Tariff-Dispersion Shocks: The Mean is the Variance*

Stephanie Schmitt-Grohé† Martín Uribe‡

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Abstract

This paper studies the joint behavior over time of the mean and dispersion of U.S. import tariff rates across goods at the HTS 6-digit level, as well as the macroeconomic consequences of the shocks that drive these two moments. We document that the cross-sectional mean and the cross-sectional dispersion of import tariffs move closely together over time. Using a state-space model, we find that both are driven primarily by common shocks, while mean- and dispersion-specific tariff shocks play a negligible role. Thus, effectively, there are no separate mean-tariff shocks or tariff-dispersion shocks; there are only mean-dispersion tariff shocks. These common shocks account for a sizable share of movements in imports and the trade balance but only a small fraction of movements in output. A positive transitory mean-dispersion tariff shock reduces the import-to-output ratio and improves the trade-balance-to-output ratio; a positive permanent mean-dispersion tariff shock also reduces the import-to-output ratio but has a muted effect on the trade-balance-to-output ratio. Positive transitory mean-dispersion tariff shocks are expansionary, whereas positive permanent mean-dispersion tariff shocks are contractionary in the short run and expansionary in the medium run.

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†Columbia University, CEPR, and NBER. E-mail: stephanie.schmittgrohe@columbia.edu.
‡Columbia University and NBER. E-mail: martin.uribe@columbia.edu.

1 Introduction

When the U.S. government changes import tariffs, it does not change tariffs on all goods by the same amount. Typically, it changes tariffs on a subset of goods, and, within that subset, not all goods receive the same tariff change. This tariff-setting behavior can generate joint movements in the mean and dispersion of import tariff rates. Using quarterly data on imports and import-duty revenues at the HTS 6-digit level over the past three decades, we document that this link is borne out in the data: the cross-sectional mean and standard deviation of import tariff rates move closely together over time. Changes in the cross-sectional mean tariff are systematically associated with changes in cross-sectional tariff dispersion in the same direction. This positive association holds not only for an intensive measure of cross-sectional dispersion, which we measure by the standard deviation of import tariff rates across dutiable goods, but also for an extensive measure, which we proxy by the dutiable share, that is, the share of import value or product lines subject to positive import tariffs.

We then investigate structurally the drivers of the mean and the cross-sectional standard deviation of import tariffs and their macroeconomic effects. To this end, we formulate a state-space model that allows for common and specific shocks to both the mean and dispersion of tariffs. These shocks can have transitory and permanent components. The model also allows for other domestic and external transitory and permanent shocks. We estimate the model using quarterly U.S. data on the mean import tariff, the cross-sectional standard deviation of import tariffs, the dutiable share, the growth rate of output per capita, the import-to-output ratio, the trade-balance-to-output ratio, and the real exchange rate.

We find that the cross-sectional mean and the cross-sectional standard deviation of import tariff rates are driven almost entirely by common shocks, which we call common mean-dispersion tariff shocks. Mean-specific and dispersion-specific tariff shocks play a negligible role. Thus, effectively, in U.S. tariff policy there is no such thing as a mean-tariff shock or a tariff-dispersion shock; there are only mean-dispersion tariff shocks.

We estimate that mean-dispersion tariff shocks are important drivers of the U.S. external accounts, explaining about one-third of changes in imports and the trade balance. However, they explain only a small fraction of movements in U.S. output growth. We also find that positive transitory mean-dispersion tariff shocks reduce the import-to-output ratio and improve the trade-balance-to-output ratio. Permanent mean-dispersion tariff shocks also cause a reduction in the import-to-output ratio, but have a muted effect on the trade-balance to output ratio. With respect to output, we find that positive transitory mean-dispersion tariff shocks are expansionary, whereas positive permanent mean-dispersion tariff shocks are contractionary in the short run, but expansionary in the medium run.

These results are important because they suggest that, historically in U.S. data, it is not possible to separate the drivers of the mean and the drivers of the cross-sectional dispersion of import tariffs. This lack of separate variation implies that one cannot separately estimate the macroeconomic effects of movements in the mean and in the dispersion of U.S. import tariffs. Put differently, studies that estimate the macroeconomic effects of U.S. import-tariff shocks using aggregate tariff variation should be interpreted as estimating the joint effects of mean-dispersion tariff shocks.

The paper also sheds light on whether tariffs should be viewed as endogenous policy variables from a macroeconomic perspective. One reading of the U.S. import-tariff experience is that, historically, the government has not set import tariffs systematically in response to the state of the business cycle (e.g., Irwin, 2020). We provide econometric evidence consistent with this view. Specifically, we estimate the state-space model both allowing and not allowing the tariff-related variables, the cross-sectional mean and standard deviation of tariff rates and the dutiable share, to respond to lagged endogenous variables. Under both specifications, we find that virtually all of the variation in the mean and cross-sectional standard deviation of tariffs is explained by transitory and permanent mean-dispersion tariff shocks, with the other domestic and external shocks included in the model playing only a negligible role.

This paper contributes to a literature concerned with tariff changes, tariff dispersion, and their dynamic macroeconomic effects. These three aspects of trade policy have been studied separately, but work on the joint behavior of the mean and dispersion of tariffs, their drivers, and their macroeconomic consequences is relatively limited. One strand of the literature studies the effects of tariff heterogeneity and tariff harmonization. Anderson and Neary (1994) developed the concept of trade restrictiveness index (TRI), defined as the uniform tariff that delivers the same level of welfare as a given actual tariff structure. Feenstra (1995) simplifies the TRI by providing a nonparametric approximation. Kee, Nicita, and Olarreaga (2008) provide cross-country evidence on the TRI, and Irwin (2010) computes historical annual time series of the TRI for the United States from 1867 to 1961. The TRI attributes a significant role to tariff dispersion for welfare. Kee, Nicita, and Olarreaga (2008) decompose the TRI into three components: the square of the cross-sectional mean of tariff rates, their variance, and their correlation with trade elasticities. This decomposition implies that if trade elasticities are constant across product lines, then, holding constant the TRI, there is a one-for-one tradeoff between the square of the cross-sectional mean and the cross-sectional variance of tariffs. Alessandria and Avila (2023) study the 1989-1992 Colombian tariff reform through the lens of a dynamic trade model with exporter heterogeneity. They document that the reform reduced both the mean and variance of tariffs, and argue that tariff harmonization contributed to welfare gains but by substantially less than the reduction in the mean tariff, suggesting a different tradeoff than the one implied by the TRI. Ferrante et al. (2026) find, in the context of a New Keynesian model, that tariff heterogeneity is important for understanding the behavior of U.S. imports in the aftermath of the second Trump tariff wave amidst the investment boom triggered by AI. The present study adds to this literature by showing that in U.S. data the mean and cross-sectional dispersion of import tariffs are not separate processes, but share the same drivers. It also adds by estimating the effects of these common drivers on aggregate activity, the external accounts, and competitiveness.

A second strand of the literature studies empirically the dynamic macroeconomic effects of changes in the mean tariff. Barattieri, Cacciatore, and Ghironi (2021) use temporary trade barriers and Canadian data to show that protectionism acts like a supply shock, lowering output and raising inflation. Boer and Rieth (2024) estimate the macroeconomic effects of U.S. tariff shocks using a Bayesian SVAR with sign and narrative restrictions. Schmitt-Grohé and Uribe (2025) distinguish between transitory, permanent, and anticipated U.S. import-tariff shocks. den Besten et al. (2026) identify tariff shocks using a narrative approach and long-run data. Amiti et al. (2024) use tariff-announcement variation to study the effects of trade policy on financial markets. Related theoretical work characterizing the dynamic effects of tariffs includes Razin and Svensson (1983) and Calvo (1987). More recently, the Trump tariff episodes have triggered a wave of quantitative and normative work, including Barattieri, Cacciatore, and Ghironi (2021), Auray, Devereux, and Eyquem (2022, 2024), Bergin and Corsetti (2023), Erceg, Prestipino, and Raffo (2023), Boer and Rieth (2024), Jeanne and Son (2024), Kalemli-Özcan, Soylu, and Yıldırım (2025), Monacelli (2025), Bianchi and Coulibaly (2025), Cuba-Borda et al. (2025), Auclert, Rognlie, and Straub (2025), Itskhoki and Mukhin (2025), Costinot and Werning (2025), Werning, Lorenzoni, and Guerrieri (2025), and Schmitt-Grohé and Uribe (2025). The results of the present paper have two implications for this body of work. First, empirical models that estimate the macroeconomic effects of U.S. tariff shocks using aggregate tariff variation should be interpreted as capturing at least in part the joint effects of mean-dispersion tariff shocks, rather than the effects of pure mean-tariff shocks. Second, theoretical models that characterize the effects of changes in uniform tariffs might not map directly into these empirical counterparts. A closer comparison might require formulations in which trade policy shocks generate joint movements in the mean and cross-sectional dispersion of import tariffs.

The remainder of the paper is organized as follows. Section 2 presents empirical evidence on the joint behavior over time of the mean tariff, the cross-sectional standard deviation of tariffs, and the dutiable share. Section 3 presents the state-space econometric model, the data, and the estimation procedure. Section 4 presents the main results, and section 5 studies whether the main results are robust to assuming that the tariff-related variables are endogenous. Section 6 concludes.

2 Cross-Sectional Mean and Variation of Tariffs

We begin by examining the observed behavior of the cross-sectional mean of U.S. import tariff rates and two measures of cross-sectional tariff variation: an intensive measure, given by the cross-sectional standard deviation, and an extensive measure, given by the dutiable share of imports, that is, the share of imports that is subject to a positive import tariff rate.

Let τ_{it} be the import tariff rate on good i in period t. We measure τ_{it} as the ratio of import duties on good i in period t, d_{it}, to the value of imports of good i in period t, m_{it}. That is,

$$\tau_{it} = \frac{d_{it}}{m_{it}}.$$

We define the cross-sectional mean of tariff rates in period t, τ_t, as the trade-weighted average of τ_{it} over i,

$$\tau_t = \sum_i s_{it}\tau_{it},$$

where s_{it} is the share of imports of good i in period t,

$$s_{it} = \frac{m_{it}}{m_t}$$

and

$$m_t = \sum_i m_{it}$$

represent imports in period t. We also compute the fixed-weight mean tariff, $\tau_t^F = \sum_i s_i \tau_{it}$, by fixing the import shares, s_{it}, at their mean value in 2006.[1]

We define the intensive margin of cross-sectional tariff dispersion in period t, σ_t^τ, as the trade-weighted cross-sectional standard deviation of τ_{it} conditional on the good being dutiable, that is, conditional on having a positive import tariff rate. Formally,

$$\sigma_t^\tau = \sqrt{\sum_{i^d} s_{it}^d (\tau_{it} - \tau_t^d)^2},$$

where the superscript d denotes conditional on goods being dutiable in period t. We also consider a fixed-weight version of this statistic, which we denote $\sigma_t^{\tau^F}$, by fixing the import

[1] We pick 2006 as the year to fix the shares because it is roughly in the middle of the sample and outside of the two Trump tariff cycles as well as of the two global crises in the sample, the global financial crisis and the Covid-19 pandemic.

shares at their mean value in 2006.

The extensive measure of cross-sectional tariff variation that we consider is the dutiable share of imports, denoted s_t^τ, and defined as the share of total import value accounted for by goods subject to a positive tariff rate

$$s_t^\tau = \sum_i s_{it},$$

where the sum is over dutiable goods. An alternative measure of the extensive margin of tariff dispersion is the dutiable share of import goods, denoted $s_t^{\tau p}$, which is given by the share of products subject to positive tariffs in a given period,

$$s_t^{\tau p} = \frac{1}{I} \sum_i 1,$$

where I is the total number of imported products, and the sum is over products with a positive tariff rate in period t.

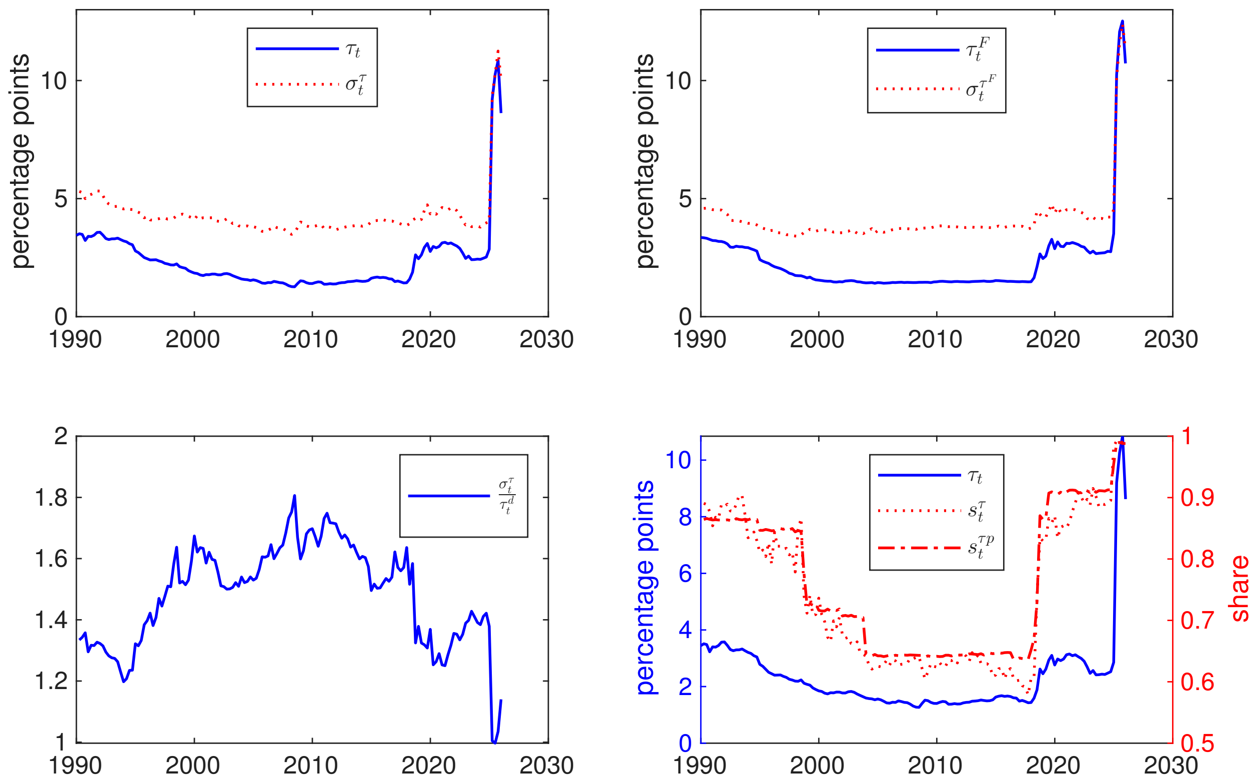
We measure these objects using data on imports and duties from USITC at the HS 6-digit level at a quarterly frequency over the period 1990:Q1 to 2026:Q1. The sample period is dictated by data availability. We impose a balanced panel and track product codes over time using concordances from United Nations Statistics. The resulting panel includes 4,022 products each period.[2] These 4,022 products account on average for 92 percent of total imports and for at least 88 percent of total imports in each quarter. In terms of customs duties, they account for 97 percent to total duties and at least 91 percent of duties in each quarter.

The top-left panel of Figure 1 plots the time paths of the trade-weighted cross-sectional mean and standard deviation of U.S. import tariff rates, τ_t and σ_t^τ, over the period 1990:Q1 to 2026:Q1. The mean tariff rate gradually declines from about 3.5 percent in 1990 to about 1.5 percent in 2016. During the first Trump administration, beginning in 2018, it rises back to about 3.5 percent, before increasing sharply to more than 10 percent in 2025, the first year of the second Trump administration.

More importantly for the purposes of the present analysis, the figure shows that the intensive measure of tariff dispersion, σ_t^τ, closely tracks the dynamics of the mean tariff rate, τ_t. The contemporaneous correlation between τ_t and σ_t^τ is 0.97. The two series also comove closely when expressed in changes, with a correlation of 0.98. The top-right panel shows that this result is robust to computing the cross-sectional mean and standard deviation of

[2] Strictly speaking, these 4,022 products represent 6-digit product lines. Throughout, however, we use the terms goods, products, and product lines interchangeably.

Figure 1: Mean and Dispersion of the Import Tariff Rate: United States, 1990:Q1 to 2026:Q1



Notes. τ_t and τ_t^F denote, respectively, the trade-weighted and fixed-weight mean U.S. import tariff rates across goods, and τ_t^d denotes the trade-weighted mean tariff conditional on goods being dutiable. σ_t^{τ} and $\sigma_t^{\tau^F}$ denote, respectively, the trade-weighted and fixed-weight cross-sectional standard deviations of import tariff rates across dutiable goods. s_t^{τ} is the dutiable share of imports, defined as the share of total import value accounted for by goods subject to a positive tariff rate. $s_t^{\tau p}$ is the dutiable share of product lines, defined as the share of product lines subject to a positive tariff rate.

import tariff rates using fixed weights. The correlation between τ_t^F and $\sigma_t^{\tau^F}$ is also 0.97 in levels and 0.98 in changes.

The high correlation between the cross-sectional mean and the cross-sectional standard deviation of import tariffs is not the result of all tariffs being scaled up or down proportionally. The bottom-left panel of Figure 1 shows that the coefficient of variation, σ_t^τ/τ_t^d, varies significantly over time ranging from 1 to 1.8. This statistic appears to comove negatively with the mean tariff, suggesting that cross-sectional tariff dispersion among dutiable goods moves less than proportionally with the cross-sectional mean.

The bottom-right panel of Figure 1 displays the time paths of the extensive measures of cross-sectional variation in import tariffs (right axis), proxied by the dutiable shares in import value and product lines, s_t^τ and $s_t^{\tau p}$. Both measures tell the same story. In 1990, about 85 percent of imports were subject to duties. This share declines more or less monotonically to about 65 percent by the early 2000s, as the result of trade liberalization in the context of NAFTA and the Uruguay Round. It remains roughly at that level until the middle of the first Trump administration, when it rises sharply back to about 85 percent. It then jumps again at the beginning of the second Trump administration, reaching almost 100 percent.

For comparison, the bottom-right panel also plots the mean tariff rate, τ_t (left axis). The dutiable share, whether measured by import value or by product lines, moves closely with the mean tariff rate over time. The contemporaneous correlation between s_t^τ and τ_t is 0.72, and that between $s_t^{\tau p}$ and τ_t is 0.70.

These results motivate the hypothesis that the cross-sectional mean, standard deviation, and dutiable share share common components. The remainder of the paper estimates these common components, analyzes their importance, and estimates their macroeconomic effects.

3 Econometric Analysis

We postulate a state-space model for seven variables: the mean import tariff, τ_t; the cross-sectional standard deviation of import tariffs, σ_t^τ; the dutiable share, s_t^τ; the log of real GDP per capita, y_t; the import-to-output ratio, moy_t; the trade-balance-to-output ratio, tby_t; and the log of the real exchange rate, $e_t \equiv \ln[P_t/(\mathcal{E}_t P_t^*)]$, where P_t is the U.S. price level, P_t^* is the foreign price level, and $\mathcal{E}_t$ is the nominal exchange rate, defined as the dollar price of one unit of foreign currency. The time unit is one quarter.

Cyclical Components. We assume that the mean tariff contains two nonstationary components: a mean-tariff-specific component, denoted X_t^τ, and a common component, denoted X_t^c, that is also present in σ_t^τ and s_t^τ. Let $\hat{\tau}_t$ denote the stationary cyclical component of

τ_t. Then $\hat{\tau}_t = \tau_t - X_t^\tau - X_t^c$. Similarly, we assume that σ_t^τ and s_t^τ each contain a variable-specific nonstationary component as well as the common nonstationary component. Thus, we define the cyclical components of these two variables as $\hat{\sigma}_t^\tau = \sigma_t^\tau - X_t^\sigma - \alpha_\sigma X_t^c$ and $\hat{s}_t^\tau = s_t^\tau - X_t^s - \alpha_s X_t^c$.

We assume that y_t is cointegrated with a nonstationary component, X_t^y, which can be interpreted as a permanent productivity shock. So $\hat{y}_t = y_t - X_t^y$ is the cyclical component of y_t. We also assume that moy_t and tby_t share a common permanent component, X_t^x, which captures nonstationary external shocks. The corresponding cyclical components are $\widehat{moy}_t = moy_t - X_t^x$ and $\widehat{tby}_t = tby_t - \alpha_{tby} X_t^x$. Finally, we assume that the real exchange rate is cointegrated with all of the nonstationary shocks affecting the economy, which results in the cyclical component $\hat{e}_t = e_t - \alpha_e^\tau X_t^\tau - \alpha_e^c X_t^c - \alpha_e^\sigma X_t^\sigma - \alpha_e^s X_t^s - \alpha_e^y X_t^y - \alpha_e^x X_t^x$.

The State-Space Model. Let $\widehat{Y}_t = \left[\hat{\tau}_t \ \hat{\sigma}_t^\tau \ \hat{s}_t^\tau \ \hat{y}_t \ \widehat{moy}_t \ \widehat{tby}_t \ \hat{e}_t\right]'$ collect the cyclical components. We assume that $\widehat{Y}_t$ evolves according to

$$\widehat{Y}_t = \sum_{i=1}^{L} B_i \widehat{Y}_{t-i} + C u_t, \tag{1}$$

where L is the lag length, B_i, for $i = 1, \ldots L$ and C are matrices of coefficients, and u_t is a vector containing the stochastic driving forces.

The driving vector u_t contains 14 exogenous shocks. In addition to the permanent shocks X_t^c, X_t^τ, X_t^σ, X_t^s, X_t^y, and X_t^x introduced above, the system is driven by eight stationary shocks. One of these shocks, denoted z_t^c, is common to τ_t, σ_t^τ, and s_t^τ. This shock is the only stationary shock that can affect all three of these variables contemporaneously. There are also three stationary shocks, denoted z_t^τ, z_t^σ, and z_t^s, that are specific to τ_t, σ_t^τ, and s_t^τ, respectively. Each of these shocks is the only stationary shock other than z_t^c that can affect its associated variable contemporaneously. Finally, there are four additional stationary shocks denoted z_t^y, z_t^{moy}, z_t^{tby}, and z_t^e that are only statistically identified. Given the purpose of the present analysis, we do not require that these four shocks have a specific economic meaning. The vector of driving forces is then given by $u_t = [z_t \ \Delta X_t]'$, with $z_t = [z_t^\tau \ z_t^\sigma \ z_t^s \ z_t^y \ z_t^{moy} \ z_t^{tby} \ z_t^e \ z_t^c\ ]'$ and $\Delta X_t = [\Delta X_t^c \ \Delta X_t^\tau \ \Delta X_t^\sigma \ \Delta X_t^s \ \Delta X_t^y \ \Delta X_t^x\ ]'$. We assume that u_t follows an AR(1) process of the form

$$u_t = \rho u_{t-1} + P \nu_t, \tag{2}$$

where ν_t is a vector of i.i.d. innovations with standard normal distributions, and ρ and P are diagonal comformable matrices. We write equations (1) and (2) in vector form as

$$\xi_{t+1} = F \xi_t + \Psi \nu_{t+1}, \tag{3}$$

where $\xi_t = [\hat{Y}_t' \ \hat{Y}_{t-1}' \ u_t']'$.

None of the variables in (3) is observable, so the system cannot be estimated directly. Because the model is linear and the shocks are Gaussian, however, ξ_t has a well-defined stochastic distribution. We can therefore introduce observable variables for which the model has precise predictions and obtain their likelihood by means of the Kalman filter.

Observables. In the spirit of DSGE-model estimation, we allow the number of exogenous shocks to exceed the number of observable variables on which the model is estimated, thereby creating competition among shocks in accounting for the dynamics of the observables. The observables we use to estimate the model are the change in the cross-sectional mean of the import tariff, $\Delta\tau_t$, the change in the cross-sectional standard deviation of the import tariff rate, $\Delta\sigma_t^\tau$, the change in the dutiable share, Δs_t^τ, the growth rate of output per capita, Δy_t, the change in the import-to-output ratio, Δmoy_t, the change in the trade-balance-to-output ratio, Δtby_t, and the growth rate of the real exchange rate, Δe_t. We assume that these variables are observed with measurement error. Specifically, let o_t be a vector that collects the observables, so that

$$o_t = \begin{bmatrix} \Delta\tau_t \\ \Delta\sigma_t^\tau \\ \Delta s_t^\tau \\ \Delta y_t \\ \Delta moy_t \\ \Delta tby_t \\ \Delta e_t \end{bmatrix} + \mu_t,$$

where μ_t is a 7-by-1 vector of measurement errors, distributed normal with mean zero and diagonal variance-covariance matrix R. The relationships linking the observables with the latent variables of the model turn out to be all identities: For example, up to measurement error, the change in the import tariff equals the change in its cyclical component plus the changes in its common and specific permanent components, and similarly for the other observables:

$$\Delta\tau_t = \hat{\tau}_t - \hat{\tau}_{t-1} + \Delta X_t^\tau + \Delta X_t^c,$$

$$\Delta\sigma_t^\tau = \hat{\sigma}_t^\tau - \hat{\sigma}_{t-1}^\tau + \Delta X_t^\sigma + \alpha_\sigma \Delta X_t^c,$$

$$\Delta s_t^\tau = \hat{s}_t^\tau - \hat{s}_{t-1}^\tau + \Delta X_t^s + \alpha_s \Delta X_t^c,$$

$$\Delta y_t = \hat{y}_t - \hat{y}_{t-1} + \Delta X_t^y,$$

$$\Delta moy_t = \widehat{moy}_t - \widehat{moy}_{t-1} + \Delta X_t^x,$$

$$\Delta tby_t = \widehat{tby}_t - \widehat{tby}_{t-1} + \alpha_{tby}\Delta X_t^x,$$

and

$$\Delta e_t = \hat{e}_t - \hat{e}_{t-1} + \alpha_e^\tau \Delta X_t^\tau + \alpha_e^c \Delta X_t^c + \alpha_e^\sigma \Delta X_t^\sigma + \alpha_e^s \Delta X_t^s + \alpha_e^y \Delta X_t^y + \alpha_e^x \Delta X_t^x.$$

Then the above identities linking latent variables to observables can be written as

$$o_t = H'\xi_t + \mu_t. \tag{4}$$

We estimate the system (3) and (4) using Bayesian techniques.

Identification. A relevant identification issue is whether the tariff-related variables, τ_t, σ_t^τ, and s_t^τ, should be allowed to respond endogenously to lagged macroeconomic conditions. We estimate two versions of the model. In one version, the tariff-related variables are allowed to depend on all lagged endogenous variables; that is, all elements of B_1 and B_2 are estimated. In the other version, the tariff-related variables are treated as exogenous by imposing B_ℓ(1:3,:)=0, for $\ell = 1, 2$. Under this restriction, all lagged macroeconomic indicators, including lagged output, the import-to-output ratio, the trade-balance-to-output ratio, and the real exchange rate do not affect the tariff-related variables. The main results of the paper, and in particular the result that the macroeconomic relevant tariff related shocks are common mean-dispersion shocks (z_t^c and X_t^c) and not mean- or dispersion-specific shocks, obtain under both specifications. We use the restricted specification as our baseline and analyze the unrestricted specification as a robustness check in section 5.1.

Our choice of the baseline specification is motivated by both historical and economic considerations. On the historical side, it has been argued (e.g., Irwin, 2020) that U.S. tariff policy has not been systematically tied to the state of the business cycle. On the economic side, we report in Section 5.1 that in the specification in which the tariff-related variables respond to lagged endogenous variables, the fractions of the variances of $\Delta\tau_t$, $\Delta\sigma_t^\tau$, and Δs_t^τ explained by tariff-related shocks, that is, by z_t^k and ΔX_t^k for $k = \tau, \sigma, s, c$, are 98, 98, and 90 percent, respectively. In other words, shocks associated with the macroeconomic variables Δy_t, Δmoy_t, Δtby_t, and Δe_t contribute little to explaining variations in the tariff-related variables. This result is in line with the historical view that U.S. tariff policy does not respond significantly to the state of the business cycle.

The identification of the nonstationary shocks, X_t^i, for $i = \tau, \sigma, s, c, y, x$ is achieved by the cointegration restrictions described above under the heading "Cyclical Components." For example, X_t^c is the only nonstationary shock that enters in the cointegration relationships of all three tariff-related variables, and similar restrictions on the other permanent shocks introduced earlier. The identification of the transitory shocks is achieved by imposing that $C(1{:}7,1{:}7)$ is lower triangular and that $C(2,1)=C(3,1)=C(3,2)=0$. These restrictions are sufficient to identify all of the stationary shocks.

We further set $C(1{:}3,9{:}14)=0$. This restriction implies that the permanent components X_t^y and X_t^x cannot affect τ_t, σ_t^τ, or s_t^τ on impact. It also implies that the permanent components X_t^τ, X_t^σ, X_t^s, X_t^c, X_t^y, and X_t^x can affect the cyclical components of τ_t, σ_t^τ, and s_t^τ only with a lag. This specification does allow the tariff-related permanent shocks X_t^τ, X_t^σ, X_t^s, and X_t^c to affect the levels of τ_t, σ_t^τ, and s_t^τ contemporaneously through the cointegration relationships. The matrix C then looks as follows:

$$C = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & c_{28} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & c_{38} & 0 & 0 & 0 & 0 & 0 & 0 \\ c_{41} & c_{42} & c_{43} & 1 & 0 & 0 & 0 & c_{48} & c_{49} & c_{4,10} & c_{4,11} & c_{4,12} & c_{4,13} & c_{4,14} \\ c_{51} & c_{52} & c_{53} & c_{54} & 1 & 0 & 0 & c_{58} & c_{59} & c_{5,10} & c_{5,11} & c_{5,12} & c_{5,13} & c_{5,14} \\ c_{61} & c_{62} & c_{63} & c_{64} & c_{65} & 1 & 0 & c_{68} & c_{69} & c_{6,10} & c_{6,11} & c_{6,12} & c_{6,13} & c_{6,14} \\ c_{71} & c_{72} & c_{73} & c_{74} & c_{75} & c_{76} & 1 & c_{78} & c_{79} & c_{7,10} & c_{7,11} & c_{7,12} & c_{7,13} & c_{7,14} \end{bmatrix}.$$

In section 5.2, we estimate an alternative version of the model in which the block $C(1{:}3,9{:}14)$ is not restricted to zero. In this case, all permanent shocks can, in principle, affect the tariff-related cyclical components on impact. There, we show that the main results of the paper are robust to this alternative specification. We pick the specification with $C(1{:}3,9{:}14)=0$ as the baseline one because it provides a more parsimonious representation of the law of motion of the tariff-related variables.

The joint process for the tariff-related variables is then given by

$$\tau_t = z_t^\tau + z_t^c + X_t^\tau + X_t^c,$$

$$\sigma_t^\tau = z_t^\sigma + c_{28} z_t^c + X_t^\sigma + \alpha_\sigma X_t^c,$$

and

$$s_t^\tau = z_t^s + c_{38} z_t^c + X_t^s + \alpha_s X_t^c.$$

Data. Appendix A provides details on the data sources and construction of all variables used in the estimation of the model. Section 2 introduced σ_t^τ and s_t^τ, both of which are available from 1990:Q1 to 2026:Q1. For τ_t, we do not use the series employed in section 2. Instead, to take advantage of a longer time span, we use aggregate import duties and goods imports from the Bureau of Economic Analysis (BEA) and construct the tariff rate as the

Table 1: Prior Distributions

Parameter	Distribution	Mean	Std. Dev.
Estimated diagonal elements of B_1	Normal	0.95	0.5
Other estimated elements of B_i, $i = 1, \ldots, L$	Normal	0	0.25
Estimated elements of C	Normal	0	0.5
Diagonal elements of P	Gamma	0.25	0.25
Diagonal elements of ρ, stationary shocks	Beta	0.7	0.2
Diagonal elements of ρ, permanent shocks	Beta	0.3	0.2
Estimated elements of H (cointegration coefficients)	Normal	0	0.25
Diagonal elements of R	Uniform	$\frac{\text{var}(o_t)}{10\times 2}$	$\frac{\text{var}(o_t)}{10\times\sqrt{12}}$

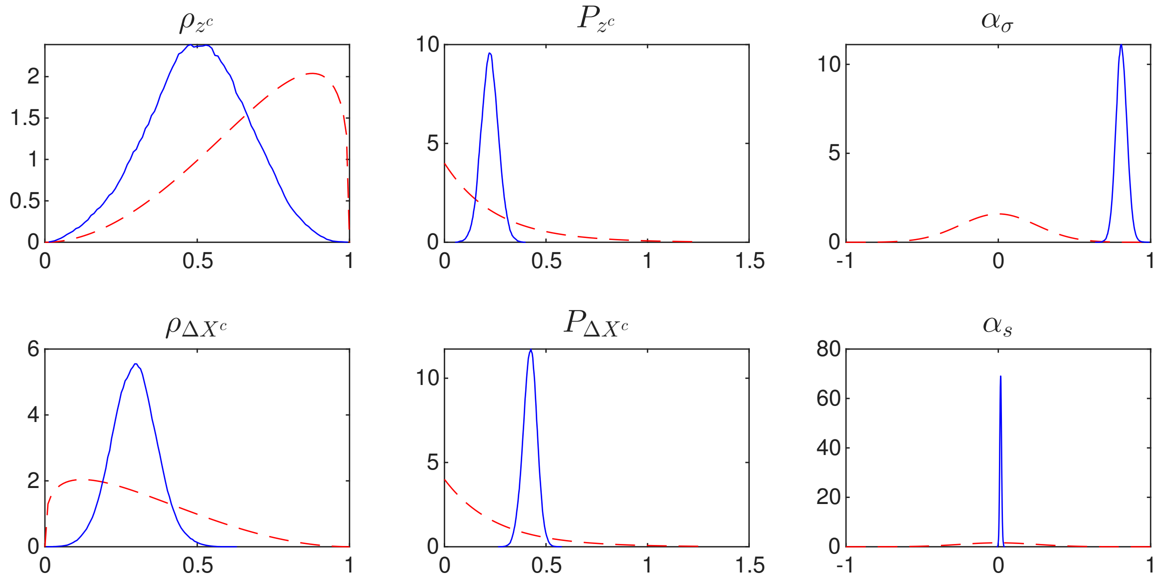
Note. The time unit is one quarter.

ratio of duties to imports. The resulting series covers the period 1959:Q1 to 2026:Q1. Over the overlapping sample, its correlation with the trade-weighted import tariff used in section 2 is 0.99. The proxies for y_t, moy_t, and tby_t are also obtained from the BEA and cover the period 1959:Q1 to 2026:Q1. The proxy for e_t is obtained from the Bank for International Settlements (BIS). It is the narrow real effective exchange rate for the United States against 27 economies and is available from 1964:Q1 to 2026:Q1. For variables whose samples begin after 1959:Q1, observations between 1959:Q1 and the initial date of the corresponding series are treated as missing data in the estimation.

Priors. Table 1 displays the assumed prior distributions. The priors are relatively loose. In the spirit of the Minnesota prior, the estimated diagonal elements of B_1 are assigned normal prior distributions with mean 0.95 and standard deviation 0.5. All other estimated elements of B_i, for $i = 1, \ldots, L$, are assigned normal prior distributions with mean 0 and standard deviation 0.25. The estimated elements of C are assigned normal prior distributions with mean 0 and standard deviation 0.5. The diagonal elements of P are assigned Gamma prior distributions with mean and standard deviation equal to 0.25. The diagonal elements of ρ are assigned Beta prior distributions. For stationary shocks, these distributions have mean 0.7 and standard deviation 0.2, whereas for the growth rate of permanent shocks they have mean 0.3 and standard deviation 0.2. The estimated elements of H, which contain the cointegration coefficients, are assigned normal prior distributions with mean 0 and standard deviation 0.25. Finally, the diagonal elements of the variance-covariance matrix of the measurement errors, R, are assigned uniform prior distributions with lower bound 0 and upper bound equal to 10 percent of the variance of the corresponding observable. We set the lag length to two ($L = 2$). It is shorter than the four lags commonly used in reduced-form vector autoregressions, but it is appropriate here because the driving-force vector u_t is itself autoregressive.

Figure 2 compares prior and posterior distributions for the parameters governing the

Figure 2: Prior and Posterior Distributions of Parameters Governing the Common Mean-Dispersion Tariff Shocks



Note. Solid lines are posterior densities, and dashed lines are prior densities.

common mean-dispersion tariff shocks, z_t^c and ΔX_t^c. Specifically, the first two columns display the prior and posterior distributions of the persistence parameters (ρ_{z^c} and $\rho_{\Delta X^c}$) and the standard deviations (P_{z^c} and $P_{\Delta X^c}$) of the two common shocks. The last column displays the prior and posterior distributions of the cointegration parameters (α_σ and α_s) linking σ_t^τ and s_t^τ with X_t^c, and therefore with τ_t.

The figure shows that the data are informative about these parameters, as the posterior distributions differ substantially from the prior distributions. In general, the posterior distributions exhibit smaller standard deviations than their prior counterparts. The interpretation of the cointegration parameters is of interest. The posterior mean values of α_σ and α_s imply that a permanent common mean-dispersion shock, X_t^c, of size 10 percentage points, which results in a long-run increase of 10 percentage points in the mean tariff, τ_t, also causes long-run increases of 8 percentage points in the cross-sectional standard deviation of tariffs, σ_t^τ, and of 15 percentage points in the share of goods that are subject to a tariff, s_t^τ.

Overall, the significant posterior learning shown in Figure 2 is relevant because, as will become clear shortly, the variance-decomposition and impulse-response analysis that follows will assign the common components of the tariff-related shocks a central role.

Table 2: Variance Decomposition

	$\Delta\tau_t$	$\Delta\sigma_t^\tau$	Δs_t^τ	Δy_t	Δmoy_t	Δtby_t	Δe_t
z_t^c	26	37	9	3	29	34	9
ΔX_t^c	74	62	9	1	2	2	2
z_t^τ	0	0	0	0	0	0	6
z_t^σ	0	0	0	0	0	1	10
z_t^s	0	0	19	0	0	0	3
ΔX_t^τ	0	0	0	0	0	1	8
ΔX_t^σ	0	0	0	0	0	0	7
ΔX_t^s	0	0	64	0	0	0	2
Sum	100	100	100	4	31	38	48

Notes. All entries are expressed in percent and are posterior means computed from a random subsample of 100,000 posterior draws from an MCMC chain of 1,000,000 draws. The first two rows report the contributions of the common stationary tariff shock, z_t^c, and the common nonstationary tariff shock, ΔX_t^c. The remaining rows report the contributions of tariff-specific stationary and nonstationary shocks. The row labeled "Sum" gives the combined contribution of the shocks listed in the table.

4 Results

We are now ready to address the main questions motivating the present investigation: What drives the cross-sectional mean and dispersion of tariffs? And what are the effects of these drivers on macroeconomic indicators of interest?

4.1 Variance Decomposition

The first question we wish to address is how important are the common drivers of the mean and the cross-sectional dispersion of the import tariff rate. Table 2 displays the variance decomposition. It shows that the common tariff shocks z_t^c and ΔX_t^c explain virtually the totality of changes in the mean tariff, $\Delta\tau_t$ (26 and 74 percent) and in its cross-sectional standard deviation, $\Delta\sigma_t^\tau$ (37 and 62 percent). This finding suggests that the data provide little support for economically important pure mean-tariff shocks or pure tariff-dispersion shocks. Instead, the relevant tariff shocks are mean-dispersion shocks: shocks that move the cross-sectional mean and dispersion of tariff rates jointly.

This result is important for the empirical and theoretical analysis of the macroeconomic effects of tariff policy. Empirical models that estimate the aggregate effects of tariff shocks are likely estimating the joint effect of changes in the mean tariff and changes in the cross-sectional dispersion of tariffs. Similarly, theoretical frameworks that model tariffs as a uniform tax on imported goods miss a salient feature of the data: movements in tariffs are typically accompanied by movements in their cross-sectional variation.

Consider now the role of tariff-related shocks in accounting for movements in output, the external accounts, and the real exchange rate. Table 2 shows that tariff-related shocks account for only a negligible fraction of the variance of output growth, about 4 percent. This result echoes the findings in our earlier work, Schmitt-Grohé and Uribe (2025), which were obtained in the context of a model that does not take into account tariff dispersion. Nonetheless, the small contribution of tariff-related shocks to output growth is explained entirely by the two common shocks, z_t^c and ΔX_t^c. Tariff-related shocks play a much more prominent role in accounting for imports and the trade balance. They explain between 30 and 40 percent of changes in the import-to-output ratio and the trade-balance-to-output ratio. Again, almost all of this variation is accounted for by the common tariff shocks, z_t^c and ΔX_t^c. By contrast, these two common shocks explain a relatively small fraction of movements in competitiveness: together, they account for only 11 percent of changes in the real exchange rate, Δe_t. Tariff-related shocks, however, explain about half of the variation in Δe_t.

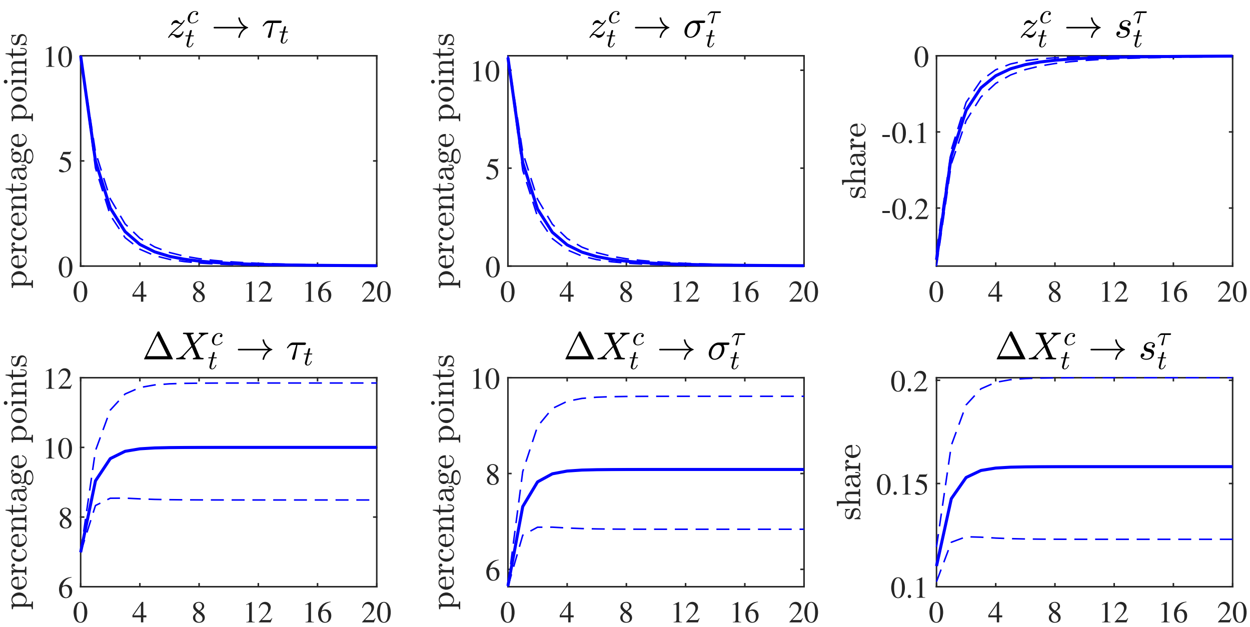
The extensive margin of tariff variation, the dutiable share, s_t^τ, displays a pattern that differs from that of the mean tariff, τ_t, and its cross-sectional dispersion, σ_t^τ. In particular, Table 2 shows that 83 percent of the variation in changes in the dutiable share is explained by its specific transitory and permanent components, z_t^s and ΔX_t^s. However, these two shocks play essentially no role in accounting for movements in output, imports, or the trade balance, and account for only a small fraction of movements in the real exchange rate.

In sum, the empirically relevant tariff shocks are common mean-dispersion shocks: they account for virtually all movements in the mean and cross-sectional dispersion of tariff rates and for a sizable fraction of movements in imports and the trade balance, while pure mean, pure dispersion, and dutiable-share-specific shocks play a minor role in explaining aggregate macroeconomic fluctuations.

4.2 Dynamic Properties of Common Tariff Shocks

We established in the variance decomposition analysis that the two common tariff shocks, z_t^c and ΔX_t^c, are the main drivers of the mean tariff, τ_t, and the cross-sectional standard deviation of tariff rates, σ_t^τ. We now examine how τ_t and σ_t^τ comove in response to each of these two shocks. The top panel of Figure 3 displays the impulse responses to a transitory common tariff shock, z_t^c, normalized to raise τ_t by ten percentage points on impact. The bottom panel displays the corresponding responses to a permanent common tariff shock, ΔX_t^c, normalized to raise τ_t by ten percentage points in the long run.

Figure 3: Response of Tariff-Related Variables to Common Tariff Shocks



Notes. The size of the transitory common tariff shock, z_t^c, is set to generate an increase in the mean tariff, τ_t, of 10 percentage points on impact. The size to the permanent common tariff shock, ΔX_t^c, is set to generate an increase in the mean tariff, τ_t, of 10 percentage points in the long run. Horizontal axes measure quarters after the shock. Solid lines denote posterior means, and dashed lines denote 90-percent Sims and Zha (1999) credible bands. The responses and credible bands are computed from a random subsample of 100,000 posterior draws from an MCMC chain of 1,000,000 draws.

The main result conveyed by Figure 3 is that the cross-sectional mean and the cross-sectional standard deviation of tariffs move in tandem in response to both common shocks. Following the transitory shock, the two variables display nearly identical dynamics: both increase by approximately the same amount on impact and return toward their pre-shock levels at roughly the same pace. Following the permanent shock, the mean tariff rises by about 7 percentage points on impact and reaches its long-run increase of 10 percentage points after approximately one year. The standard deviation rises by about 5.5 percentage points on impact and reaches its long-run level of approximately 8 percentage points over a similar horizon.

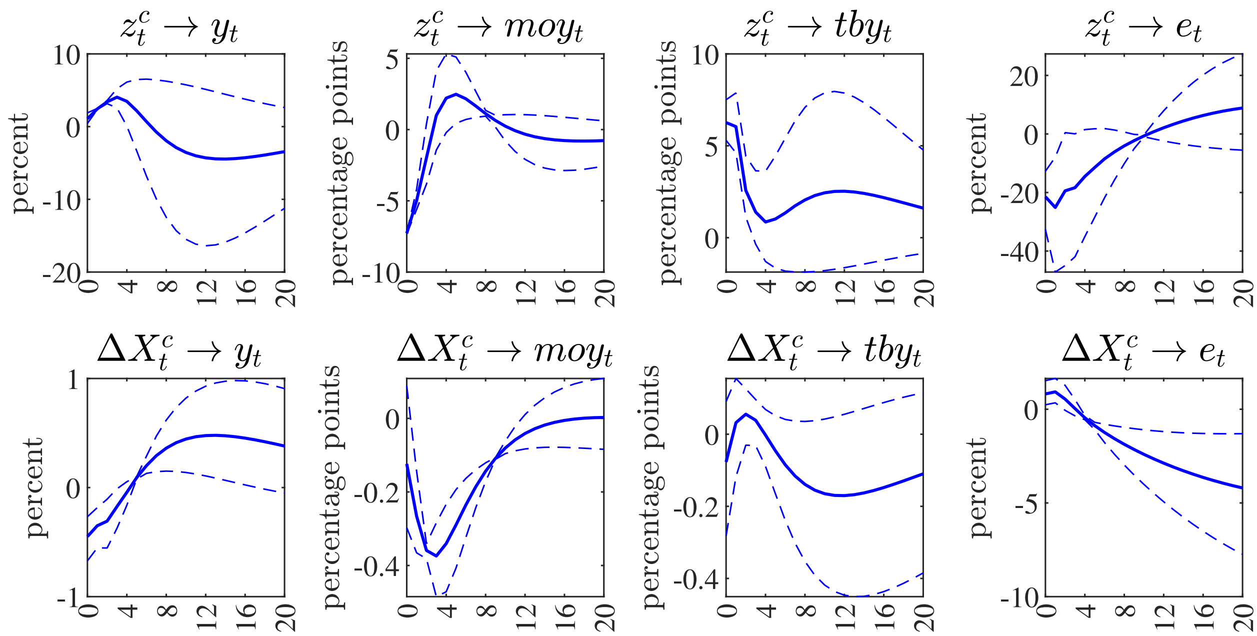
The top-right panel of Figure 3 shows that following the transitory common tariff shock the dutiable share, s_t^τ, initially declines and then converges back to zero from below. This is a somewhat counterintuitive result as one would expect that an increase in the mean tariff would also increase number of products subject to positive tariffs. However, this result is limited to the transitory shock. The bottom right panel of Figure 3 shows that a positive permanent common tariff shock, ΔX_t^c, has a positive effect on s_t^τ: a shock that raises the mean tariff by 10 percentage points in the long run increases the dutiable share permanently by approximately 15 percentage points within a year.

4.3 Effects of Common Tariff Shocks on the Macroeconomy

The top panel of Figure 4 displays the impulse responses of the endogenous variables of the model to a transitory common tariff shock, z_t^c, normalized to raise the mean tariff by 10 percentage points on impact. The shock generates an expansion in aggregate activity, a decline in the import-to-output ratio, and an improvement in the trade-balance-to-output ratio. The responses of imports and the trade balance are in line with the predictions of the intertemporal approach to the balance of payments following a transitory increase in import tariffs in the absence of tariff dispersion, as a transitory tariff shock induces agents to postpone purchases of imported goods. The fact that tariff dispersion also rises does not appear to move the empirical responses away from this pattern.

The innovation in z_t^c also causes a real exchange rate depreciation. Two competing effects may be at work. On the one hand, higher tariffs make imports more expensive, which should tend to appreciate the domestic currency. On the other hand, if the shock contracts domestic absorption, demand for nontradable goods will tend to fall. This decline in demand would lower the relative price of nontradable goods in terms of tradable goods, making the domestic economy less expensive and thereby tending to depreciate the real exchange rate. Indeed, the impulse responses in Figure 4 imply that aggregate absorption declines on impact. This

Figure 4: Response of Endogenous Variables to Common Tariff Shocks



Notes. The size of the transitory common tariff shock, z_t^c, is set to generate an increase in the mean tariff, τ_t, of 10 percentage points on impact. The size to the permanent common tariff shock, ΔX_t^c, is set to generate an increase in the mean tariff, τ_t, of 10 percentage points in the long run. Horizontal axes measure quarters after the shock. Solid lines are posterior means and dashed lines are 90-percent Sims and Zha (1999) credible bands. The responses and credible bands are computed from a random subsample of 100,000 posterior draws from an MCMC chain of 1,000,000 draws.

can be inferred from the fact that output changes little on impact while the trade-balance-to-output ratio improves substantially. The finding that the real exchange rate depreciates therefore suggests that the absorption channel dominates the import-price channel.

The bottom panel of Figure 4 displays the responses to a permanent common tariff shock, ΔX_t^c, normalized to raise the mean tariff by 10 percentage points in the long run. In response to this permanent disturbance, output contracts briefly and by a small amount. It also generates a short-lived and small decrease in the import-to-output ratio and an insignificant response in the trade-balance-to-output ratio. The muted response of the trade balance is in line with the predictions of the intertemporal approach to the current account: permanent increases in tariffs do not generate intertemporal price distortions and therefore do not incentivize economic agents to postpone demand.

The permanent common tariff shock causes a small real exchange rate appreciation in the short run. This response may reflect the import-price channel: because tariffs are higher, imported goods become more expensive relative to domestic goods. In the long run, however, the real exchange rate depreciates, that is, the United States becomes cheaper relative to the rest of the world in spite of the fact that tariffs remain permanently elevated. One possible interpretation of this result is that in the long-run importers can avoid the tariff by switching source countries. A complementary explanation could be that in the long run domestic substitutes for previously imported goods emerge.

5 Tariff Endogeneity

This section considers specifications in which the tariff related variables, τ_t, σ_t^τ, and s_t^τ, are allowed to depend on lagged endogenous variables or on shocks that are associated with endogenous variables. The main results of the paper are robust to these modifications: In both cases, the mean and cross-sectional variation of tariffs are driven primarily by common mean-dispersion shocks, and these shocks continue to play the central role in accounting for the effects of tariff-related disturbances on imports and the trade balance.

5.1 Endogenizing the Tariff Related Variables

The baseline specification assumes that the tariff-related variables, τ_t, σ_t^τ, and s_t^τ, form an exogenous system. Here, we allow these variables to respond to lagged values of the endogenous macroeconomic aggregates, y_t, moy_t, tby_t, and e_t, as well as to their own lagged values. Specifically, in the baseline specification, we restricted $B_\ell(1{:}3,{:})$ to be zero for $\ell = 1, 2$. Here, we lift this restriction and estimate these parameters. The priors assigned to these elements of B_ℓ are as specified in Table 1.

Table 3 presents variance decompositions. For convenience, the top panel of the table reproduces the variance decomposition of the baseline model from Table 2. The second panel of the table presents the variance decomposition for the present model. As in the baseline model, virtually all of the variance of the mean tariff and its cross-sectional variation is driven by the two common tariff shocks, z_t^c and ΔX_t^c. Jointly, these two shocks explain 97 percent of the variation in changes in τ_t and σ_t^τ, confirming that in U.S. tariff data the mean is the variance. One difference is that under the present specification transitory common tariff shocks appear to play a more important role relative to permanent ones in driving the mean and the cross-sectional variance of import tariffs.

It is noteworthy that disturbances to the macroeconomic aggregates (z_t^k for $k = y, moy, tby, e$ and ΔX_t^h for $h = y, x$) explain only a negligible fraction of the variance of changes in the three tariff-related variables (2 percent of the variance of both $\Delta\tau_t$ and $\Delta\sigma_t^\tau$ and 10 percent of the variance of Δs_t^τ). This result suggests that endogeneity is not a relevant feature of U.S. tariff policy.

Consistent with the findings obtained under the baseline model, in the endogenous-tariff model, the common mean-dispersion tariff shocks, z_t^c and ΔX_t^c, explain almost all of the variance of imports and the trade balance accounted for by tariff-related shocks (46 out of 48 percent and 39 out of 44 percent, respectively).

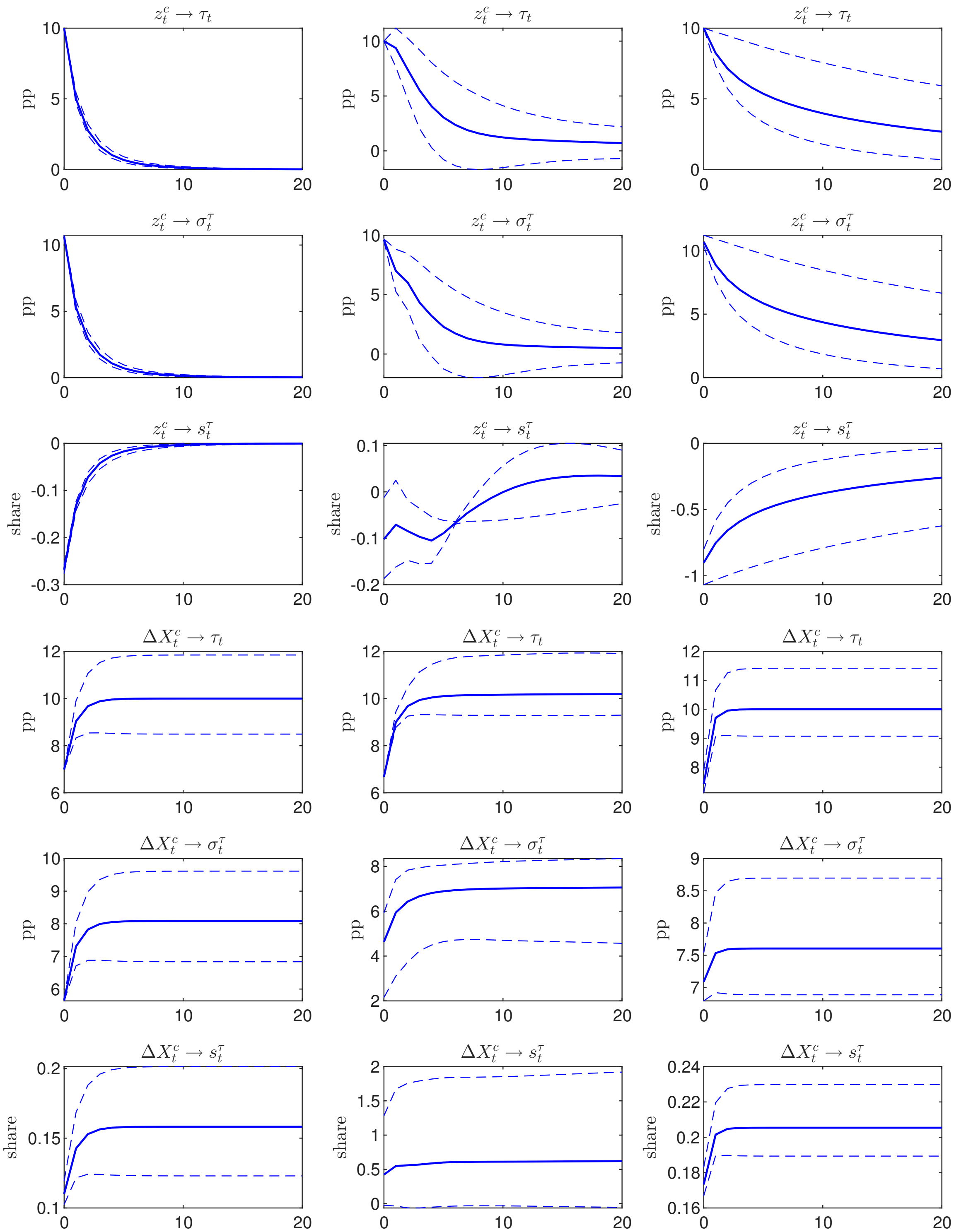
The dynamic effects of the common tariff shocks are broadly similar to those estimated under the baseline specification, particularly for the transitory shock. Figure 5 displays impulse responses of the tariff-related variables to the transitory and permanent common mean-dispersion tariff shocks. The first column reproduces from Figure 3 the impulse responses implied by the baseline specification. The second column corresponds to the present specification. As in the baseline model, in response to both shocks, the mean tariff and its cross-sectional standard deviation, τ_t and σ_t^τ, move in tandem. Figure 6 displays the responses of the macroeconomic aggregates to the transitory and permanent common mean-dispersion tariff shocks. The first column corresponds to the baseline specification and the second column to the current one. The responses to the transitory common tariff shock, z_t^c, are qualitatively similar to those obtained in the baseline model: output initially increases, the import-to-output ratio falls, the trade-balance-to-output ratio improves, and the real exchange rate depreciates, making the country cheaper. The responses to the permanent common tariff shock, ΔX_t^c, differ more noticeably from those in the baseline model. In the endogenous-tariff specification, the permanent tariff increase generates a short-lived increase in output and in the import-to-output ratio, as well as a sizable, although statistically insignificant, deterioration in the trade-balance-to-output ratio. More generally, the credible bands are considerably wider than in the baseline model, indicating that the impulse responses are less precisely estimated.

5.2 Tariff Variables Responding Contemporaneously to Trend Shocks

The baseline specification does not allow the cyclical components of the tariff-related variables, τ_t, σ_t^τ, and s_t^τ, to respond contemporaneously to trend shocks, ΔX_t^j for $j = c, \tau, \sigma, s, y, x$. Specifically, the baseline estimation imposes the restriction $C(1{:}3,9{:}14)=0$. Here, we relax this restriction and estimate these parameters. The priors assigned to these elements of the matrix C are the same as those assigned to the other estimated elements of C, as given in Table 1.

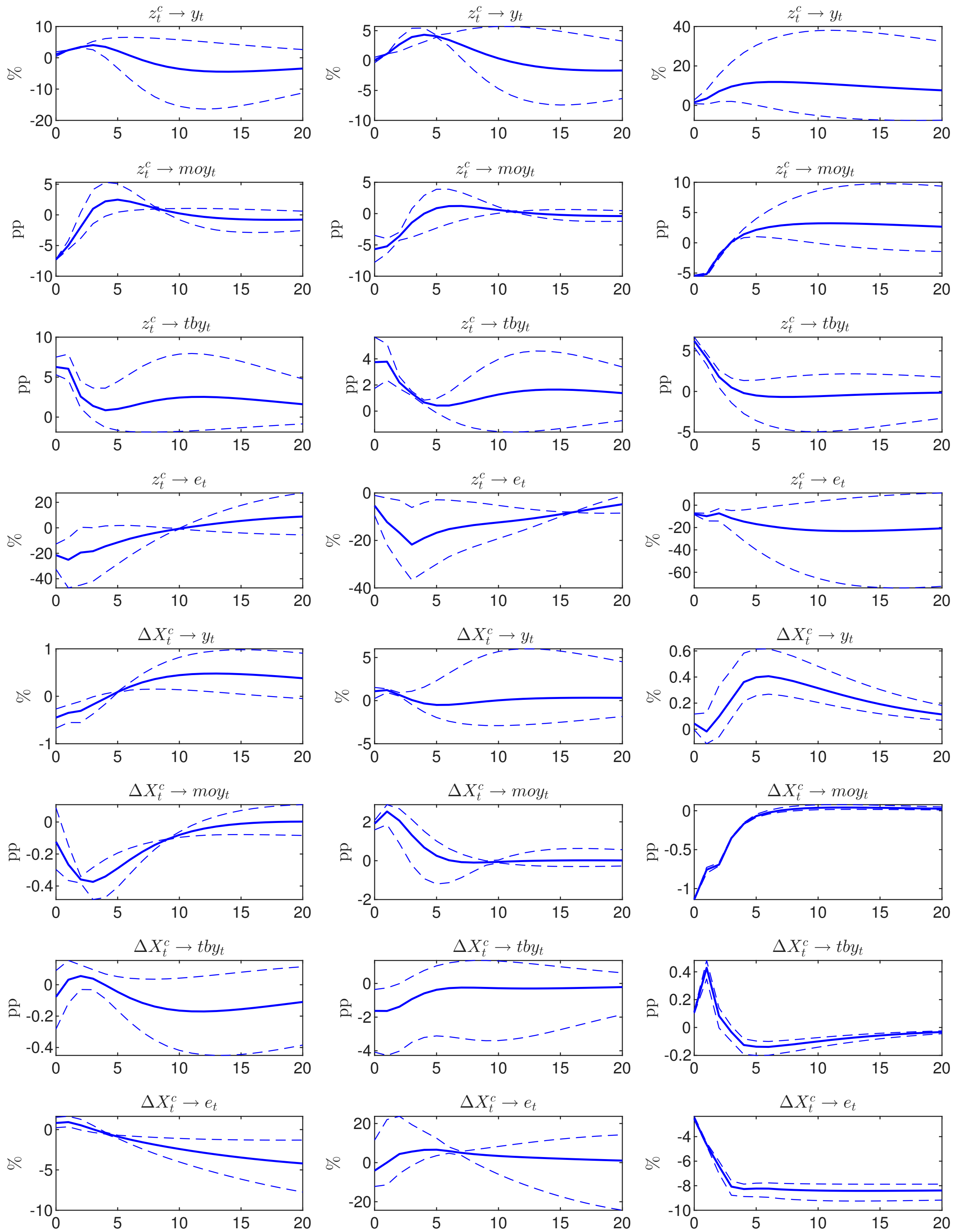
As just mentioned, the key results of the paper are robust to the present modification. In particular, the variance decomposition displayed in the third panel of Table 3 shows that the common tariff-related shocks, z_t^c and ΔX_t^c, continue to explain virtually all of the

Figure 5: Response of Tariff-Related Variables to Common Tariff Shocks: Robustness



Notes. See the notes to Figure 3. The first column reproduces the results of the baseline model shown in Figure 3. The second column corresponds to the case in which τ_t, σ_t^τ, and s_t^τ respond to lagged endogenous variables; that is, $B_\ell(1{:}3,:)$ for $\ell = 1, 2$ is estimated. The third column corresponds to the case in which τ_t, σ_t^τ, and s_t^τ respond contemporaneously to trend shocks; that is, $C(1{:}3,9{:}14)$ is estimated.

Figure 6: Response of Macroeconomic Aggregates to Common Tariff Shocks: Robustness



Notes. See the notes to Figure 4. The first column reproduces the results of the baseline model shown in Figure 4. The second column corresponds to the case in which τ_t, σ_t^τ, and s_t^τ respond to lagged endogenous variables; that is, $B_\ell(1{:}3,:)$ for $\ell = 1, 2$ is estimated. The third column corresponds to the case in which τ_t, σ_t^τ, and s_t^τ respond contemporaneously to trend shocks; that is, $C(1{:}3,9{:}14)$ is estimated.

Table 3: Variance Decomposition: Robustness

	$\Delta\tau_t$	$\Delta\sigma^\tau_t$	Δs^τ_t	Δy_t	Δmoy_t	Δtby_t	Δe_t
Baseline							
z^c_t	26	37	9	3	29	34	9
ΔX^c_t	74	62	9	1	2	2	2
Sum	100	100	100	4	31	38	48
Endogenous tariffs							
z^c_t	61	68	8	3	39	32	8
ΔX^c_t	36	29	18	1	7	7	6
Sum	98	98	90	5	48	44	46
Tariffs responding to all permanent shocks							
z^c_t	16	20	41	3	12	22	6
ΔX^c_t	83	79	18	1	5	3	3
Sum	99	99	94	4	18	27	36

Notes. See notes to Table 2. The row labeled "Sum" reports the share of the variance of each variable explained jointly by all eight tariff-related shocks.

variation in the mean tariff and its cross-sectional standard deviation. Also, among all tariff-related shocks, the two common tariff shocks, z^c_t and ΔX^c_t, remain virtually the only drivers of imports and the trade balance, with mean- and dispersion-specific shocks playing a negligible role.

The third column of Figure 5 shows that the mean and cross-sectional standard deviation of tariffs continue to move hand in hand in response to innovations in z^c_t and ΔX^c_t. The third column of Figure 6 shows that a positive innovation in the transitory common tariff shock, z^c_t, causes a fall in the import-to-output ratio and an improvement in the trade-balance-to-output ratio, as in the baseline specification (first column of the figure). Also, the permanent common tariff shock, ΔX^c_t, continues to lower the import-to-output ratio and has a small effect on the level of the trade-balance-to-output ratio.

6 Conclusion

Mean import tariffs and tariff dispersion can, in principle, affect the macroeconomy through different channels. A natural question is whether their effects can be separately identified in the data. In this paper, we argue that empirically they cannot be easily separated. We document that, in the United States, the cross-sectional mean and cross-sectional standard deviation of import tariff rates move closely together over time. More fundamentally, we show that these two moments are driven by common shocks, while mean-specific and dispersion-specific tariff shocks play a negligible role. We estimate that these common mean-dispersion shocks are important drivers of the U.S. external accounts.

This inseparability result has several implications. First, separating the effects of mean- and dispersion-tariff shocks requires a theoretical approach. Second, realistic theoretical macroeconomic models of U.S. import-tariff setting should take into account the close link between the mean and dispersion of tariffs detected in the data. In Schmitt-Grohé and Uribe (2026), we take steps in these two directions. We believe that further research into the intricacies of trade-policy setting can contribute to a better understanding of its macroeconomic and welfare consequences.

Appendix

A Data Sources

This appendix describes the data sources for all the variables used in the estimation of the econometric model.

A.1 Aggregate Data

This appendix describes the sources and construction of the data on real GDP per capita, the import-to-output ratio, the trade-balance-to-output ratio, the aggregate import tariff, and the real exchange rate. Unless otherwise indicated, the underlying data are quarterly. The BEA data were accessed on July 9, 2026.

Real GDP per capita. The variable y_t is the natural logarithm of real GDP per capita. Real GDP is obtained from the U.S. Bureau of Economic Analysis (BEA), National Income and Product Accounts (NIPA), Table 1.1.6, "Real Gross Domestic Product, Chained Dollars." We use real GDP in billions of chained 2017 dollars, seasonally adjusted at annual rates. Population is obtained from BEA NIPA Table 2.1, "Personal Income and Its Disposition." The population series is reported in thousands of persons and corresponds to the total U.S. population, including members of the Armed Forces stationed abroad and the institutionalized population. Quarterly population observations are averages of the corresponding monthly estimates. Letting Y_t^r denote real GDP and N_t population, we construct

$$y_t = \ln\left(\frac{Y_t^r}{N_t}\right).$$

The underlying quarterly series runs from 1959:Q1 to 2026:Q1.

Imports and the trade balance. Nominal GDP, imports, and exports are obtained from BEA NIPA Table 1.1.5, "Gross Domestic Product." All three series are measured in billions of dollars and are seasonally adjusted at annual rates. We use total imports of goods and services, total exports of goods and services, and nominal GDP. Letting M_t denote imports of goods and services, X_t exports of goods and services, and Y_t^n nominal GDP, the import-to-output ratio is

$$moy_t = 100\frac{M_t}{Y_t^n},$$

and the export-to-output ratio is

$$xoy_t = 100\frac{X_t}{Y_t^n}.$$

The trade-balance-to-output ratio is then constructed as

$$tby_t = xoy_t - moy_t = 100\frac{X_t - M_t}{Y_t^n}.$$

Thus, both moy_t and tby_t are expressed in percentage points of GDP. Their underlying quarterly series run from 1959:Q1 to 2026:Q1.

Aggregate import tariff. For the aggregate tariff series used in the econometric analysis, we combine data on customs-duty revenue and imports of goods from the BEA. Customs-duty revenue is obtained from NIPA Table 3.5U, "Taxes on Production and Imports," specifically the series for federal taxes on products, customs duties. This series is reported in millions of dollars, seasonally adjusted at annual rates, and is converted to billions of dollars. Imports of goods are obtained from NIPA Table 1.1.5 and are reported in billions of dollars, seasonally adjusted at annual rates.

The BEA measure of imports of goods excludes customs duties. Thus, letting D_t denote customs-duty revenue and M_t^g the value of imports of goods exclusive of customs duties, we construct the aggregate import-tariff rate as

$$\tau_t = 100\frac{D_t}{M_t^g}.$$

The resulting series is expressed in percent and runs from 1959:Q1 to 2026:Q1. We use this aggregate BEA-based measure, rather than the trade-weighted tariff measure constructed from product-level USITC data in Section 2, because the BEA series provides a substantially longer sample. Over their common sample, the correlation between the two tariff measures is 0.99.

Real exchange rate. The real exchange rate is obtained from the Bank for International Settlements (BIS), Effective Exchange Rates, data set WS_EER 1.0. We use the monthly narrow real effective exchange rate for the United States, which covers 27 economies and is normalized to equal 100 in 2020. The nominal effective exchange rate underlying this measure is a geometric trade-weighted average of bilateral exchange rates. The BIS constructs the corresponding real effective exchange rate by adjusting the nominal index for relative consumer prices. An increase in the index represents a real appreciation of the U.S. dollar.

The monthly BIS series begins in January 1964. We convert it to quarterly frequency by taking the geometric average of its monthly observations. In particular, if $REER_{mt}$ denotes the monthly index in month m of quarter t, the quarterly index is

$$e_t = \exp\left(\frac{1}{3}\sum_{m\in t} \ln REER_{mt}\right).$$

A.2 Product-Level Data

This section describes the sources and construction of the intensive and extensive measures of cross-sectional variation in U.S. import tariffs, denoted σ_t^τ and s_t^τ, respectively.

Data source and sample. The underlying data are monthly observations on U.S. imports for consumption and calculated import duties obtained from the U.S. International Trade Commission (USITC) and accessed on June 20, 2026.[3] Import values are measured using customs value. The data are organized at the six-digit Harmonized System product level and cover the period 1990:M1 to 2026:M3. The data is converted to quarterly frequency.

We construct a balanced panel by using concordances from United Nations Statistics to track product codes across revisions of the Harmonized System classification. The resulting panel contains 4,022 products in every quarter.

Let m_{it} denote the customs value of imports of product i in quarter t, and let d_{it} denote the corresponding duties. The product-level tariff rate is constructed as

$$\tau_{it} = \frac{d_{it}}{m_{it}}.$$

Let total imports in quarter t be

$$m_t = \sum_i m_{it},$$

and define the import share of product i as

$$s_{it} = \frac{m_{it}}{m_t}.$$

Thus, the product weights sum to one in every quarter.

Dutiable share of imports. Let $\mathcal{D}_t$ denote the set of products subject to a positive tariff

[3]In U.S. trade statistics, “imports for consumption” is a customs term. It refers to merchandise that has cleared Customs for entry into the U.S. market, either directly or after withdrawal from bonded warehouses or Foreign Trade Zones. It does not mean that the imported goods are used for final consumption rather than as intermediate inputs.

in quarter t,

$$\mathcal{D}_t = \{i : \tau_{it} > 0\}.$$

The extensive-margin measure of tariff variation, s_t^τ, is the share of total import value accounted for by dutiable products:

$$s_t^\tau = \sum_{i \in \mathcal{D}_t} s_{it} = \frac{\sum_{i \in \mathcal{D}_t} m_{it}}{\sum_i m_{it}}.$$

The variable s_t^τ is expressed as a fraction. Thus, for example, $s_t^\tau = 0.73$ indicates that 73 percent of the value of imports is accounted for by products subject to a positive tariff.

Tariff dispersion among dutiable goods. The intensive-margin measure, σ_t^τ, is the trade-weighted cross-sectional standard deviation of tariff rates conditional on the product being dutiable. To construct it, we first renormalize the import shares of dutiable products so that they sum to one:

$$\widetilde{s}_{it} = \frac{s_{it}}{s_t^\tau}, \qquad i \in \mathcal{D}_t.$$

The trade-weighted mean tariff among dutiable products is then

$$\tau_t^d = \sum_{i \in \mathcal{D}_t} \widetilde{s}_{it} \tau_{it}.$$

Tariff dispersion across dutiable goods is defined as

$$\sigma_t^\tau = \left[\sum_{i \in \mathcal{D}_t} \widetilde{s}_{it} \left(\tau_{it} - \tau_t^d \right)^2 \right]^{1/2}.$$

Thus, σ_t^τ measures variation in tariff rates across goods that are subject to a positive tariff, rather than variation generated mechanically by the distinction between duty-free and dutiable products. The latter margin is captured separately by s_t^τ.

We seasonally adjust σ_t^τ using the X-13 procedure and retain the resulting D11 series. The seasonally adjusted series is multiplied by 100 and is therefore expressed in percentage points. For example, $\sigma_t^\tau = 3.4$ represents a cross-sectional standard deviation of 3.4 percentage points among dutiable products.

As a robustness measure, we also construct a fixed-weight standard deviation, $\sigma_t^{\tau^F}$. For this measure, product weights are fixed at their average values during 2006 and are renormalized in each quarter over the set of products that are dutiable in that quarter.

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