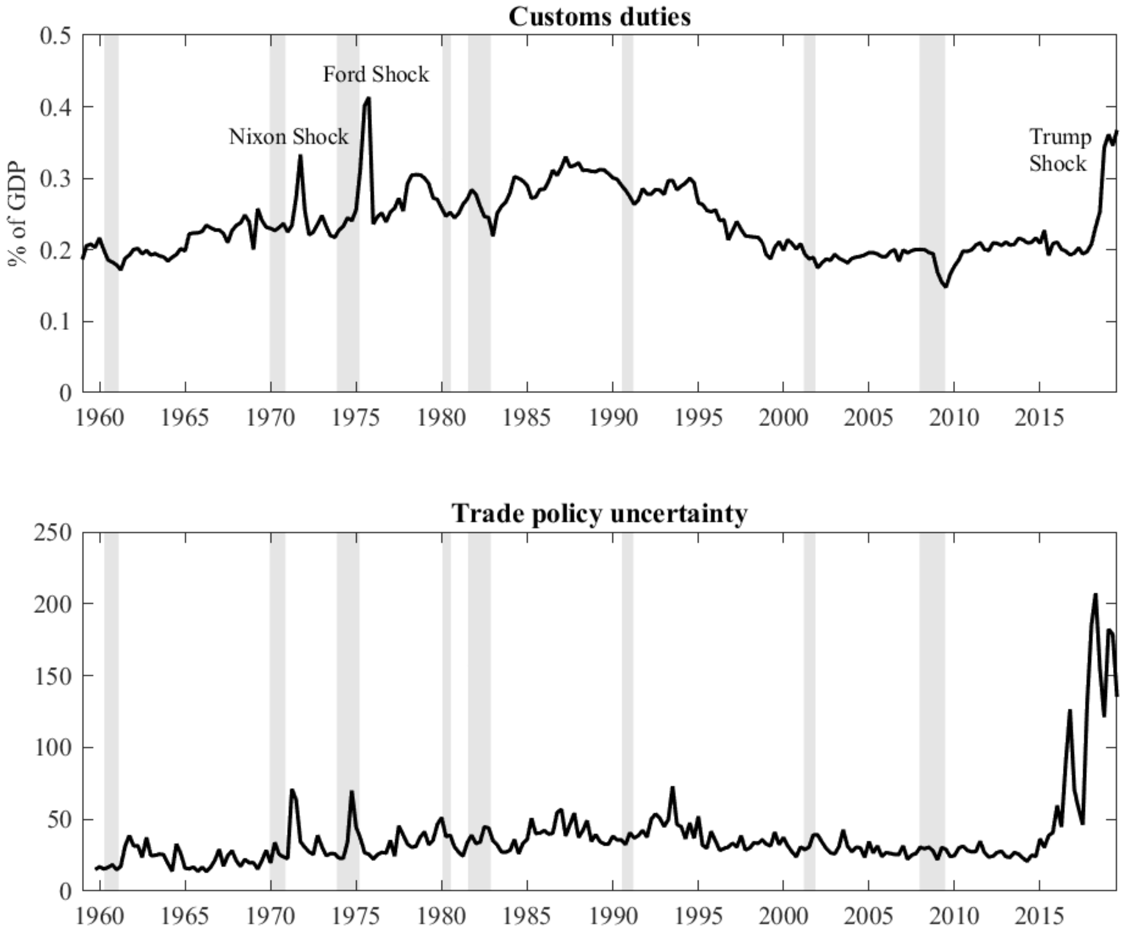



Figure 3: US customs duties relative to GDP and trade policy uncertainty. *Notes:* The vertical grey areas represent NBER recession dates. The trade policy uncertainty index is from Caldara et al. (2020).

where $\varepsilon_t$ are independent structural shocks. These are related to the reduced form errors via the linear transformation $u_t = B_0^{-1}\varepsilon_t$. Thus, $B_0^{-1}$ contains the impact effects of the structural shocks on the endogenous variables in $y_t$. By assuming a unit variance for the uncorrelated structural shocks, $\mathbb{E}(\varepsilon_t \varepsilon_t') = I_n$ (an $n$ x $n$ identity matrix), the reduced form covariance matrix $\Sigma$ is related to the structural impact matrix as $\Sigma = \mathbb{E}(u_t u_t') = B_0^{-1}\mathbb{E}(\varepsilon_t \varepsilon_t')B_0^{-1\prime} = B_0^{-1}B_0^{-1\prime}$. The coefficients of the reduced form are related to the coefficients of the structural form as $A_i = B_0^{-1}B_i$ and $\nu = B_0^{-1}\vartheta$.

### 3.2 Identification

To identify the structural parameters, we apply traditional sign restrictions, following Faust (1998) and Uhlig (2005), and narrative sign restrictions, following Antolín-Díaz and Rubio-Ramírez (2018). We place the traditional sign restrictions on the impact matrix $B_0^{-1}$. They are shown in Table 2 and based on the theoretical impulse responses of Section 2.

| Variable | Shock Tariff | TPU | Supply | Demand |
|---|---|---|---|---|
| Customs duties | + | − | * | + |
| Trade policy uncertainty | * | + | * | * |
| Imports | − | − | * | + |
| Exports | − | * | + | * |
| Consumer prices | + | + | − | + |
| Nominal exchange rate | − | * | − | + |
| GDP | * | * | + | + |

Table 2: Sign restrictions on impact responses. *Notes:* The table shows the sign restrictions on the impact responses of the Bayesian SVAR in (5) used to identify shocks to the tariff level, trade policy uncertainty (TPU), domestic demand, and domestic supply. A decrease in the nominal exchange rate denotes a US-Dollar appreciation. Customs duties, GDP, imports, and exports are in real terms. * denotes no restriction.

To identify exogenous changes in the level of tariffs, we use several of the sign restrictions implied by the impulse responses in Figure 1. We assume that a positive tariff shock increases the volume of real customs duties, that is, an increase in the tariff rate leads to an increase in tariff proceeds. Real imports decrease because their final price including tariffs is higher such that domestic households switch their expenditure toward domestic goods. Real exports decrease as import costs of inputs increase, pushing up consumer prices, and firms switch to producing goods for domestic consumption. The nominal exchange rate appreciates due to expenditure switching toward domestic goods, which entails a reduced demand for foreign currency by domestic agents. These sign restrictions are in line with other (Keynesian) open economy models (Mundell, 1961; Chan, 1978; Krugman, 1982; Barattieri et al., 2021; Caldara et al., 2020; Erceg et al., 2023).

We do not impose a sign restriction on the response of output as the theoretical impact effect is ambiguous (Figure 1). Moreover, it is an outcome variable of main policy interest and we want to stay agnostic, following the spirit of Uhlig (2005), and let the data decide on the sign of the effect. Finally, we do not use the theory-implied sign of the terms of trade effect because this variable is typically the mirror image of the nominal exchange rate and we therefore do not include it in the

SVAR to keep the empirical model tractable.

To identify trade policy uncertainty (TPU) shocks, we assume that a positive shock raises the index of trade policy uncertainty. According to Figure 2, imports decrease persistently. Thus, we assume that the shock also lowers customs duties on impact. Moreover, the model predicts a persistent increase in consumer prices, so we impose this sign. We do not use the theory-implied signs of the other responses as these are less clear. While exports tend to increase and the exchange rate to depreciate, the responses are sensitive to parameter values. For the trade balance the model prediction is clear but we leave its response unrestricted as it is also a key outcome variable.

Instead, we whet inference by identifying domestic demand and supply shocks, following the argument of Canova and Paustian (2011), and to ensure that the signs of the two trade policy shocks are distinct from important drivers of the US business cycle. We obtain the signs from the predictions of the DSGE model (Figures A.1 and A.2). The theoretical signs are robust to parameter uncertainty and in line with standard open economy New Keynesian models (de Walque et al., 2006) and the FED's sigma model (Erceg et al., 2006).

Relying on these traditional sign restrictions yields a set of possible candidate solutions for $B_0^{-1}$. Narrative sign restrictions that restrict the effects of shocks during historical periods can shrink this set and sharpen inference. To derive suitable narrative sign restrictions, we draw from the customs duties series and trade policy uncertainty index in Figure 3 and the historical account of US trade policy in Irwin (2017). Table 3 summarizes the narrative restrictions.

We use periods of unanticipated major changes in actual tariff levels that are at the same time visible in the customs duties series.[8] President Nixon imposed a 10% tariff surcharge on all dutiable imports in 1971Q3, dubbed the 'Nixon shock' by historians (Irwin, 2013). President Ford induced a second unanticipated shock in 1975Q1, when he announced and implemented higher taxes on oil imports. This happened a few weeks after Congress had voted on the 1974 Trade Act that was intended to liberalize trade. Moreover, we use President Trump's steel and aluminum tariffs enacted in 2018Q1. The tariffs were announced and implemented within the same quarter and retaliative actions were exercised only beginning in the following quarters. For these episodes, we specify a positive sign of the tariff policy shock and assume that it is the most important driver

[8] Anticipation of tariff policy is an important concern as anticipated changes in taxes may have different effects than unanticipated changes (Mertens and Ravn, 2012). Therefore, we choose only narrative episodes where announcement and implementation fall within the same quarter.

| Period | Shock | Sign | Variable | Contribution | Narrative |
|---|---|---|---|---|---|
| 1971Q3 | Tariff | + | Customs duties | largest | Nixon shock |
| 1975Q1 | Tariff | + | Customs duties | largest | Ford shock |
| 2008Q4 - 2009Q1 | Tariff | | Imports | smallest | Great Recession |
| 2018Q1 | Tariff | + | Customs duties | largest | Steel and aluminum tariffs |
| 1971Q3 | TPU | + | TPU | largest | Nixon shock |
| 1975Q1 | TPU | + | TPU | largest | Ford shock |
| 2016Q4 - 2017Q1 | TPU | + | TPU | largest | Trump election and inauguration |
| 2018Q1 | TPU | + | | | Trump shock |
| 2019Q2 - 2019Q3 | TPU | + | | | Trump shock |

Table 3: Narrative sign restrictions. *Notes:* The table shows the narrative sign restrictions on the shocks and on the historical decomposition of the variables in the Bayesian SVAR in (5) used to identify shocks to the level of tariffs and to trade policy uncertainty (TPU). The sign entry + means a positive shock in that period and variable names denote the variable to which the shock contributes most (largest) or least (smallest) in that period.

of customs duties. In contrast, governments refrained from increasing tariffs during the Great Recession, being aware of the adverse consequences of the Smoot-Hawley tariffs during the Great Depression (Bown and Crowley, 2013). We define a fourth narrative sign restriction that restricts the tariff shock to be the least important driver of imports in 2008Q4-2009Q1. Concerning the trade policy uncertainty shock, we place corresponding restrictions for the Nixon and Ford shock, as trade policy uncertainty spikes considerable during these quarters. Moreover, we use Trump's election and presidency to place additional narrative restrictions on the uncertainty shock.

## 3.3 Estimation

Estimation and inference are Bayesian and follow Antolín-Díaz and Rubio-Ramírez (2018). We use a Minnesota prior with standard shrinkage parameters (Giannone et al., 2015) in combination with a sum-of-coefficients prior (Doan et al., 1984) and a dummy-initial-observation prior (Sims, 1993). The variance for the priors on the reduced form coefficients is given by $var((A_i)_{jj}) = \frac{\lambda^2 \psi_j}{i^\alpha}$, where $i$ denotes the lag and $j$ the variable. The tightness is $\lambda = 0.2$, the decay is $\alpha = 2$, and the scales $\psi_j$ are set to the OLS residual variance of an autoregressive model for each variable $j$. The variance for priors on the exogenous variables are set to 1,000.

Identification via sign restrictions does not yield point estimates but sets of possible parameter intervals for the elements in $B_0^{-1}$. We obtain 1000 admissible draws. These are also used for inference, that is, they yield an indication of the uncertainty around the pointwise median estimates. We report point-wise median and percentiles of impulse responses, as it is common in the literature.[9]

# 4 The macroeconomic effects of US trade policy

In this section, we present the estimated tariff shocks and trade policy uncertainty shocks as well as impulse responses. Then, we gauge the importance of both shocks for the US business cycle and estimate their sectoral and spatial effects. Finally, we perform a structural scenario analysis to quantify the output gains of reversing the protectionist measures of 2016-19.

## 4.1 Estimated tariff shocks and trade policy uncertainty shocks

Before we quantify the macroeconomic effects of tariff shocks and trade policy uncertainty shocks, we discuss the two estimated shock series to develop a notion about the historical events in US trade policy that the shocks capture. The two upper panels of Figure 4 plot the median tariff shocks and the cumulative version thereof. The largest spikes occur in 1971, 1975, and 2018/19. These are the periods with the largest changes in tariffs and customs duties revenues and for which we have specified narrative sign restrictions. There are also two large drops in the first quarter of 1972 and 1976, respectively. The tariffs under Nixon and Ford were quickly withdrawn such that tariffs reached their prior levels, captured as two large negative shocks. The third largest positive spike in the series takes place in 2018 when the US increased tariffs mainly on China.

The cumulative series displays a sequence of tariff reduction shocks in the mid-1970s. Through

[9]The literature has made substantial recent progress on inference in Bayesian models, which is important to take into account when interpreting the results. First, Baumeister and Hamilton (2015, 2020) and Watson (2019) remark that readers are used to associating error bands with sampling uncertainty, but in large-sample sign-restricted SVARs these error bands only result from the prior for the rotation matrix $Q$, not sampling uncertainty. Inoue and Kilian (2020) point out that the share of uncertainty resulting from the prior on $Q$ tends to be rather small in most applications, in particular, when assuming several sign restrictions. Our results are not based on a large sample and we use a large number of different sign restrictions. In this case, the inference summarizes both prior uncertainty and sampling uncertainty. We report the full set of impulse responses in Figure A.3 to provide another sense of the uncertainty around the estimates.

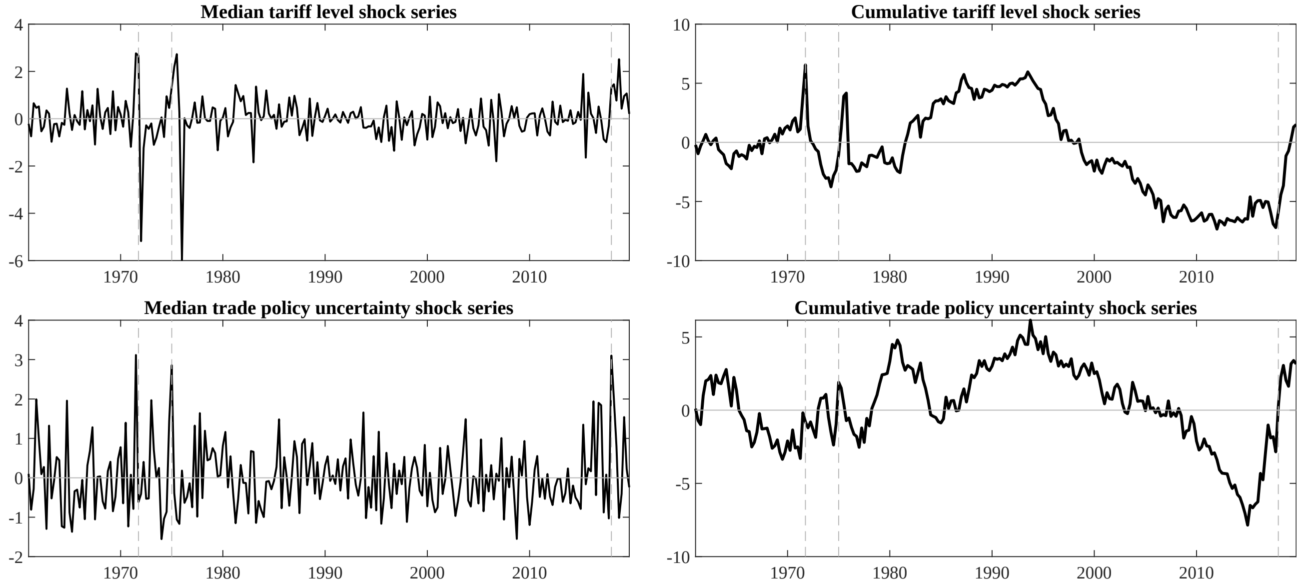



Figure 4: Estimated tariff level shocks and trade policy uncertainty shocks. *Notes:* The figure shows the estimated median shocks to the tariff level and to trade policy uncertainty (left panels) and their cumulative versions (right panels). Grey dotted vertical lines show periods of Nixon, Ford, and Trump shocks.

the mid-1990s, we estimate a series of protectionist shocks. Then, cumulative tariff level shocks fall again until the second half of the the 2000s. The first major trade policy event in the sample is the sixth round of multilateral trade negotiations by the members of the General Agreement on Tariffs and Trade (GATT), known as the Kennedy Round, which was concluded in 1967.[10] As a consequence, US average tariffs on dutiable imports decreased from 14% in 1967 to about 6% by 1975 (Irwin, 2017). The cumulative shock series shows consecutive drops until the mid-1970s.

From 1980 to 1984 the share of imports that was covered by some type of trade restrictions increased from 12% to 21% (Irwin, 2017) and the shock series rises in the early 1980s. The US increased, for instance, tariffs on Japanese trucks in August 1980 and on motorcycles in 1983 (Feenstra, 1989). Moreover, quotas in various industries like steel and textiles constituted a major element of US trade policy during this period. Another increase in tariffs was enacted in 1987 when the US imposed tariffs on computers, televisions, and power tools from Japan (Irwin, 2017); the series displays another notable uptick.

In the 1990s trade policy became less restrictive. In 1993 the North American Free Trade Agreement (NAFTA) was approved by Congress and the GATT Uruguay Round established the

[10]Prior to the Kennedy Round, the 25% ‘chicken tax’ on trucks imported from Europe and imposed by President Johnson in 1964 is a tariff that is still active today (Lawrence, 2009).

WTO. This led to a reduction in tariffs and non-tariff barriers over a horizon of 10 years, thereby explaining the series of easing shocks starting after 1993. Moreover, permanent normal trade relations were established with China in 2000, which led to China's WTO accession. From 2002 to 2007, the US concluded several free trade agreements but the next round of GATT negotiations, the Doha round, failed and it was put to rest in 2015. During the Great Recession in 2008/09, there was no major increase in tariffs except that the Obama administration levied duties on car and truck tires from China (Irwin, 2017). The final major rise in the shock series is related to the tariffs by President Trump on steel and aluminum and on imports from China in 2018/19.

The estimated trade policy uncertainty shocks partially mirror these developments. However, the largest shocks typically occur a few quarters before the largest spikes of the tariff level shocks, indicating that uncertainty may rise before actual tariffs change. This is best visible in the quarters preceding the 2018-20 US-China trade dispute. The cumulative uncertainty shocks rise more than a year before the cumulative level series picks up. Moreover, Figure A.5 shows by means of historical decompositions that level shocks are much more important for the dynamics of customs duties than uncertainty shocks and that uncertainy shocks are more relevant for the time-variation in the trade policy uncertainty index than level shocks, indicating that the model successfully disentangles the two dimensions of US trade policy.

### 4.2 Dynamic effects and trade elasticities

The top panels of Figure 5 present the macroeconomic effects of a tariff level shock over a horizon of 32 quarters. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets. Figure A.3 shows the responses for all draws. Figure A.4 shows the estimated responses to domestic demand and domestic supply shocks.

A positive tariff level shock of one standard deviation raises customs duties by about 5% on impact.[11] Thereafter, duties fall slowly. It takes more than eight years for them to return to

[11] A model where we replace customs duties with the import-weighted average tariff rate, calculated as customs duties relative to imports, shows that the tariff level shock raises the tariff rate by 6% on impact, which constitutes a 0.21 percentage points increase for the average tariff rate of 3.56% over the sample horizon (Figure A.27). Both this average tariff rate and customs duties have two noteworthy drawbacks as i) prohibitively high tariffs are disregarded due to zero tariff proceeds; and ii) changing import shares across periods affect the index even when no change in tariff legislation has taken place (Crucini, 1994). However, they are often used in the literature as tariff rates for more granular data exist only at lower frequencies.

trend. Imports drop strongly on impact, by 1%, and decrease further to –1.5% in the second quarter after the shock. After eight years they are still below the level where they would have been without the shock. The response of exports is similar. They recover marginally quicker. GDP falls immediately by 0.2%, and then to 0.3% below trend, but the bands cover zero. The exchange rate tends to appreciate by up to 0.8% and the consumer price level to rise by 0.3%. The trade policy uncertainty index increases, reflecting that changes in tariffs are often associated with increased uncertainty about future trade policy. In addition, the increase might occur mechanically as the uncertainty index is constructed by counting words related to trade policy and uncertainty. Overall, the exogenous increase in tariffs has persistently adverse macroeconomic effects. International trade suffers most, but output is also negatively affected.

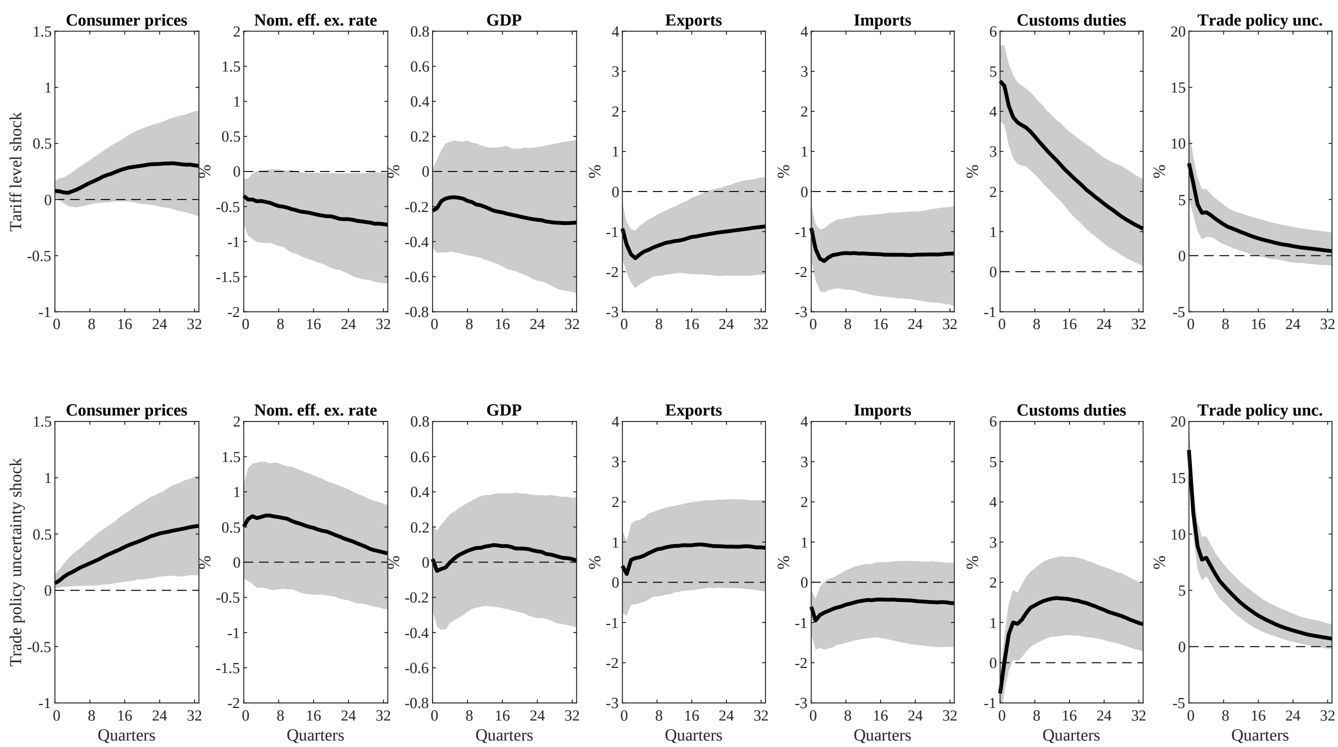



Figure 5: Estimated responses to tariff level shock and trade policy uncertainty shock. *Notes:* The figure presents the macroeconomic effects of a shock of one standard deviation to tariffs in the upper panels and to trade policy uncertainty in the lower panels over a horizon of 32 quarters in the US. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets. An increase in the nominal effective exchange rate is a US-Dollar depreciation.

The bottom row of Figure 5 shows the effects of a positive one standard deviation shock to trade policy uncertainty. The uncertainty index increases by more than 15% on impact. Imports fall by about 1%. They remain below trend for the full horizon but the effect is not distinguishable from zero after the first quarters. Customs duties fall upon impact. Then, they overshoot, possibly mirroring that increases in trade policy uncertainty often precede actual tariff changes. The nominal exchange rate tends to depreciate. Consistently, exports increase, although the response is imprecisely measured. The output reaction is first negative and then positive but insignificant. Consumer prices increase strongly and persistently by up to 0.5%, and the credible sets exclude zero over the full horizon of eight years. Overall, unexpected increases in trade policy uncertainty have notably negative effects on imports and are inflationary but their output effects are moderate.[12]

From the responses to the tariff shock we compute general equilibrium trade and output elasticites. For each horizon $h$, we divide the response of, respectively, imports, exports, and GDP by the response of customs duties. Figure 6 shows the results. The median import elasiticity upon impact is –0.2. It falls to –0.4 after two years, and to –0.8 after six years. The values are different from zero according to the credible sets. The eight-year import elasticity is –0.9 but the estimation uncertainty is high. These estimates are in line with the findings of Boehm et al. (2023) who embed their partial equilibrium estimates into a general equilibrium structural framework and obtain similar results (compare their Figure 6D).[13] We estimate an export elasticity that is similar in absolute value to our import elasticity in the short run but smaller in the long run. It starts at –0.2 and falls to –0.5 after eight years. The GDP elasticity is –0.05 when the shock hits and declines continuously. It is –0.2 after eight years as tariffs fall back to trend whereas output remains persistently depressed. However, the credible sets are wide and cover zero at all horizons.

To paint a broader picture of the effects of tariff shocks and trade policy uncertainty shocks we analyze the responses of further variables. We replace output by one of its components at a time and re-estimate model (5) with the same identifying traditional and narrative sign restrictions as before, or we add additional variables to the model one at a time. We leave the responses of the alternative variables unrestricted and collect them in Figure 7.

The top panels show the effects of tariff level shocks. Domestic consumption declines persistently. But the effect is small and only different from zero for a few quarters. Investment drops

[12]Using a news-based measure of trade policy uncertainty, we estimate the average effect of unexpected innovations to this series which picks up changes in uncertainty about both liberalization and more restrictive trade policy which might attenuate the average estimated impact.

[13]The estimates are not directly comparable because they consider changes in tariff rates whereas we employ shifts in tariff revenues. However, Figure A.27 suggest that the quantitative implications of this difference are small as revenues respond nearly one-to-one to rate changes.

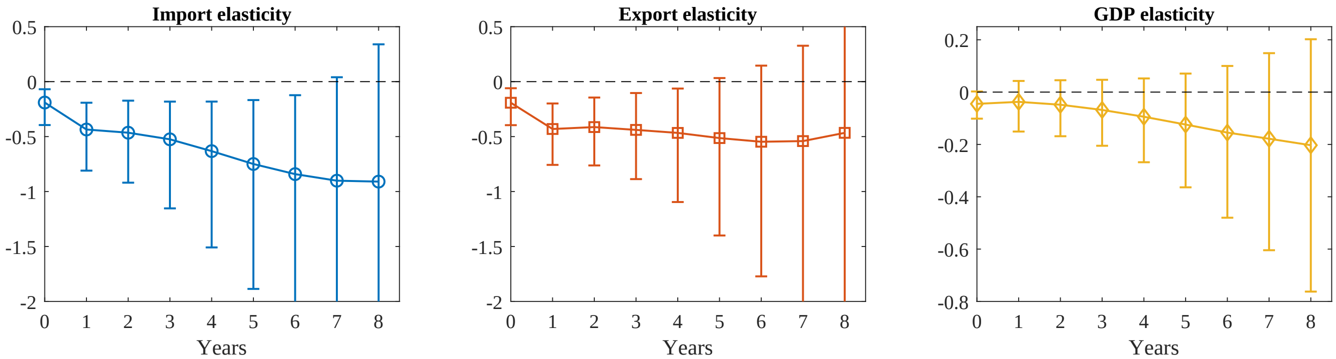



Figure 6: Import, export and GDP elasticity estimates based on the tariff level shock. *Notes:* The figure displays the responses from Figure 5 of imports, exports and GDP relative to the response of customs duties at the same horizon following a tariff level shock. Median estimates and 68% confidence bands are based on the individual model draws.

strongly, by 1%, and with high probability. It remains persistently below trend for more than eight years. Employment drops marginally on impact as well, but then tends to overshoot. Although the gains are not distinguishable from zero, the positive medium run employment response is in line with microeconomic evidence documenting job losses in the US following the WTO accession of China and the corresponding tariff reductions (Autor et al., 2013, 2016). Wages decline by 0.3%, consistent with a reduced marginal product of labor due to lower investment. The trade balance increases by 0.5 percentage points of GDP after one quarter. The credible sets exclude zero after two years and the positive effect remains for another six years.

Import prices decline for many years. Scaled by the customs duties response, the degree of pass-through is 0.1 upon impact and 0.5 in the medium run. The values suggest that the US on average affects world prices and that the estimate of 0 pass-through to import prices (excluding tariffs) of the 2018 tariffs (Amiti et al., 2019; Fajgelbaum et al., 2019; Cavallo et al., 2021) is specific to that episode. As import prices decline more than export prices (not shown), the terms of trade improve by up to 0.5% in the first year after the shock, before falling back to their long run value.

The bottom row shows the effects of a positive trade policy uncertainty shock on the same variables. Consumption does not respond, while investment, employment, and wages fall. For the latter two, the decline is distinguishable from zero. The investment response is similar qualitatively and quantitatively to Caldara et al. (2020) but less precisely estimated, probably because we lift the contemporaneous exogeneity assumption with respect to tariff shocks. The trade balance improves quickly and persistently and the credible sets exclude zero. The response of imports is not precisely

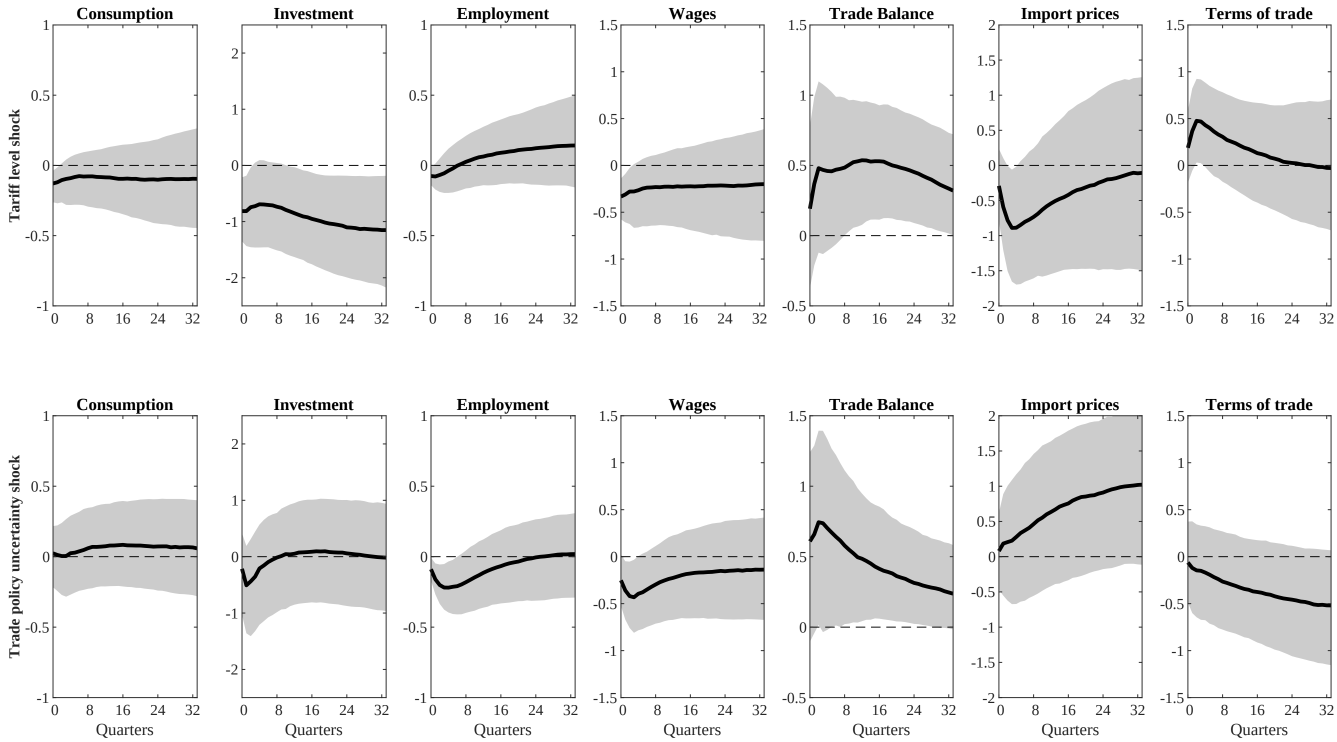



Figure 7: Responses of other variables to tariff level and trade policy uncertainty shocks. *Notes:* The top panels show the effects of a positive tariff level shock of one standard deviation on consumption, investment, employment, wages, the trade balance, import prices, and the terms of trade over 32 quarters. The solid line shows point-wise median impulse responses and the shaded areas 68% highest posterior density credible sets. The lower panels show the effect of a positive trade policy uncertainty shock of one standard deviation.

measured but the terms of trade tend to worsen.

## 4.3 Macroeconomic relevance

After estimating the dynamic effects of the two shocks, we now quantify their macroeconomic importance for the US. First, we compute the average importance in the sample by means of a forecast error variance decomposition. The upper panels of Figure 8 show the fraction of the unexpected variability of the endogenous variables due to tariff level shocks over 32 quarters.

Tariff level shocks explain half of the impact variability in customs duties, documenting an important role for exogenous policy changes. The tariff shocks are also relevant for the variation in exports and imports, contributing 10-18%. Their explanatory power for fluctuations in the nominal exchange rate and consumer prices is lower at the 1-2 year horizon, but increases to 10-15% in the 8th year. Given their importance for import and export fluctuations, the shocks also drive US output. The contribution to unexpected GDP volatility is close to 10% for most quarters.

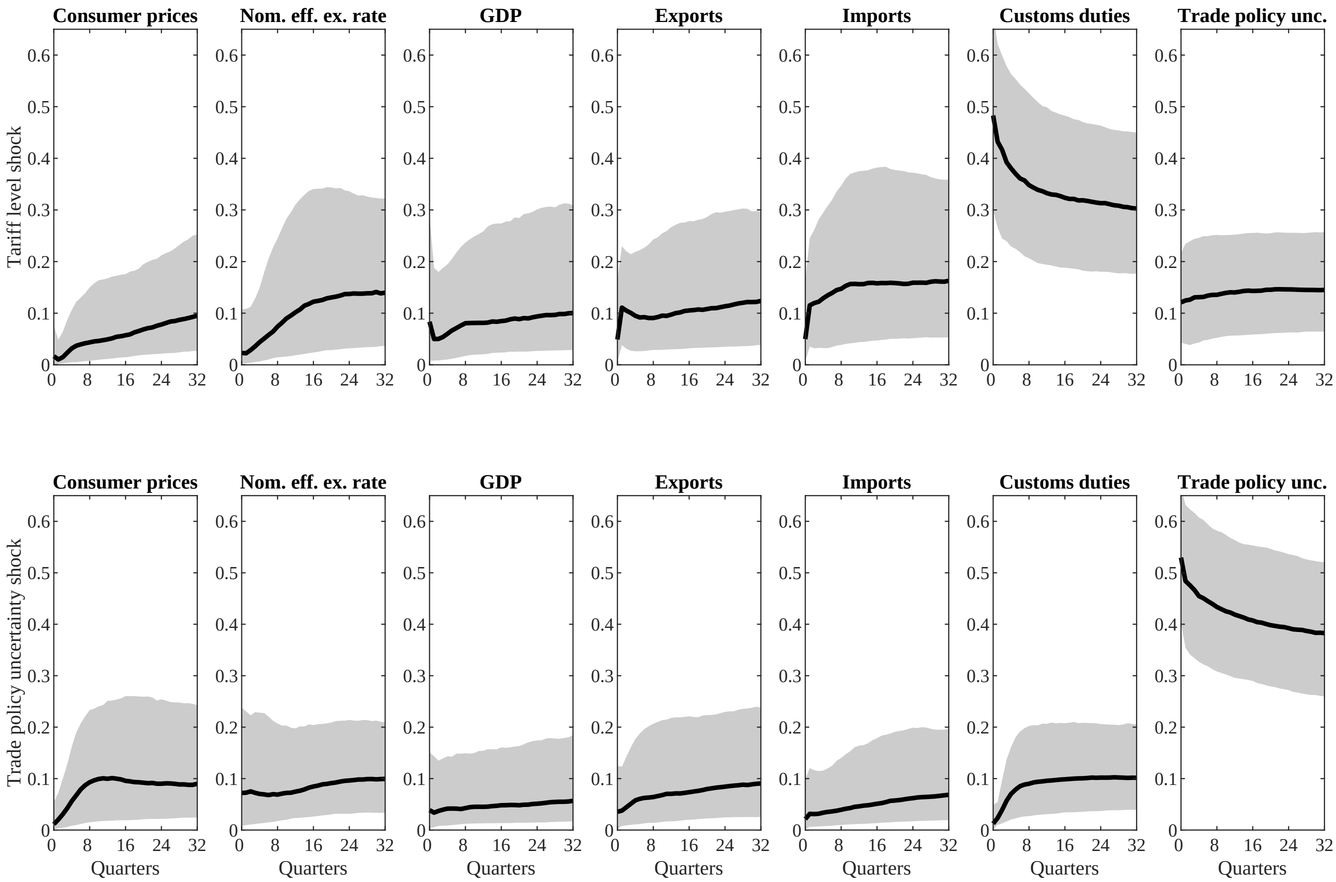



Figure 8: Forecast error variance decomposition. *Notes:* The figure shows the percentage of the forecast error variance of the endogenous variables (in columns) due to tariff level shocks in the upper panels and due to trade policy uncertainty shocks in the lower panels over a horizon of 32 quarters in the US. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

The relevance of trade policy uncertainty shocks for the variability in exports, imports, and output is about half of the relevance of tariff shocks. They explain a bit less than 5% of the forecast errors at short horizons and a little more than 5% at longer horizons. As they affect imports, they also drive customs duties. But the impact explanation is negligible, suggesting that the identified exogenous variation in the uncertainty index is not due to tariff changes. Instead, the uncertainty shocks account for more than half of the impact variation in the uncertainty index. At the same time, this number indicates that recursive identification strategies assuming that trade policy uncertainty is exogenous may lead to biased results as half of the variation in the measure is an endogenous response to other shocks. Taken together, the high fraction of the variance explained by own shocks of custom duties and trade policy uncertainty adds to the evidence that the model successfully disentangles first and second moment shocks to US trade policy.

The average relevance of the two shocks may mask that their importance changes over time. To capture this variation, we compute historical decompositions. The blue bars in the top panels of Figure 9 show the contribution of tariff level shocks to GDP (left) and to the trade balance (right). The solid lines show the model-consistent output gap and trade balance. Until the mid-1980s, tariff shocks contribute little to both variables. Visible exceptions are the Nixon and Ford tariff episodes in 1971 and 1974, when protectionist shocks shortly lowered GDP and raised the trade balance.

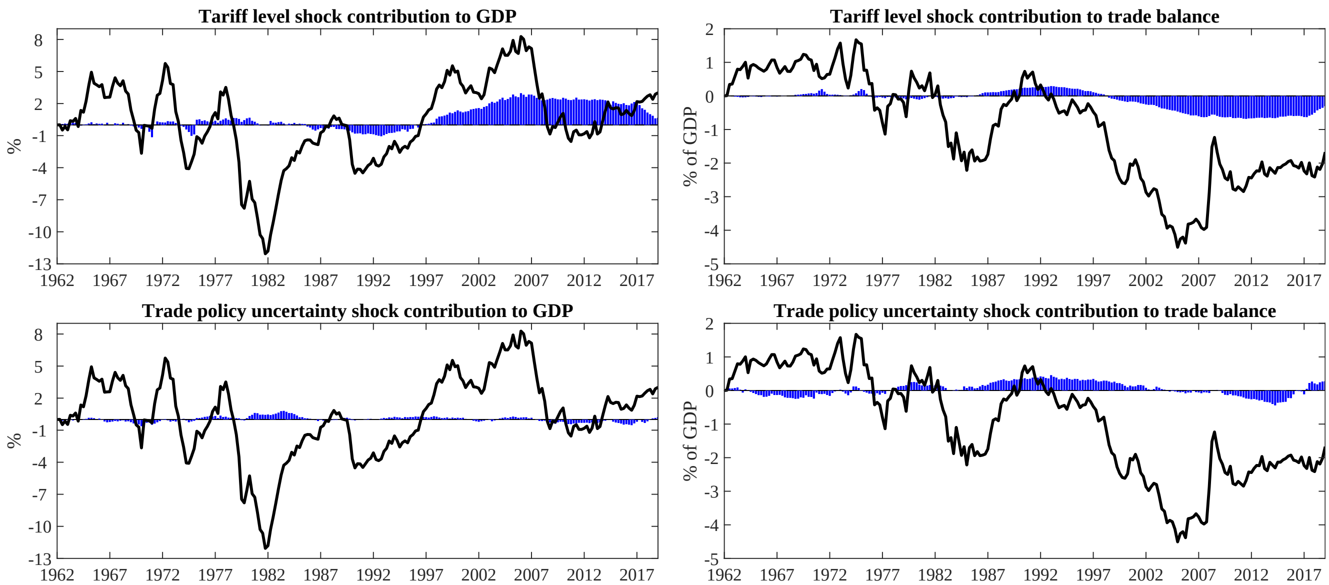



Figure 9: Historical decomposition of GDP and trade balance. *Notes:* The black lines show detrended data and the blue bars show the historical contribution of tariff level shocks (upper panels) and of trade policy uncertainty shocks (lower panels) to GDP (left panels) and to the trade balance (right panels). The trade balance is defined as net exports relative to GDP and is added in growth rates as an additional variable to the baseline model.

Since the mid-1980s, tariff shocks are an important driver of output and trade. First, the trade tensions with Japan, among others, lowered GDP and raised the trade balance until the mid-1990s. Thereafter, the trade liberalization of NAFTA in 1993, the creation of the WTO in 1995, and the accession of China to the WTO in 2001 generated a long boom. The estimates suggest that the shift to lower tariffs raised the output gap by up to 3 log points for nearly 20 years. This historic support only came to an end with the return to protectionism since 2016.

The estimates paint a more favorable picture of the implications of China's WTO accession for the US than the influential work of Autor et al. (2013, 2016). The authors find that following this event wages and employment fell significantly in local US labor markets that are most exposed to import competition from China. We confirm their results with general equilibrium estimates. Figure A.6 shows that aggregate employment indeed fell after the free trade shocks of the 1990/2000s (with a long delay, consistent with the sluggish behavior of employment shown in Figure 7). At the same time, we find a strong opposite reaction of investment to this swing in US trade policy (Figure A.6), with aggregate investment increasing by up to 5 log points above trend for more than a decade. Together, our estimates indicate that the trade liberalizations induced a shift from labor to capital intensive production. The overall effect on GDP was positive.

A flip side of the free trade shocks and the increased capital demand is a persistent widening of the trade balance since the mid-1990s. Tariff shocks account for about one fourth of the deficit during the last 10 years. Alessandria and Choi (2021) obtain a similar fraction in a calibrated two-country general equilibrium model with firm dynamics.

Trade policy uncertainty shocks explain little of the output gap but are relevant for the trade balance. The back and forth of the trade relations with Japan in the 1980s and the NAFTA/GATT negotiations increased uncertainty and, hence, the trade balance. The completion of the agreements in the mid-1990s and China joining the WTO resolved a large part of that uncertainty, which raised US capital imports and trade deficits.

We also use the historical decomposition to assess the overall output effects of the latest return to protectionism. For this, we compute the contribution of trade policy level and uncertainty shocks to GDP over the period 2018Q1-2019Q4. Figure A.7 zooms into this episode. The contributions of the restrictive tariff shocks are all negative from 2018Q2 onward. The cumulative output costs of the upward shift in US import tariffs reduced GDP by 1.1% in 2018 and by 2.9% in 2019. These costs are an order of magnitude higher than the partial equilibrium estimate of Amiti et al. (2019) or the estimate of Fajgelbaum et al. (2019) based on a general equilibrium but static trade model with fixed capital. Our impulse response estimates suggest that this difference is due to strong negative general equilibrium effects of the tariff shocks, in particular on investment. By contrast, the output contributions of trade policy uncertainty shocks are all positive in 2018/19, reflecting the tendency of output to increase following these shocks. They raised output by 2% over both years. In sum, the trade disputes in 2018/19 entailed an output cost of 2% of GDP to the US.

## 4.4 Sectoral and regional effects

We complement the aggregate results with sectoral and regional analyses. We project disaggregated data on the estimated trade policy level and uncertainty shocks, using the following regressions:

$$y^i_{t+h} = \alpha^i_h + (\beta^i_h)' x^i_{j,t-1} + \varphi^i_h Shock_{j,t} + \xi^i_{t+h} \quad \text{for} \quad h = 0, \ldots, H, \tag{6}$$

where $y^i_{t+h}$ is the sectoral or regional outcome variable of interest, $\alpha^i_h$ is an intercept, $x^i_{j,t-1}$ is a vector of controls, $Shock_{j,t} = \hat{\varepsilon}_{j,t}$ is the tariff level or trade policy uncertainty shock, and $\xi^i_{t+h}$ is an error term for outcome variable $i$ at horizon $h$. $\varphi^i_h$ is the impulse response estimate of the outcome variable $i$ to shock $j$ at horizon $h$. $x^i_{j,t-1}$ includes one lag of the outcome variable $i$. We estimate (6) for each posterior estimate of the shock series $\hat{\varepsilon}_{j,t}$ and compute 68% point-wise credible sets of the impulse responses. Using the median estimated shock series and frequentist confidence bands yields similar results. Throughout the section, we focus on the peak/trough responses. The full set of underlying responses is in Online Appendix C.2.

First, we estimate the sectoral responses to a unit positive tariff shock. Figure 10 shows the absolute maximum responses of imports, exports, investment, and employment for each sector, ordered by size. All but two sectors reduce imports significantly. Mineral fuels, industrial supplies, and crude material respond most negatively, with import reductions of 5-15%. The picture for exports is essentially the same. Firms reduce exports across the board, by between 2-10%. There is a single sector (foods, feeds, and beverages) that exports more, but the credible set includes zero. For investment, the pattern is similar. 13 out of 19 sectors cut back on capital formation and the effect is often different from zero with high probability. A few sectors increase investment, suggesting some redistribution of economic activity across sectors. Employment declines in the majority of sectors but increases in other. The estimation uncertainty is high, reflecting the same tendency of sectoral employment as aggregate employment (Figure 7) to first fall and then overshoot. All in all, the results indicate that US international trade and investment suffers in most sectors from import protection, while the employment effects are mixed.

Figure 11 shows the absolute maximum responses to a unit positive trade policy uncertainty shock. The results are diverse. Imports drop in 6 sectors and increase in 10, suggesting that the aggregate effects (Figure 5) are driven by a few uncertainty-sensitive sectors. However, many peak

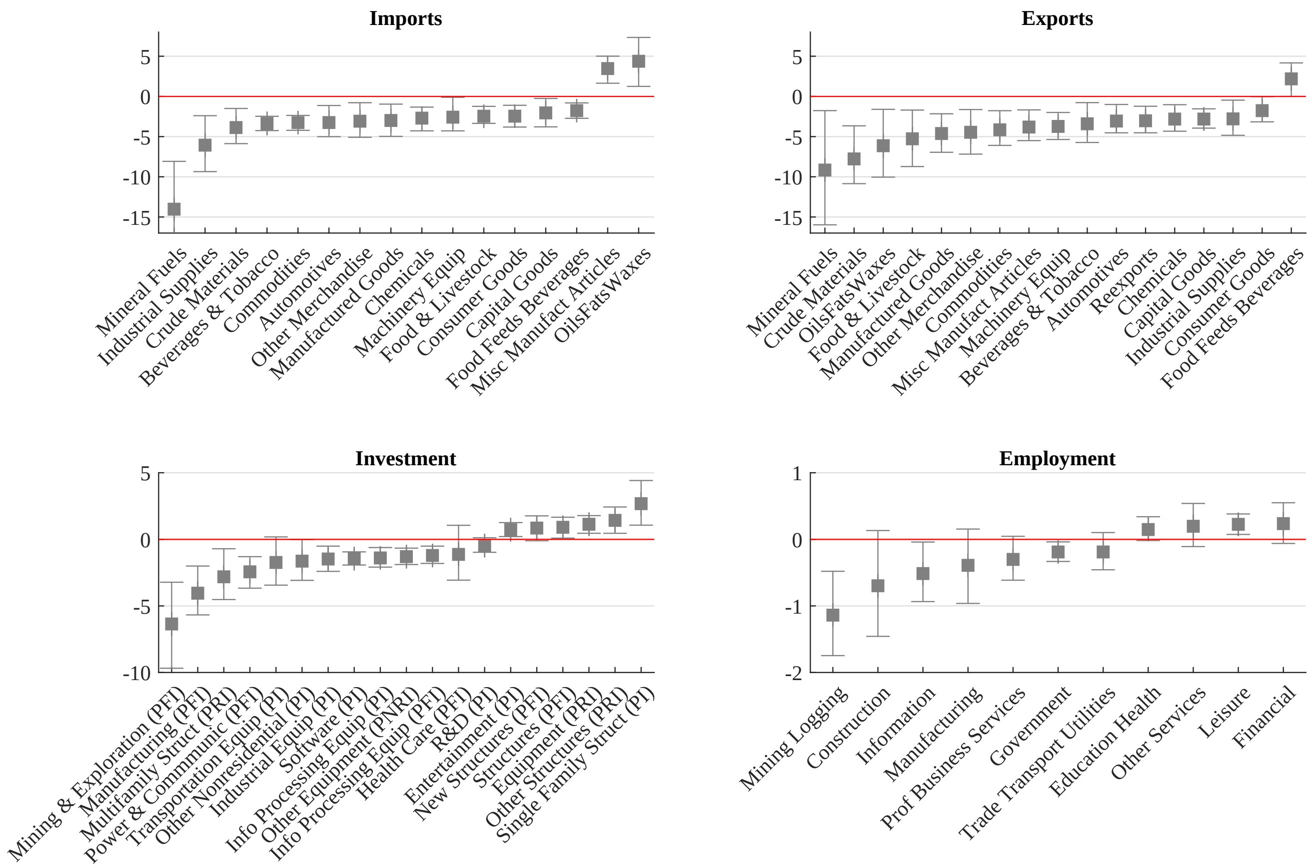



Figure 10: Sectoral resonses to tariff level shocks. *Notes:* The figure shows the absolute maximum response of sectoral imports, exports, investment, and employment to a unit tariff level shock, obtained from local projections. The box is the median response, the lines are the 68% point-wise sets. PFI: Private fixed investment, PI: Public investment, PNRI: Private nonresidential investment, PRI: Public residential investment.

responses are indistinguishable from zero. Exports increase in all but one sectors and the increases are largely different from zero with high probability. This uniform pattern mirrors the positive aggregate response of exports, which tend to rise in line with the currency depreciation. The investment responses, in turn, are mostly negative, suggesting that firms in most sectors reduce investment when trade policy uncertainty increases. Finally, employment falls in 10 out of 11 sectors and the drop is distinguishable from zero in 4.

Comparing the effects of level and uncertainty shocks indicates that the former are more detrimental to US sectoral economic activity than the latter. Tariffs reduce US international trade and investment in most sectors. Higher trade policy uncertainty also reduces sectoral investment but raises exports and partially imports.

Next, we assess the spatial distribution of the effects across US states. Panel (a) of Figure 12

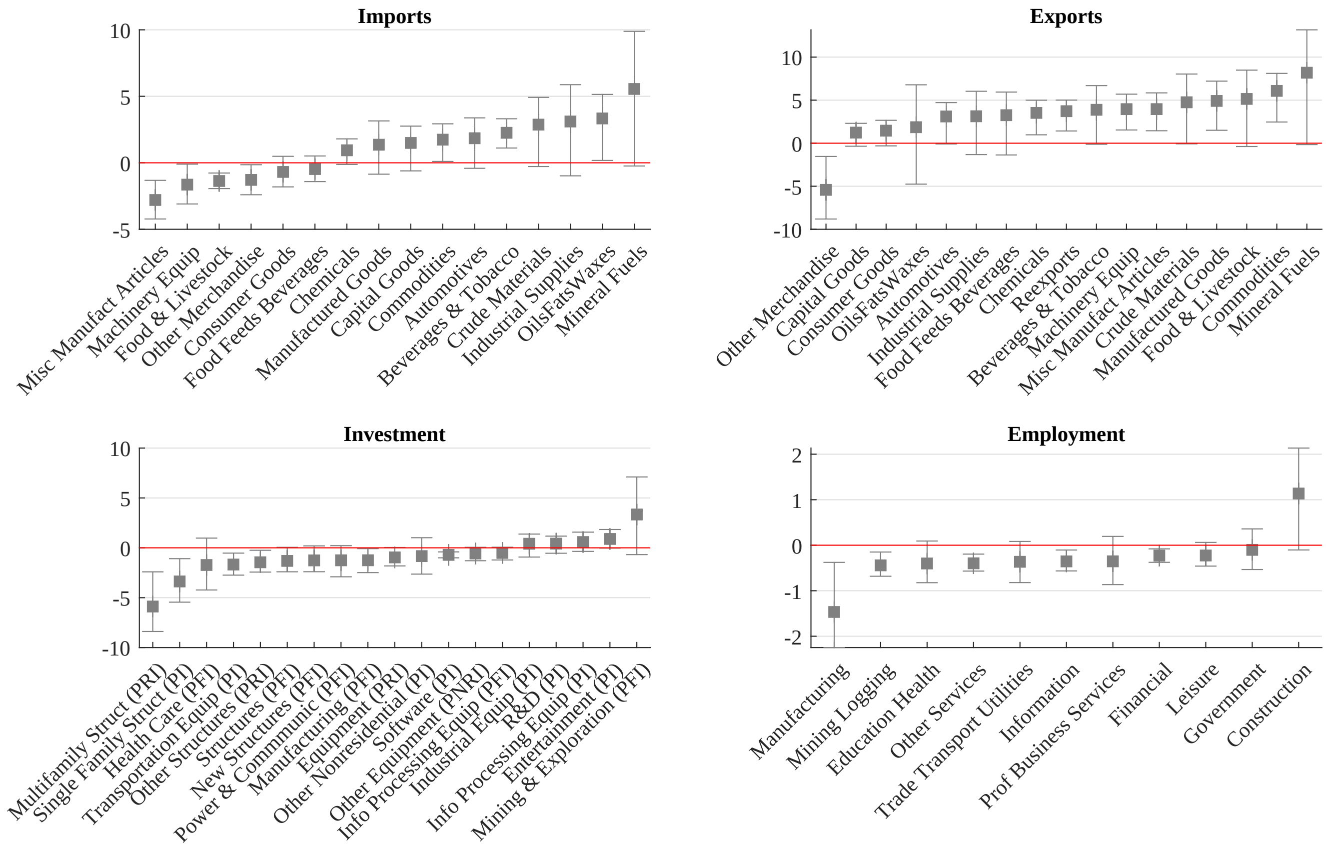
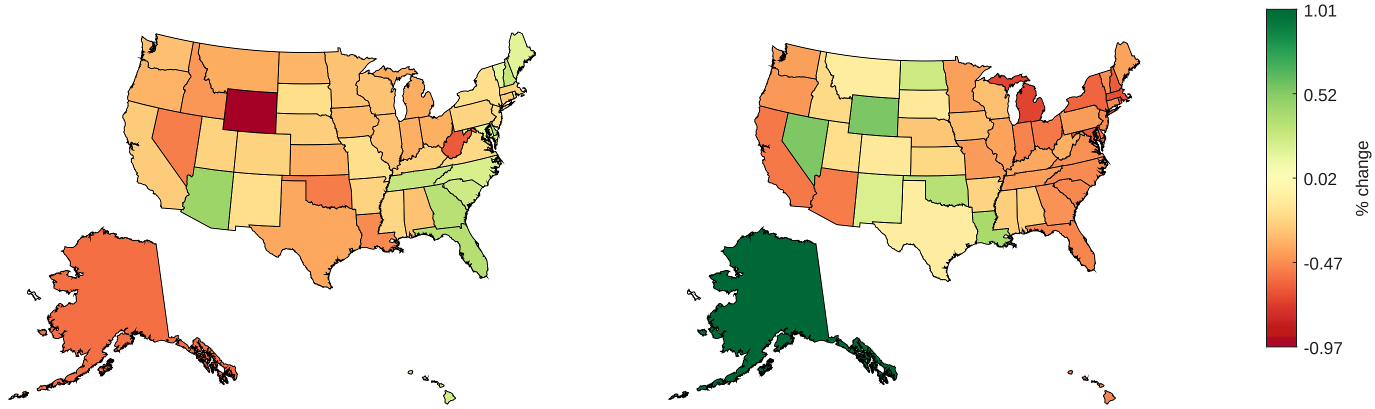



Figure 11: Sectoral resonses to trade policy uncertainty shocks. *Notes:* The figure shows the absolute maximum response of sectoral imports, exports, investment, and employment to a positive unit trade policy uncertainty shock, obtained from local projections. The box is the median, the lines are 68% credible sets. PFI: Private fixed investment, PI: Public investment, PNRI: Private nonresidential investment, PRI: Public residential investment.

shows the peak/trough response of state employment to a unit positive tariff level shock. Greener states indicate more positive peaks, whereas darker red states refer to deeper troughs. Most states are yellow to orange, which indicates no discernible to a slightly negative employment reaction. Some states clearly lose jobs (Alaska, Luisiana, Nevada, Oklahoma, West Virginia, Wyoming), while a few gain some (Arizona, Florida, Georgia).

Panel (b) of Figure 12 shows the estimates for unit trade policy uncertainty shocks. The legend is the same so that the magnitude of the effects are directly comparable across panels. The spatial pattern is a bit clearer than for tariff shocks. The map is predominantly red at the coasts and in the Rust Belt. The states in the middle-west and Alaska are yellow to green. One explanation might be the differential exposure to the exchange rate depreciation. These states produce many commodities, which are sold at competitive world markets and thus respond more strongly to US-Dollar fluctuations than more differentiated goods like industrial or information technology




(a) Employment effect of tariff level shock

(b) Employment effect of trade policy uncertainty shock

Figure 12: Peak employment effect across US states. *Notes:* The figure shows the absolute maximum response of state employment to a unit positive tariff level shock in panel (a) and to a unit positive trade policy uncertainty shock in panel (b), obtained from local projections. The colors indicate the sign and size of the effect.

products. The latter also depend more on intermediate inputs and are thus more negatively affected when imports fall. Overall, the findings question the idea that protectionism creates systematically more domestic jobs or allows redistributing them across the country or sectors.

## 4.5 The output effects of a return to free trade

After having documented the largely adverse effects of higher tariffs and trade policy uncertainty, we ask: what would be the macroeconomic effects if the US was to reverse the tariff and uncertainty increases since 2016. To answer this question, we construct a corresponding structural scenario, using the baseline SVAR model and following Antolín-Díaz et al. (2021). We assume that customs duties and trade policy uncertainty gradually decrease back to their pre-2016 levels, driven only by trade policy level and uncertainty shocks. Technically, we search for two scenario shock series that induce the prespecified paths for customs duties and the trade policy uncertainty index over the period 2020Q1-2022Q4. The required shocks are shown in Figure A.8.

The scenario paths of customs duties and the uncertainty index are the solid red lines in the first and second panel of Figure 13. The black lines show historical data until 2019Q4. Both variables return linearly to their initial levels within three years. We contrast the scenario paths to the unconditional forecasts of the model, in blue. The scenario assumes a quicker return to free trade than the model predicts, in particular for customs duties. For the uncertainty index, the difference between the scenario and the forecast is small for the first two years but then widens visibly.

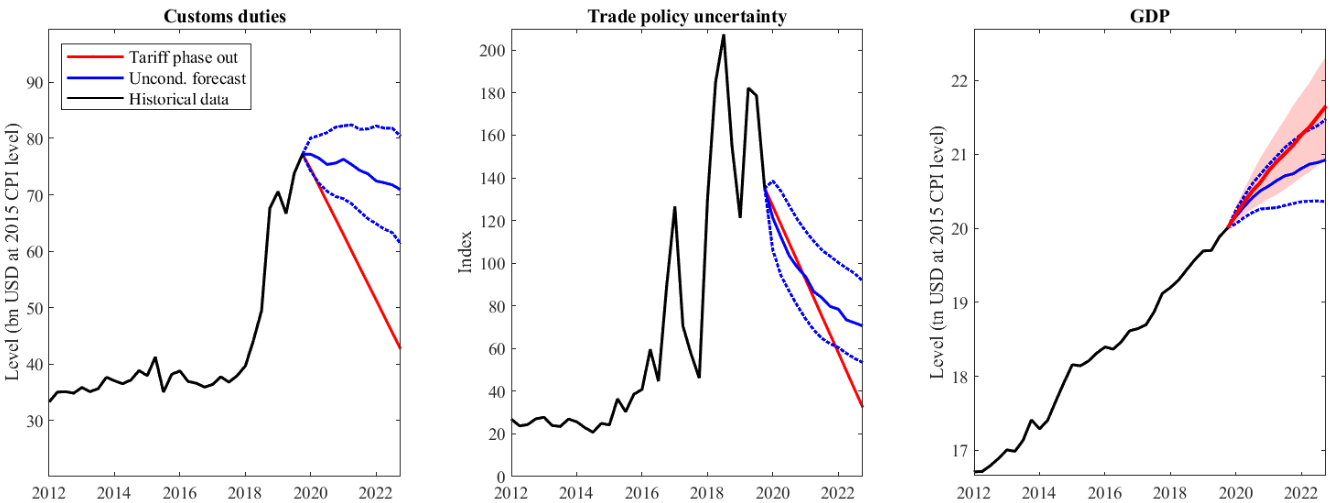



Figure 13: Structural scenario of return to free trade. *Notes:* The red solid line and shaded region in the third panel are the median forecast and 40% point-wise credible sets of GDP for a scenario in which customs duties and trade policy uncertainty revert to pre-2016 levels, shown by the red solid lines in the first two panels. The scenario is driven by trade policy level and uncertainty shocks. The blue dotted lines show medians and 40% point-wise credible sets of the unconditional forecasts of the model.

The right panel shows the evolution of GDP in both cases. The differing paths result from the alternative stances of trade policy as we constrain the remaining shocks in the system to their unconditional distributions. The GDP increases are similar in the first two quarters after the policy change. Thereafter, the return to free trade generates increasingly higher output than the forecast. After three years, the difference in median GDP is 3.3%. The cumulative output differences are large. They are 4.4%; in the first year 0.3%, in the second 1.4%, and in the third 2.7%.

These number are probably conservative estimates of the potential output gains of quickly undoing protectionism. The unconditional forecast implies a reduction in customs duties and trade policy uncertainty, which has not materialized in the actual data as tariffs have remained at their 2019 levels. Therefore, in Figures A.9 and A.10 we consider a second comparison. We contrast the free trade scenario (the same as in Figure 13) with a scenario (not the unconditional forecasts) in which we assume that tariffs remain at the 2019 level for three years. The cumulative output gain of the free trade scenario versus the alternative scenario is 5.3%.

## 5 Sensitivity analysis

We assess the sensitivity of the main results. This section contains a summary thereof. The details are in Online Appendix C. Overall, the main findings are robust to alterations of the endogenous variables, the lag length, the trend assumption, and the identification strategy. First, we compute the responses to trade policy level and uncertainty shocks when changing some of the endogenous variables. In Figures A.21-A.23, we replace output with consumption, investment, and employment, respectively. In Figure A.24, we replace the nominal by the real exchange rate. In Figure A.25, we replace the consumer with the producer price index. In Figure A.26, we include trade in services. In Figure A.27, we use the average effective tariff rate instead of customs duties. In Figures A.28-A.30, we add to the model the trade balance to GDP ratio, the terms of trade, or total factor productivity, respectively. In Figure A.32, we start the sample after Bretton Woods in 1973Q2.[14] In Figure A.33, we end the sample in 2016Q4, before the Trump administration took office. In Figure A.34, we use eight lags of the endogenous variables. In Figure A.35, we include a linear trend. In Figure A.31, we additionally identify a monetary policy shock. Finally, in Figure A.36, we restrict the output impact response to a level shock to be negative.

## 6 Conclusion

Since the US trade disputes in 2018/19, trade policy is again at the center stage of the international economic policy debate. This paper provides evidence that unexpected increases in import tariffs and in trade policy uncertainty have mostly negative consequences for the US macro-economy, and help only little to redistribute economic activity across sectors or space. We use a canonical two-country DSGE model to derive theory-consistent yet robust sign restrictions, complemented with narrative restrictions, for the identification of tariff shocks and trade policy uncertainty shocks in Bayesian SVARs. We estimate and compare the effects of these two shocks consistently in one model to provide a macroeconomic account of the impact of these two dimensions of US trade policy on the US since the 1960s.

[14] In early 1973, the Bretton Woods system of fixed exchange rates collapsed. Government restrictions to international capital movements were abolished and the US-Dollar has been freely floating since then. Moreover, the US started incurring larger trade balance deficits.

Protectionist tariff surprises reduce US foreign trade and domestic investment strongly, in aggregate and across most sectors. Greater uncertainty about US trade policy has also negative effects. It weighs particularly on imports. Both first and second moment trade policy shocks improve the trade balance, but this comes at the cost of a domestic demand compression and persistent GDP losses. The employment impacts are ambiguous. On average, tariff level shocks are about twice as important for macroeconomic dynamics as trade policy uncertainty shocks. Historically, the shifts to free trade after NAFTA/GATT/WTO in the 1990s/2000s widened trade deficits but engendered a two decades lasting investment and output boom. Correspondingly, we estimate that reversing the 2018/19 protectionism would generate a cumulative output gain of 4% over three years. While policy makers typically also pursue non-economic goals with trade policies, these estimates may help them to gauge the macroeconomic costs of protectionism.

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# Online Appendix to 'The consequences of import tariffs and trade policy uncertainty for the US economy'

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January 10, 2024

# A Theoretical model impulse responses

Figure A.1: Impulse responses to a demand shock. *Notes:* The figure shows the responses to a shock of 1% to the demand shifter $d_t^1$ of the home country. The solid line refers to the point-wise median and the shaded area to the 68% credible set.

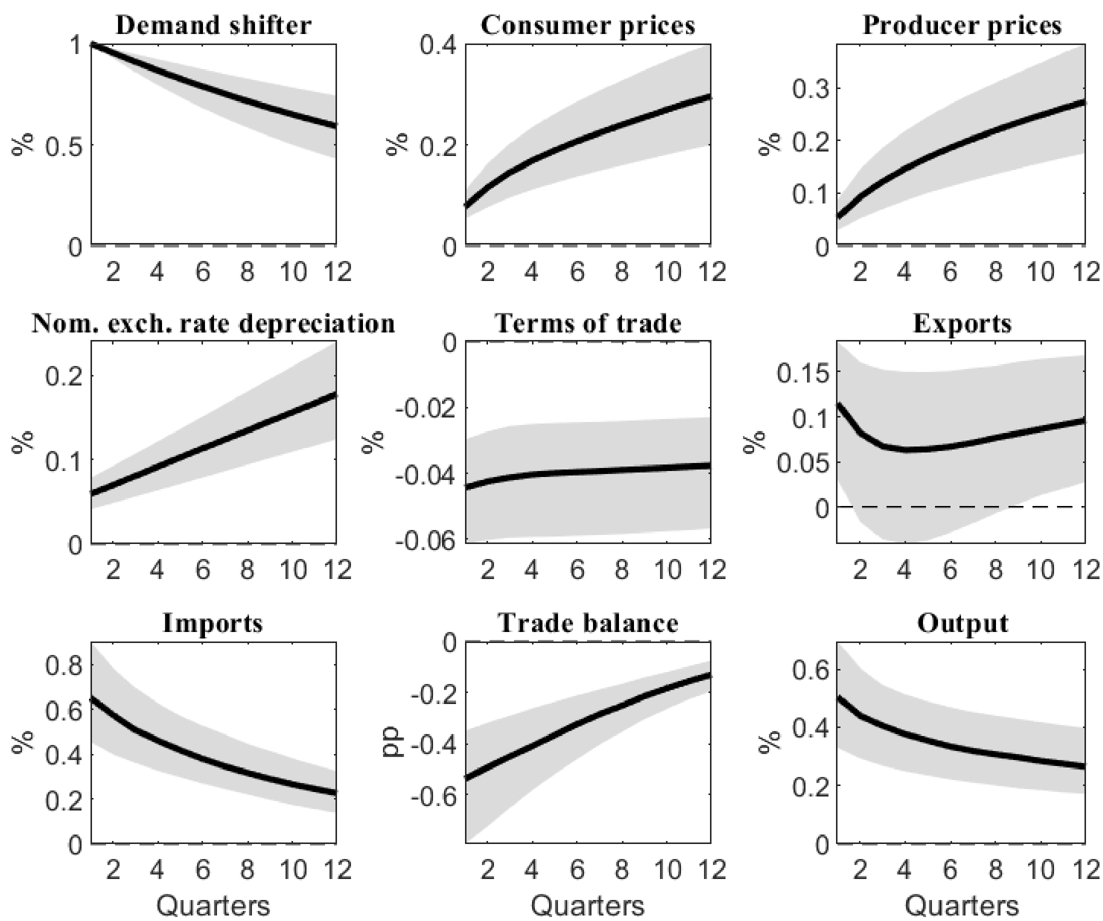
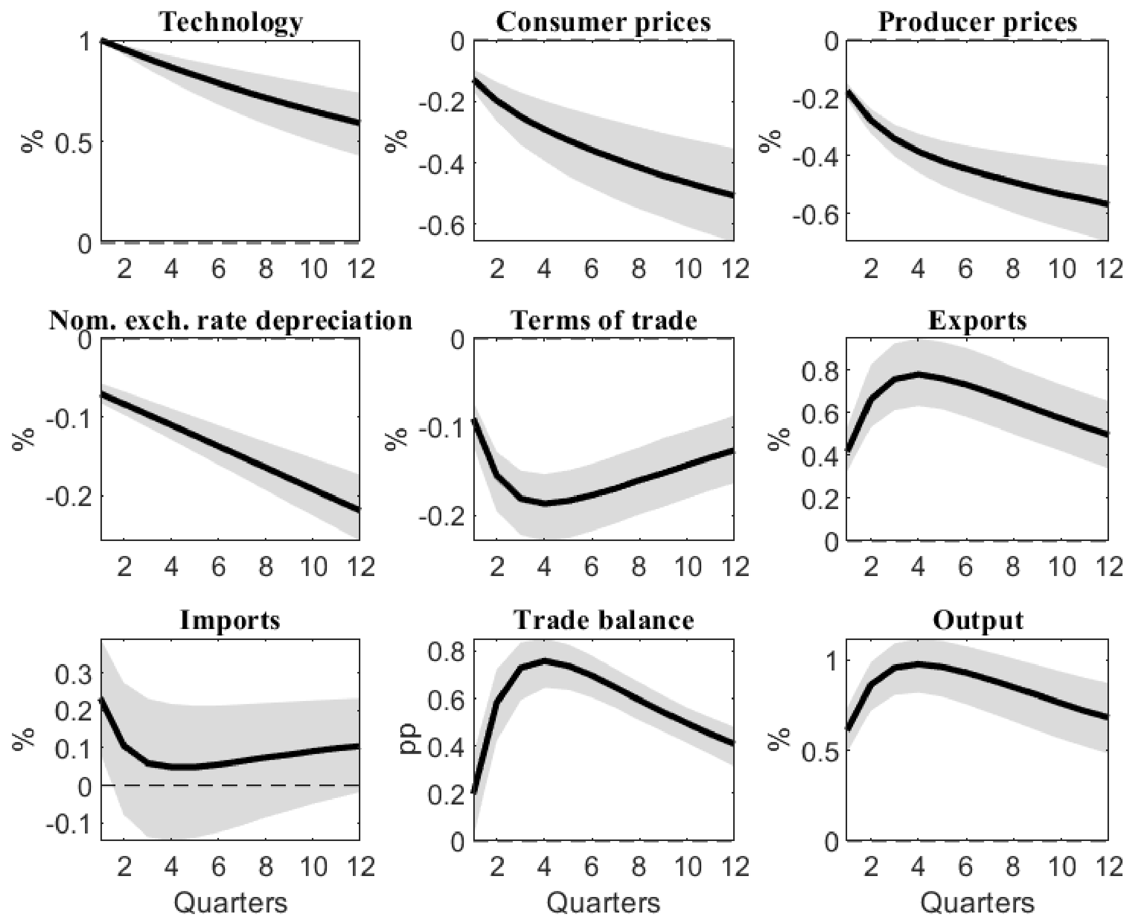


Figure A.2: Impulse responses to a technology shock. *Notes:* The figure shows the responses to a shock of 1% to the technology shifter $a_t^1$ of the home country. The solid line refers to the point-wise median and the shaded area to the 68% credible set.



# B Data

Gross domestic product and custom duties are downloaded from the U.S. Bureau of Economic Analysis and both series are seasonally adjsuted. Imports and exports of goods are taken from the OECD's main economic indicators database and are seasonally adjusted. The series have been adjusted for inflation with the total consumer price index for all goods that is also downloaded from the OECD database. The real effective exchange rate is taken from Darvas (2021). It is defined as $Q_{US,t} = S_{US,t} \cdot \frac{P_{US,t}}{P_{W,t}}$ The real effective exchange rate $Q_{US,t}$ is based on the OECD's consumer price indices for the US $P_{US,t}$ and for the world $P_{W,t}$, calculated as an average over 51 trading partners' price indices. The nominal exchange rate $S_{US,t}$ is a weighted average over the 51 trading partners' currencies. An increase in the index represents a real appreciation of the US Dollar. Monthly values are averaged to obtain quarterly values. The tariff rate $\tau$ is calculated from custom duties $CD$ and imports $M$ as $\tau = \frac{CD}{M}$.

Table A.1: Data Description, Sources and Coverage

| Variable | Description | Source | Sample |
|---|---|---|---|
| **Baseline Variables** | | | |
| GDP | Gross Domestic Product (s.a.) | FRED | 1960q1 - 2019q4 |
| CPI | Total CPI - all goods | OECD | 1960q1 - 2019q4 |
| Goods Imports | Imports in goods (value) | OECD | 1960q1 - 2019q4 |
| Goods Exports | Exports in goods (value) | OECD | 1960q1 - 2019q4 |
| B235RC1Q027SBEA | Customs Duties (s.a.) | FRED | 1960q1 - 2019q4 |
| Nominal Effective Exchange Rate | Zsolt Darvas (2021), against 51 trading partners, quarterly average | Bruegel webpage | 1960q1 - 2019q4 |
| Trade Policy Uertainty | Caldara et al. (2020) | Iacoviello's webpage | 1960q1 - 2019q4 |
| **Additional Variables** | | | |
| W170RC1Q027SBEA | Gross Domestic Investment (s.a.) | FRED | 1960q1 - 2019q4 |
| PAYEMS | All Employees, Total Nonfarm (s.a.) | FRED | 1960q1 - 2019q4 |
| PCEC | Personal Consumption Expenditures (s.a.) | FRED | 1960q1 - 2019q4 |
| Trade Balance | Net Exports as (Goods Exports - Goods Imports)/GDP | | 1960q1 - 2019q4 |
| USTOTPRCF | Terms of Trade | datastream | 1969q2 - 2019q4 |
| Real Effective Exchange Rate | Zsolt Darvas (2021), against 51 trading partners, quarterly average | Bruegel webpage | 1960q1 - 2019q4 |
| BOGZ1FL072052006Q | Effective Federal Funds Rate | FRED | 1960q1 - 1989q4 |
| Shadow Federal Funds Rate | Wu and Xia (2016) | Wu's webpage | 1990q1 - 2019q4 |
| Utilization-adjusted quarterly-TFP | Fernald (2014) | Fernald's webpage | 1960q1 - 2019q4 |
| Tariff Rate | Customs Duties/Goods Imports | | 1960q1 - 2019q4 |
| IMPGS | Imports of Goods and Services (s.a.) | FRED | 1960q1 - 2019q4 |
| EXPGS | Exports of Goods and Services (s.a.) | FRED | 1960q1 - 2019q4 |
| PPI | Producer Price Index | OECD | 1960q1 - 2019q4 |
| **Sectoral Data** | | | |
| Employment sectoral | | Macrobond | 1960q1 - 2019q4 |
| Employment by states | 51 states | Macrobond | 1960q1 - 2019q4 |
| FNSCM, FNSMG, FNSPC, FNSMN, FNSO, FNEN, FNEI, FNET, FNEO, FNPS, FNPR, FNPE, FRSH1, FRSH2, FRSO, FRE, FSS, FSSN, FNQS (all @USNA) | Sectoral Investment | Haver Analytics | 1960q1 - 2019q4 |
| TMMEFBAC, TMMEIMAC, TMMECGAC, TMMEAVAC, TMMECNAC, TMMEOMAC (all @USECON) | Imports by End-use | Haver Analytics | 1986q1 - 2019q4 |
| TMXEFBA, TMXEIMA, TMXECGA, TMXEAVA, TMXECNA, TMXEOMA (all @USECON) | Exports by End-use | Haver Analytics | 1986q1 - 2019q4 |
| MSITC00, MSITC01, ... MSITC09 (all @USECON) | Sectoral Imports by SITC | Haver Analytics | 1978q1 - 2019q4 |
| XSITC00, XSITC01, ... XSITC09, XSITCFGN (all @USECON) | Sectoral Exports by SITC | Haver Analytics | 1978q1 - 2019q4 |

# C Additional SVAR results

## C.1 Additional results for main model

Figure A.3: Impulse responses to tariff level shock and trade policy uncertainty shock for all draws. *Notes:* The figure shows the responses for each of the 1000 draws with point-wise median impulse responses (solid red), 68% highest posterior density credible sets (dotted red), and modal model using an absolute loss function (dashed green).

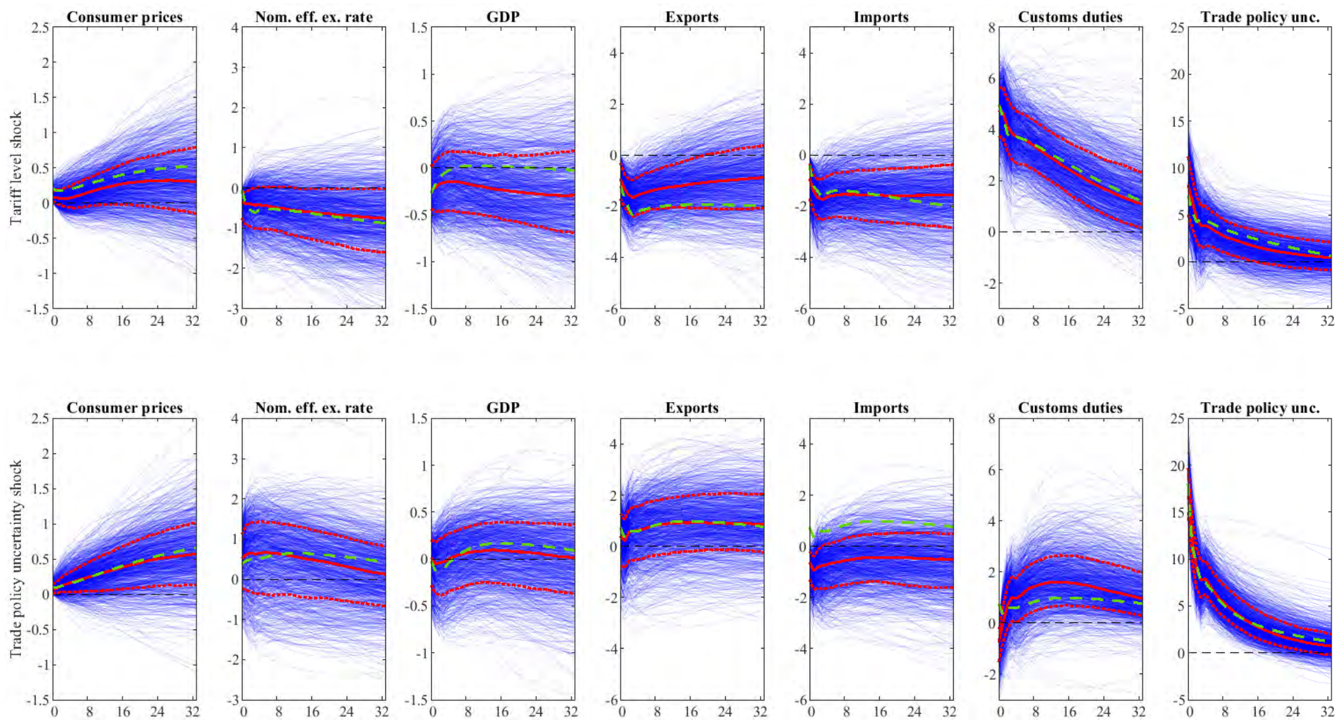


Figure A.4: Impulse responses to all four types of shocks. *Notes:* The figure shows the structural impulse responses to a tariff level shock, a trade policy uncertainty shock, a domestic demand shock, and a domestic supply shock in rows on the endogenous variables in columns. It reports point-wise median impulse responses and 68% highest posterior density credible sets.

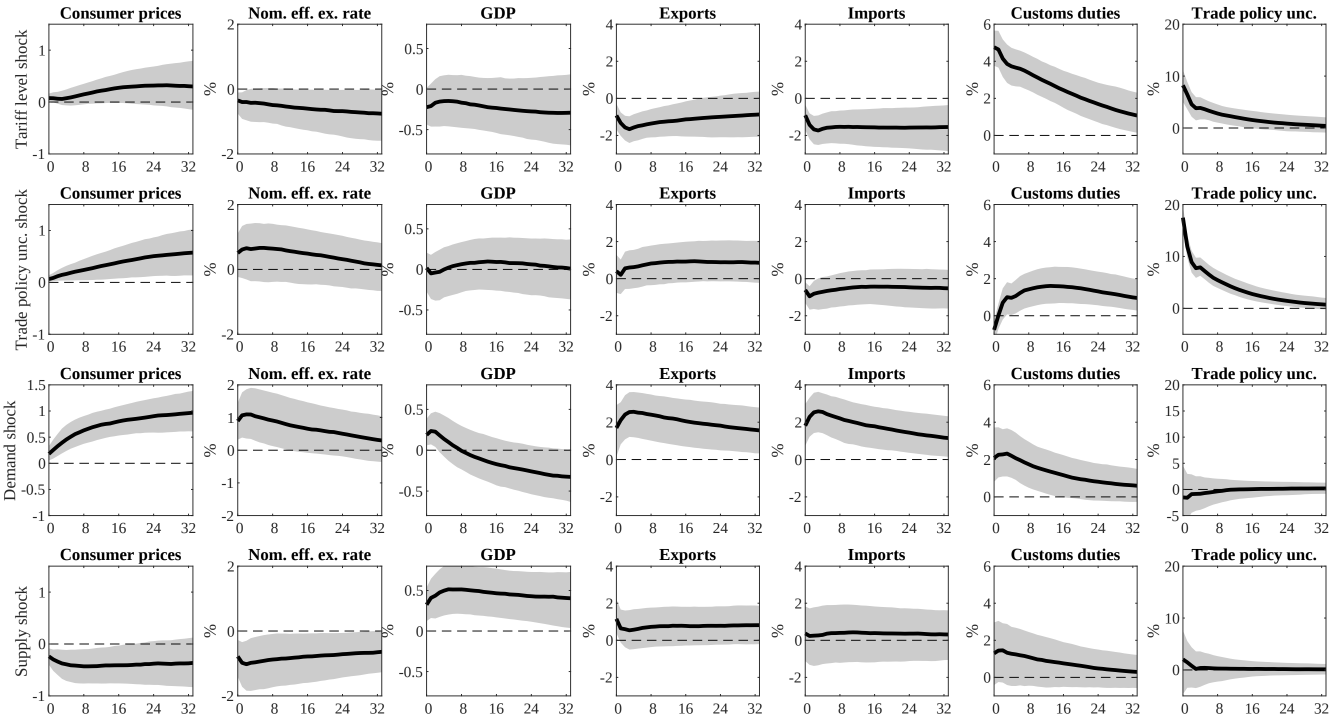



Figure A.5: Historical decomposition of customs duties and trade policy uncertainty. *Notes:* Thick back lines show actual detrended data, thin blue lines show counterfactuals driven by the respective shock only.

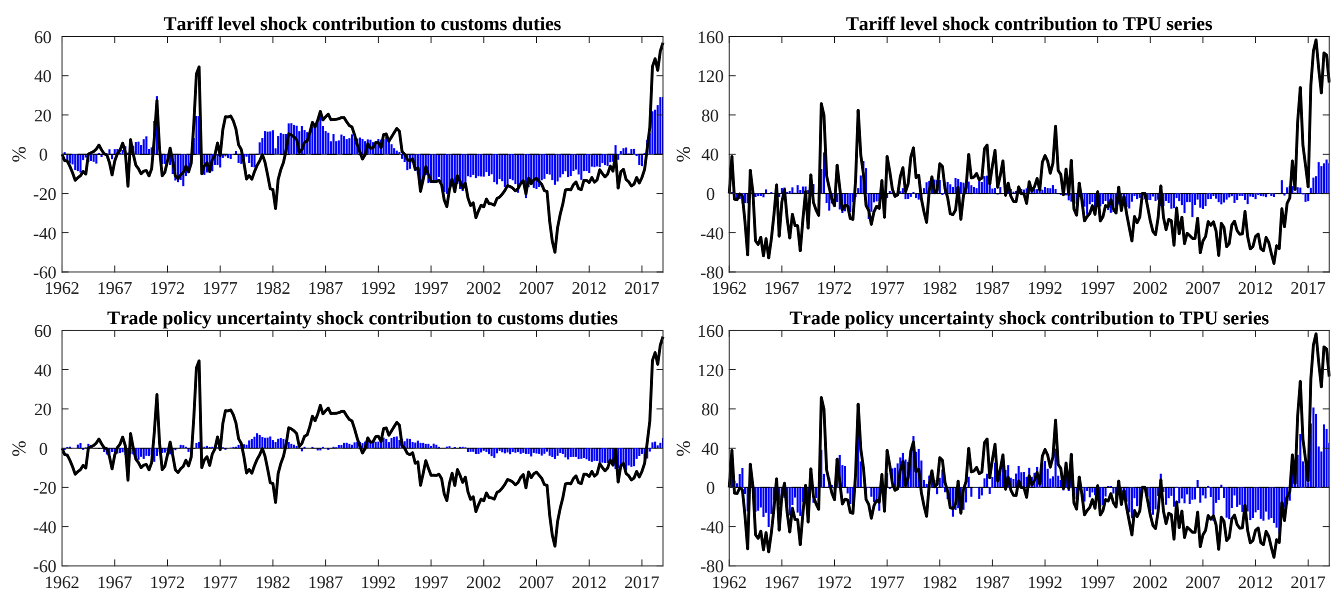


Figure A.6: Historical decomposition of employment and investment. *Notes:* Thick back lines show actual detrended data, thin blue lines show counterfactuals driven by the respective shock only.

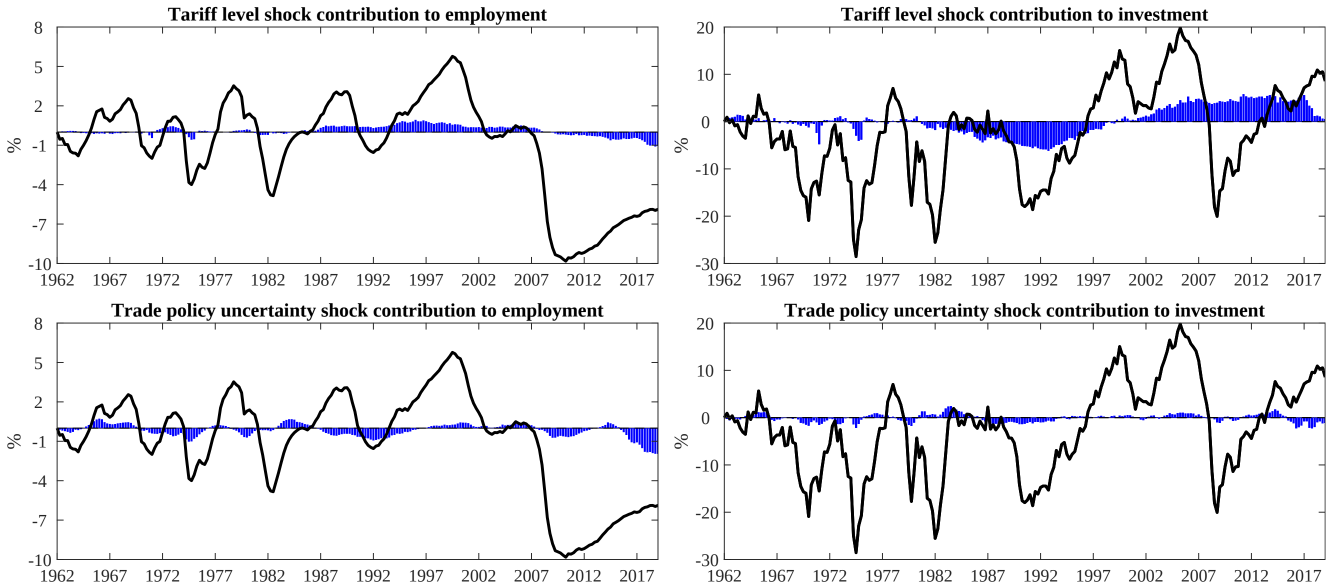



Figure A.7: Historical decomposition of output 2016Q1-2019Q4. *Notes:* Thick back lines show actual detrended data, thin blue lines show counterfactuals driven by the respective shock only.

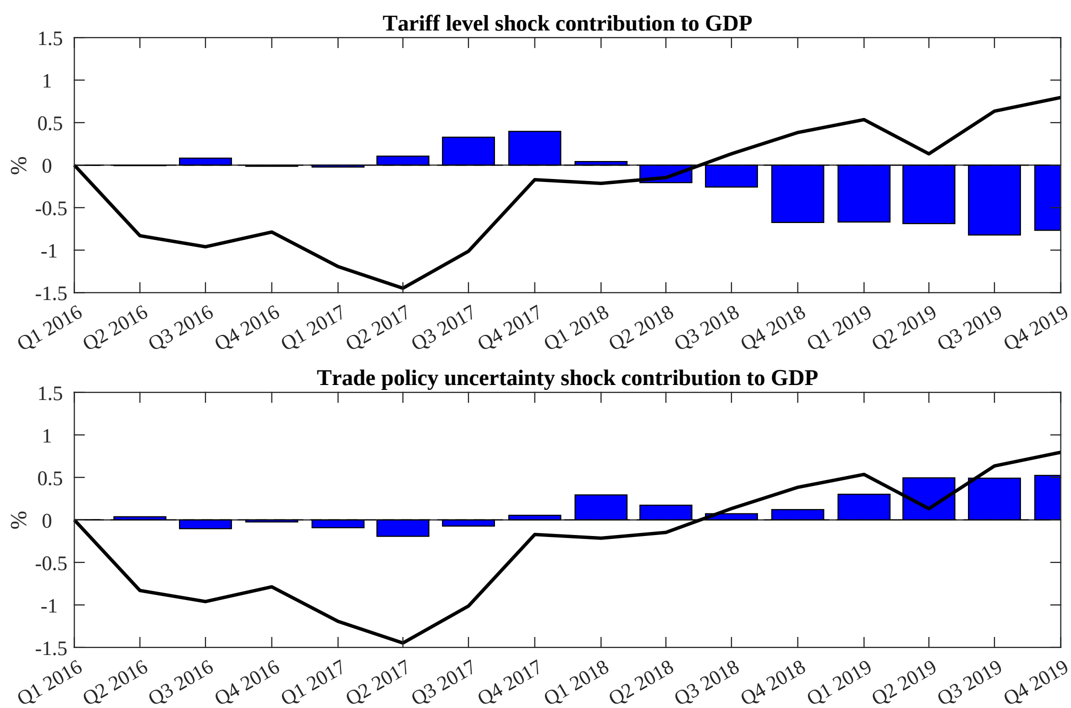


Figure A.8: Shock series in the scenario of a phasing out of tariffs. *Notes:* The red solid lines and shaded regions are the median and 40% point-wise credible sets for the shock series in the scenario 'Tariff phase out'.

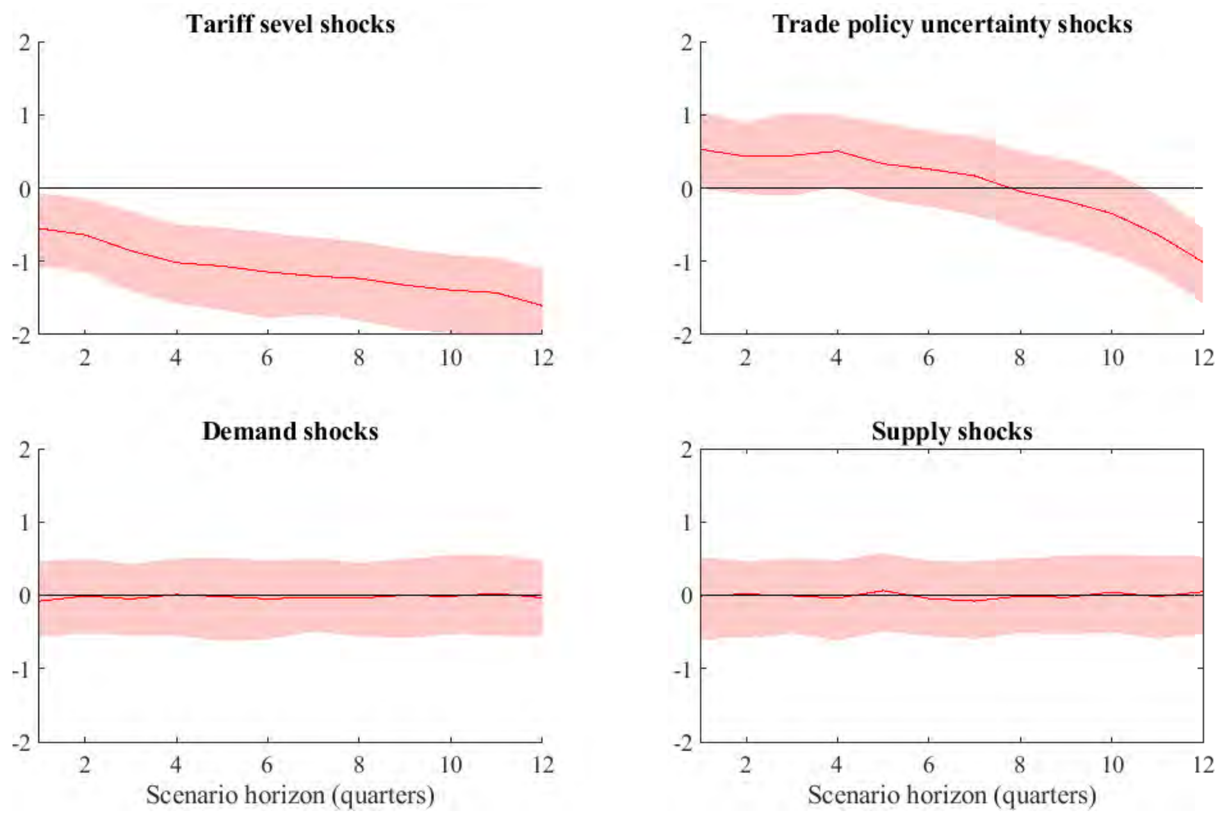



Figure A.9: Comparing two structural scenarios. *Notes:* The red solid lines and shaded regions are the median forecast and 40% point-wise credible sets for the scenario 'Protectionism'. It conditions on the displayed paths of customs duties allowing for uncertainty. The blue dotted lines show the median forecast and 40% point-wise credible sets for the scenario 'Tariff phase out'. It conditions on the displayed paths of customs duties and TPU, not allowing for uncertainty. Both scenarios are driven by series of the tariff level and uncertainty shock.

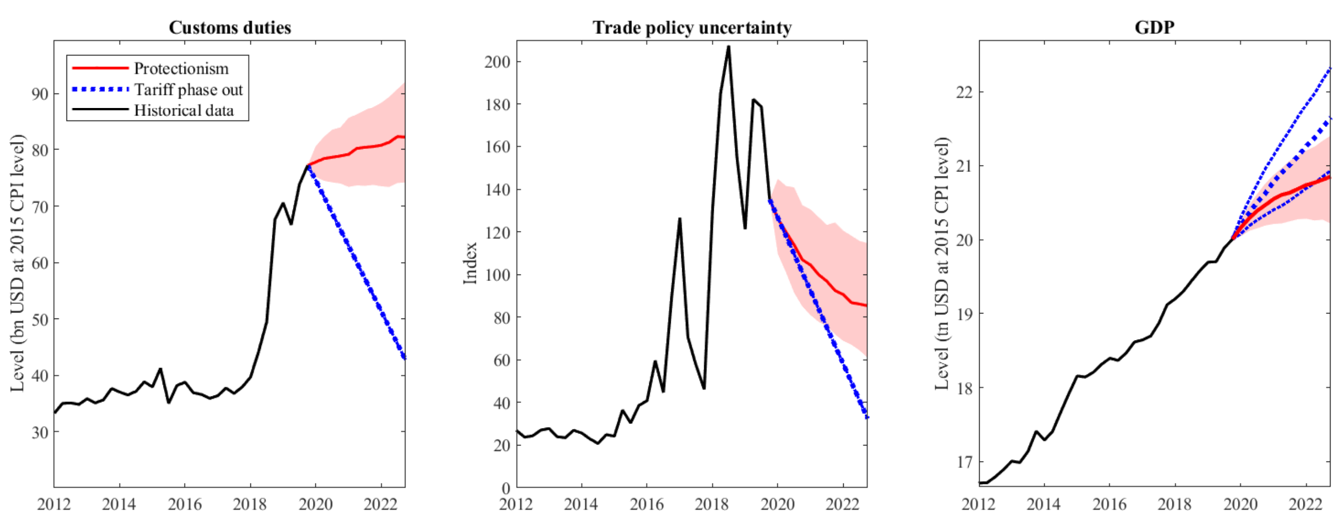
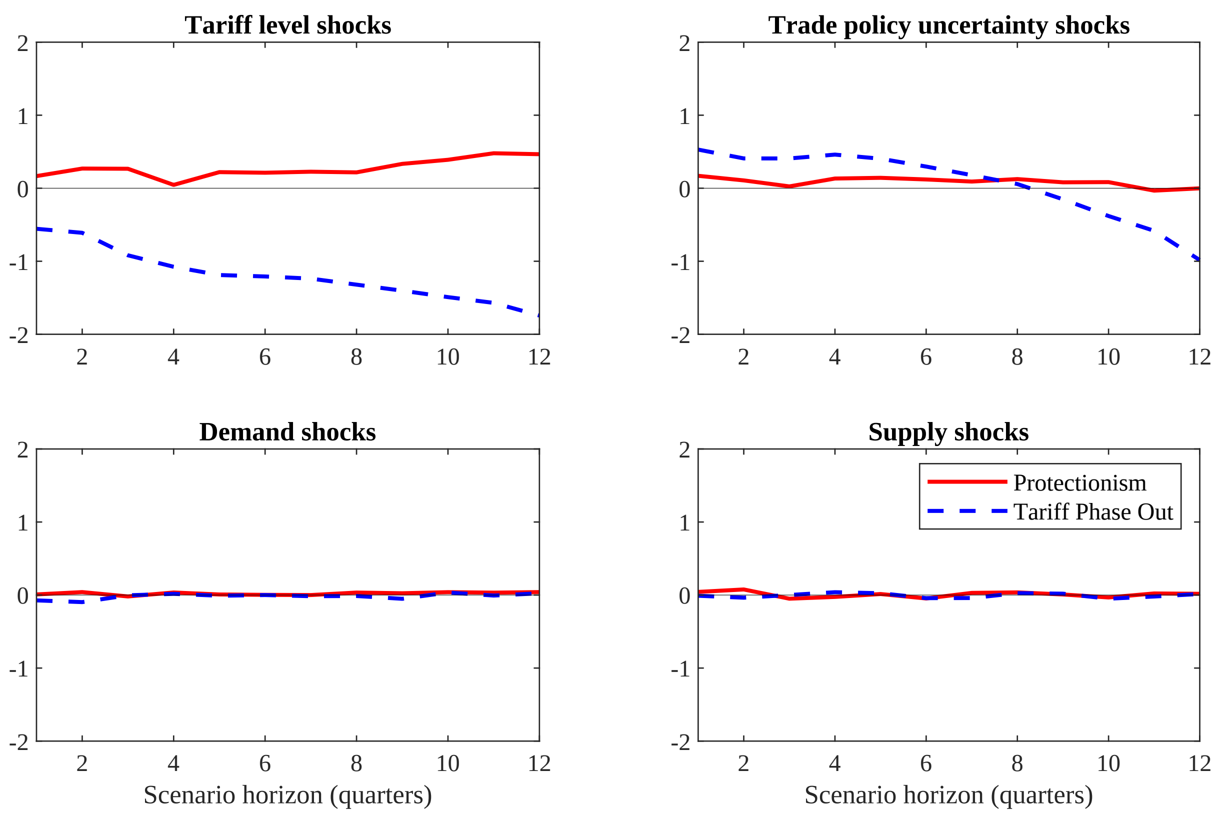


Figure A.10: Shock series in the trade policy scenarios of continued protectionism vs. phasing out of tariffs. *Notes:* The red solid lines show the mean shock series in the scenario 'Protectionism' and the blue dotted lines show the mean shock series in the scenario 'Tariff phase out'.



## C.2 Additional results of sectoral analysis

Figure A.11: Responses of sectoral imports to a tariff level shock. *Notes:* The figure shows the responses of sectoral imports obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

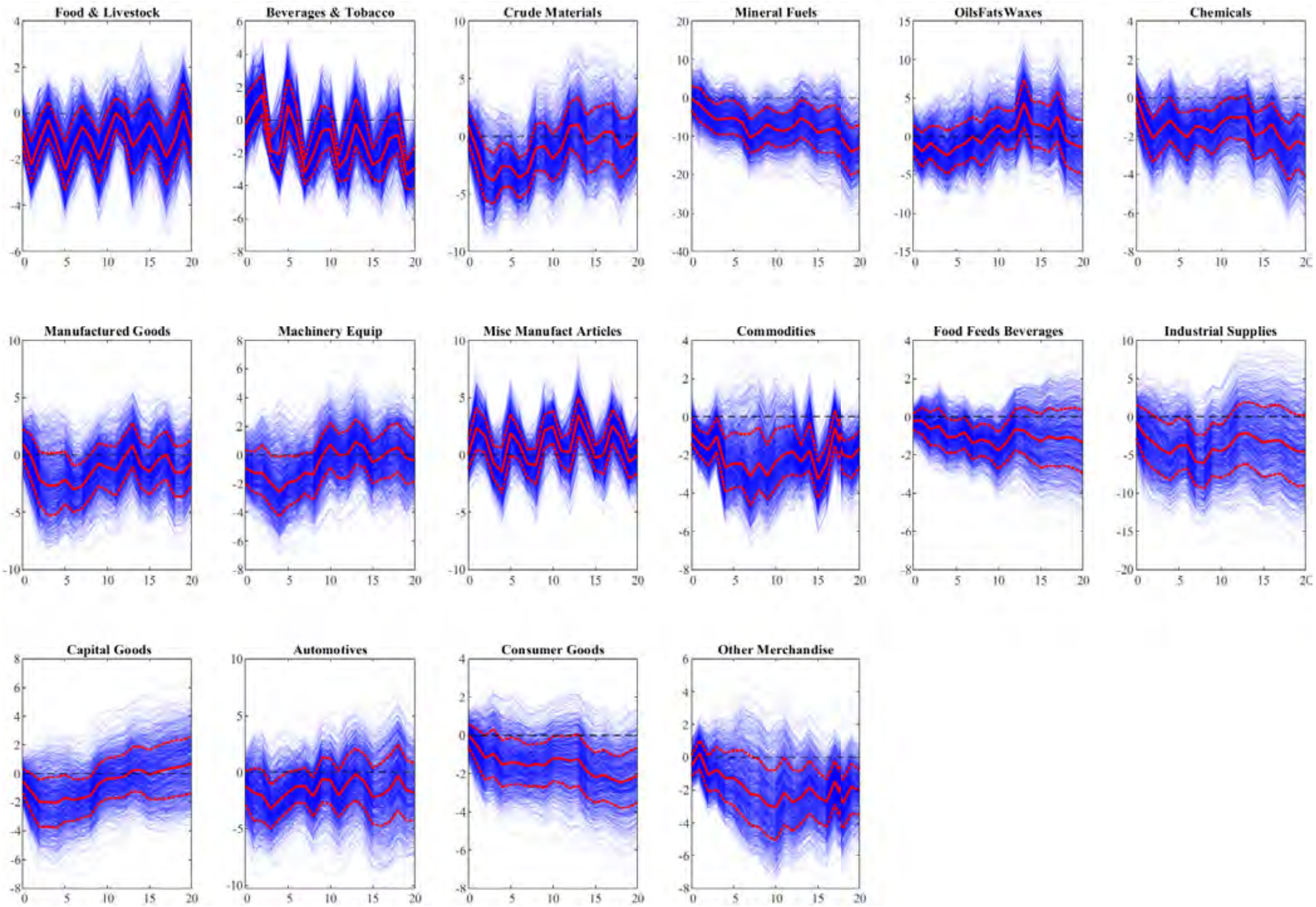


Figure A.12: Responses of sectoral exports to a tariff level shock. *Notes:* The figure shows the responses of sectoral exports obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

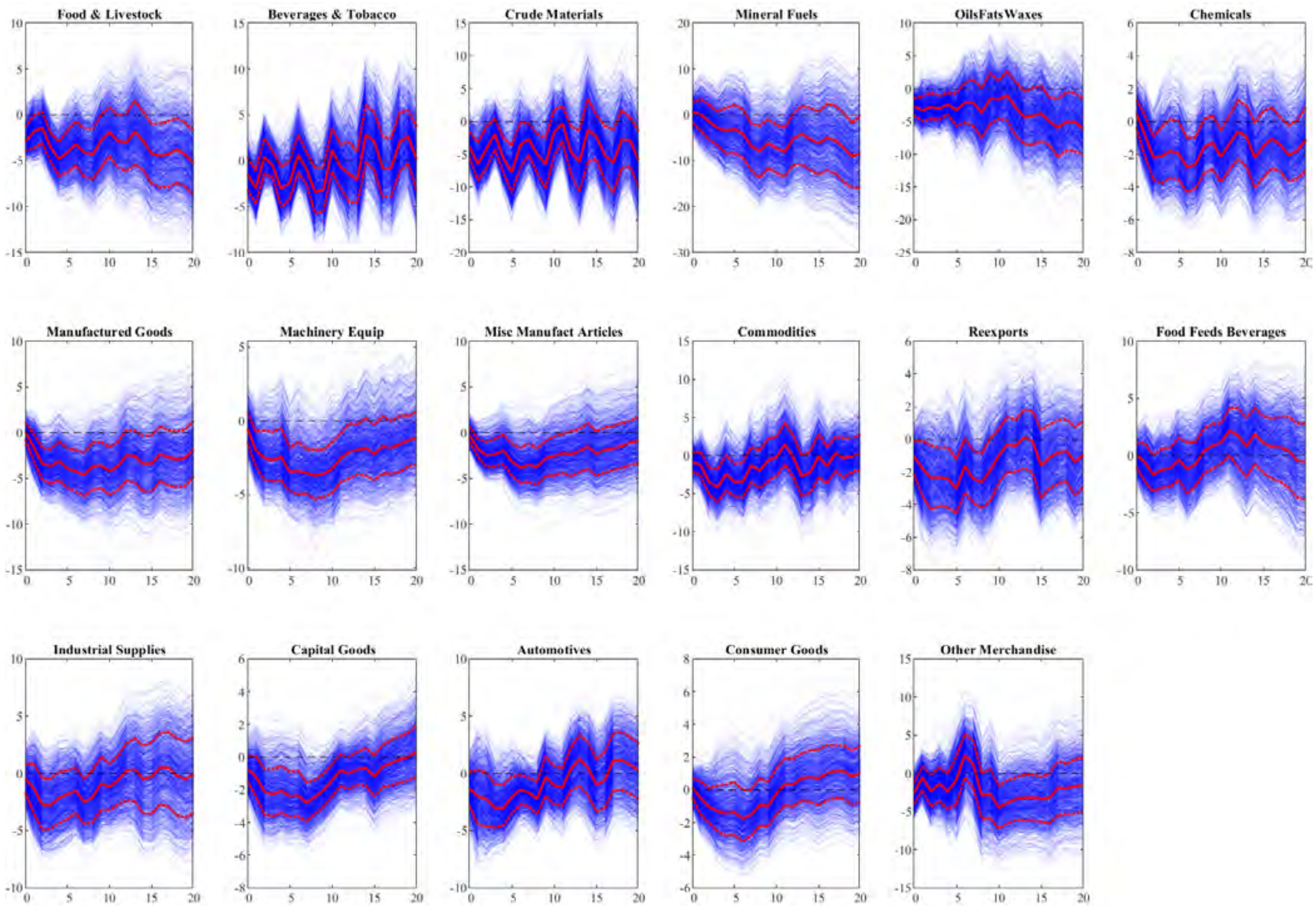


Figure A.13: Responses of sectoral investment to a tariff level shock. *Notes:* The figure shows the responses of sectoral investment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

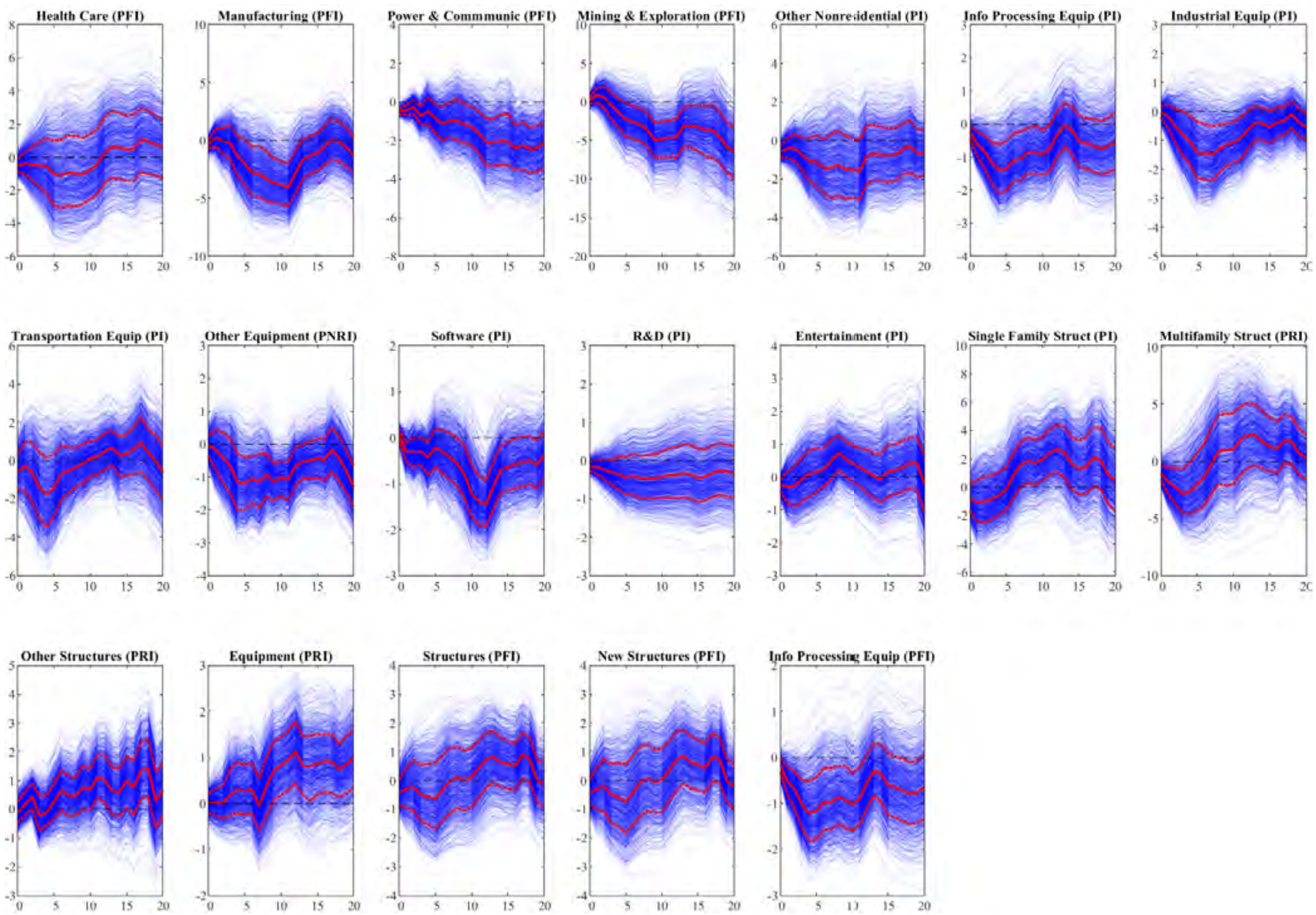


Figure A.14: Responses of sectoral employment to a tariff level shock. *Notes:* The figure shows the responses of sectoral employment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

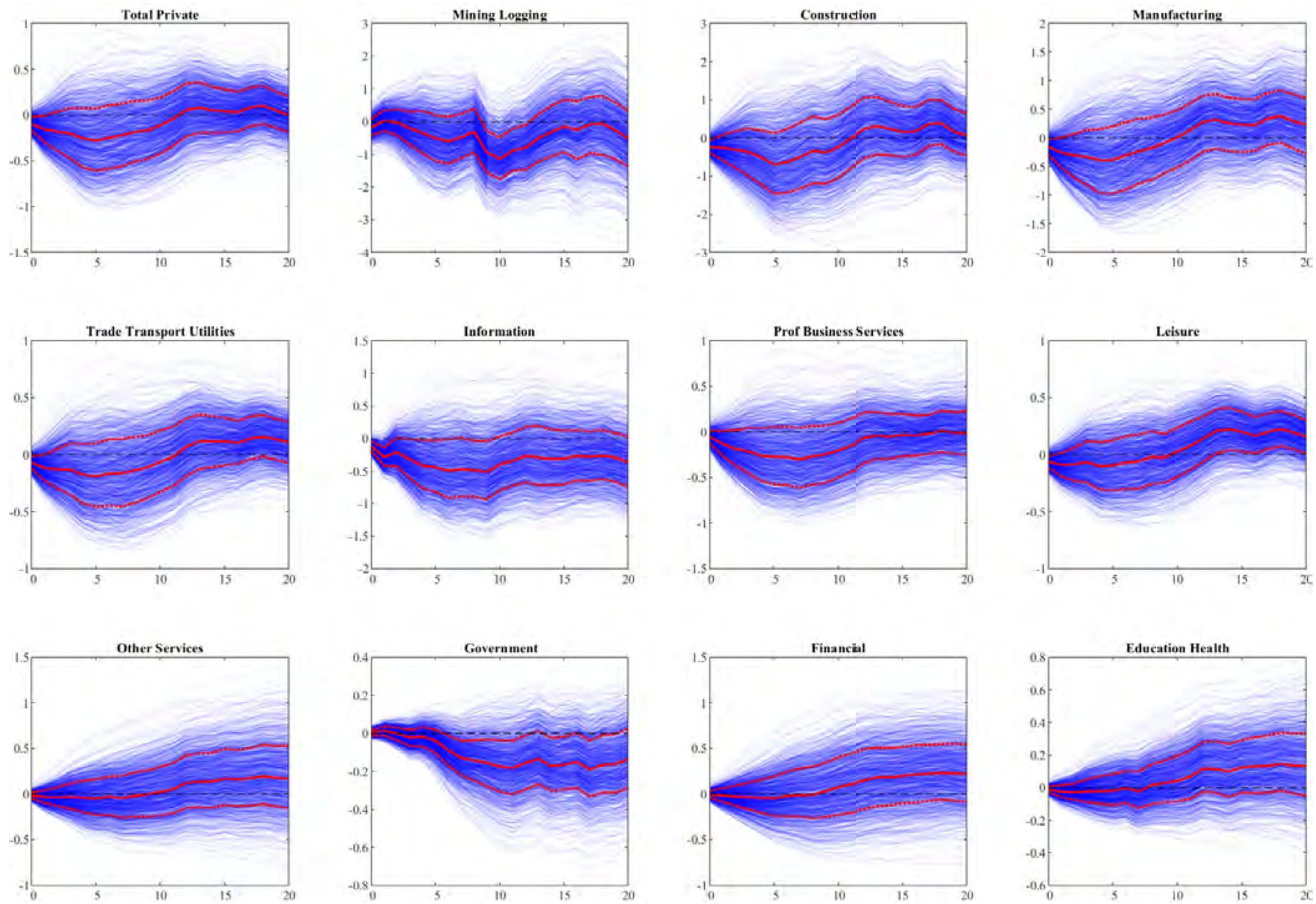


Figure A.15: Responses of sectoral imports to a trade policy uncertainty shock. *Notes:* The figure shows the responses of sectoral imports obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

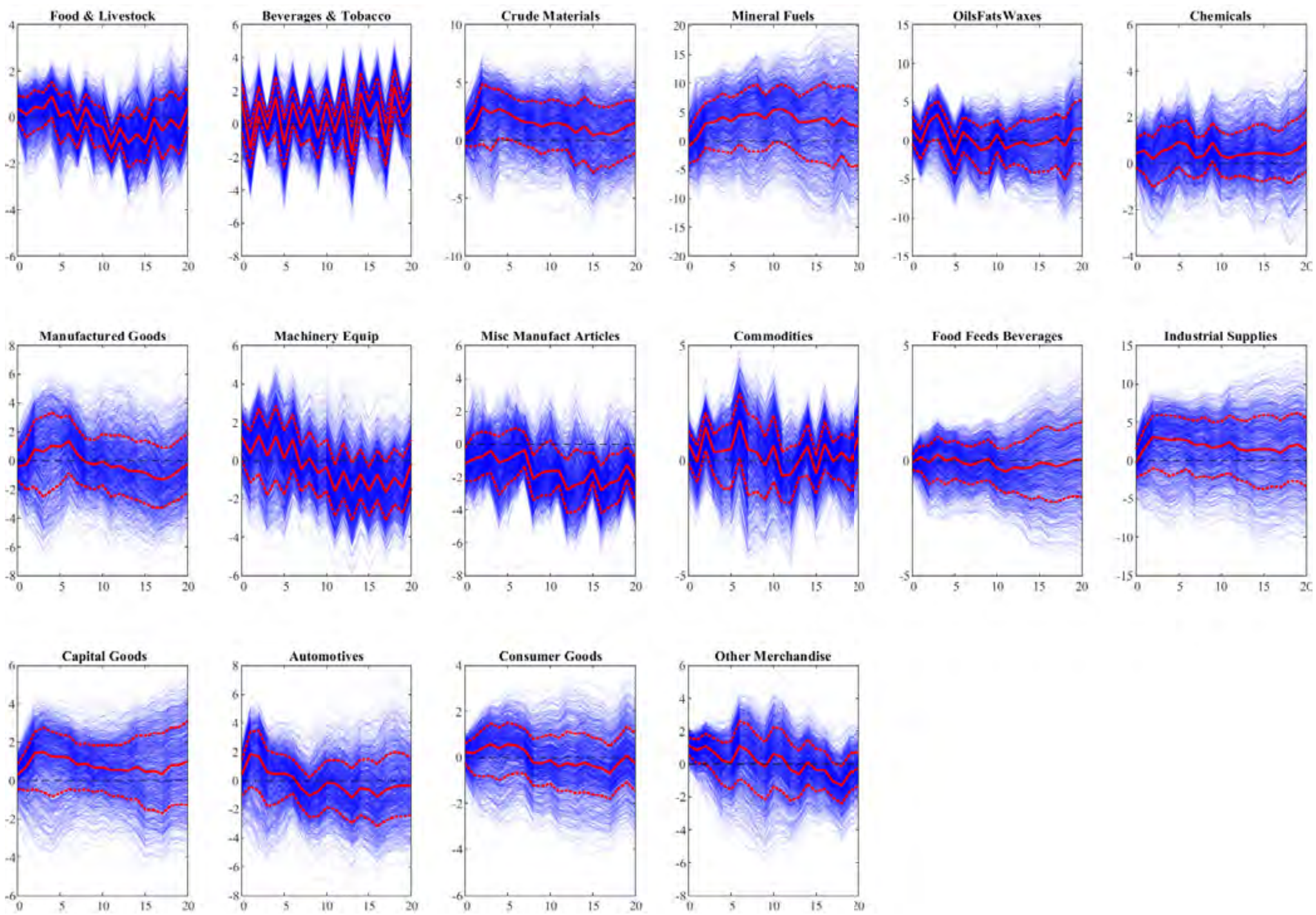


Figure A.16: Responses of sectoral exports to a trade policy uncertainty shock. *Notes:* The figure shows the responses of sectoral exports obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

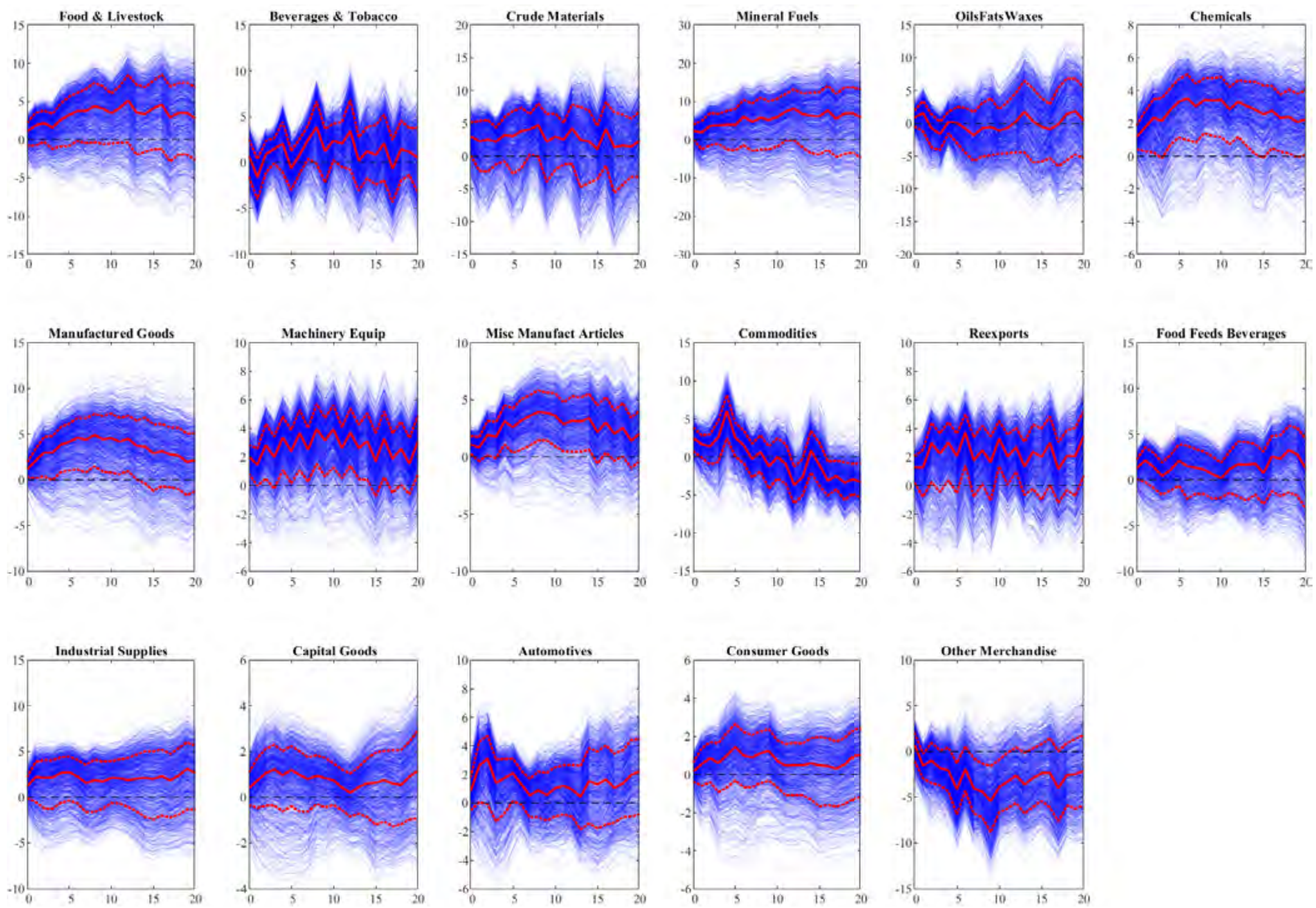


Figure A.17: Responses of sectoral investment to a trade policy uncertainty shock. *Notes:* The figure shows the responses of sectoral investment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

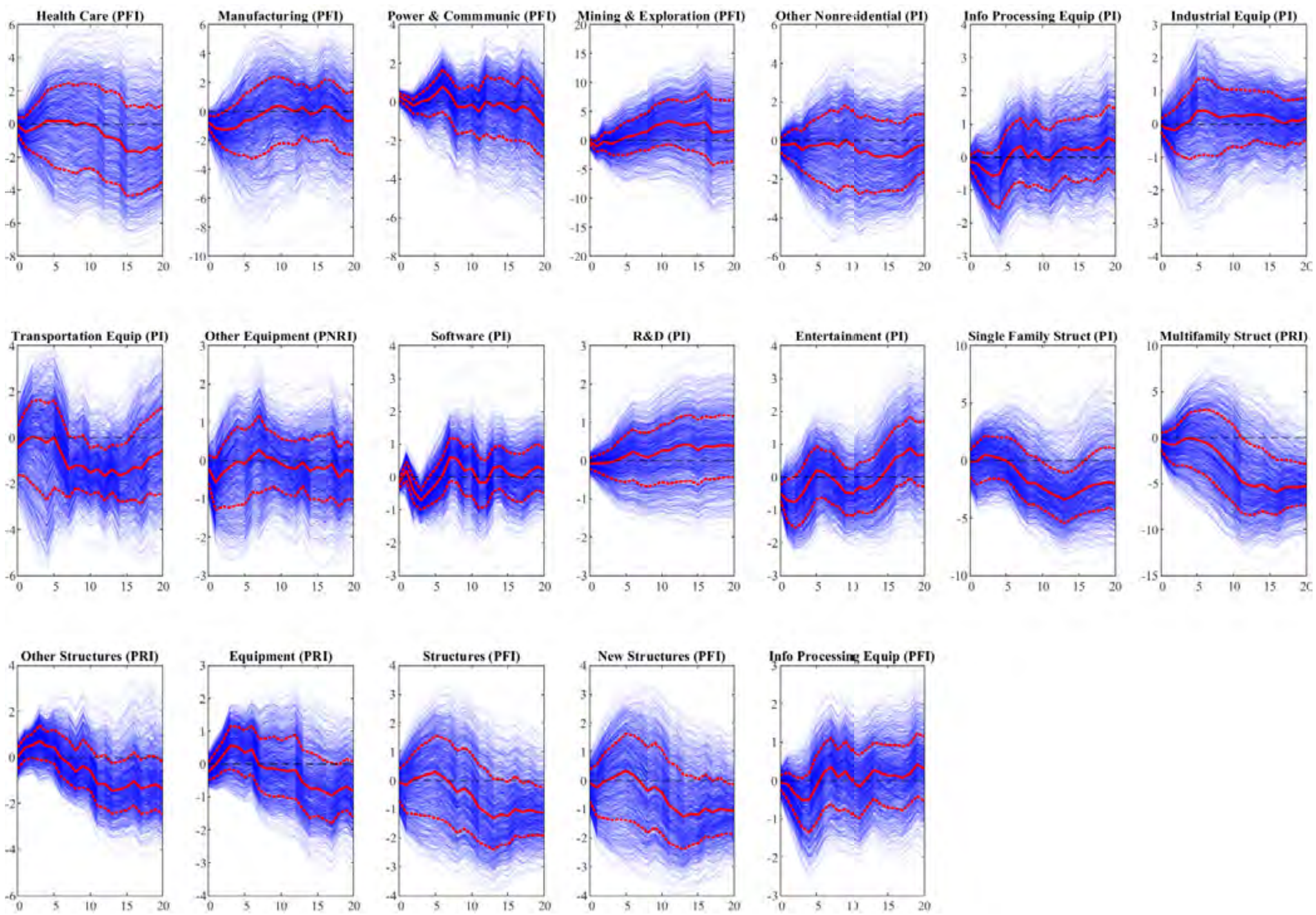


Figure A.18: Responses of sectoral employment to a trade policy uncertainty shock. *Notes:* The figure shows the responses of employment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

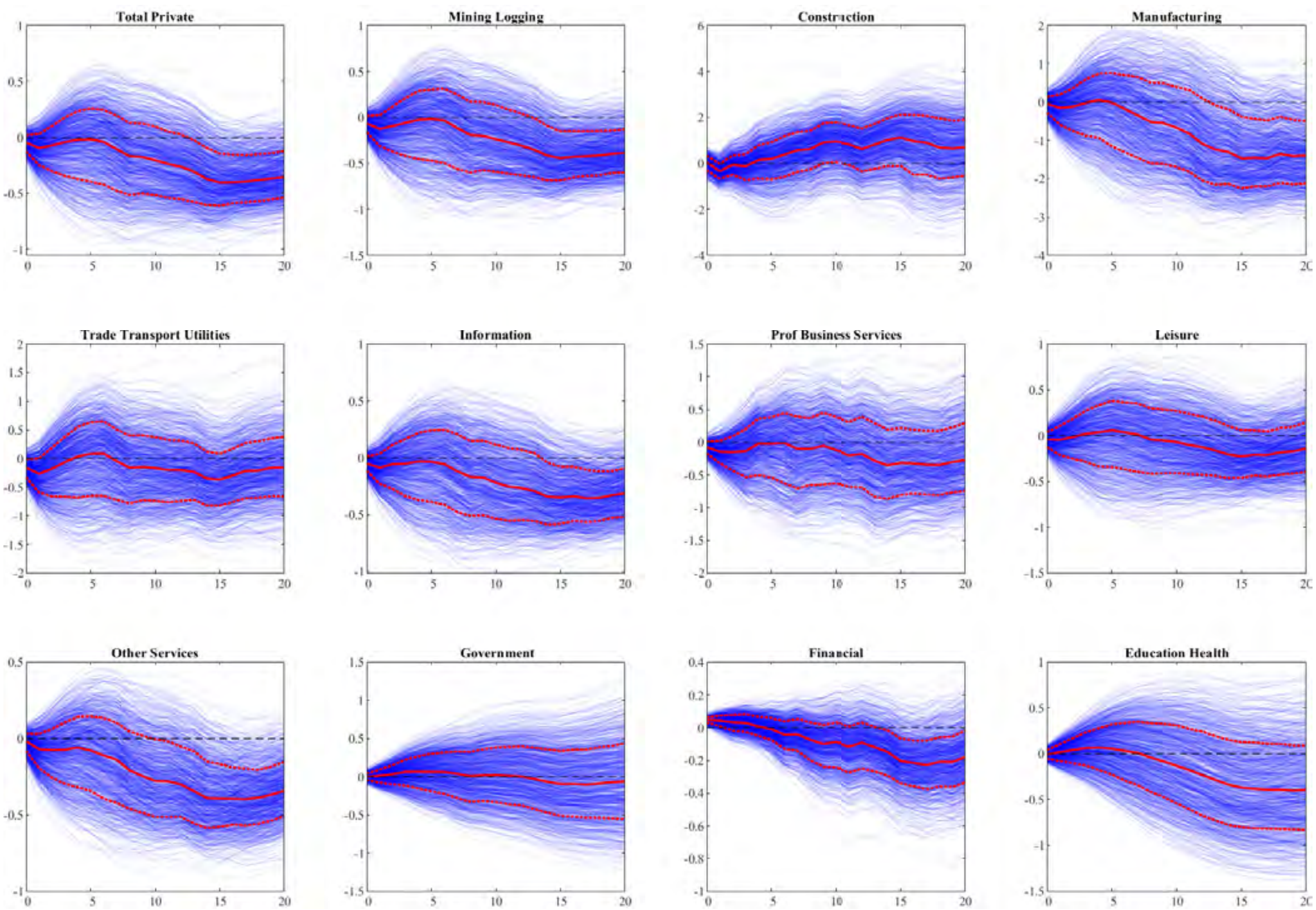


Figure A.19: Responses of state employment to a tariff level shock. *Notes:* The figure shows the responses of state employment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.

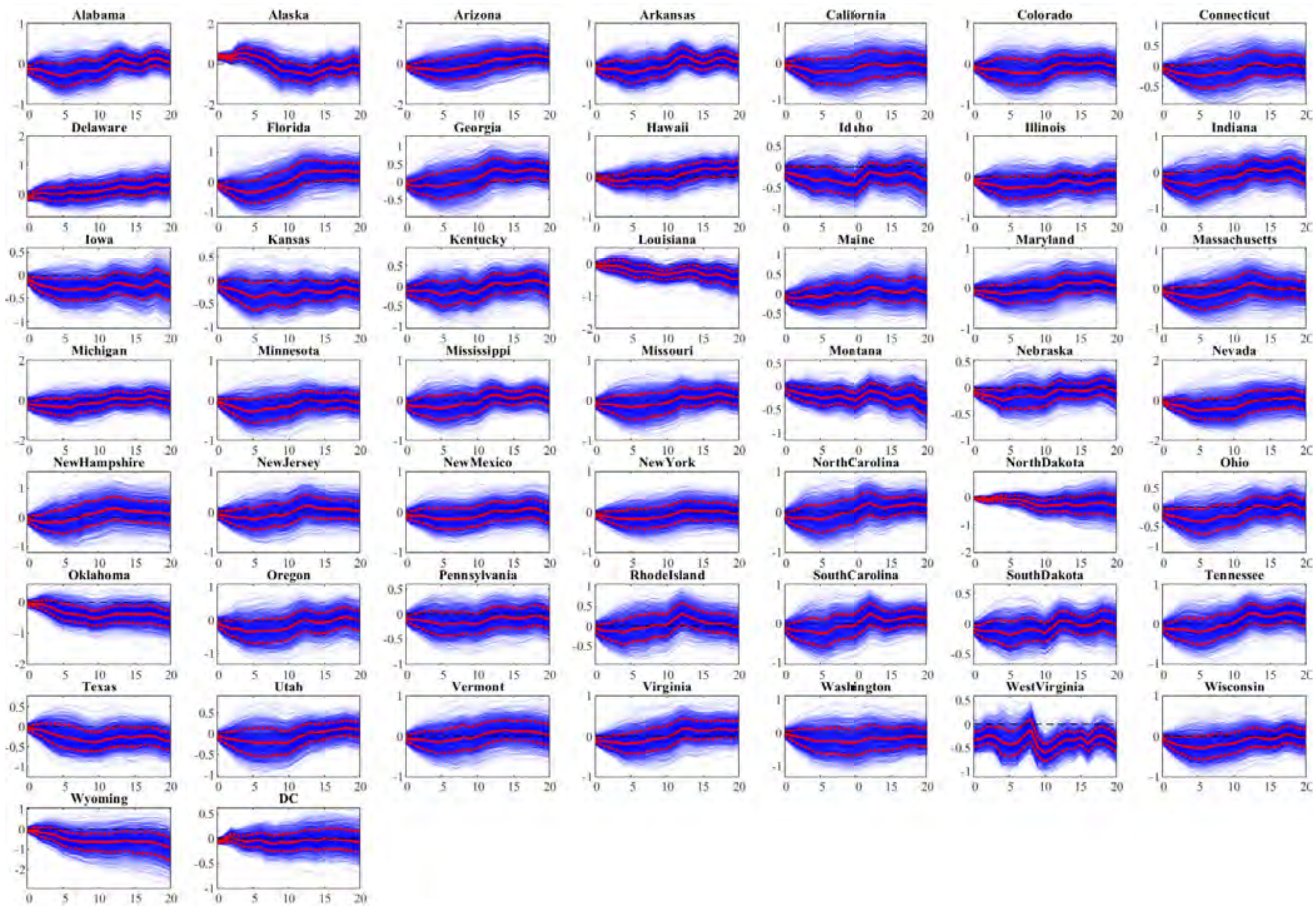
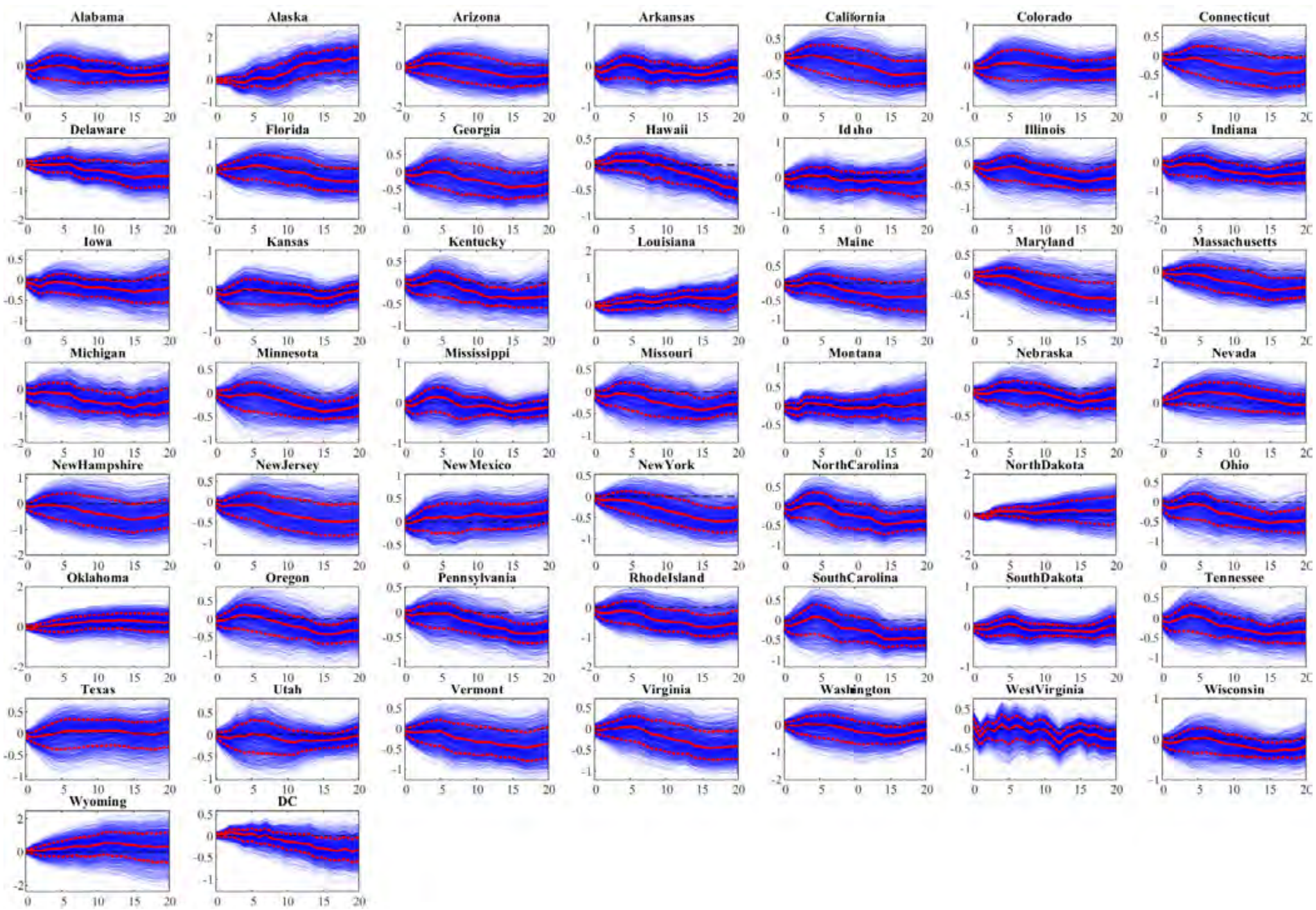


Figure A.20: Responses of state employment to a trade policy uncertainty shock. *Notes:* The figure shows the responses of state employment obtained from local projections. It shows the responses for each of the 1000 draws and the point-wise median and 68% highest posterior density sets.



## C.3 Sensitivity analysis

Figure A.21: Impulse responses with consumption. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when replacing output by total private consumption. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

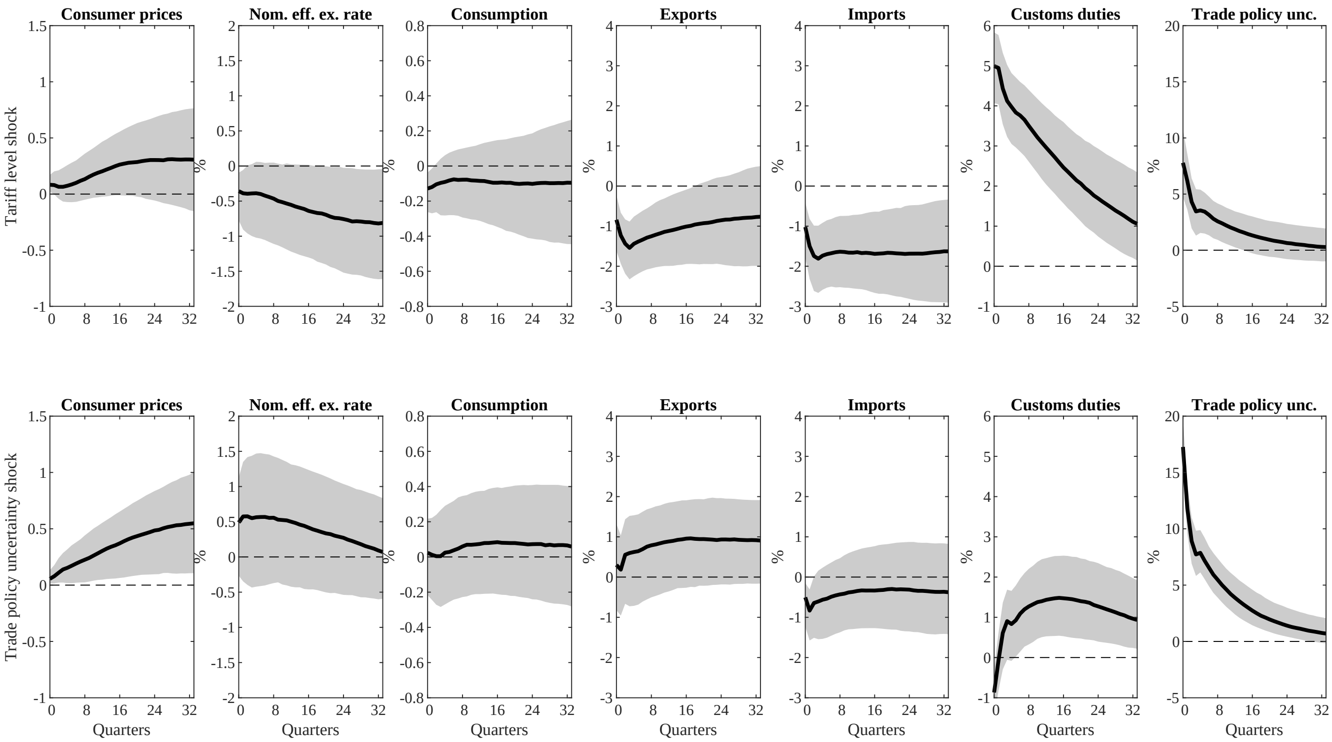


Figure A.22: Impulse responses with investment. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when replacing output by investment. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

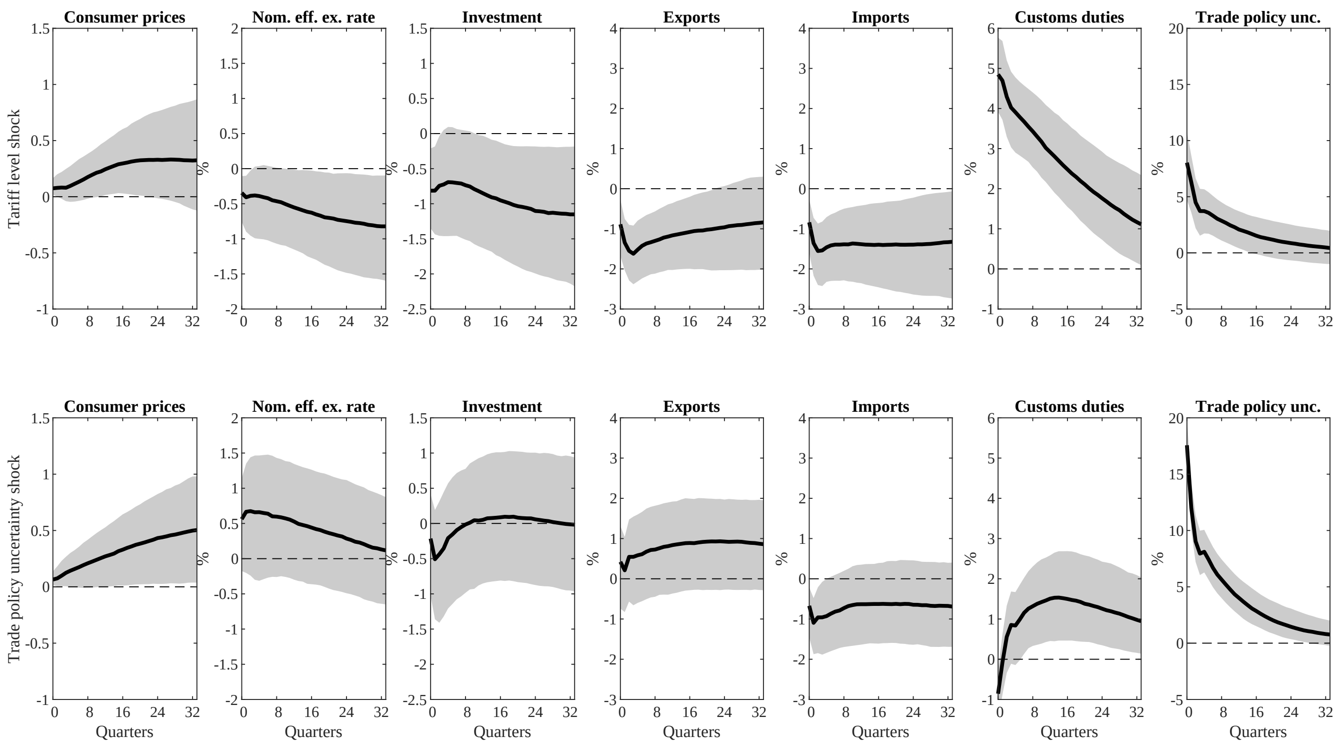


Figure A.23: Impulse responses with employment. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when replacing output by non-farm payrolls. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

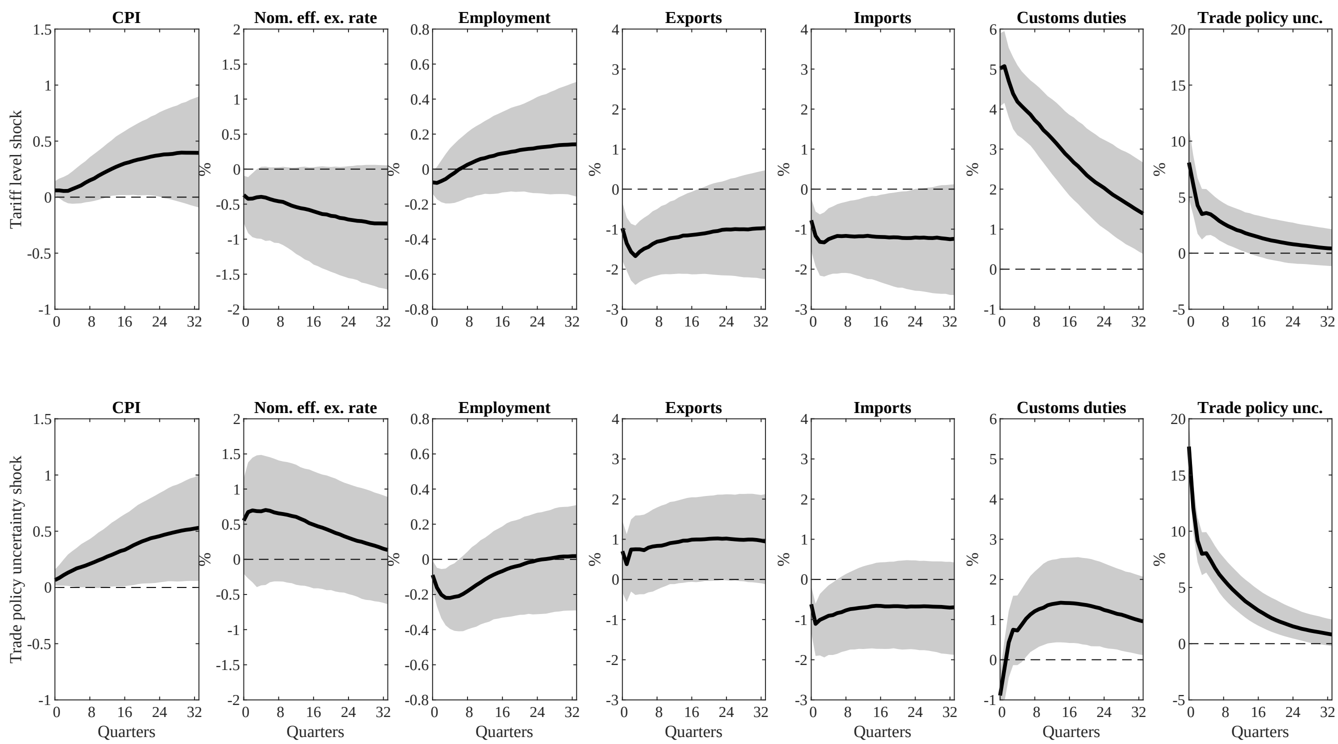


Figure A.24: Impulse responses when using the real effective exchange rate. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when using the real instead of the nominal exchange rate (an increase is a depreciation). The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

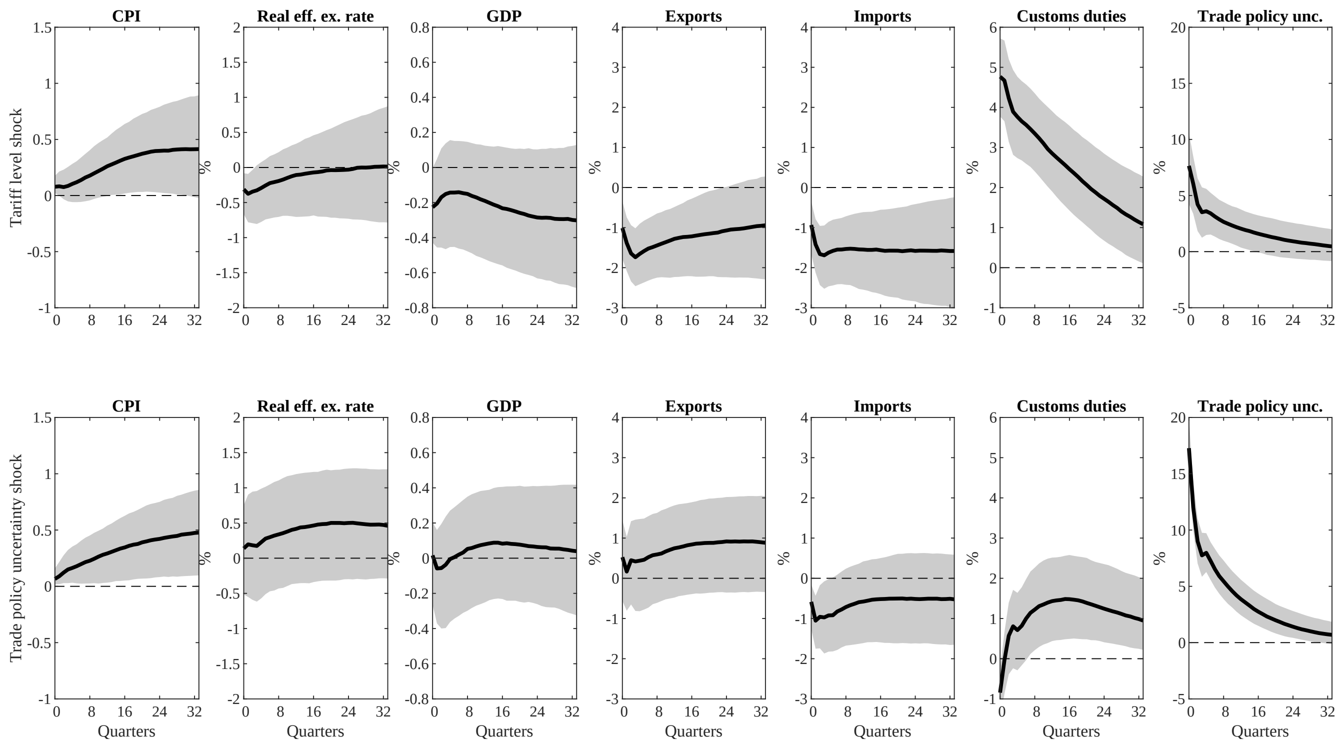


Figure A.25: Impulse responses when using producer prices. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when using the producer instead of consumer prices. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

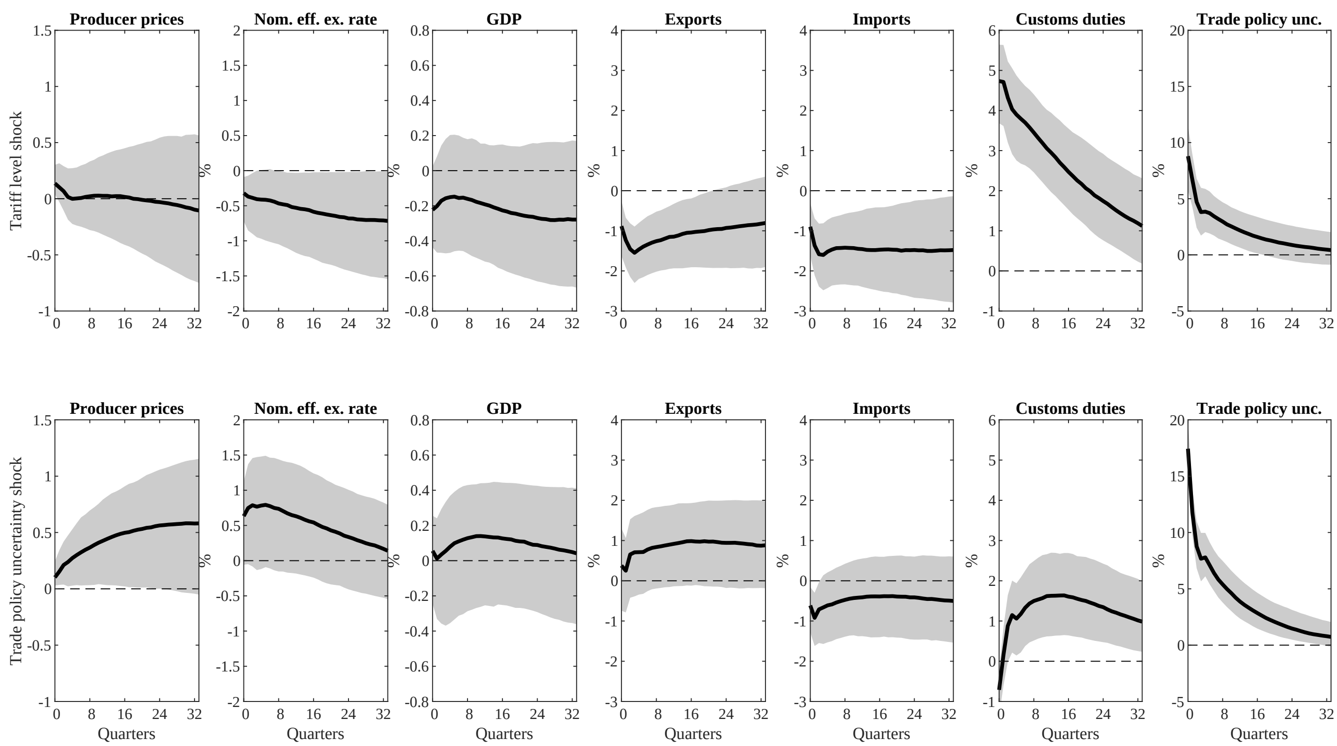


Figure A.26: Impulse responses when including trade in services. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when including trade in services in imports and exports. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

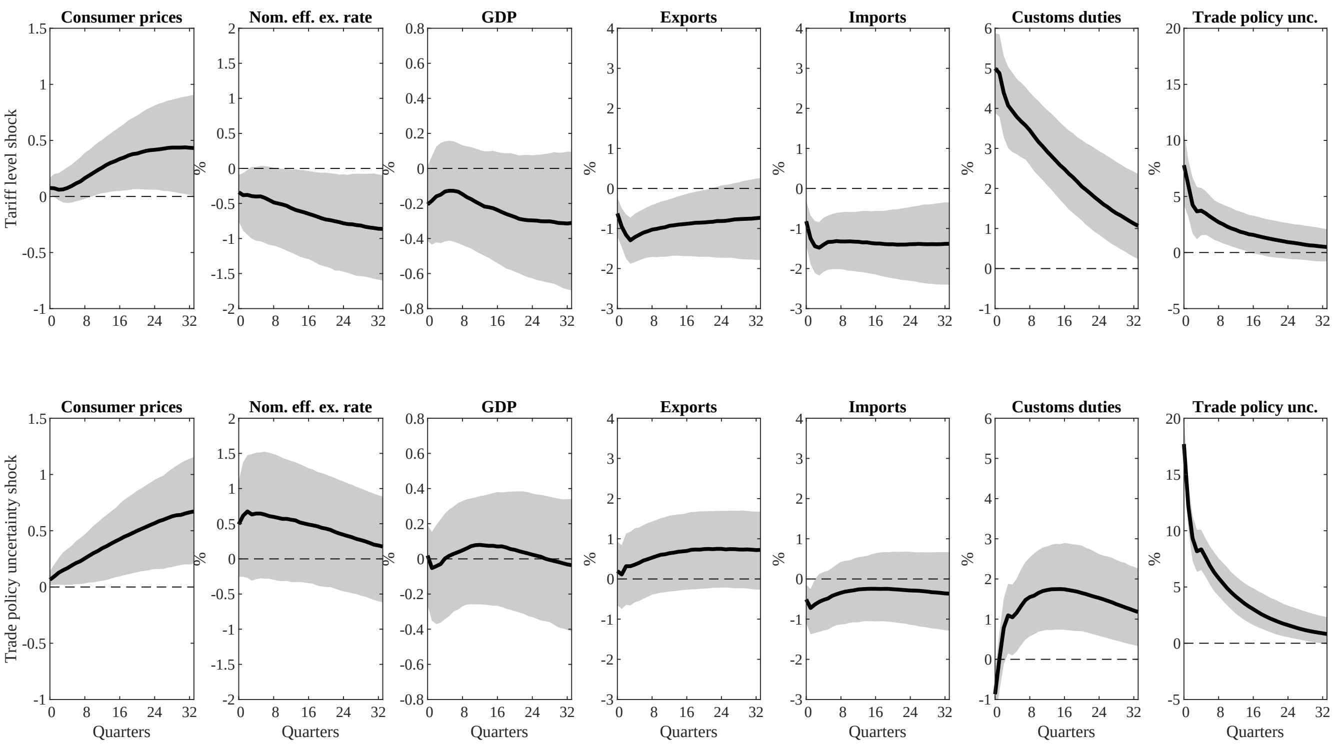


Figure A.27: Impulse responses with tariff rate. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when replacing customs duties by the tariff proceeds to import ratio. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

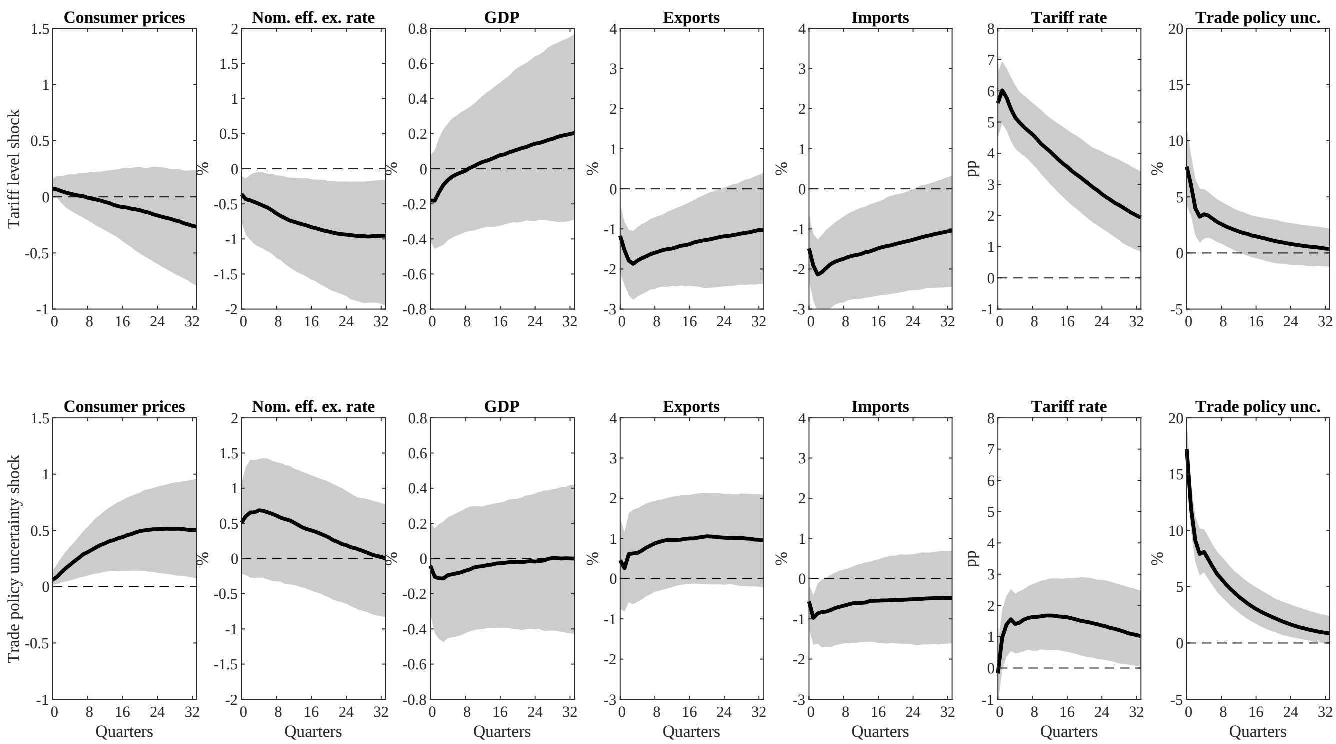


Figure A.28: Impulse responses with trade balance. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when adding the ratio of net exports to GDP. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

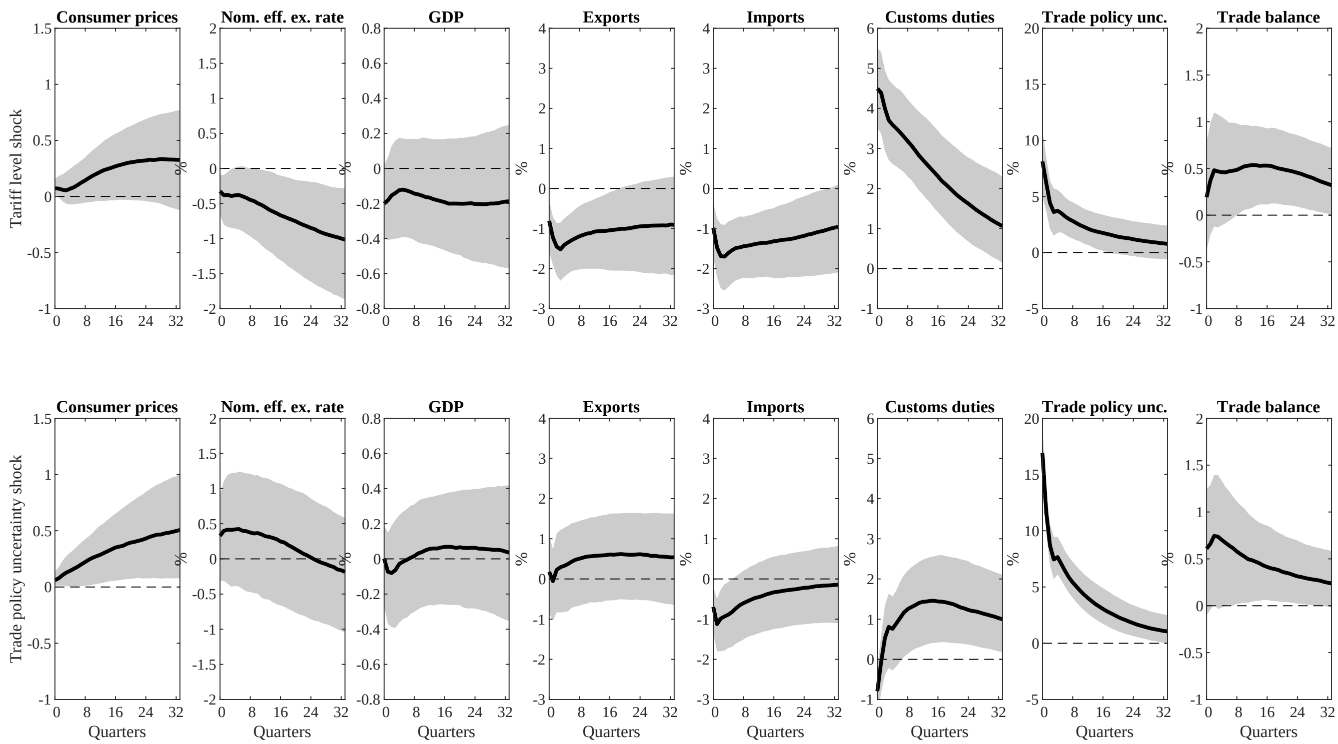


Figure A.29: Impulse responses with terms of trade. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when adding the terms of trade. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

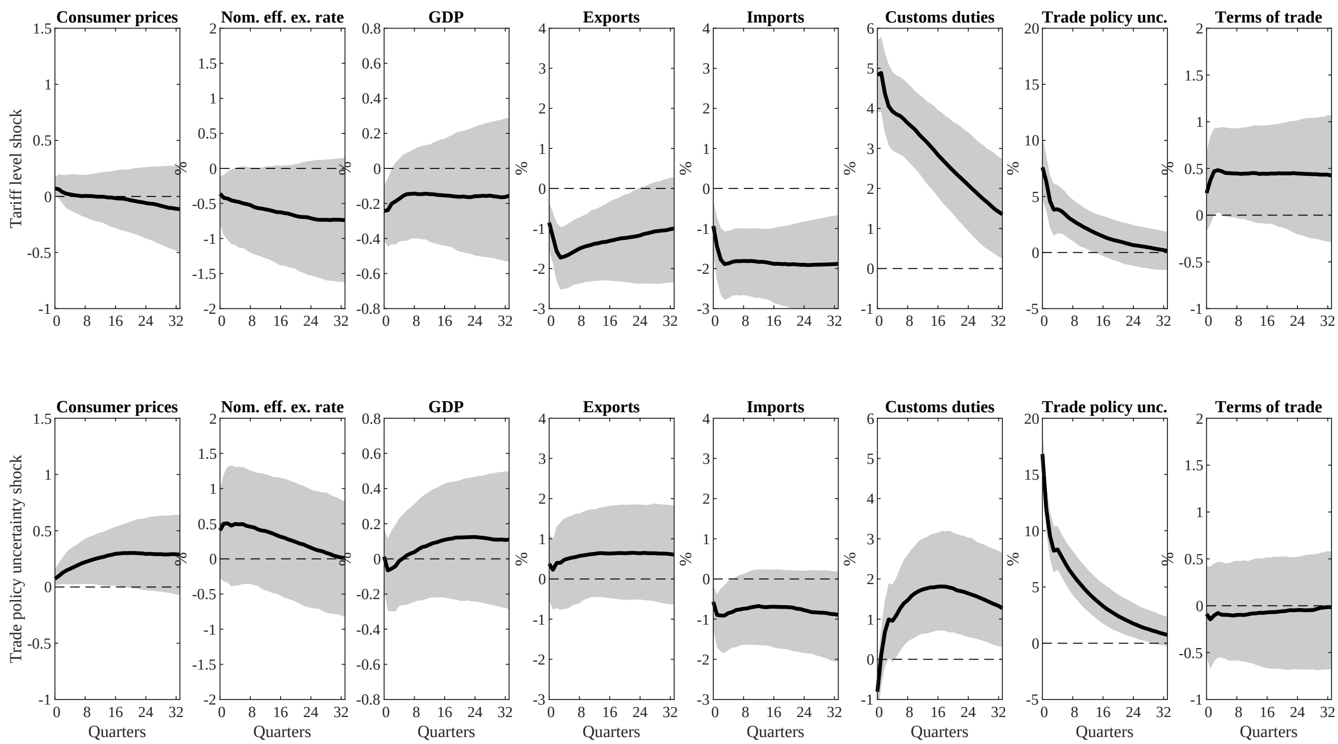


Figure A.30: Impulse responses with total factor productivity. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when adding TFP (total factor productivity). The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

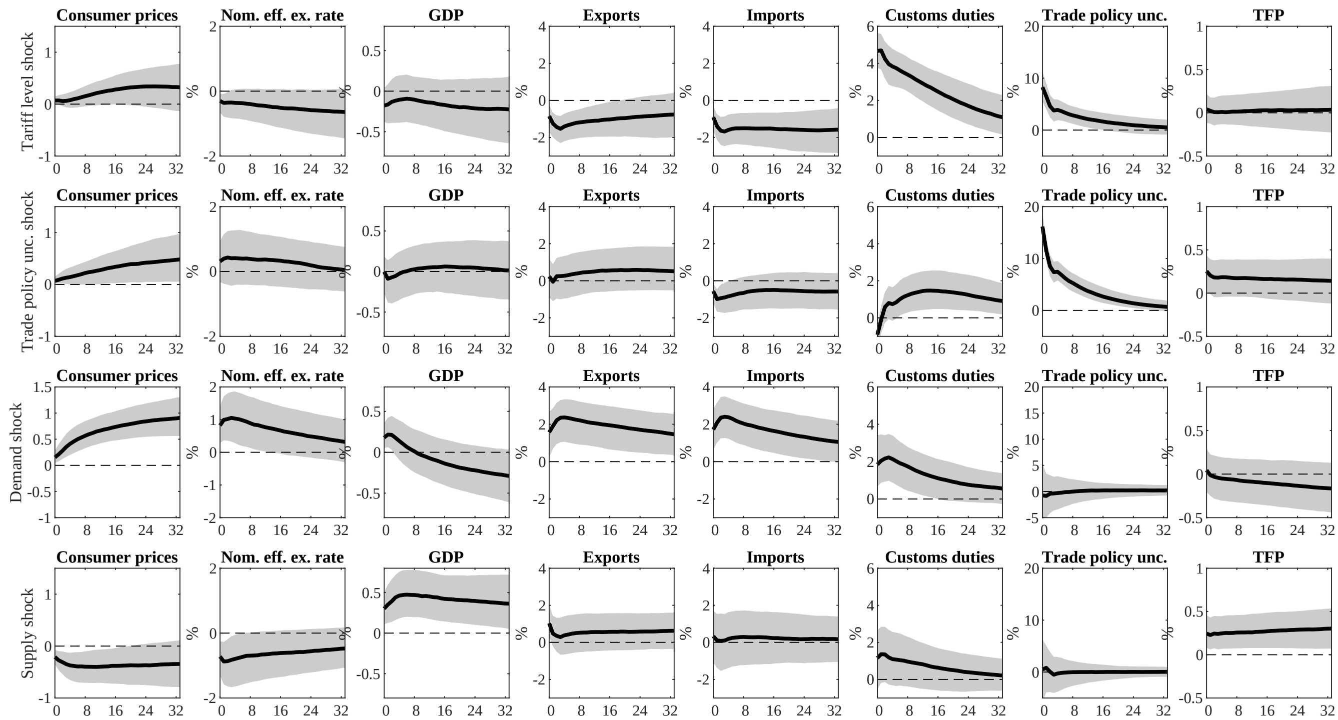


Figure A.31: Impulse responses with monetary policy shock. *Notes:* The figure shows the structural impulse responses to a tariff level shock, a trade policy uncertainty shock, a domestic demand shock, a domestic supply shock, and a domestic monetary policy shock in rows on the endogenous variables in columns. It reports point-wise median impulse responses and 68% highest posterior density credible sets.

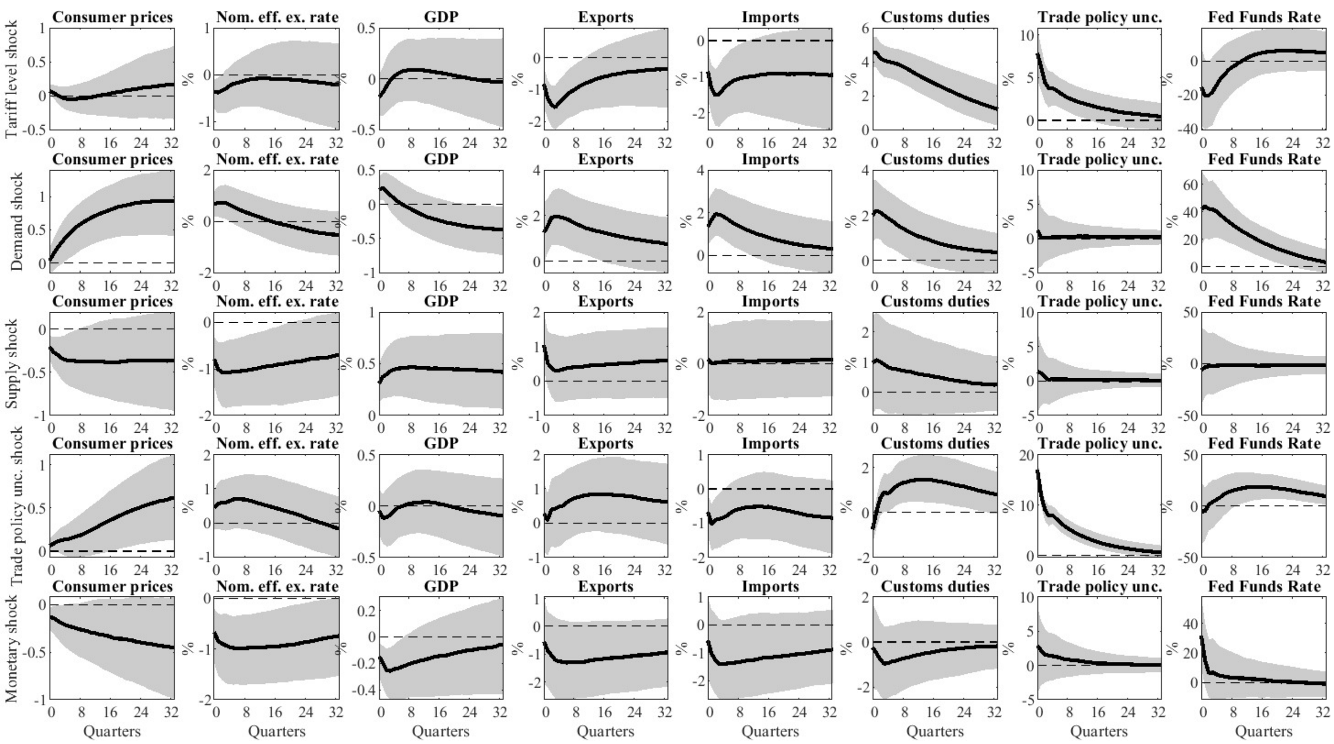


Figure A.32: Impulse responses for sample starting in 1973Q2. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when the sample starts in 1973Q2. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

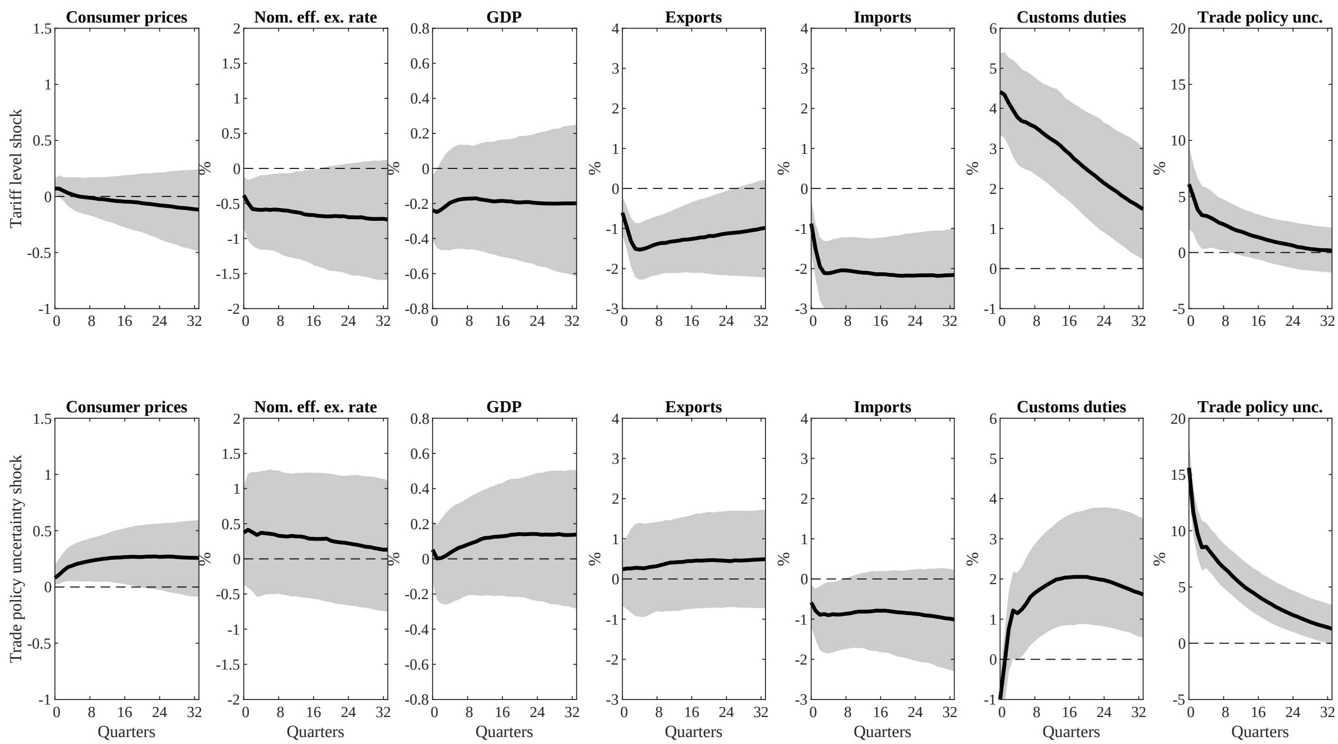


Figure A.33: Impulse responses for sample ending in 2016Q4. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when the sample ends in 2016Q4. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

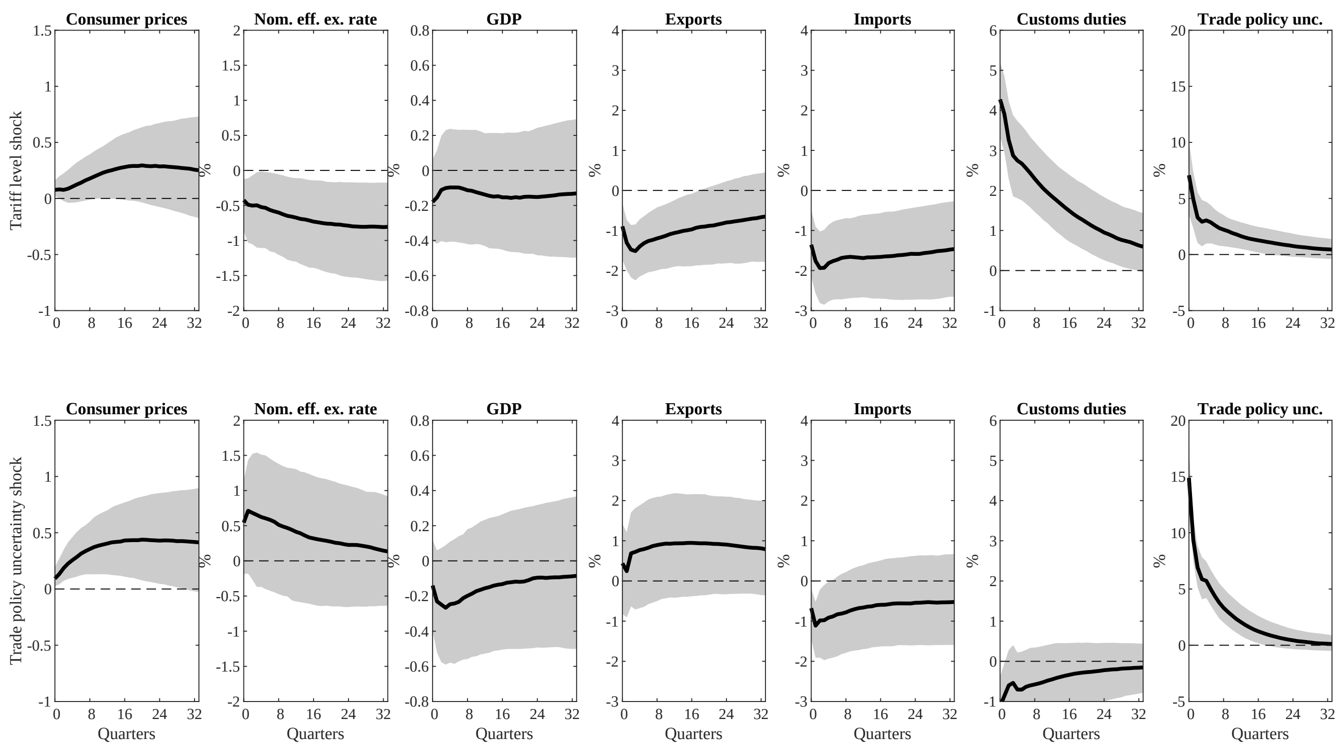


Figure A.34: Impulse responses using eight lags. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when using eight lags of the endogenous variables. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

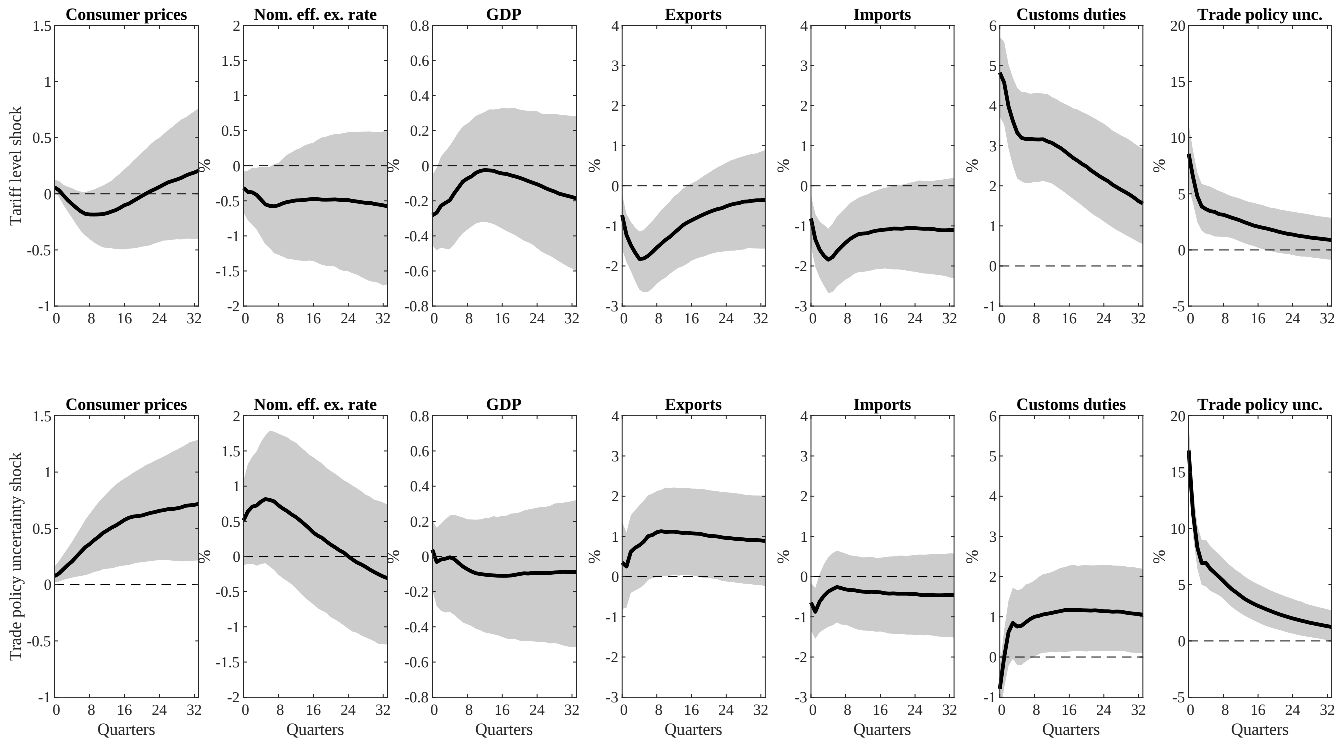


Figure A.35: Impulse responses including linear trend. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when including a linear trend into the model. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.

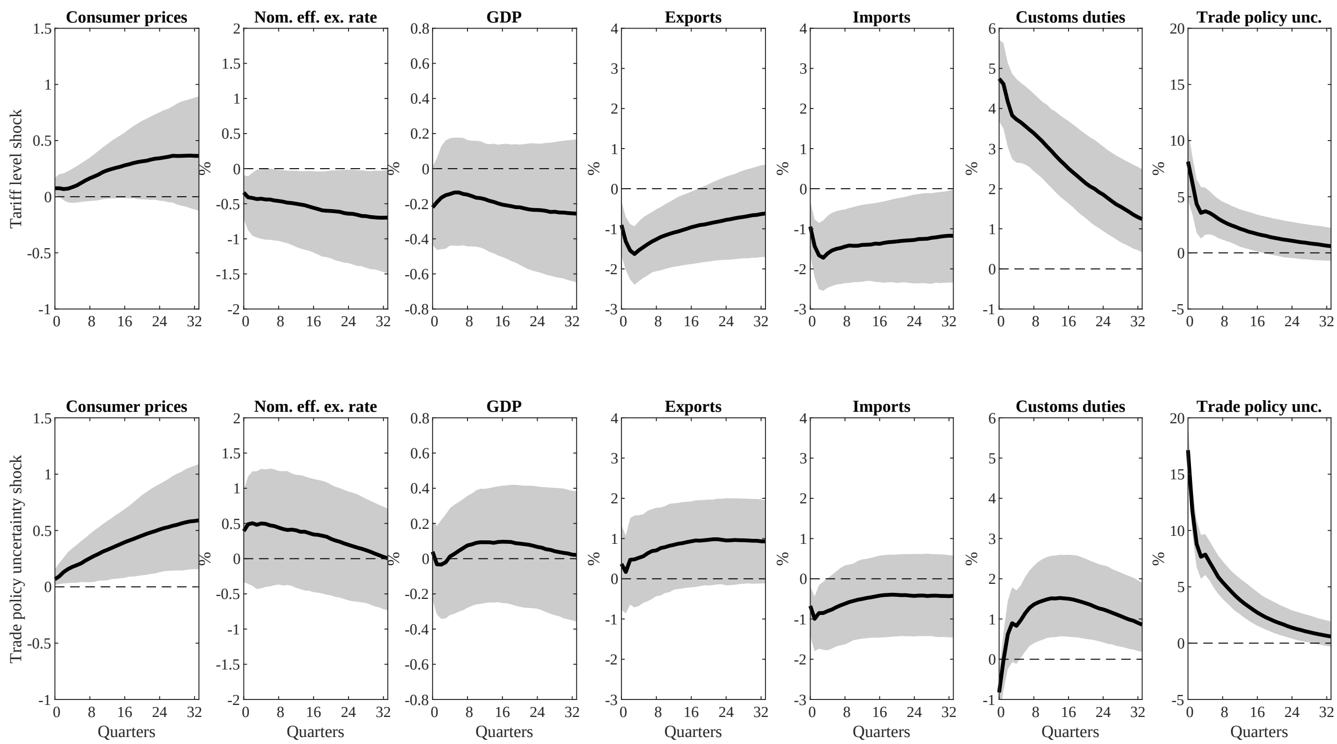
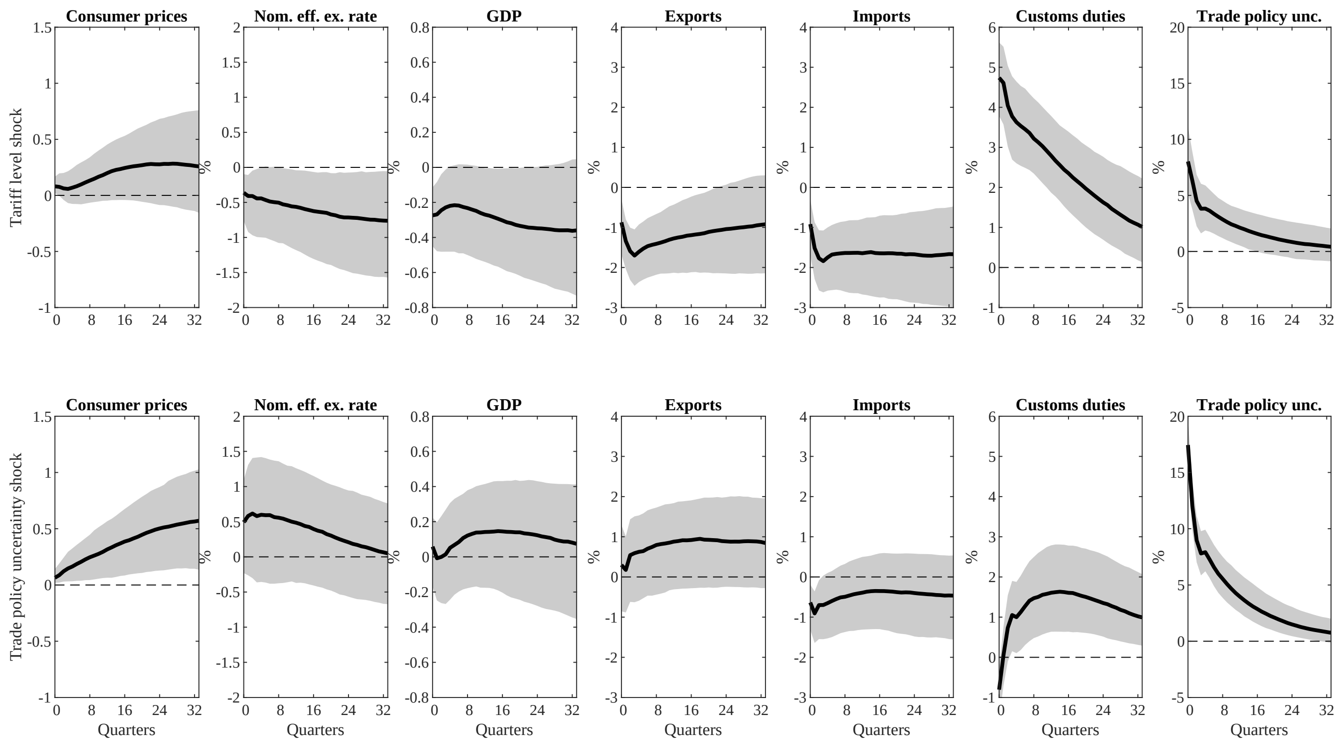


Figure A.36: Impulse responses with sign restriction on output. *Notes:* The figure shows the effects of a positive one standard deviation shock to import tariffs (upper panels) and to trade policy uncertainty (lower panels) over a horizon of 32 quarters in the US when restricting the impact output response to a level shock to be negative. The solid lines show the point-wise median estimates and the shaded areas the 68% highest posterior density credible sets.



PUBLICATIONS

**The Macroeconomic Consequences of Import Tariffs and Trade Policy Uncertainty**

Working Paper No. WP/2024/013