The Aggregate(d) Effects of Tariff Policy

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Abstract

What are the macroeconomic effects of tariffs? With tariffs set on thousands of products, answering this question requires aggregation. We show that the aggregation method has profound consequences for the effects one estimates. The standard ad valorem equivalent (AVE) tariff contains endogenous components—import weights and import prices—that introduce variation unrelated to legislated policy changes. Using a new product-level dataset of U.S. tariffs from 1951–2017, we propose alternative measures that address these concerns and show that they yield materially different macroeconomic responses. We further demonstrate that aggregating over heterogeneous products obscures important differences in how tariffs transmit to the economy.

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1 Introduction

What are the macroeconomic effects of tariffs? With tariffs set on thousands of products, this question potentially has thousands of answers. To provide estimates that are parsimonious and useful for policymakers, one has to aggregate tariffs in some way. In this paper, we show that the aggregation method has profound consequences for the effects that one estimates.

The standard approach to aggregating tariffs is to construct the aggregate ad valorem equivalent (AVE) rate—measured as total duties collected over total imports, or, equivalently, an import-weighted average of legislated tariff rates. Aggregation in the form of the AVE introduces two endogenous components to legislated tariff rates. First, import weights are endogenous both to the tariff policy itself—to the extent that import shares shift in response to changes in relative rates of protection—and to the business cycle. It is well known, for example, that consumption of durables falls during recessions, implying that the import share of durable goods may also be pro-cyclical. The second endogenous component arises from import prices or unit values, which are used to convert specific tariffs (which are legislated as dollars per unit) into ad valorem equivalents. If import prices share a common component with aggregate prices, the ad valorem equivalent tariff rate will be inversely related to aggregate inflation. The presence of these additional components in the AVE is made clear by the fact that in some cases, there is substantial variation in the AVE even when there are no legislated changes in trade policy. This was the case in the period between 1972 and 1989, highlighted by Greenland et al. (2023). In other cases, the AVE can even move in the opposite direction of the legislated changes, if these additional forces are strong enough.

In addition to the inherent problems with the aggregation process, it is somewhat misguided to try to summarize tariff policy in terms of a single number. Tariffs are imposed at a highly disaggregated level—today, there are over 12,000 individual tariff rates. Even the simplest of models would suggest that tariffs on a highly upstream input like oil or steel are likely to impact the economy in a different way that a tariff on a final good, like tennis shoes. As such, any measure of tariffs that is constructed by averaging over different types of products may yield estimates of macroeconomic impacts that confound these different effects.

In this paper, we rely on a new dataset of product-level tariffs and imports from 1951 to 2017 to highlight the first-order impacts that aggregation choices can have on the estimated relationship between tariffs and macroeconomic variables.[1] After illustrating how the endogenous components can contaminate standard measures of the aggregate AVE, we then propose two methods for addressing these endogeneity concerns. In the first, we define an "acyclical" ad valorem equivalent tariff rate, in which we directly purge the endogenous components of the AVE (import weights and import unit values) of their relationship with cyclical factors. We then build the AVE back up with these orthogonalized components, and

[1] We are in the process of finalizing an extended dataset back to 1900.

show that it moves closer to the path implied by statutory changes. Our second approach is a simpler one, in which we rid the aggregation process of endogenous weights and prices altogether by calculating the simple average of ad valorem tariffs. Though specific tariffs were a dominant form of protection during much of the 20th century, this simple average ad valorem tariff can be thought of as a clean proxy for the path of legislated rates over the past 65 years.

We show that using our cleaner measures of legislated tariff changes generates, most notably, an inflationary response of inflation to increases in tariffs, which contrasts with the response estimated using the AVE. Relative to the AVE, the cleaned tariff measures generate more muted responses of output and imports. This could arise if, for example, deflationary pressure from weak demand mechanically lead to higher ad valorem equivalent tariffs. Alternatively, if consumers shift to purchase "cheap" imported goods during recessions, the AVE would mechanically rise since consumer goods have relatively high tariff rates. In other words, the endogenous components of the AVE likely amplify the responses of real variables.

Finally, we explore the consequences of aggregating tariffs across different types of goods. We show that when we disaggregate our tariff measures into three broad categories of goods: food/agricultural products, manufactured final goods, and intermediate inputs, there is variation in the estimated responses of macro variables. Increases in tariffs on manufactured final goods are associated with an increase in the price level, and eventual increases in output and exports. This is consistent with tariff protection insulating domestic industries and spurring increases in domestic output. Increases in input tariffs, on the other hand, behave more like negative supply shock, with the response characterized by rising prices and a contraction in GDP.

Our work contributes to a growing empirical literature that studies the macroeconomic effects of tariff shocks, with particular emphasis on their implications for real activity, prices, and policy transmission. A robust finding from existing work is that tariff increases are contractionary: they reduce imports, weaken exports, and lead to declines in output and employment. However, there is less consensus on the mechanisms through which tariffs propagate, as well as on the role of expectations, policy responses, and the composition of tariff changes.

A first strand of this literature exploits historical and institutional variation to identify tariff shocks that were plausibly exogenous to macroeconomic conditions. den Besten and Känzig (2026)—relying heavily on the work of Irwin (2017)—construct a novel series of plausibly exogenous tariff changes for the United States over more than a century and show that tariff increases lead to persistent declines in economic activity and trade volumes, with effects that vary across policy regimes. A second strand emphasizes the role of expectations and the persistence of tariff shocks. Schmitt-Grohe and Uribe (2025) develop a framework that dis-

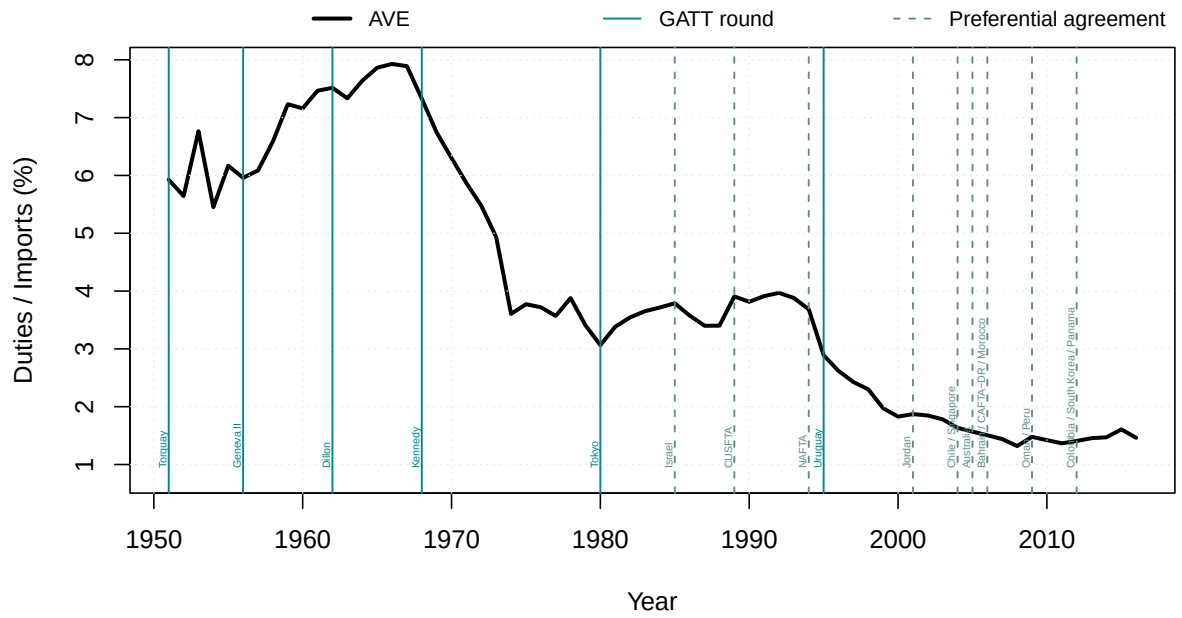
tinguishes between transitory, permanent, and anticipated tariff changes. Using U.S. post-war data, they show that both transitory and permanent tariff shocks can generate short-run increases in output, highlighting the importance of expenditure-switching effects and forward-looking behavior. Their results underscore that the macroeconomic effects of tariffs depend critically on their expected duration and on the nature of the underlying shock. Complementing this approach, Barnichon and Singh (2025) exploit 150 years of tariff policy and show that tariff increases are associated with declines in economic activity and deteriorations in labor market outcomes, highlighting the role of general equilibrium channels linking domestic demand and international trade. Finally, Franconi and Hack (2026) emphasize the interaction between tariff shocks and monetary policy, showing that the macroeconomic effects of tariffs depend on the systematic response of the central bank, with tariff increases generating a contraction in output alongside upward pressure on prices and a partial monetary policy accommodation.

While the literature generally finds strong contractionary effects of tariffs, much of that work also suggests that the effects depend on a multitude of factors. Given the relatively few changes in tariff policy in general, our prior is that the ability to tease out such heterogeneous effects is limited. To this point, the literature has had to work either with the aggregate AVE, or disaggregated data over a period (since 1989) that has witnessed very few changes in tariff *policy*. That is where we make our contribution. Our disaggregated, historical, product-level data allows us to measure actual tariff policy, and use those policy variables to estimate macroeconomic effects.

A smaller body of work has emphasized, as we do, the measurement of tariffs and the various channels through which AVEs change. Work by Irwin (1998), for example, emphasized the effect of price changes on AVEs in the Smoot-Hawley era, a period in which specific tariffs were pervasive in the tariff schedule. Crucini (1994), exploring US tariff levels between 1900 and 1940, decomposes changes in AVE into components driven by statutory tariff changes, rising import price indices, and changes in the relative price of imports. More recently, Greenland et al. (2023) provide exact decompositions of the endogenous components of AVEs, and show how they explain puzzling patterns in the shape of the AVE with respect to known changes in tariff legislation. Our work follows in this spirit, but departs by showing how measures of tariff policy contaminated by these endogenous components can obscure important differences in how tariff policy transmits to the macroeconomy.

In the remainder of the paper, we proceed as follows. In Section 2, we describe the standard method of aggregating tariffs across products and the macroeconomic effects typically estimated using the standard tariff series. In Section 3, we describe the new dataset that we bring to bear on this question: a panel of legislated tariff rates and imports by product from 1951 to the present. In Section 4 we describe the mechanical endogeneity arising from standard aggregation methods, and propose two alternative measures for aggregate tariff rates that better track the path of legislation. In Section 5, we illustrate that aggregating tariffs

FIGURE 1. U.S. Ad Valorem Equivalent Tariff



NOTE. This Figure shows the ad valorem equivalent tariff rate from 1951-2017. Solid vertical lines indicate the conclusion dates of various rounds of the GATT. Vertical lines mark the date that bilateral or multilateral preferential trade agreements went into effect.

over products prone to different macroeconomic effects can also yield conflated estimates. Finally, in Section 6, we discuss our results and conclude.

2 The Standard Method of Aggregating Tariffs

The standard measure of the aggregate tariff rate in the United States is the import-weighted average ad valorem equivalent tariff, or AVE, which can be shown in equation 1.

$$\text{AVE}_t = \sum_i s_{it} \left(\tau_{it} + \frac{1}{p_{it}} f_{it} \right) \tag{1}$$

Here, $s_{it} = \frac{m_{it}}{M_t}$ is the import share of product i in year t, τ_{it} is the ad valorem tariff rate on product i in year t, p_{it} is the unit value of imports of product i in year t net of tariffs, and f_{it} is the specific tariff rate (in dollars per unit) on product i in year t. This measure is published by the U.S. International Trade Commission (USITC), and is plotted in Figure 1[2]

Vertical lines mark key trade liberalization events over this 65 year period. Multilateral

[2]These statutory tariff rates τ_{it} and f_{it} can differ across countries v as is often the case GATT vs non-GATT members or those in preferential trade agreements. We ignore them for notational simplicity, but incorporate this variation and the appropriate adjustments in any empirical exercises. Additionally, we note that the "duties" reported by the USITC and its predecessors has technically not reflect actual duties collected, but "calculated duties," which are an estimate. To our knowledge, there is no way to account for this limitation of the data.

negotiating rounds of the General Agreement on Tariffs and Trade— Torquay, Geneva II, Dillon, Kennedy, Tokyo, and Uruguay — are indicated with solid lines at their respective completion dates. In each of these sets of negotiations, the United States committed to broad based reductions in Most Favored Nation (MFN) tariff rates. Bilateral and preferential trade agreements (PTAs) are indicated with dashed lines, including the U.S.-Israel FTA, CUSFTA, NAFTA, and a series of agreements concluded in the 2000s with Jordan, Chile, Singapore, Australia, Bahrain, CAFTA-DR, Morocco, Oman, Peru, Colombia, South Korea, and Panama.

An important feature of Figure 1 to take note of is that there is substantial variation in the AVE tariff even during inter-policy periods, when there were little to no legislated changes in tariff rates. In Sections 4 and 5 we will discuss the specific causes of this variation, but its presence should serve as a hint that the AVE reflects more than just changes in legislated tariffs and should be used with caution as a proxy for U.S. tariff policy. Moreover, understanding the drivers of this non-statutory variation is first order for interpreting the response of macroeconomic variables to the AVE.

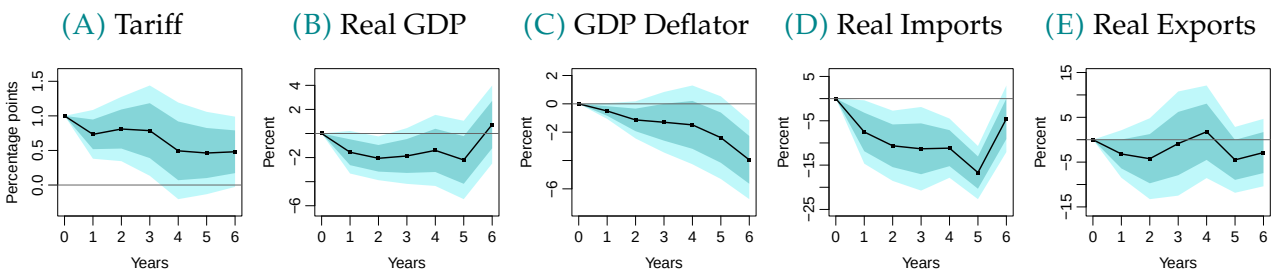
As a point of reference, we present the estimated "responses" of macroeconomic variables to the ad-valorem equivalent tariff using local projections. In particular, we estimate

$$y_{t+h} - y_{t-1} = \alpha_h + \beta_h \tau_t + \Gamma_h' \mathbf{c}_t + \sum_{\ell=0}^{2} \Lambda_{h,\ell}' \mathbf{y}_{t-\ell} + e_{t,h} \tag{2}$$

where y_t is either the log of real GDP, the log of the GDP deflator, the log of real imports, or the log of real exports. The source of each macroeconomic variable is described in appendix B. The coefficient of interest, β_h, is on τ_t: the tariff variable (here, the ad-valorem equivalent rate). We also present estimates when $y_t = \tau_t$, to understand the persistence properties of the shock. The vector $\mathbf{c}_t$ contains other controls: In this specification, that includes only three lags of log oil prices. That control makes little difference in this specification, but will be important later. We report heteroskedasticity robust standard errors, following the recommendation of Montiel Olea and Plagborg-Møller (2021). We opt for a local-projection specification, over a vector auto-regression, to minimize the risk of bias potentially introduced by VARs, described by Montiel Olea et al. (2025).

In Figure 2, we plot the estimates of equation (2). Changes in the AVE have effects that resemble a contractionary demand shock—a reduction in output, inflation, and imports, and little impact on exports. Though we are estimating these responses via ordinary least squares, the responses resemble those estimated in the literature using instrumental variable approaches during a similar sample period (see Appendix A). From the perspective of standard theory, the most surprising result is the estimated deflationary effect. The literature rationalizes this finding by interpreting tariff shocks as disturbances that exert downward pressure on prices through demand-side channels or broader general equilibrium effects

FIGURE 2. Impulse Responses to the Ad-Valorem Equivalent Tariff



NOTE. This figure shows impulse responses to the ad-valorem equivalent tariff (left-most panel), estimated using equation (2). Heteroskedasticity-robust standard errors are used to construct the 68% and 90% confidence bands denoted by the shaded regions. The sample is 1951–2016.

(see Schmitt-Grohe and Uribe (2025) and Barnichon and Singh (2025)). While these forces are a possibility, we show in the remainder of this paper that this "price puzzle," can also be explained by the errant inclusion of endogenous components of AVE tariffs through the standard aggregation approach.

3 Disaggregated Tariffs

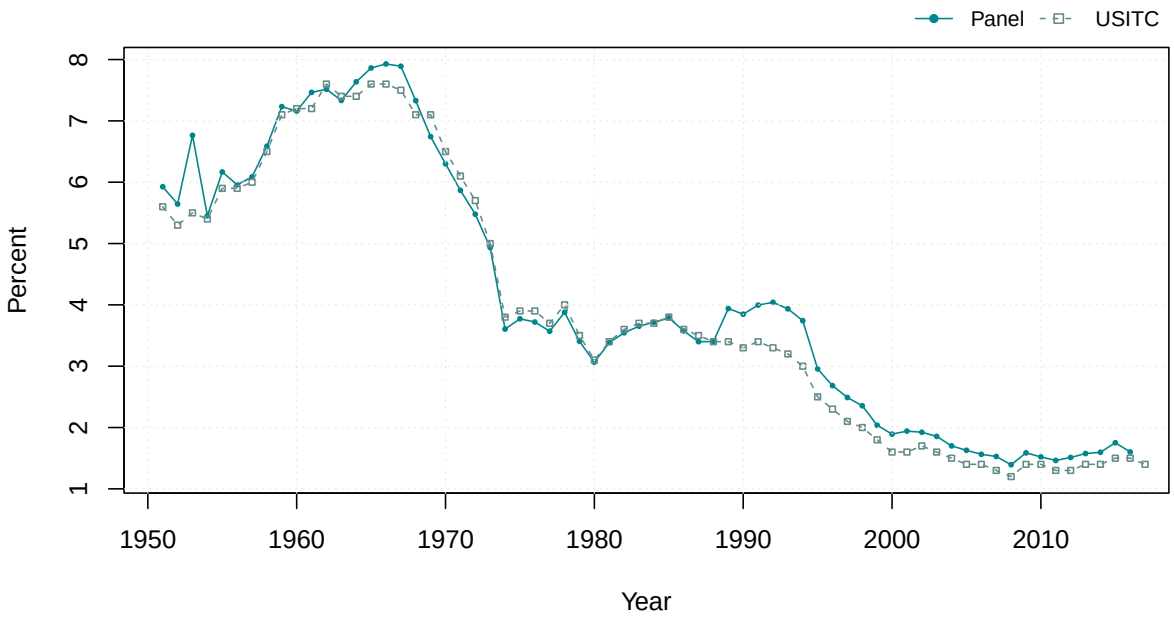
In the remainder of our analysis, we rely on a new dataset of disaggregated tariffs and imports from 1951 to the present day.[3] While product-level U.S. tariffs are readily available from 1989 on from the USITC, tariffs and imports at the tariff line level prior to that year are not systematically available in machine-readable format. U.S. tariff schedules and import data have been digitized in recent work by Greenland et al. (2023) (1972-88), Acosta and Cox (2025) (1930-1971), and Greenland and Lopresti (2024) (1900-1930).

Starting in the 20th century, tariff schedules and import data in the United States have primarily been organized using numerical classification systems that identify individual products. The disaggregated data in the period we currently study in this paper cover three different classification systems. In the early part of the sample, prior to 1963, products were classified by Schedule A code. The most disaggregated Schedule A codes are 7 digits long, which also represents the tariff line (the level of aggregation at which tariff policy is determined). In 1963, the classification system was converted to the *Tariff Schedules of the United States*, or TSUS. TSUS codes are also 7 digits long at their most disaggregated, but tariffs were set at the 5-digit level. Finally, beginning in 1989, the modern *Harmonized System* (HS) emerged. HS codes are 10-digits long at their most detailed, but 8-digit HS codes represent the tariff line.

Our raw data contain the legislated tariff rate for each product—either an ad valorem rate, a specific rate, or a compound rate (which has an ad valorem component and a specific

[3] In ongoing work, we are extending the data used for this analysis back to the year 1900.

FIGURE 3. Ad Valorem Equivalent Tariffs: Disaggregated Panel vs USITC



NOTES. This figure shows the ad valorem equivalent tariff constructed using our disaggregated tariff panel (solid line) alongside the AVE that is published by the USITC (calculated duties divided by imports).

component). For all of the years in our dataset, we have information on the Column 1 tariff rate for each product, which was applied to any country with "most favored nation" (MFN) status. Beginning in 1972, we have information on tariff rates by individual countries, which allows us to incorporate the differential rates applied to individual countries or country groups via preferential trade agreements, which become much more prevalent starting in the mid-1980s. We also have data on nominal imports and imported quantities.[4]

To visualize the coverage of our dataset, we reconstruct the average ad valorem equivalent tariff rate using our disaggregated panel. Specifically, we calculate the implied ad valorem duties for each individual product in year t as $\tau_{it} \times m_{it}$—the ad valorem tariff rate on product i times the nominal value of imports of that product. The implied specific duties for each product are given by $f_{it} \times q_{it}$—the specific tariff rate in dollars per unit of quantity times the total quantity imported. Finally the ad valorem equivalent tariff rate is equal to the sum of ad valorem duties and specific duties, divided by total imports. In Figure 3, we show that the AVE computed using our disaggregated panel lines up almost perfectly with the aggregate AVE published by the USITC.

[4]The import data is disaggregated by origin country back to 1933, but prior to that point is aggregated to the product level.

4 Aggregating with Endogenous Weights

In this Section, we describe the potential endogeneity in the AVE that is introduced through aggregation. In Section 4.1 we describe the components of the AVE formula that are problematic, and in Section 4.2, we describe two approaches to address these endogeneity concerns that rely on our disaggregated tariff panel. Finally, in Section 4.3, we show how these aggregation choices have first order effects on the estimated macroeconomic responses to changes in tariffs.

4.1 Identification Challenge

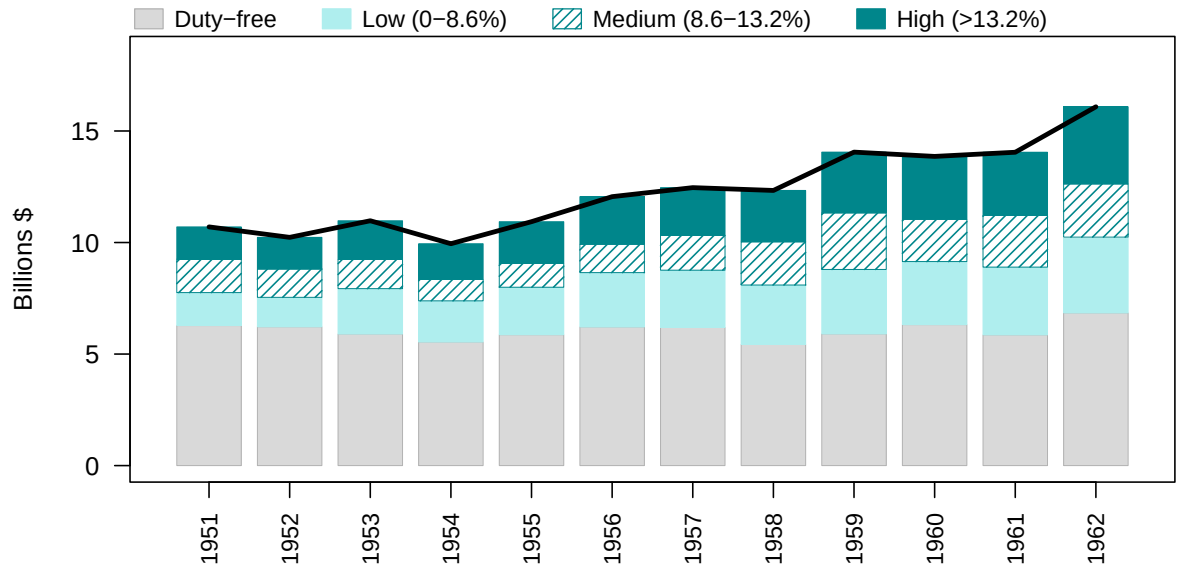
An examination of equation 1 in more detail reveals two channels through which aggregating tariff rates in this manner renders the AVE endogenous to macroeconomic outcomes.

Working from left to right, the first problematic term is s_{it}—product i's share of total imports in year t, which is used to weight individual tariff rates. On one hand, import weighting is helpful for ensuring that the aggregated tariff rate is representative of the basket of imports that is actually being consumed. On the other hand, those weights are potentially endogenous with respect to both the tariff rates themselves—a reduction in tariffs on product i relative to product j induces an increase in the relative imports of product i—and to macroeconomic conditions—for example, that consumption of durable goods tends to fall during recessions implies that import shares of durable goods may reflect the business cycle.

Import composition is largely responsible for the puzzling increase in the AVE during the 1950s—a decade marked by three different rounds of tariff-reducing GATT negotiations. As Figure 4 shows, total imports rose from about $10 billion in 1951 to around $15 billion in 1962. This growth, however, was not distributed evenly across the tariff schedule. Imports of duty-free goods were roughly stable through the period, so the growth in imports was concentrated in dutiable goods. This composition shift explains why the AVE rose through the decade, despite the fact that legislated tariffs were, in fact, declining.

The second problematic term in equation 1 is $\frac{1}{p_{it}}$—the unit value of product i, which is used to convert specific tariffs, f_{it} (dollars per unit), into ad valorem terms. As has been highlighted in work by Irwin (1998), Crucini (1994), Greenland and Lopresti (2024), and Greenland et al. (2023), when specific tariffs are present, inflation erodes the level of the legislated tariff in ad valorem terms. For example, a tariff of $1 per pair of shoes is higher in percentage terms if the pair of shoes is valued at $10 per pair than if the pair of shoes is valued at $20 per pair. To the extent that prices of individual products, i, are driven in part by aggregate inflation, a mechanically negative relationship between the AVE and inflation arises.

FIGURE 4. Imports by Tariff Bin (1951-1962)



NOTE. This figure shows total U.S. imports (solid black line) broken into tariff rate bins: duty free, low tariff (0 to 8.6 percent), medium tariffs (8.6 to 13.2 percent) and high (greater than 13.2 percent). Sample period is 1951 to 1962.

The behavior of the AVE during the period between 1972 and 1980 exemplifies this issue. Following the approach of Greenland et al. (2023), we can decompose changes in the AVE into changes driven by composition, statutory changes, inflation erosion, and a residual.[5] Letting I^C, I^X, and I^N be the set of goods traded in both periods, exiting, and entering respectively, the decomposition breaks down aggregate tariff changes into changes among is shown in equation 3:

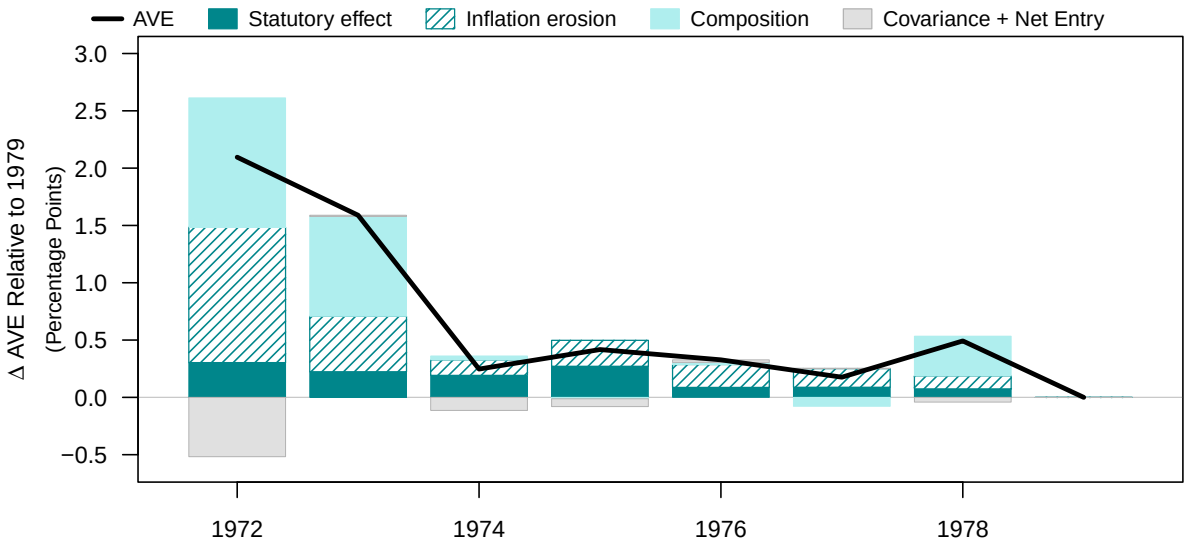
$$\begin{aligned}\Delta \text{AVE}_t \equiv & \text{AVE}_t - \text{AVE}_{t_0} \\ = & \underbrace{\sum_{i \in I^C} s_{it_0}\left(s_{it_0} + \frac{\Delta f_{it}}{p_{it_0}}\right)}_{\text{Statutory changes}} - \underbrace{\sum_{i \in I^C} s_{it_0}\frac{\Delta p_{it}}{p_{it_0}}\text{STS}_{vgt}\text{AVE}_{it}}_{\text{Inflation erosion}} + \underbrace{\sum_{i \in I^C} \text{AVE}_{it_0}\Delta s_{it}}_{\text{Composition Changes}} + \mathcal{R}_t \end{aligned} \tag{3}$$

where the specific-tariff share, $\text{STS}_{it} = \frac{f_{it}}{p_{it}\tau_{vgt} + f_{it}} \in [0,1]$, is the share of good level tariff protection accounted for by specific tariffs, and $\mathcal{R}_t$ is the sum of a covariance term, $\sum_{i \in I^C} \Delta s_{it} \Delta \text{AVE}_{it}$, and a term that reflects product entry and exit, $\sum_{i \in I^N} s_{it}\text{AVE}_{it} - \sum_{i \in I^X} s_{it_0}\text{AVE}_{it_0}$.

In Figure 5, the AVE is shown by the solid black line, while the bars show the components driving changes in the AVE relative to 1979. As expected, the period between the Kennedy Round tariff phase-ins (which ended in 1972) and the Tokyo Round phase-ins (which began in 1980) was characterized by very few changes in legislated tariff rates. The statutory component of the AVE is close to zero for the whole period. The AVE is falling sharply over the period, however, driven largely by rising inflation, which eroded the ad valorem equivalent

[5]The residual contains a covariance effect and net entry. See Greenland et al. (2023) for more detail.

FIGURE 5. Exact Decomposition of the AVE: 1972-1979



NOTE. This figure shows an exact decomposition of changes in the AVE relative to 1979, as shown in equation 3.

of specific tariffs. This mechanical relationship is one possible reason that the AVE produces weak inflationary, or deflationary, dynamics—to the extent that product-level prices p_{it} are driven by the aggregate price level, increases in AVE_t driven by $\frac{1}{p_{it}}$ can be associated with deflationary dynamics.

4.2 Two Alternative Methods

In this subsection, we present two alternative methods for constructing an aggregated tariff rate that address the endogeneity concerns highlighted in Section 4.1. In the first, we define an "acyclical" ad valorem equivalent tariff rate, in which we directly purge the problematic weights and prices of their systematic relationship with cyclical factors. This approach is described in Section 4.2.1. In the second approach, described in Section 4.2.2, we use a simple average of ad valorem tariff rates to proxy for the path of legislated rates, removing the problematic weights and prices entirely.

4.2.1 The Acyclical AVE

Our first approach for addressing the endogeneity of the AVE is to purge the problematic components—the import weights and import prices—of their components that are endogenous to the macroeconomy. One option would be to hold weights and prices fixed in some base year, so that the movement in aggregated tariffs reflects only changes in legislated tariff rates. The downside of this approach is that the "basket" of goods in the base year

may become less economically relevant as time progresses. This is especially true for new inventions (e.g., cell phones). The alternative approach we propose recognizes that for estimating the macroeconomic effects of tariff changes, not all variation in weights and prices is problematic—just variation that is cyclical. As such, we can strip out the cyclical components of the import weights, ω_{it}, and prices p_{it}. To that end, we begin by estimating the cyclical component of a selection of macroeconomic variables using the Hamilton (2018) filter. For a given macroeconomic time series x_t, we estimate the cylical component x_t^c as the two-step-ahead forecast error from the direct projection

$$\log(x_t) = \alpha + \beta \log(x_{t-2}) + x_t^c.$$

We estimate the cyclical component of real GDP, the GDP deflator, and real imports and combine them into the vector $\mathbf{x}_t^c$. Then, for each product i, we construct what we call acyclical import values and unit values by first estimating

$$\log(p_{it}) = \alpha_i + \beta_i \log(p_{i,t-2}) + \boldsymbol{\gamma}_i' \mathbf{x}_t + \boldsymbol{\delta}_i' \mathbf{x}_{t-1} + \varepsilon_{it}^p$$
$$\log(m_{it}) = a_i + b_i \log(m_{i,t-2}) + \boldsymbol{c}_i' \mathbf{x}_t + \boldsymbol{d}_i' \mathbf{x}_{t-1} + \varepsilon_{it}^m$$

and then retaining the portion of m_{it} and v_{it} that cannot be explained by the aggregate cycle:

$$\tilde{p}_{it} \equiv \exp(\log(p_{it}) - \hat{\boldsymbol{\gamma}}' \mathbf{x}_t^c - \boldsymbol{\delta}_i' \mathbf{x}_{t-1}^c) \tag{4a}$$
$$\tilde{m}_{it} \equiv \exp(\log(m_{it}) - \hat{\boldsymbol{c}}' \mathbf{x}_t^c - \boldsymbol{d}_i' \mathbf{x}_{t-1}^c). \tag{4b}$$

We then reconstruct the ad valorem equivalent tariff in equation 1, but replacing s_{it} and p_{it} with their orthogonalized counterparts:

$$\widetilde{\text{AVE}}_t = \sum_i \tilde{s}_{i,t-1} \left(\tau_{i,t} + \frac{1}{\tilde{p}_{i,t}} f_{i,t} \right). \tag{5}$$

Several comments are in order. First, the lag structure—in particular, using a two-year forecast error—follows the recommendation of Hamilton (2018) for annual data. Second, we allow for a lag in the transmission of the aggregate cycle to the price and import value of each product by including both the contemporaneous and lagged value of $\mathbf{x}_t$ in equation (4).

Finally, in practice, time series for individual products can be quite short due to changes in product classification over time, which can make the orthogonalization procedure noisy. We address this by constructing longer time series using concordances of HS, TSUS, and Schedule A codes — both within and across classification regimes. For each new product code, we observe how it was formed: from two codes merging, one code splitting, or a simple relabeling.[6] We use this information to construct "shadow" values that trace product-

[6]See Acosta and Cox (2025) for more detail on how these concordances were constructed for the TSUS and

FIGURE 6. Difference between the AVE and Acylical AVE



NOTE. This figure shows the difference between the acylical ad-valorem equivalent tariff and the acylical version, $\widetilde{\text{AVE}}$, defined in equation (5). The teal-shaded region denotes the period 1951–1962, and the gray-shaded denotes the period 1972–1979.

level prices and imports before and after a code is observed. For instance, if product k is relabeled to product j in year t, we assign product j's shadow values the observed data from year t onward, and the prices and values of product k for years prior to t. Splits and merges are handled similarly, though with added complexity. The full algorithm will be described in an Appendix.

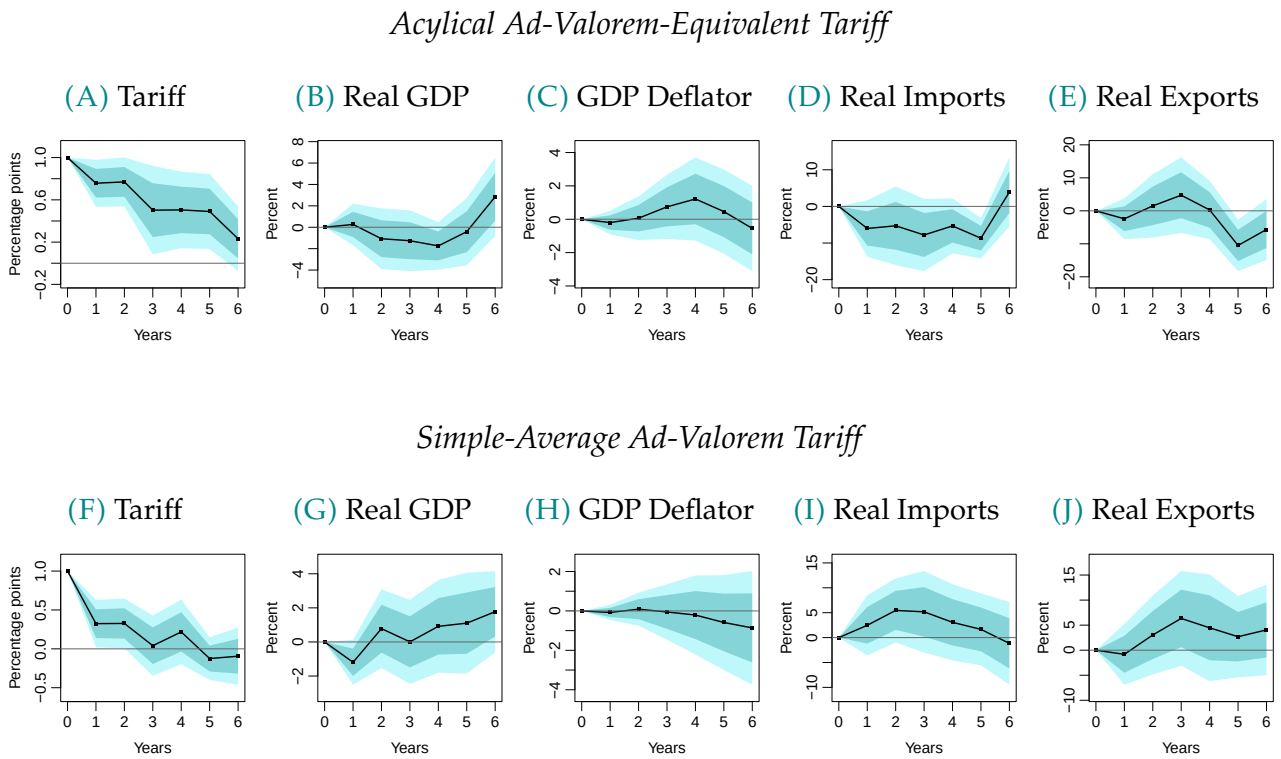
To illustrate the difference between the ad-valorem equivalent tariff, AVE_t, and the acylical AVE, $\widetilde{\text{AVE}}_t$, we plot the difference between the two series in Figure 6. Positive values indicate that the AVE exceeds the acyclical AVE, and negative values the reverse. The two shaded regions correspond to the eras discussed in Section 4.1. In the 1950s, when the AVE was rising despite legislated reductions in tariff rates, the difference is positive — the acyclical AVE is pulled downward, bringing it closer to the path implied by statutory changes. In contrast, during 1972–1979, when inflation rather than statutory action was eroding the AVE, the acyclical AVE remains elevated, producing a negative gap.

4.2.2 A Proxy for the Path of Legislated Rates

As a second, simpler, approach, we remove the endogenous prices and import weights from the aggregation process altogether. Specifically, we use the simple average of ad valorem tariffs in each year, $\frac{1}{|I^C|+|I^N|}\sum_{i\in I^C\cup I^N}\tau_{it}$. This measure has the benefit of only changing as a result of tariff policy. There are are two downsides. First, using a simple average means

Schedule A eras. For the HS era, the over-time concordance is based on the work of Pierce and Schott (2009).

FIGURE 7. Impulse Responses to Acyclical and Simple Average Ad Valorem Tariff Shocks



NOTE. This figure shows impulse responses to the acyclical tariff (top row) and the simple average ad valorem tariff (bottom row), estimated using equation (2). Heteroskedasticity-robust standard errors are used to construct the 68% and 90% confidence bands denoted by the shadedregions. The sample is 1951–2016.

that changes in tariffs from products that are hardly imported receive the same weight as products that are heavily imported. Second, any changes in statutory specific tariffs are not captured by this measure. In the modern tariff schedule, specific tariffs account for a relatively small share of tariffs. This was not the case historically. Both concerns mean that this measure may not fully capture changes in the effective rate of duty that results from changes in tariff policy. However, to the extent that this measure is correlated with systematic changes in tariff policy, it provides an alternative measure of tariff policy not driven by mechanically endogenous factors.

4.3 Estimates

Figure 7 presents local-projection estimates when we replace the ad-valorem equivalent in equation (2) with the two alternative measures of tariff policy described in sections 4.2.1 and 4.2.2. The top panel shows the responses to the acylical ad-valorem equivalent tariff (equation (5)). The most notable difference in the responses, relative to the responses to the ad-valorem equivalent tariff in figure 2, is the response of the price level, which is strongly inflationary. The response of output and imports are somewhat smaller. This could arise from a couple variety reasons: Price-level variation driven by (weak) demand would me-

chanically lead to higher ad-valorem equivalent tariffs and lower GDP. If consumers shift to "cheap" imported goods during recessions, the AVE would mechanically rise. Finally, the ad-valorem equivalent shock is more persistent than the acyclical shock, potentially driving the larger response of real variables. The responses to the simple-average of ad-valorem tariffs are qualitatively similar, though less precisely estimated, likely due to the factors described in section 4.2.2.

5 Aggregating over Heterogeneous Products

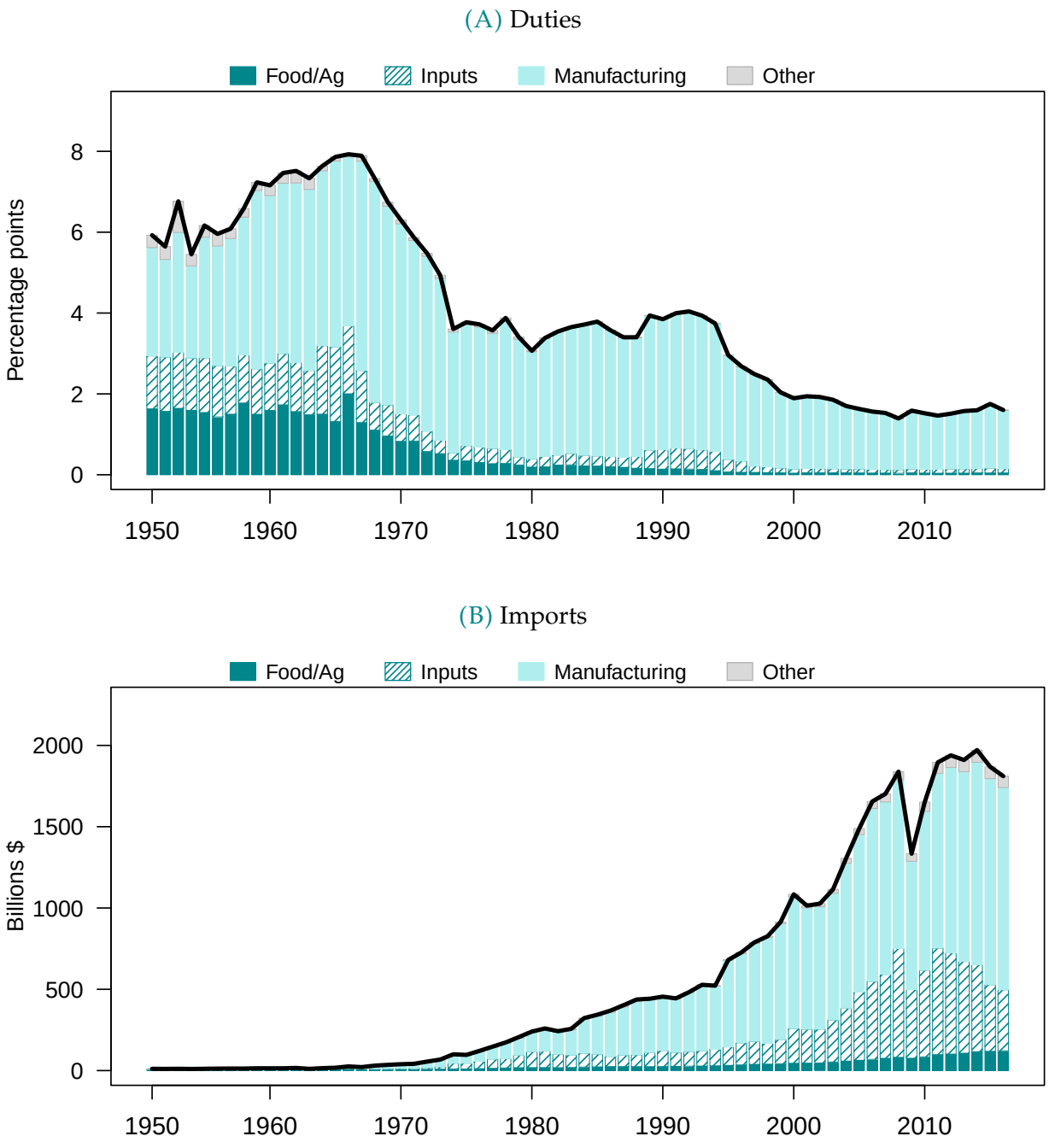
Whether there is even a single tariff rate that can appropriately describe the level of protection in the economy is a question in and of itself. The U.S. tariff schedule prescribes rates of duty for thousands of individual products. Tariff rates are established for products that span the entire production process, from highly upstream products like iron ore (used to make stainless steel) and isobutane (for refrigerant), to final goods like refrigerators. To the extent that the effects of tariffs on different products yield different macroeconomic effects, an average tariff rate of 10 percent that is entirely imposed on final goods is very different than an average tariff rate of 10 percent imposed entirely on intermediate inputs. As such, any measure of tariffs that is constructed by averaging over products can yield estimates of macroeconomic effects that confound these different effects. We consider the implications of averaging over tariffs with heterogeneous effects in this section.

A tariff on a final good is a tax on consumers of that good. A tariff on an intermediate input is a tax on firms that use that input. Standard macroeconomic theory predicts these propagate differently—a tax on consumption affects aggregate demand, while a tax on intermediate inputs affects firm costs and propagates through supply chains. Seen in this light—and even in the absence of changes in prices and weights, so that variation in tariffs is driven only by legislated changes—the question of how tariffs affect the economy depends on which products are covered by those tariffs.

To investigate the possibility that the effects of tariffs may vary by industry, we divide products into three broad groups: food and agricultural products, inputs, and final goods. We determine this categorization by concording our tariff data from the three tariff classification systems (Schedule A, TSUS, and HTS) to Standard International Trade Classification Revision 2 (SITC Rev. 2) codes. We group products in SITC Sections 0 and 1 and label them as Food and Agricultural Products; products in SITC Sections 2-5 are labeled as Inputs; and SITC Sections 6-8 are labeled as final goods. The descriptions of these SITC Sections are shown in Table 1.

Panel (A) of Figure 8 again shows the ad-valorem equivalent tariff, broken down by three broad industries: food/agricultural products, inputs, and manufacturing. Throughout the

FIGURE 8. Composition of Duties and Imports by Broad Category



NOTE. The top panel shows the ad-valorem equivalent tariff, broken down by the share of duties (over total revenue) that is attributable to products in the sectors shown in the legend. The bottom panel shows total imports, and broken down by the industries in the legend.

TABLE 1: SITC (Revision 2) Section Descriptions

Section Code	Description	Category
0	Food and Live Animals Chiefly for Food	Food/Ag
1	Beverages and Tobacco	Food/Ag
2	Crude Materials, Inedible, Except Fuels	Input
3	Mineral Fuels, Lubricants, and Related Materials	Input
4	Animal and Vegetable Oils, Fats and Waxes	Input
5	Chemicals and Related Products, N.E.S.	Input
6	Manufactured Goods Classified Chiefly by Material	Final
7	Machinery and Transport Equipment	Final
8	Miscellaneous Manufactured Articles	Final

NOTE. This table contains descriptions of the SITC (Rev. 2) Sections and the broad categories that we've assigned products contained in those sections to for the analysis Section 5.

sample, tariff revenue has predominantly come from manufactured goods, but the composition has changed dramatically over time. Early in the sample, revenue was more equally distributed across the three sectors than by the end of the sample, at which point almost all revenue was generated from manufactured goods. As Panel (B) of Figure 8 shows, this shift in composition has not been driven by a decline in imports of inputs and agricultural products—in fact, the opposite occurred—but by the fact that tariff rates have been reduced on these different categories of goods at different rates.

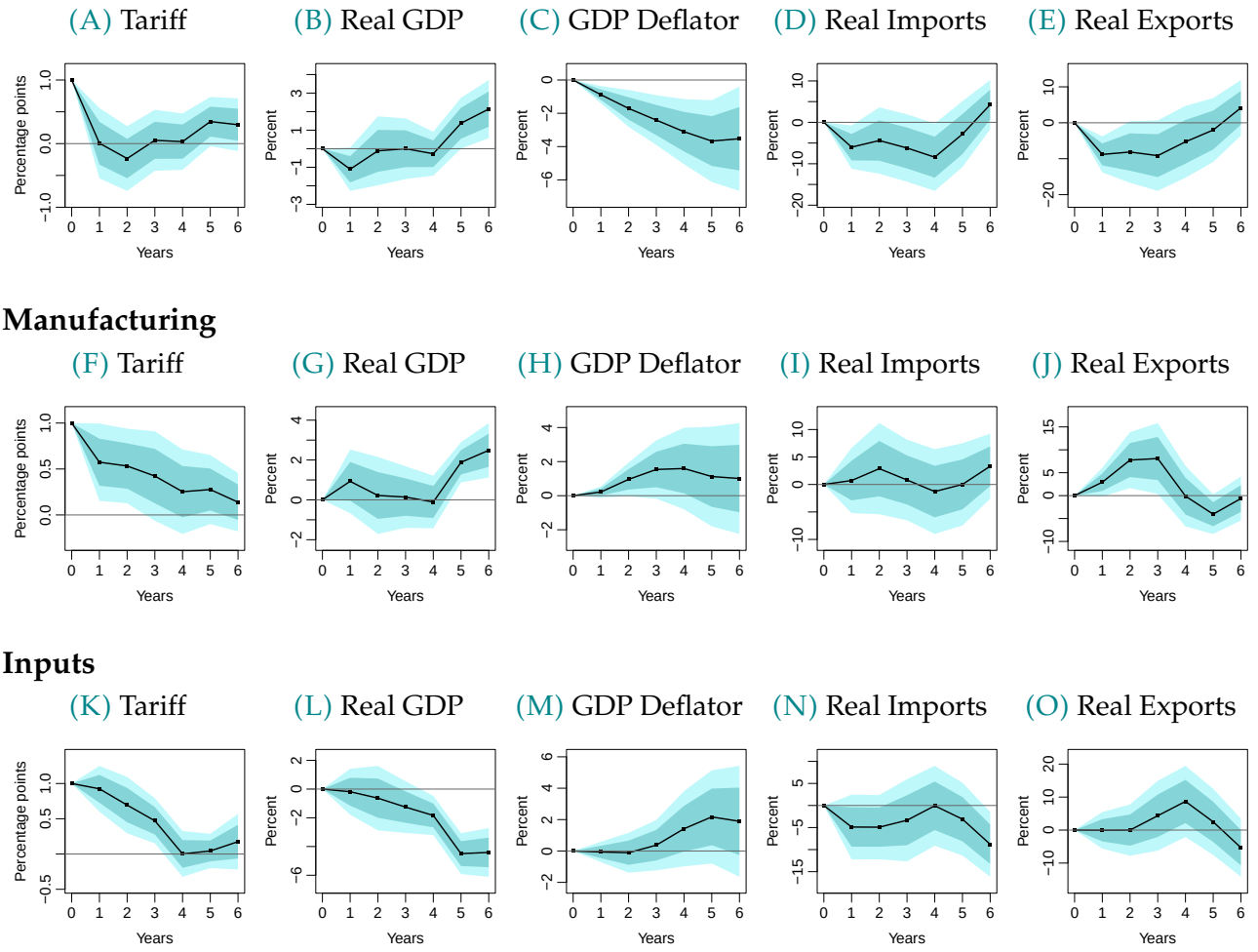
5.1 Estimated Responses to Industry-Level Tariffs

Given the breakdown of tariffs by industry, we estimate local projections again using equation (2). When estimating the responses to tariffs in industry i (e.g., inputs) we include as a control (the vector $\mathbf{c}_t$) the tariff rate in the other two industries (e.g., manufacturing and agricultural). We use the acuclical AVE as our measure of tariff policy, and plot impulse responses in figure 9. While the point estimates for both GDP and inflation are imprecisely estimated, they suggest that shocks to tariffs in both industries are not deflationary. The real effects are quite different: the input tariff leads to a gradual decline in real GDP, while the tariff on manufactured goods leads to an eventual increase in GDP.

6 Conclusion

With tariffs on so many products, aggregating tariffs across products is a necessary evil if one hopes to directly estimate the effects of tariff policy on macroeconomic variables. We have shown in this paper that the choice of how to aggregate is not innocuous. Aggregating using observed import shares and prices—the dominant approach in the macroeconomics

FIGURE 9. Industry-Level Impulse Responses to the Acyclical Tariff Shock



NOTE. This figure shows industry-level impulse responses to the acyclical tariff shock (H2P1C0imp), estimated from the joint three-industry regression using equation (2). Heteroskedasticity-robust standard errors are used to construct the 68% and 90% confidence bands denoted by the shaded regions. The sample is 1951–2016.

literature to this point—confounds tariff policy with endogenous changes in prices and beliefs. When we take steps to address these endogenous components, the estimated effects differ substantially. Disaggregating tariffs across groups of products that, a-priori, seem likely to have different economic effects also shows that aggregating across industries can yield estimated effects that conflate potentially offsetting effects.

While our estimates suggest that standard measures of tariffs may be endogenous, they are not immune to all forms of endogeneity. If tariffs are set in response to macroeconomic events, our estimates may suffer from a reverse causality problem. Over our current sample period, in which tariffs were governed primarily by international agreements, this may potentially be of less concern. At the industry level, one might worry that the extent to which tariffs were cut on a given industry may reflect the relative strength of that industry, which may itself have implications for future macroeconomic outcomes. We plan to investigate these concerns going forward.

Understanding the macroeconomic effects of tariffs is of utmost importance for policymakers. For example, many studies have suggested that tariffs may be deflationary, or have nearly undetectable inflationary effects, and proposed mechanisms to support that potentially puzzling finding. By constructing annual data on product-level tariffs and imports going back to 1951, we are able to look under the hood of the conventional measures of aggregate tariffs investigated by these studies. Our results suggest that any deflationary effects, and large contractionary effects on output, may arise from the endogenous weights used to construct those conventional measures, and not from other proposed economic mechanisms.

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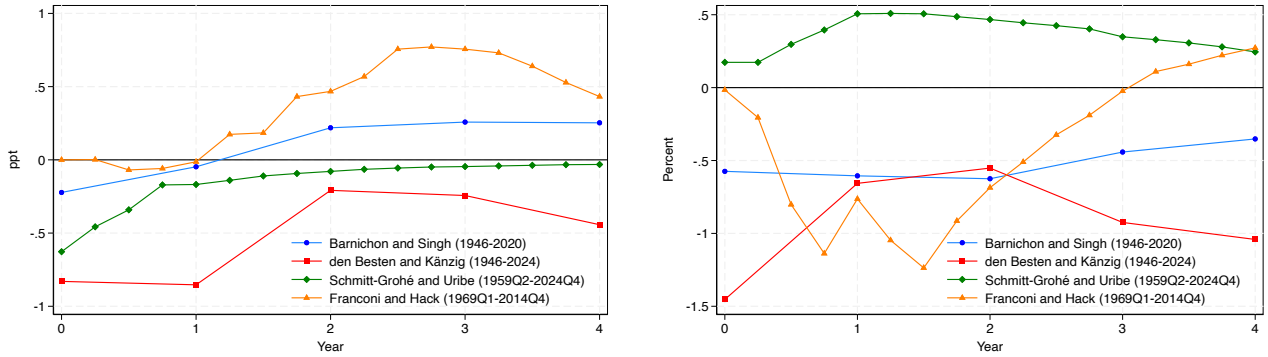
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Appendix

A Macroeconomic Responses to Tariff Shocks

FIGURE A1. Inflation and GDP Response to 1 pp Increase in Tariffs



(A) Inflation (B) GDP

NOTE. The first panel reports the response of inflation to a 1 percentage point increase in tariffs across studies that differ in identification strategies and sample periods. The second panel presents the corresponding response of GDP. Barnichon and Singh (2025) report the response of unemployment to a tariff shock; we map these estimates into GDP effects using Okun's law. Responses are presented at an annual horizon; when only quarterly estimates are available, we display them at quarterly horizons (0, 0.25, 0.5, 0.75, 1,. . . years).

B Sources of Macroeconomic Data

We estimate local projections using annual data on real GDP, the GDP deflator, real consumption, real investment, the manufacturing production index, real trade flows (exports and imports), non-core CPI, and oil prices over 1951–2016. GDP, its components, and core CPI are gathered from NIPA Tables, the implied GDP deflator comes from Müller et al. (2025), the Manufacturing Production Index comes from the Board of Governors of the Federal Reserve System, and WTI oil prices are from U.S. Energy Information Administration.

1. **Real GDP:** Real Gross Domestic Product, Billions of Chained 2017 Dollars, Not Seasonally Adjusted. Code: `GDPCA`, available here.

2. **Real Consumption:** Real Personal Consumption Expenditures, Billions of Chained 2017 Dollars, Not Seasonally Adjusted. Code: `PCECCA`, available here

3. **Real Investment:** Real Gross Private Domestic Investment, Billions of Chained 2017 Dollars, Not Seasonally Adjusted. Code: `GDPICA`, available here.

4. **Real Exports:** Real Exports of Goods and Services, Billions of Chained 2017 Dollars, Not Seasonally Adjusted. Code: `EXPGSCA`, available here.

5. **Real Imports:** Real Imports of Goods and Services, Billions of Chained 2017 Dollars, Not Seasonally Adjusted. Code: `IMPGSCA`, available here.

6. **Manufacturing Production Index**: Manufacturing component of Industrial Production Index from Federal Reserve Board available here.

7. **Core CPI:** CPI for all urban consumers excluding food and energy (1982–1984 = 100; monthly; seasonally adjusted). Annual series are computed as the average of monthly observations. Code: `CPIAUCSL`, available here.

8. **Implied GDP Deflator:** Directly from Müller et al. (2025). In particular, we are using data in sheet labeled `deflator` in column `D`. This corresponds to the implicit price deflator:

$$D_t = \frac{\$Y_t}{Y_t},$$

   where $\$Y_t$ is nominal GDP in period t, and Y_t corresponds to real GDP in year t.

9. **Oil prices:** Corresponds to price dollars per barrel from U.S. Energy Information Administration available here.