

# The Macroeconomy After Tariffs

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## Abstract

What does the macroeconomy look like in the aftermath of tariff changes? This paper estimates impulse response functions from local projections using a panel of annual data that spans 151 countries over 1963–2014. Tariff increases are associated with persistent, economically and statistically significant, declines in domestic output and productivity, as well as higher unemployment and inequality, real exchange rate appreciation and insignificant changes to the trade balance. Output and productivity impacts are magnified when

tariffs rise during expansions and when they are imposed by more advanced or smaller (as opposed to developing or larger) economies; effects are asymmetric, being larger when tariffs go up than when they fall. While firmly establishing causality is always a challenge, the results are robust to a large number of perturbations to the baseline methodology, and hold using both macroeconomic and industry-level data.

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## 1. INTRODUCTION

Perhaps more than on any other issue, there is agreement among economists that international trade should be free.<sup>1</sup> This foundational principle goes back at least to Adam Smith, and rests on the notion that, in the absence of distortions, externalities or other market failures, free and competitive markets do best in allocating resources to their most productive uses. In reality of course, the world is full of market imperfections, but tariffs seem poorly suited to addressing them in the many circumstances in which they are actually applied. Indeed, oftentimes tariffs make matters worse by encouraging the deflection of trade to inefficient producers, or smuggling and evasion: deadweight losses seem likely as broad losses by consumers exceed narrow gains by a few producers. The redistributions associated with tariffs create vested interests, so harm persists. Broad-based protectionism can also provoke retaliation which adds further to global costs. All these losses are exacerbated if inputs are protected, since this means output is produced less efficiently.

Because market imperfections are at their core microeconomic, a lot of the literature on trade barriers focuses on individual industries (Grossman and Rogoff (1995), for example). While average barriers have fallen over the decades, there are exceptions at the individual industry level, for example in agriculture or apparel. The Great Depression illustrated the futility and destructiveness of using tariffs for macroeconomic purposes, and the consensus is that macro objectives are more easily attainable through macro tools such as monetary and fiscal policy. So, while protectionism *has* not been much used in practice as a macroeconomic policy (especially in advanced countries) in the post-War period, most economists also agree that it *should* not be so used.

Times change. Newspapers are full of recent examples when tariffs have been used to achieve macroeconomic gains. For instance, tariffs are claimed to raise GDP and/or employment by improving the trade balance. So it seems an opportune moment to see what the historical record has actually been in terms of the macroeconomic effects of tariff changes. Taking a fresh look at the macroeconomic evidence is also important because previous studies are dated.

Our strategy is to use a straightforward and established methodology that strikes us as fit for the purpose at hand. We use Jorda's (2005) local projection method to estimate impulse response functions, which allows us as to account flexibly for non-linearities without imposing potentially inappropriate dynamic restrictions. We also try to account for potential endogeneity by allowing changes in tariffs to react to changes in economic activity within the same year—that is, by controlling for contemporaneous changes in economic activity – and via an instrumental variable approach in the spirit of Acemoglu et al. (2019) and Furceri and Loungani (2018), where changes in tariffs in major large trading partners are our instrument for national tariff rate changes. Our panel of annual data is long if unbalanced, covering 1963 through 2014; more recent data is of greater relevance, but older data contains more protectionism. We use a broad span of 151 countries, including 34 advanced and 117 developing countries.

We focus on the key macroeconomic variables: output; productivity; unemployment; inequality; the real exchange rate; and the trade balance. Our chief data set is aggregate in nature, but we also use sectoral data, both to control for macroeconomic shocks that may drive tariff changes and to identify some of the channels through which tariffs affect

economic activity—we differentiate between “input” and “output” tariffs . We also explore whether the results depend upon: the stage of the business cycle; whether there are asymmetric effects of tariff rises and falls; and whether tariff consequences are similar for countries at different stages of development or different size.

We study tariffs rather than other types of protectionism for three reasons. First, tariffs are the preferred protectionist policy of rich governments, past and present, and the current episode is being driven by tariff changes in the world’s largest economy. Second, tariffs are easier to measure in the aggregate than non-tariff barriers, and available for a broader span of time and countries.<sup>2</sup> Third, to the degree that other forms of protection have greater costs than tariffs (for which there is abundant evidence), our results on tariffs might be considered as a lower bound on the macro effects of protection.

So what does the macroeconomy look like in the aftermath of tariffs? We find that tariff increases are followed by declines of output and productivity in the medium term, as well as increases in unemployment and inequality. We do not find much effect on the trade balance, consistent with the evidence in our data (and the literature) that tariff increases are followed by real exchange rate appreciations which might undo any direct impact of protection on the trade balance. The longer-term consequences of tariffs are likely higher than the effects that we estimate since we truncate our analysis at a five-year horizon.

To check the robustness of our results we: (i) control for contemporaneous changes in economic activity, the trade balance and real exchange rates to address the concern that other shocks to trade might be driving our results; (ii) employ a VAR model where tariffs are ordered after the macroeconomic variable of interest so that changes in tariffs may react to

changes in the relevant variable within the same year—in such a setup, tariff changes will be orthogonal to both past and contemporaneous changes in the macroeconomic variable of interest; (iii) control for expected future growth to address the concern that governments may enact trade liberalization because of worries about declining future growth (the so-called problem of perfect foresight—Ramey, 2011); and (iv) apply an instrumental variable approach, using as instrument the changes in tariff in major trading partners. Our baseline results survive this battery of robustness checks.

Our panel data set allows us to probe some additional questions about the effects of tariff changes. We find that the medium-term decline in output following a tariff increase is larger if the tariff increase is undertaken during an economic expansion; and that the output gains from trade liberalization are smaller during recessions (consistent with intersectoral resource shifts being costly when the macroeconomy is weak). There is, moreover, an asymmetry that runs through the data, whereby tariff increases lead to larger output changes (in absolute value) than tariff decreases. The output costs from tariff increases seem to be larger for advanced and small countries than for non-advanced and large countries, possibly reflecting optimal tariff considerations.

Our paper relates to several strands of the literature on the impact of trade policies. Earlier studies have shown that there is no theoretical presumption about the effects of tariffs on output or the trade balance, with the impact depending on a host of factors including the timing and expected duration of the tariff change, the behavior of real wages and exchange rates, the values of various elasticities, and institutional factors like the exchange rate regime and degree of capital mobility (Ostry and Rose, 1992). More recent work has drilled further

into the reasons for possibly ambiguous effects on the macroeconomy including through: the impact of trade openness on currency movements and the trade balance (Santos-Paulino and Thirlwall, 2004; UNCTAD, 1999; Ju, Wu, and Zeng, 2010; Li, 2004), and productivity/output (Feyrer, 2009; Alcalá and Ciccone, 2004; Estevadeordal and Taylor, 2013); the impact of trade policies versus technology on inequality (Helpman, 2016) or wage inequality (Artuc and McLaren, 2015; Klein, Moser, and Urban, 2010). More recently, the impact of temporary trade barriers on macroeconomic fluctuations has also been studied (Barattieri, Cacciatore, and Ghironi, 2021).

Compared to this literature, our paper is more ambitious in terms of data (across countries and time) and outcome variables explored, and the payoff is a fuller picture of the macroeconomic and distributional effect of tariffs. While recent simulation models shed light on the channels through which trade policies influence the macroeconomy, the gains (losses) from trade (protectionism) generated by these models are often implausibly small.<sup>3</sup> Hence, we consider a reduced-form approach that uses a wide span of data to be an essential contribution to the literature and the current policy debate; the correlations uncovered by this empirical exercise seem robust to the battery of checks undertaken, and as such will hopefully be considered useful from a policy perspective as well.

## **2. EMPIRICAL METHODOLOGY**

Our strategy is to allow the data to speak as clearly as possible using a reduced-form approach without imposing unreasonable constraints. We use two levels of granularity. The first is more important; it is applied to country-level data and serves to quantify the



macroeconomic effects of tariffs. As a robustness check, we also bring to bear sector-level data, which provides insight into the channels through which the effects of tariffs are transmitted, while also addressing some of the inherent limitations of the macroeconomic analysis (by controlling for country shocks that may be correlated with tariff changes).

#### A. Country-Level Analysis

We use the local projection method (LPM, Jordà, 2005) to estimate impulse-response functions. LPM allows us to retrieve the dynamics of the dependent variable after a shock, and has been widely used in empirical macro, for example: Auerbach and Gorodnichenko (2013); Jordà and Taylor (2016); Ramey and Zubairy (2018); Alesina et al. (2019); Furceri et al. (2019). LPM seems relatively attractive in our context because it does not impose the dynamic restrictions embedded in models like vector autoregressions or autoregressive-distributed lag specifications. The framework is flexible enough to accommodate a panel structure. It is particularly suited to estimating nonlinearities in the dynamic responses and state-dependencies that may be impractical in a multivariate context (Ramey and Zubairy 2018, IMF 2019). The estimates generated by LPM are more robust to misspecification of the data generating process since each impulse response is estimated separately for each horizon (Ramey 2016, Biljanovska et al. 2017). For our purpose, this approach provides a simple and flexible way of estimating the dynamic effects on a panel with large number of observations. The state-dependent properties allow to understand the asymmetric effects of tariffs across various dimensions. The baseline regression is specified as follows:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta \Delta T_{i,t} + \nu X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where:

- $y_{i,t+k}$  is the outcome variable of interest (log of output, productivity, unemployment rate, Gini coefficient, log real exchange rate, or trade balance/GDP) for country  $i$  at time  $t+k$ ,
- $\{\alpha_i\}$  are country fixed effects to control for unobserved cross-country heterogeneity,
- $\{\gamma_t\}$  are time fixed effects to control for global shocks,
- $\Delta T_{i,t}$  is the change in the tariff rate,
- $v$  is a vector of nuisance coefficients
- $X_{i,t}$  is a vector of control variables, including two lags of each of: a) changes in the dependent variable, b) the tariff, c) log output, d) the log of real exchange rates and d) the trade balance in percent of GDP, and
- $\varepsilon$  is an unexplained (hopefully well-behaved) residual.

The country fixed effects allow us to control for all time-invariant country characteristics, while the time fixed effects control for all global or common shocks and factors. For each dependent variable,  $k+1$  regressions are run separately as specified in equation (1). In other words, there is one regression for each time horizon. For our purpose, this represents six regressions showing the impact of tariff changes for the year of tariff shock and five years afterwards. The coefficients of greatest interest to us are  $\{\beta\}$ , the impulse responses of our variables of interest to changes in the tariff rate.<sup>4</sup> The impulse responses are constructed by plotting the coefficient  $\{\beta\}$  for the set of six regressions. The confidence bands are based on the respective standard errors estimated. Equation (1) is estimated at the annual frequency for an unbalanced sample of 151 countries from 1964 to 2014. Table S1.1 of the Supplementary Online Appendix provides the list of countries used in the country-level analysis.

## Data Sources

The macroeconomic series for annual GDP (in constant prices), labor productivity (defined as the ratio of GDP to employment), the unemployment rate, real effective exchange rates (period average, deflated by CPI) and the trade balance (period average, deflated by GDP) are taken from IMF WEO and World Bank WDI databases. Data on the Gini coefficient, a measure of inequality, come from the Standardized World Income Inequality Database (SWIID). Table S1.2 provides a summary of our data sources. Our tariff series,  $T$ , is based on trade tariff rate data at the product level and aggregated to country level, with weights given by the import share of each product, measured as a fraction of value. The main source is the reform dataset compiled by the IMF (Ostry, Prati, and Spilimbergo 2009; Prati, Onorato, and Papageorgiou 2013; Giuliano, Mishra, and Spilimbergo 2013) which cover an unbalanced sample of 151 countries from 1964 to 2004. We extend the data to 2014 using tariff data from the World Integrated Trade Solution (WITS) and World Development Indicators (WDI). Appendix S2 provides a description of the tariff data (including data sources) and presents key descriptive statistics for tariffs and tariff changes. The appendix also includes time series plots of tariffs for a number of individual countries as well as aggregated grouped by income.

### B. Industry-level analysis

The empirical specification for industries is analogous to the macro specification:

$$y_{j,i,t+k} - y_{j,i,t-1} = \alpha_{ij} + \gamma_{it} + \rho_{jt} + \beta^I \Delta T_{j,i,t}^I + \beta^O \Delta T_{j,i,t}^O + v X_{j,i,t} + \varepsilon_{j,i,t} \quad (1')$$

where  $y_{j,i,t+k}$  is the log of sectoral output (or productivity) for industry  $j$  in country  $i$  at time  $t+k$ ;  $\gamma_{it}$  are country-year effects to control for any variation that is common to all sectors of the country's economy, including, for instance, aggregate output growth or reforms in other areas;  $\alpha_{ij}$  are country-industry fixed effects to control for industry-specific factors, including, for instance, cross-country differences in the growth of certain sectors that could arise from differences in comparative advantages;  $\rho_{jt}$  are industry-time fixed effects to control for common factors across countries that affect specific industries;  $T_{j,i,t}^O$  and  $T_{j,i,t}^I$  denote output and input tariffs, respectively; and  $X_{j,i,t}$  is a vector of control variables, including two lags of changes in the dependent variables and output- and input-sectoral tariffs.

The output tariff,  $T_{j,i,t}^O$  in each sector  $j$  is the 2-digit level corresponding tariff rate. Following closely Amiti and Konings (2007) and Topalova and Khandelwal (2011), input tariffs in each sector  $j$  are computed as a weighted average of output tariffs in all sectors, with weights reflecting the shares of imported inputs in each sector  $j$ 's total input cost:

$$T_{j,i,t}^I = \sum_k \theta_{j,i,t} T_{k,i,t}^O$$

The underlying tariff data is obtained from World Integrated Trade Solution (WITS), while the information on the production structure is taken from OECD's input-output tables.

We match the input and output tariff rates with sectoral-level data (output, value added, employment and productivity) from the United Nations Industrial Development Organization (UNIDO) database. This database provides information for 22 manufacturing industries based on the INDSTAT2 2016, ISIC Revision 3.<sup>5</sup> To match the sectoral information in the OECD input-output table, we combine some of the sectors in the UNIDO

database. The resulting dataset comprise an unbalanced panel with 16 sectors for 39 countries over the period 1991-2014. Tables S1.3 and S1.4 provide the list of countries and sectors.

### 3. **RESULTS**

#### A. Aggregate Results

A concern in the background is that tariff changes may themselves be a function of macroeconomic variables (reverse causality), which would contribute to biased coefficient estimates. A first pass at the relevance of such concern in our data can be gleaned by regressing tariff changes on key macroeconomic and structural variables (one variable at a time), controlling for time and country fixed effects: Table 1 reports the results. It is reassuring that, with the exception of M2 growth and financial crises, the other variables (e.g. the unemployment rate, inequality, fiscal deficit, political regime) are not correlated with tariff changes in the sense that the coefficients are not statistically significant; we address the issue of M2 growth and crises directly below by explicitly controlling for these variables in the regression. Moreover, to check whether tariff changes can be determined by external factors like foreign demand, we regress tariff changes on the real GDP growth of top-5 trading partners and again find no statistical significance.

#### Baseline

Our benchmark aggregate results are presented in Figure 1. Each of the six panels presents the estimated dynamic response for a variable of interest (output, productivity, and so forth) to a one-standard deviation rise in the tariff rate. This is a moderate increase in the

tariff rate, of about 3.6 percentage points, that lies well within the standard range of the data.<sup>6</sup> Collectively, the impulse response functions in Figure 1 provide a convenient way to portray the responses of key indicators of the macroeconomy to tariff changes. Time is portrayed on the x-axes; solid lines portray the average estimated response, and 90 percent confidence intervals (using Driscoll-Kraay standard errors) are shown as dotted lines.<sup>7</sup>

The results in Panel A suggest that a one standard deviation (3.6 percentage point) tariff increase leads to a decrease in output of about 0.4% five years later. We consider this effect to be plausibly sized and economically significant; it is also significantly different from zero in a statistical sense. Why does output fall after a tariff increase? Panel B indicates that a key channel is the statistically and economically significant decrease in labor productivity, which cumulates to about 0.9% after five years. Both these key findings make sense; the wasteful effects of protectionism eventually lead to a meaningful reduction in the efficiency with which labor is used, and thus output.<sup>8</sup> In addition, the decline in output seems to be driven by both declines in consumption (Panel A of Figure 2) and investment (Panel B), though the latter effect is not statistically significant. In addition, both real exports and imports also decline, and these effects are statistically significant (Panels C and D of Figure 2). Protectionism also leads to a small (statistically marginal) increase in unemployment, as shown in Panel C. We also find that tariff increases lead to more inequality, as measured by the Gini index; the effect becomes statistically significant two years after the tariff change (Panel D).<sup>9</sup>

Higher tariffs lead to an appreciation of the real exchange rate as shown in Panel E, though the effect is only statistically significantly different from zero in the short term (this is unsurprising, given the noisiness of exchange rates). Panel F shows the net effects of higher

tariffs on the trade balance are small and insignificant; absent shifts in saving or investment, commercial policy has little effect on the trade balance.<sup>10</sup> The appreciation of the currency owing to tariffs leads to a deterioration of the trade balance (Panel A of Figure S6.1), due to both a decline in exports (which is statistically significant in the short run) and an increase in imports (statistically significant in the outer years).

### Tariff Increases vs. Decreases

The baseline specification assumes that tariff increases and decreases have symmetric effects. Is this assumption warranted? This is a simple matter to examine, since around 40% of our sample consists of tariff rises (with mean of 1.7 ppt and standard deviation of 3.3), while 53% of observations consist of tariff falls (with mean of -1.8 ppt and standard deviation of 3.4).<sup>11</sup> This variation allows us to test for asymmetry; we extend the baseline specification to allow the response to vary with the sign of the tariff change:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^P D^P_{i,t} \Delta T_{i,t} + \beta^N (1 - D^P_{i,t}) \Delta T_{i,t} + vX_{i,t} + \varepsilon_{i,t} \quad (2)$$

where  $D^P_{i,t}$  is a binary variable which is equal to unity when the change in tariff is positive, and zero otherwise.

We present our results in the top half of Figure 3. The left column presents impulse response functions (estimated from (2) but otherwise similar to those of Figure 1), portraying the effects of tariff increases (in the top row) and decreases (immediately below) on output. The right column is similar, but portrays the response of productivity instead of GDP; we focus on output and productivity since they are two of the most important variables that are plausibly affected by protectionism. To facilitate comparison, the dynamic responses under

the assumption of symmetry (estimated with (1), and thus presented in the top row of Figure 1) are also shown as dashed lines. Manifestly, the decline in output following a one standard deviation *increase* in the tariff rate is higher than the baseline; this effect is statistically significant, as shown in Panel A of Figure 3 for both output and productivity. In contrast, Panel B shows that the effects of a tariff fall on both output and productivity are much smaller. That is, there are asymmetric effects of protectionism; tariff increases hurt the economy more than liberalizations help.

One of the possible channels for the asymmetric effects is due to intertemporal effects on domestic demand (Irwin, 2014). The decline in tariffs usually results in a slight, immediate increase in demand because purchasers know that lower prices will prevail in the future. On the other hand, tariff increases usually lead to an increase in buying before policy implementation, followed by a collapse afterwards. In other words, the decline in domestic demand following a positive tariff shock is higher than the increase in domestic demand following a negative tariff shock. This line of argument is also supported by our results on consumption, as shown in Figure S6.2 (Panels A and B): tariff increases lead to a higher decline in consumption than in the baseline. However, this intertemporal effect is not likely to be persistent, evident from the fact consumption tend to return to pre-crisis levels towards the outer years. What then explains the persistent effect of positive tariff increases? While more work is needed on this question, our analysis points towards the persistent effect on investment (panels C and D of Figure S6.2): a positive increase in tariffs leads to a decline in investment even after five years, possibly due to the negative effect on production chain and business confidence effects. On the other hand, the effect of negative tariff changes peters out



after five years. This is also supported by the industry-level analysis later in the paper, which finds that input tariffs lead to decline in output and productivity.

### Advanced Economies vs. Emerging Markets & Developing Economies

We now explore whether the effect of tariffs depends on a country's development level, an important issue given that advanced economies use protectionism less than poorer economies.<sup>12</sup> We extend the baseline regression to test for asymmetry depending upon income level:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^{AE} D^{AE}_i \Delta T_{i,t} + \beta^{Oth} (1 - D^{AE}_i) \Delta T_{i,t} + vX_{i,t} + \varepsilon_{i,t} \quad (3)$$

where  $D^{AE}_i$  is a binary variable which is equal to unity for advanced economies, and zero otherwise. The list of advanced economies follows the IMF classification and is tabulated in Table S1.5.

Our results appear in the bottom part of Figure 3; the impulse response functions are analogous to those in the top half (which is based on (2)), but for a different split of the data (based on equation 3). An interesting asymmetry emerges; for advanced economies, the decline in output after tariff increases is larger than in the baseline. Panel C shows that output declines by about 1% after four years for advanced economies, compared to the 0.4% in the baseline over the same time horizon. Similarly, the effect on productivity is higher than in the baseline for advanced economies, but lower for other economies.

Why might this be the case? There is some evidence that trade liberalization's effects depend on the country's development level (Leibovici and Crews, 2018). Factors like financial development, infrastructure quality, and human capital level may prevent poorer

countries from increasing production for export following trade liberalization, leading to smaller output gains: Estevadeordal and Taylor (2013). Also, poorer countries rely more on tariffs for government revenue, which could imply that tariff increases give more latitude for stabilizing fiscal policies in poorer countries. Finally, richer countries may be more open and thus exposed to tariff shocks than poorer countries.

### Recessions vs. Expansions

Do the effects of tariff changes vary with the business cycle? Trade reforms, insofar as they induce resource shifts between industries, occupations, and firms, might lead to larger output losses during periods of weak economic activity. To test whether the effect of tariff changes is symmetric across expansions and recessions, we use a setup which permits the effect of tariff changes to vary smoothly across stages of the business cycle:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^L_k F(z_{i,t}) \Delta T_{i,t} + \beta^H_k (1 - F(z_{i,t})) \Delta T_{i,t} + \varphi Z_{i,t} + \varepsilon_{i,t} \quad (4)$$

with

$$F(z_{i,t}) = \exp(-\theta z_{i,t}) / (1 + \exp(-\theta z_{i,t})), \quad \theta > 0,$$

where  $z_{i,t}$  is an indicator of the state of the economy (such as GDP growth or unemployment) normalized to have zero mean and unit variance, and  $Z_{it}$  is the same set of control variables used in the baseline specification but now also including  $F(z_{it})$ .  $F(\cdot)$  is a smooth transition function used recently by Auerbach and Gorodnichenko (2012) to estimate the macroeconomic impact of fiscal policy shocks. This transition function can be interpreted as the probability of the economy being in a recession;  $F(z_{it})=1$  corresponds to a de very deep recession ( $z$  tends to minus infinity), while  $F(z_{it})=0$  corresponds to a very strong expansion

( $z$  tends to plus infinity)—with the cutoff between expansions and contractions being 0.5. As Auerbach and Gorodnichenko, we use  $\theta = 1.5$ , which corresponds to the economy spending about 20 percent of time in recessions.<sup>13</sup>

Estimation results for equation (4) for output (left column) and productivity (right) are presented in Figure 4. We use two different measures of business cycle conditions; the panels at the top use GDP growth, while those below use the unemployment rate. For each indicator, impulse responses for expansions are presented above those for recessions. Since the results from the two different indicators are similar, we concentrate on the top four panels, which use GDP growth as the business cycle measure.

The results in Figure 4 suggest that the response of both output and productivity is more dramatic during expansions. When tariffs increase by a standard deviation and the economy is enjoying good times, the medium-term output loss is higher than the baseline by about 1%; the productivity decline is also larger. Consistently, tariff increases during recessions seem to *increase* output and productivity in the medium-term, though the effects are not statistically significant; protection during recessions may have a mild stimulating effect.<sup>14</sup> A possible explanation for our findings relates to the role of monetary policies. To the extent that increases in tariffs lead to an increase in inflation during expansions and that monetary policies are tightened in response, the negative impact of tariffs would be magnified. Our results on inflation seem to support this reasoning: using our standard regression-framework, we find that higher tariffs lead to an increase in inflation after two years, as shown in Panel B of Figure S6.1. Furthermore, the effect on inflation is stronger during economic expansions, as shown in Panels A and B of Figure S6.3. These results are consistent with Barattieri, Cacciatore, and Ghironi (2021) who find that protectionism acts as

a supply shock by decreasing output and increasing inflation in the short run. They also find that protectionism leads to higher inflation which, in turn, prompts central banks to respond with a contractionary impulse.

### Small versus Large Economies

Other things equal, theory predicts that larger countries should experience a smaller decline in output following a tariff increase owing to optimal-tariff considerations (an improvement in the terms of trade). We extend the baseline regression to test for asymmetry depending on country size in the following way:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^L D_i^L \Delta T_{i,t} + \beta^{Oth} (1 - D_i^L) \Delta T_{i,t} + v X_{i,t} + \varepsilon_{i,t} \quad (5)$$

where  $D_i^L$  is a binary variable which is equal to unity for large economies, and zero otherwise. For each year, large economies are countries that are above the 75<sup>th</sup> percentile of GDP in US dollars.

Figure 5 reports the results. As expected, the decline in output is higher for smaller economies than the baseline, with a one standard deviation tariff change leading to an output decline of 0.5 percent over five years for smaller economies, compared to the baseline result of 0.4 percent. Similarly, the decline in productivity is also more pronounced, with productivity declining by 1.5 percent over five years following a one standard deviation tariff change, compared to the 0.9 percent in the baseline. Both effects are statistically significant. The impact on other macroeconomic variables reported in Appendix S4 (Figure S4.5) likewise point toward more detrimental effects on small relative to large economies.

## **Robustness Checks**

We begin by considering sensitivity of our results to transformations of our key regressor.<sup>15</sup> Our robustness analysis is presented in a series of fifteen IRFs, which are presented for output and productivity respectively in Figures 6 and S5.1.<sup>16</sup> Our default results are presented in the top-left panel of the figures to facilitate comparison. In the two other top panels, we transform our key regressor, tariffs. In the top-middle panel, we examine whether the results hold when considering tariff changes in percentage (that is, dividing our baseline measure by the lagged level of tariff), rather than absolute terms. In the top-right panel, we substitute the lag of tariffs for its contemporaneous value. In both (and indeed all) panels, the default response and its confidence interval (taken from the top-left) is plotted; the mean response for the perturbation is plotted with a thick black line. If it lies within the confidence interval and is relatively close to the dashed line, we consider our results to be robust. Clearly, the way we transform the regressor has little effect on the results. The IRFs for our different transformations indicate that the output response to changes in tariff are not statistically different from those reported in the baseline: in both cases, these responses lie well inside the confidence bands of the baseline responses.

## **Estimation Sensitivity**

Our specification implicitly assumes that shocks to the tariff do not respond to changes in the outcome variables within a year. A potential limitation of this assumption is that tariff changes are not exogenous, and may be correlated with other macroeconomic variables and with contemporaneous and future changes in economic activity. In line with Rose (2013), we find no statistically significant correlation between changes in tariff and

changes in economic activity (e.g., the correlation between changes in tariff and output growth is 0.0006; this also holds when controlling for country and time fixed effects—see Table 1). Nevertheless, we use three alternative estimation techniques to check whether the results are sensitive to this assumption. *First*, we modify equation (1) by controlling for the contemporaneous changes in the trade balance and the real exchange rate—this is equivalent to considering tariff changes that are orthogonal to contemporaneous shocks in these variables.<sup>17</sup> *Second*, we consider tariff changes that are orthogonal to contemporaneous changes in economic activity, by performing a VAR analysis using a Cholesky decomposition with the following order to recover orthogonal shocks: the change in the log of output (or productivity), the change in tariff, the change in log of real exchange rate and the change in trade balance (in percent of GDP).<sup>18</sup> Alternatively, we also modify equation (1) by allowing all explanatory variables, including changes in tariffs, to enter with a lag—that is, we estimate the effect of tariffs on the outcome variables only with a lag while controlling for contemporaneous changes in other macroeconomic variables. *Third*, we follow Corsetti et al. (2012) and Duval and Furceri (2018) and estimate a specification that also controls for expected future GDP growth (using IMF WEO forecasts) in addition to past growth. These three perturbations are presented in the second row of Figure 6, and do not fundamentally change our conclusions. In addition, the results are robust to including regional time trends.

To address the endogeneity concerns further, we implement an instrumental variable (IV) approach in the same spirit of Acemoglu et al. (2019) and Furceri and Loungani (2018). As an instrument, we use the weighted-average of changes in the tariff in major (top 5) trading-partner countries, where the weights are determined by the strength of trade linkages with other countries. Specifically, the instrument is computed as follows:

$$I_{i,t} = \sum_{j \in \Omega_i} \Delta T_{j,t} w_{i,j,t} \quad (6)$$

where  $I_{i,t}$  is the instrument of tariff for country  $i$  at time  $t$ ;  $\Omega_i$  is the set of five largest trading partners of  $i$ ;  $\Delta T_{j,t}$  is the change in the tariff for country  $j$  (up to the 5 largest trading partners) at time  $t$ ; and  $w_{i,j,t}$  is the share of total exports and imports between country  $i$  and country  $j$  in the total exports and imports for country  $i$ :  $\frac{Export_{i,j,t} + Import_{i,j,t}}{Export_{i,t} + Import_{i,t}}$ .

The first-stage estimates suggest that this instrument is “strong” and statistically significant (see Appendix S7 for details).<sup>19</sup> What about the excludability of the instrument? To test the validity of our instrument, we run several checks. First, we regress the residual of the baseline against the instrument (Table S7.3). Second, we add the instrument in the baseline specification (Table S7.4). The results of these two exercises suggest that tariff changes in major trading partners do not have any effect on output or other outcome variables of interest in country  $I$ , if not through tariff changes in country  $i$ . Interestingly, the effect of domestic tariffs on output and productivity remains similar to, and not statistically different from, the baseline results (Figure S7.1)

Another concern is that the instrument could be correlated with the error term to the extent that changes in tariff rates in main large trading partners could affect domestic output through contemporaneous changes in the real exchange rate. To address this issue, we modify the equation to control for the contemporaneous changes in other control variables, including the real exchange rates. The results are robust to this specification (Figure S7.2).

The IV technique leads to an even larger decline in output within five years. This may suggest that changes in tariffs induced by retaliation are likely to have larger effects than changes in tariffs due to other motives.

Finally, we control for additional structural and cyclical variables in our regressions, namely political regime, executive constraints, income, trade openness, financial crises, conflicts, M2 growth, and budget deficit. The results for crises, M2 growth, political regimes and executive constraints are reported in the third row, and the others are available upon request. These results do not fundamentally change the conclusions.

### Sample Sensitivity

In our final set of aggregate results, we check the robustness of the results to a number of perturbations to the sample. We change our sample of data in eleven ways: a) we drop small countries (with population below a million); b) we drop outliers (those observations corresponding to the residuals in the output regression in the bottom and top 1<sup>st</sup> percentiles of the distribution)<sup>20</sup>; c) we restrict the time sample to years after 1979; d) we drop high tariff episodes (those with tariff rates above 66 percent—corresponding to the 99<sup>th</sup> percentile of the distribution); e) we drop observations from the Americas; f) we drop Asian and Sub-Saharan African economies; g) we drop series with gaps and less than 20 consecutive years; h) we drop high inflation episodes (inflation above 100 percent); i) for output, we restrict the time sample to years after China's WTO entry (from 2002); j) for output and productivity, we winsorize all the variables in the regressions at 1<sup>st</sup> and 99<sup>th</sup> percentiles; and k) we remove country fixed effects and include region dummies for advanced Europe, developing Europe, Asia, MENAP (Middle East, North Africa,



Afghanistan, and Pakistan), and Latin America. The last five results are not reported in the tables but available upon request. Our results persist through all these perturbations.

### Industry-level results

This section explores the role of sectoral input and output tariffs in shaping the aggregate effect of protectionism. As a first step, it is useful to note that the effect on aggregate value added of a tariff increase in sector  $j$  can be expressed (in the absence of output spillovers across sectors) as the sum of two components: the effect of the tariff increase on the value added of sector  $j$  (that is, the output tariff effect); and its effect on the value added of all remaining sectors (that is, effects through the input channel):

$$\frac{dY_t}{dT_{j,t}} = \frac{dY_{j,t}}{dT_{j,t}} + \sum_{s \neq j} \frac{dY_{s,t}}{dT_{j,t}} \quad (7)$$

The four panels of Figure 7 show the estimated dynamic responses of sectoral output (on the left) and productivity (on the right) to one-standard deviation increases in input tariffs (above, equivalent to an increase of about 0.4 ppt) and output tariffs (below, equivalent to a 2.0 ppt increase). As always, we portray results for the five years following the tariff change, and include 90 percent confidence intervals around the point estimate (computed using Driscoll-Kraay standard errors for the estimated coefficients).

The results in the top panels of Figure 7 suggest that an increase in the input tariff leads to a statistically-significant decline in sectoral output of about 6.4% five years after the tariff hike. It also results in a statistically significant decline in productivity (shown to the right) of about 3.9% five years after the tariff hike. While input tariff increases lead to

declines in output and productivity, increases in output tariffs have a statistically positive impact on output, with output increasing by 3.1 percent in five years. The impact on productivity is positive but not statistically significant.<sup>21</sup>

#### **4. CONCLUSION**

Using impulse response functions from local projections on a panel of annual data spanning 151 countries over 1963-2014, we find that tariff increases are followed by adverse effects on output and productivity; these effects are economically and statistically significant. They are magnified when tariffs are used during expansions, for advanced economies, and for smaller economies. We also find that that tariff increases are followed by higher unemployment and inequality, further adding to deadweight losses. Tariffs have only small effects on the trade balance, in part because they are associated with offsetting real exchange rate appreciations. To the degree that tariffs are being deployed today to achieve macroeconomic objectives (boost output, jobs, and the trade balance), the evidence presented in this paper—which seems robust to a long list of perturbations of the methodology—suggests that the chosen policy will fail miserably to achieve its goal. One caveat is that this paper does not analyze country- or region-specific trade impacts and does not include all the dimensions of how trade could affect people. Recent studies have found trade costs related to factors like labor adjustment to be substantial, particularly for subgroups of highly exposed workers (e.g., Autor et al. (2014) and Pierce et al. (2016) on the US; Helpman et al. (2016) and Dix-Carneiro et al. (2017) on Brazil). Pavnik (2017) find that the effect of trade on poverty and inequality are context specific. For example, the effect of trade on earnings could be geographically concentrated, partly due to low and imperfect inter-regional worker

mobility. This would suggest that country-specific factors and concomitant policies would be crucial in reaping the gains from trade, particularly in an inclusive manner.

## End note

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<sup>1</sup> For example, see the survey on free trade in Initiative on Global Markets (University of Chicago Booth School of Business): <http://www.igmchicago.org/surveys/free-trade>.

<sup>2</sup> If changes in tariffs are correlated with changes in non-tariff barriers (NTBs), there may be a concern with omitted variable bias. To test this, we run panel regressions on the relationship between three different measures of NTBs (anti-dumping cases initiated, safeguards, and WTO disputes) and changes in tariffs, controlling for country- and time-fixed effects (as in our estimation framework described in equation 1). We do not find evidence of any strong correlation, mitigating this concern in our set-up. However, the results should be taken with a pinch of salt since NTBs are difficult to measure and data is scarce for this exercise.

<sup>3</sup> Kehoe (2003) compares the predictions of three ex-ante CGE studies of NAFTA with observed outcomes and concludes that trade increases in most sectors surpassed the predictions more than ten-fold. Corcos et. al (2012) find same results for the EU.

<sup>4</sup> Since the set of control variables includes lags of output growth as well as the real exchange rate and trade balance, this approach is equivalent to a VAR approach in which tariff shocks do not respond to shocks in other variables within a year. We relax this assumption later as a robustness check.

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<sup>5</sup> While the original INDSTAT 2 database includes 23 manufacturing industries, exclude the “manufacture of recycling” industry due to insufficient observations.

<sup>6</sup> The average and standard deviation of the change in the tariff rate in our sample are -0.4 and 3.6 percentage points, respectively. Tariff changes range from -52.0 to 41.0 percentage points.

<sup>7</sup> Table 2 tabulates the underlying regression results.

<sup>8</sup> Employment increases by about 0.5 percent but the effect is not statistically significant.

<sup>9</sup> This result is consistent with evidence in Jaumotte, Lall and Papageorgiou (2013) who find that trade openness is associated with lower income inequality. While more work is needed to understand the distributional effects of tariffs, we believe that the increase in unemployment is a potentially important channel. Another possibility is that rent-seeking means that protectionism benefits more the rich than the poor.

<sup>10</sup> All the results are robust when the real trade balance is deflated by trend real output (instead of real output).

<sup>11</sup> See Appendix S3 for some examples of major tariff increases in our sample.

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<sup>12</sup> Around 28 percent of our sample observations consist of tariff changes for advanced economies (with a mean of -.3 percentage points and standard deviation of 2.2) and 65 percent of the observations consist of tariff changes for other countries (with mean of -.3 and standard deviation of 4.1). While tariff changes have been less frequent in rich countries, the average magnitude of the changes is similar across the samples. Similarly, we do not observe significant differences in the ratio of positive-to-negative changes between AEs (65 percent) and non-AEs (75 percent).

<sup>13</sup> This approach is equivalent to the smooth transition autoregressive model developed by Granger and Teräsvirta (1993). The results are robust to different values of  $\theta$ , and to substituting  $F(z_{it})$  with a dummy variable which takes value 1 for  $F(z_{it})$  greater than 0.5.

<sup>14</sup> In line with Rose (2013), we find no statistically significant correlation between changes in tariffs and the measure of state of economy used in the paper. In particular, the correlation between changes in tariffs and the smooth transition function  $F(z_{it})$  is -0.001.

<sup>15</sup> In addition to the robustness checks described in detail below, we run a version where the estimations include observations with trade balance between +/-50 percent of GDP given some of the extreme movements in this variable. Our baseline results are robust to this specification.

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<sup>16</sup> Analogous results for the other variables of interest (unemployment, inequality, the real exchange rate and the trade balance) are reported in Figures S5, 2-5 of the Appendix S5; they demonstrate the basic insensitivity of our baseline results.

<sup>17</sup> Specifically, we control for contemporaneous changes in the trade balance and real exchange rate for the regressions on output, productivity, unemployment and inequality. For the regression on trade balance (real exchange rate) we control only for simultaneous changes in the real exchange rate (trade balance).

<sup>18</sup> The results are robust to alternative orderings.

<sup>19</sup> The Kleibergen–Paap rk Wald F statistic for each horizon of the IRF is always higher than the associated Stock-Yogo critical values.

<sup>20</sup> Similar results are obtained when top and bottom 5<sup>th</sup> percentiles of the same distribution are considered.

<sup>21</sup> The result that input tariffs have a more detrimental output effect than output tariffs is consistent with previous empirical work examining the effect of input and output tariffs at the macro (e.g., Ahn et al. 2016) and at the firm level (e.g. Amiti and Konings 2007).

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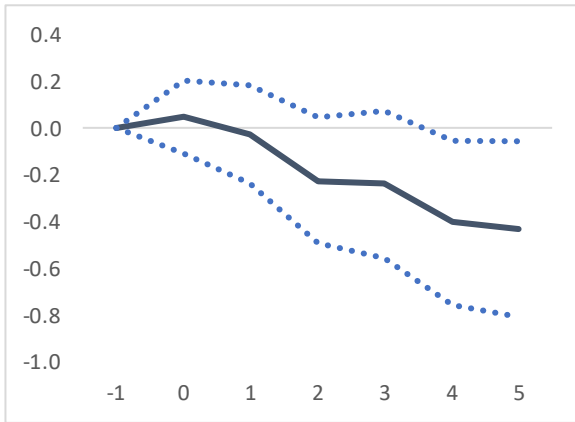
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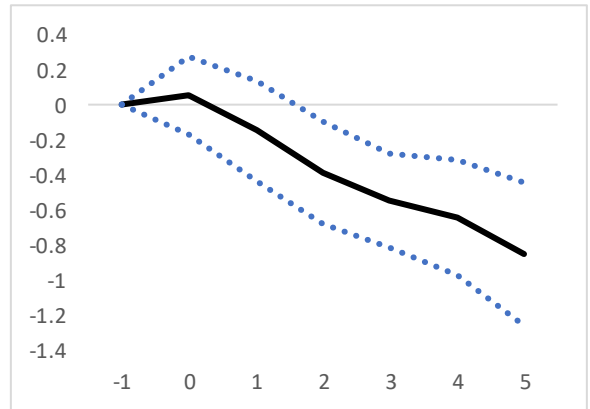
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**Figure 1. The Effect of Tariffs**

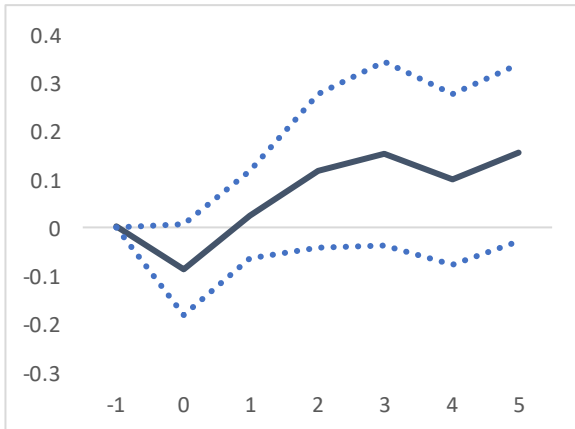
**Panel A. Output (%)**



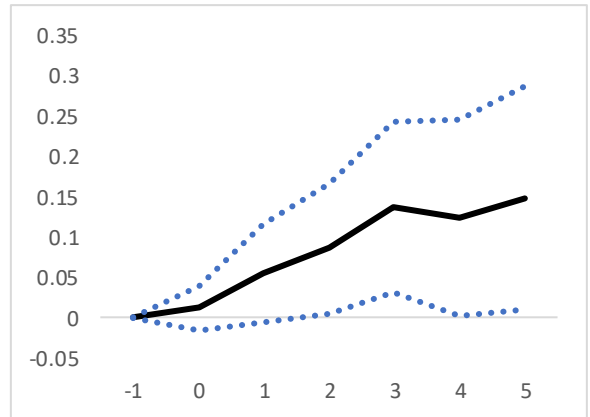
**Panel B. Productivity (%)**



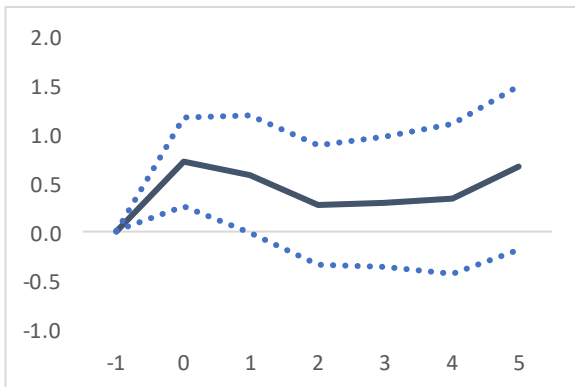
**Panel C. Unemployment (ppt)**



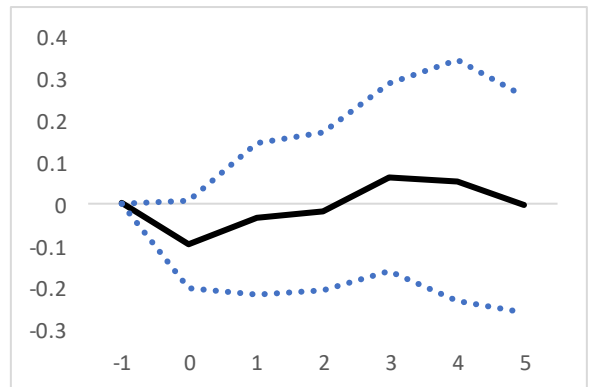
**Panel D. Inequality (ppt)**



**Panel E. Real exchange rate (%)**



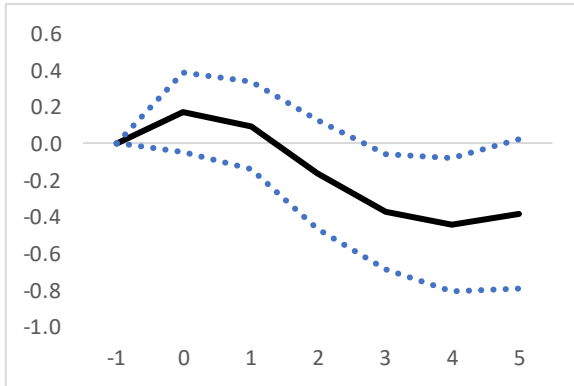
**Panel F. Trade balance-to-GDP ratio (ppt)**



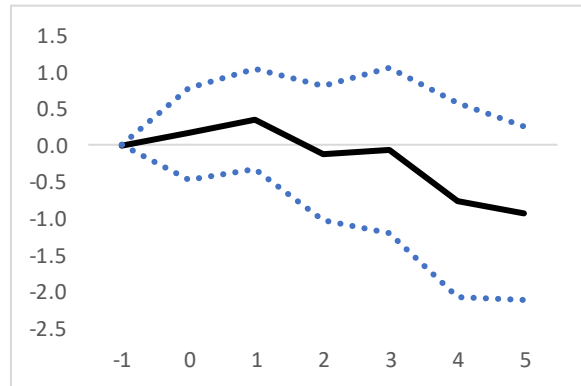
*Source:* Authors' estimations. *Note:* The solid line indicates the response of output (real exchange rate, trade balance, labor productivity, unemployment, inequality) to a one standard deviation increase in tariff; the dotted lines correspond to 90% confidence bands. The x-axis denotes time.  $t=0$  is the year of the change. The estimates are based on equation (1).

**Figure 2. The Effect of Tariffs**

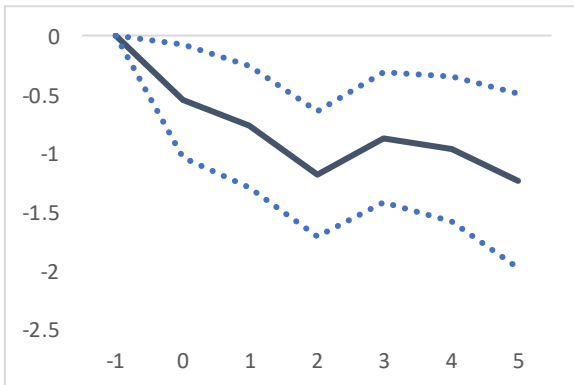
**Panel A. Real Consumption (%)**



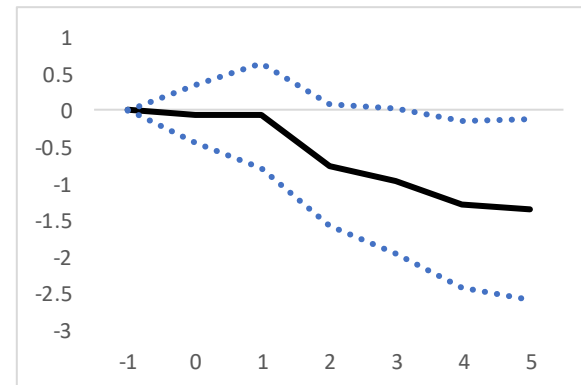
**Panel B. Real Investment (%)**



**Panel C. Real Exports (%)**

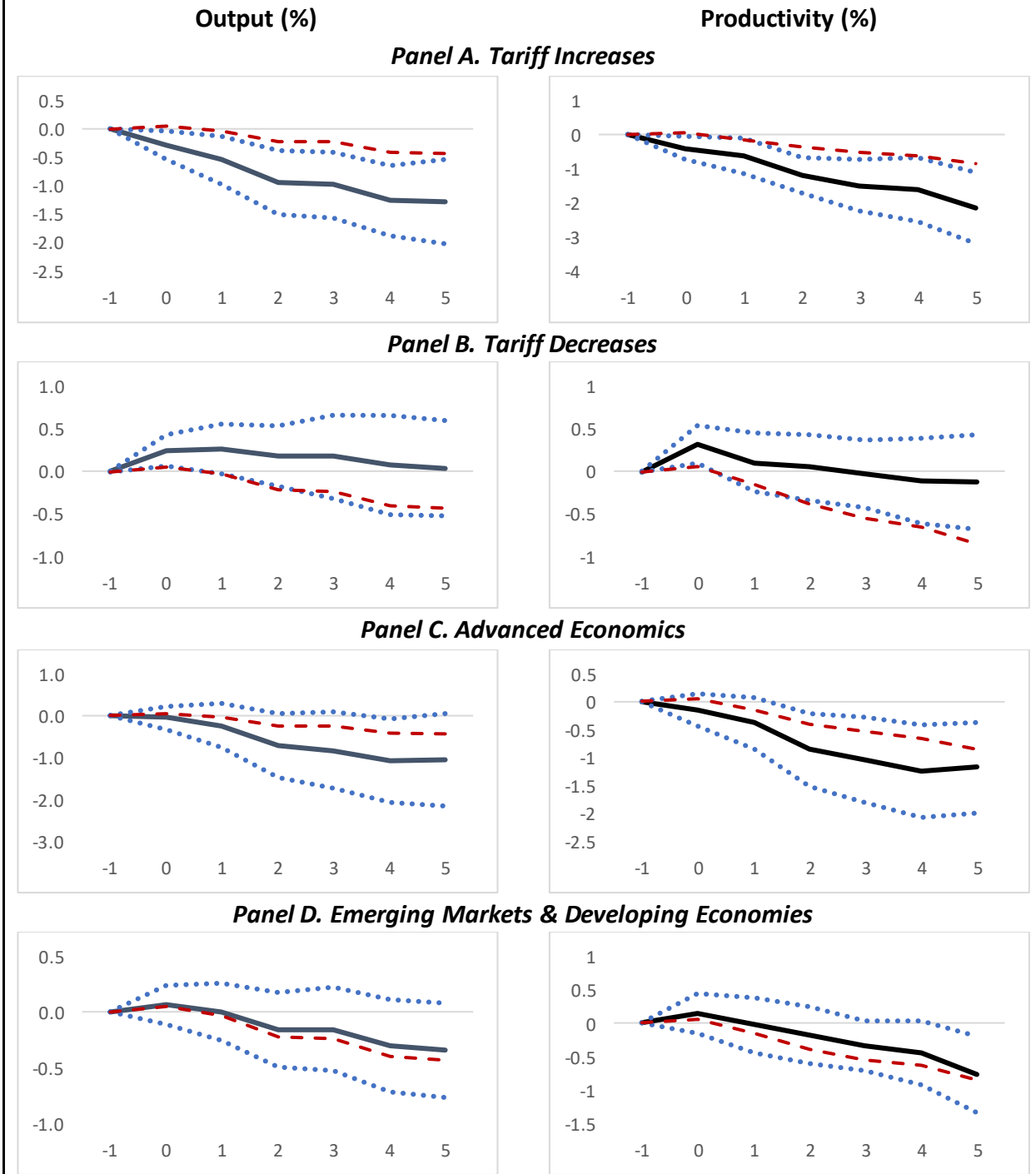


**Panel D. Real Imports (%)**



*Source:* Authors' estimations. *Note:* The solid lines indicate the response of consumption (investment, exports, and imports) to a one standard deviation increase in tariff. The dotted lines in both panels correspond to 90% confidence bands. The x-axis denotes time.  $t=0$  is the year of the change. The estimates are based on equation (1).

**Figure 3. The Effect of Tariffs—Tariff Increases vs. Decreases; Advanced Economies vs. Emerging Markets & Developing Economies**



Source: Authors' estimations. Note: The solid line indicates the response of output (productivity) to a one standard deviation increase and decrease in tariff (advanced economies and emerging markets & developing economies); the dotted lines correspond to 90% confidence bands; estimates for Panel A and B are based on equation (2); estimates for Panel C and D are based on equation (3). Dashed lines indicate the response of output (productivity) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

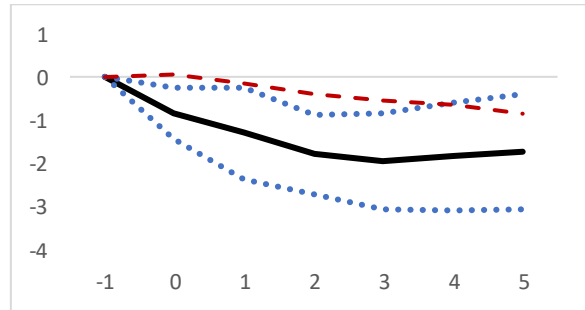
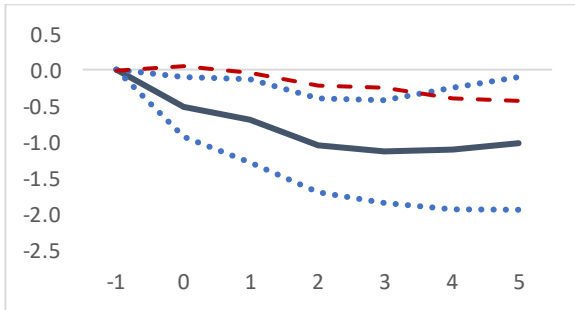


**Figure 4. The Effect of Tariffs—Expansions vs. Recessions**

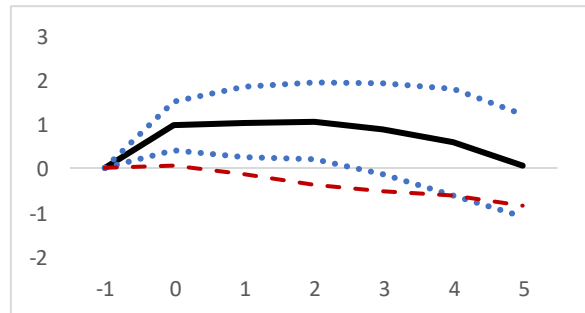
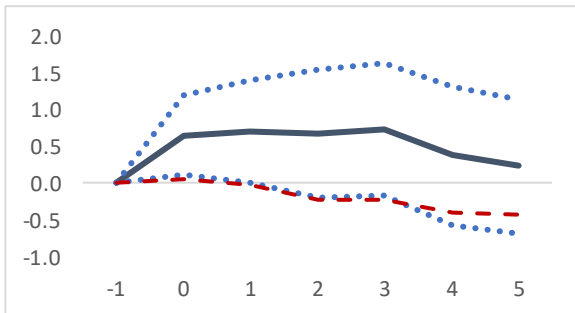
**Output (%)**

**Productivity (%)**

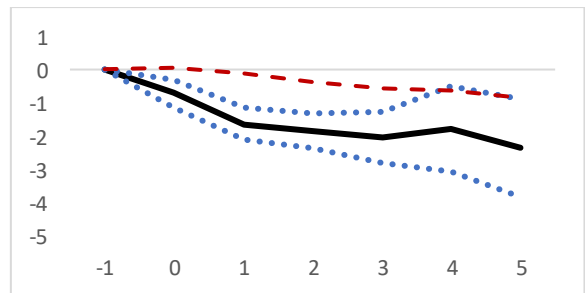
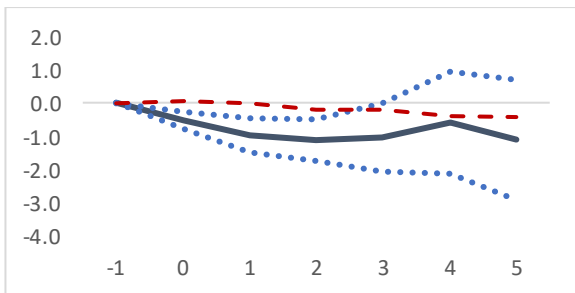
**Panel A. Expansions (based on GDP growth)**



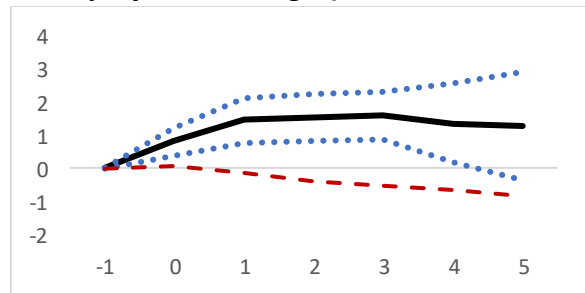
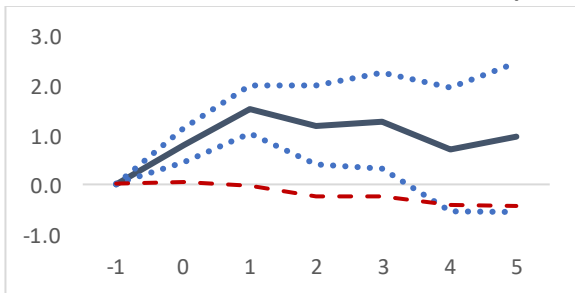
**Panel B. Recessions (based on GDP growth)**



**Panel C. Expansions (based on unemployment changes)**

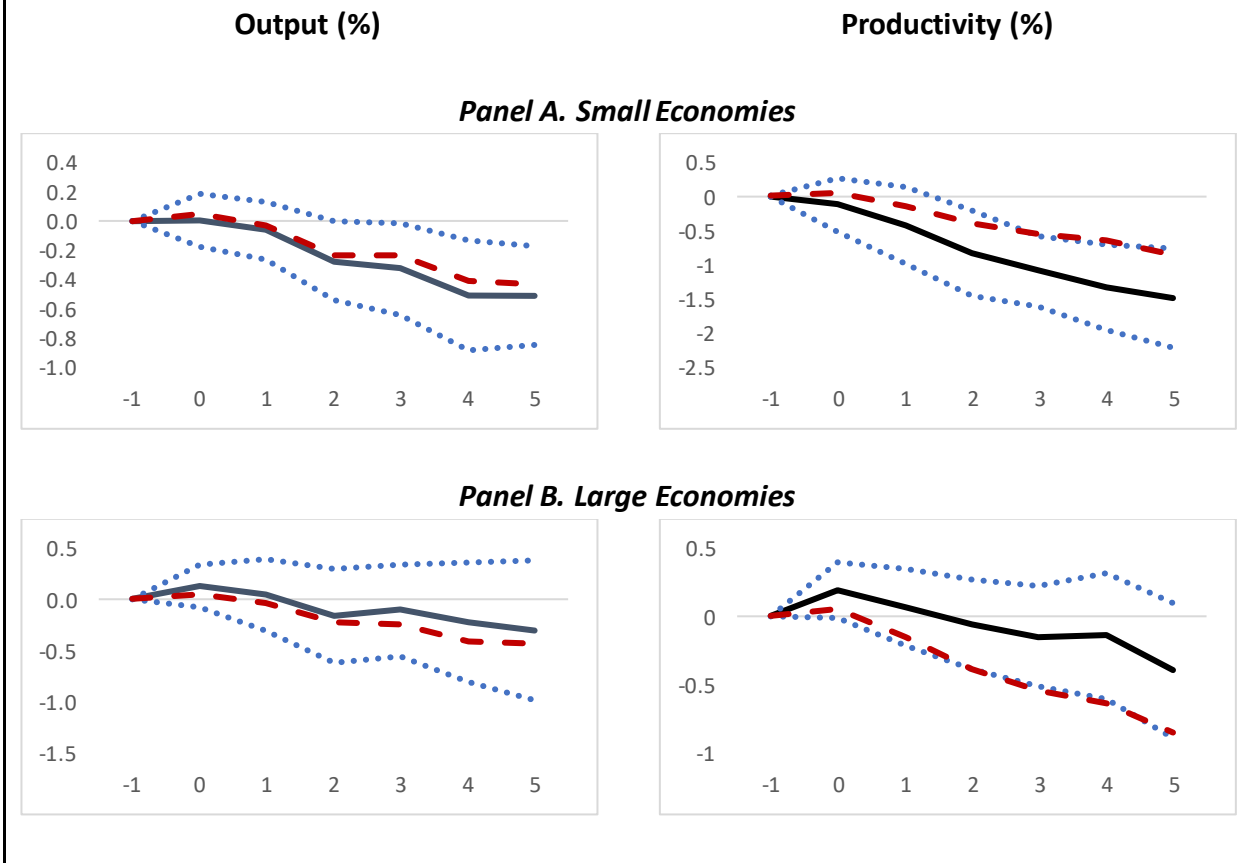


**Panel D. Recessions (based on unemployment changes)**



*Source:* Authors' estimations. *Note:* The solid line indicates the response of output (productivity) to a one standard deviation increase in tariff during expansions and recessions; the dotted lines correspond to 90% confidence bands; estimates based on equation (4); for Panel A and B expansions and recessions are identified using GDP growth; for Panel C and D using unemployment changes. Dashed lines indicate the response of output (productivity) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

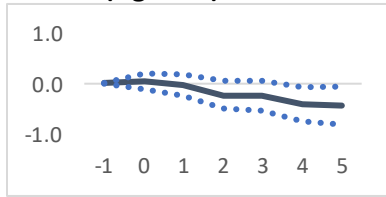
**Figure 5. The Effect of Tariffs—Small Economies vs. Large Economies**



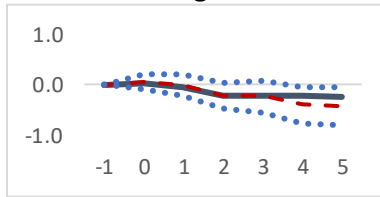
*Source:* Authors' estimations. *Note:* The solid line indicates the response of output (productivity) to a one standard deviation increase in tariff; the dotted lines correspond to 90% confidence bands; estimates for Panel A and B are based on equation (5). Dashed lines indicate the response of output (productivity) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

**Figure 6. Robustness for Output**

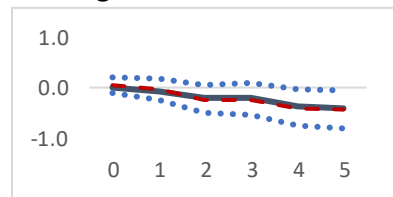
**Default (Figure 1)**



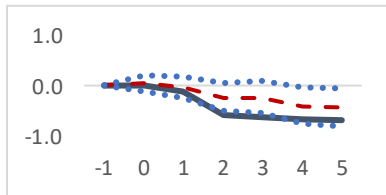
**Percent change of tariffs**



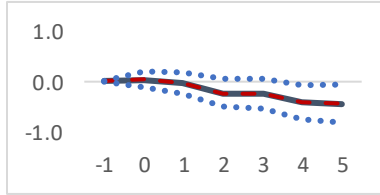
**Lag tariffs**



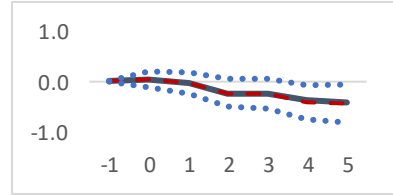
**VAR-style**



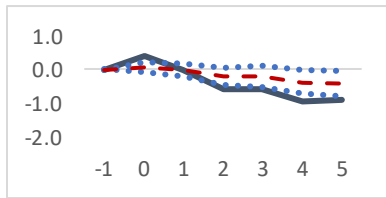
**Include contemporary shocks**



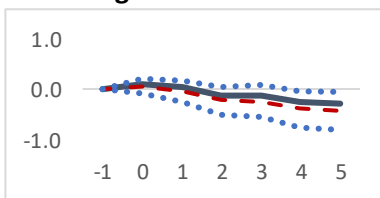
**Include growth forecasts**



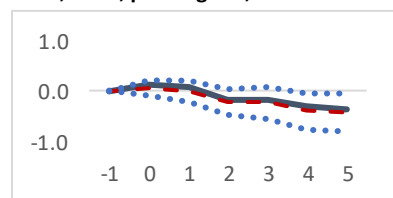
**IV**



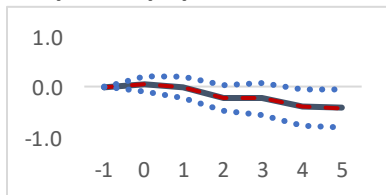
**Add M2 growth and crisis**



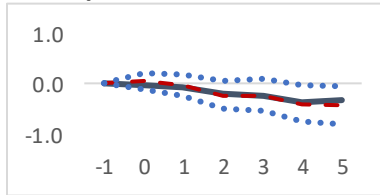
**Add M2, crisis, pol. regime, ex. constraint**



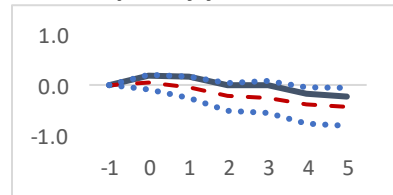
**Drop small population (<1million)**



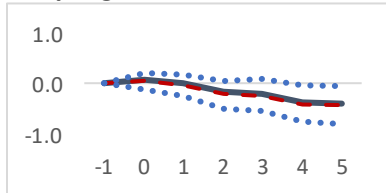
**Drop outliers**



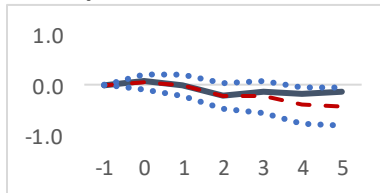
**Drop early years (<1980)**



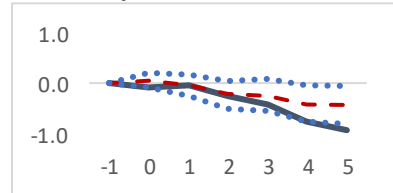
**Drop high tariffs (>66 percent)**



**Drop Americas**



**Drop Asians/Africans**



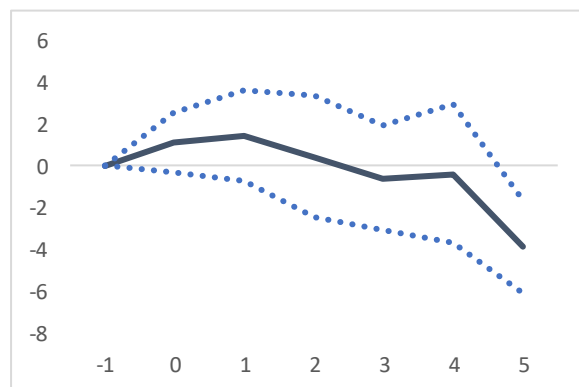
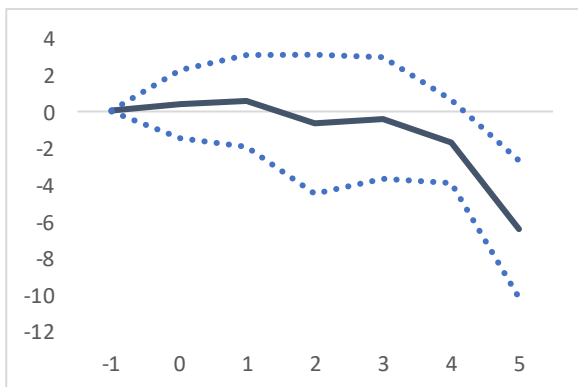
*Source:* Authors' estimations. *Note:* The solid line indicates the response of output to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The dashed line represents the baseline results, estimated based on equation (1). The dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the change.

**Figure 7. The Effect of Tariffs using Industry-level Data**

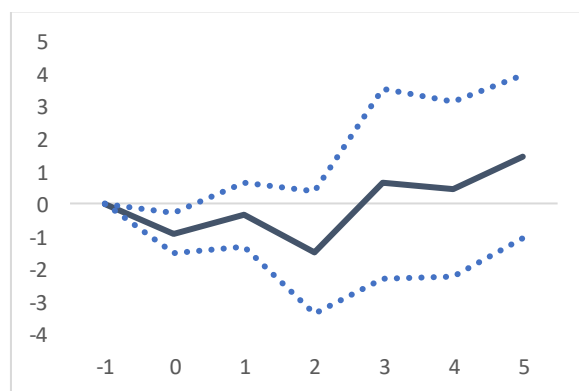
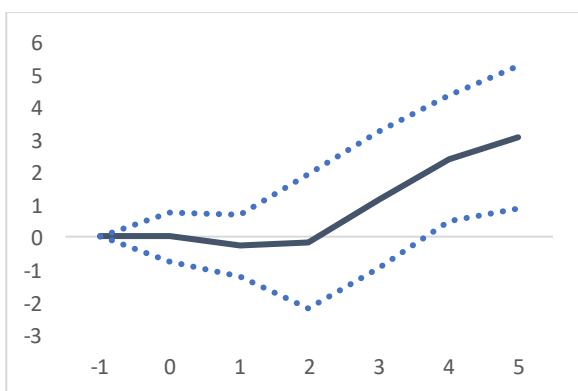
**Output (%)**

**Productivity (%)**

**Panel A. The Effect of Input Tariffs**



**Panel B. The Effect of Output Tariffs**



Source: Authors' estimations. Note: The solid line indicates the response of output/labor productivity to a one standard deviation increase in input/output tariff; the dotted lines correspond to 90% confidence bands. The x-axis denotes time.  $t=0$  is the year of the change. The estimates are based on equation (1').

**Table 1.** Dependent Variable: Tariff Changes (ppt)

Variables	(1) Control for Output Growth	(2) No control for output growth
Unemployment rate, percent	-0.01 (0.05)	-0.03 (0.05)
Inequality, percent	0.07 (0.06)	0.07 (0.06)
Government budget, percent GDP	-0.03 (0.02)	-0.03 (0.02)
M2 growth, percent	-0.00*** (0.00)	-0.00*** (0.00)
Political regime (-10 autocracy; 10 democracy)	0.07 (0.08)	0.07 (0.08)
Executive constraints (1 unlimited authority; 7 parity/subordination)	0.19 (0.34)	0.19 (0.34)
War (0 no war; 7 war)	0.14 (0.16)	0.13 (0.16)
Crisis (1 crisis; 0 no crisis)	0.27** (0.10)	0.25** (0.11)
Output growth		1.37 (1.60)
Real GDP Growth of top-5 trading partners, percent (trade weighted)	0.22 (0.19)	0.23 (0.19)

*Source:* Authors' estimations. *Note:* Driscoll-Kraay standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Each cell represents the coefficient when tariff changes is regressed on the change of that variable, controlling for time and country fixed effects. Column 1 also controls for output growth.

**Table 2.** The Aggregate and Distributional Effects of Tariffs

	A	B	C	D	E	F
	Output (%)	Real exchange rate (%)	Trade balance (ppt)	Productivity (%)	Unemployment (ppt)	Inequality (ppt)
$t = 0$	0.013 (-0.026)	0.196** (-0.076)	-0.02657 (0.01759)	0.015 (-0.037)	-0.02384 (0.01578)	0.00308 (0.00460)
$t = 1$	-0.008 (-0.035)	0.161 (-0.099)	-0.00964 (0.03011)	-0.040 (-0.048)	0.00707 (0.01496)	0.01498 (0.01017)
$t = 2$	-0.063 (-0.045)	0.075 (-0.103)	-0.00492 (0.03135)	-0.107** (-0.049)	0.03176 (0.02646)	0.02332* (0.01344)
$t = 3$	-0.066 (-0.052)	0.083 (-0.111)	0.01719 (0.03704)	-0.150*** (-0.044)	0.04171 (0.03187)	0.03732** (0.01756)
$t = 4$	-0.111* (-0.059)	0.092 (-0.128)	0.01488 (0.04820)	-0.177*** (-0.055)	0.02708 (0.02963)	0.03380 (0.02017)
$t = 5$	-0.119* (-0.063)	0.180 (-0.139)	-0.00042 (0.04308)	-0.234*** (-0.068)	0.04248 (0.03035)	0.04030* (0.02311)
Average number of observations	3468	3354	3466	2217	1350	2331
Average number of countries	148	147	148	102	86	128

*Source:* Authors' estimations. *Note:* The table reports the response of outcome variables to 1 percentage point increase in tariffs  $t$  years after the tariff increase. For example, the data point for column A at  $t=5$  denotes that, following a 1 percentage point increase in tariffs, output declines by 0.119 percent five years after the tariff increase. Standard errors are reported in parenthesis. \*\*\*, \*\*, and \* denote significance at 1 percent, 5 percent, and 10 percent, respectively. Estimates based on equation (1).

**Supplementary Online Appendix**

**The Macroeconomy After Tariffs**

*Davide Furceri, Swarnali A. Hannan, Jonathan D. Ostry and Andrew K. Rose*

## Appendix S1. List of Countries, Industries and Data Sources

**Table S1.1. List of Countries in Country-level Analysis**

Albania	China	Hungary	Moldova	Singapore
Algeria	Colombia	Iceland	Mongolia	Slovak Republic
Angola	Comoros	India	Montenegro, Rep. of	Slovenia
Antigua and Barbuda	Congo, Republic of	Indonesia	Morocco	South Africa
Argentina	Costa Rica	Iran	Mozambique	Spain
Armenia	Croatia	Ireland	Myanmar	Sri Lanka
Australia	Cyprus	Israel	Namibia	St. Lucia
Austria	Czech Republic	Italy	Nepal	Swaziland
Azerbaijan	Cote d'Ivoire	Jamaica	Netherlands	Sweden
Bahrain	Denmark	Japan	New Zealand	Taiwan Province of China
Bangladesh	Dominica	Jordan	Nicaragua	Tanzania
Barbados	Dominican Republic	Kazakhstan	Niger	Thailand
Belarus	Ecuador	Kenya	Nigeria	Togo
Belgium	Egypt	Korea	Norway	Tonga
Belize	El Salvador	Kuwait	Oman	Trinidad and Tobago
Benin	Estonia	Kyrgyz Republic	Pakistan	Tunisia
Bolivia	Ethiopia	Lao P.D.R.	Panama	Turkey
Bosnia and Herzegovina	Finland	Latvia	Papua New Guinea	Turkmenistan
Botswana	France	Lebanon	Paraguay	Uganda
Brazil	Gabon	Lithuania	Peru	Ukraine
Brunei Darussalam	Gambia, The	Luxembourg	Philippines	United Arab Emirates
Bulgaria	Germany	Macedonia, FYR	Poland	United Kingdom
Burkina Faso	Ghana	Madagascar	Portugal	United States
Burundi	Greece	Malawi	Qatar	Uruguay
Cabo Verde	Guatemala	Malaysia	Romania	Uzbekistan
Cambodia	Guinea	Mali	Russia	Vanuatu
Cameroon	Guinea-Bissau	Malta	Rwanda	Venezuela
Canada	Haiti	Mauritania	Saudi Arabia	Vietnam
Central African Republic	Honduras	Mauritius	Senegal	Yemen
Chad	Hong Kong SAR	Mexico	Sierra Leone	Zambia
Chile				

**Table S1.2. Data Sources for Country-level Analysis**

Indicator	Source
Total employment (persons, millions)	World Economic Outlook (WEO)
Unemployment rate (percent)	WEO and World Development Indicators from World Bank (WDI)
Gross Domestic Product in constant prices (national currency, billions)	WEO and WDI
Growth of Real GDP Exp. In Current Oct. Pub. (%)	WEO
Real effective exchange rate (2010=100)	Information Notice System (IMF)
Gini net mean of 100	The Standardized World Income Inequality Database (SWIID)
Tariff rates	Compiled by IMF Research Department (Prati, Onorato, and Papageorgiou 2013; Giuliano, Mishra, and Spilimbergo 2013). Underlying sources are the WITS, WDI, WTO, GATT, BTN (Brussels Customs Union database)
Trade balance as a share of GDP; Trade balance is computed using exports of goods and services, and imports of goods and services. Exports, imports and GDP are in constant prices (national currency, billions)	WEO and WDI
Crises	Leaven and Valencia 2010
Wars, political regime	Polity database
Instruments for tariff	Author calculation using data from WDI and IMF Direction of Trade Statistics



**Table S1.3. List of Countries in Industry-level Analysis**

United States	South Africa
United Kingdom	Cyprus
Austria	Indonesia
Belgium	Korea
Denmark	Philippines
France	Vietnam
Germany	Morocco
Italy	Bulgaria
Luxembourg	Russia
Netherlands	China
Sweden	Czech Republic
Canada	Slovak Republic
Finland	Estonia
Greece	Latvia
Ireland	Hungary
Malta	Lithuania
Portugal	Slovenia
Spain	Poland
Australia	Romania
New Zealand	

**Table S1.4. List of Industries**

Food products, beverages and tobacco
Textiles, textile products, leather and footwear
Wood and products of wood and cork
Pulp, paper, paper products, printing and publishing
Coke, refined petroleum products and nuclear fuel
Chemicals and chemical products
Rubber and plastics products
Other non-metallic mineral products
Basic metals
Fabricated metal products
Machinery and equipment, nec
Computer, Electronic and optical equipment
Electrical machinery and apparatus, nec
Motor vehicles, trailers and semi-trailers
Other transport equipment
Manufacturing nec; recycling

**Table S1.5. List of Advanced Economies in Country-Level Analysis**

Australia	Japan
Austria	Korea
Belgium	Latvia
Canada	Luxembourg
Cyprus	Malta
Czech Republic	Netherlands
Denmark	New Zealand
Estonia	Norway
Finland	Portugal
France	Singapore
Germany	Slovak Republic
Greece	Slovenia
Hong Kong SAR	Spain
Iceland	Sweden
Ireland	Taiwan Province of China
Israel	United Kingdom
Italy	United States

## Appendix S2. Tariffs, Data and Descriptive Statistics

The main source is the reform dataset compiled by the Research Department of the IMF (Prati, Onorato, and Papageorgiou 2013; Giuliano, Mishra, and Spilimbergo 2013) which cover an unbalanced sample of 151 countries from 1964 to 2004. We extend the data to 2014 using tariff data from the World Integrated Trade Solution (WITS) and World Development Indicators (WDI). Tariff rates at the country-level are computed by aggregating product-level tariff data using weighted averages, with weights given by the import share of each product, measured as fractions of value. We do extensive checks of the data to ensure that they do not contain spurious jumps, by checking each jump is supported by country and policy reports.

Advanced economies comprise 28 percent of the sample, emerging markets around 44 percent and low-income economies around 28 percent.

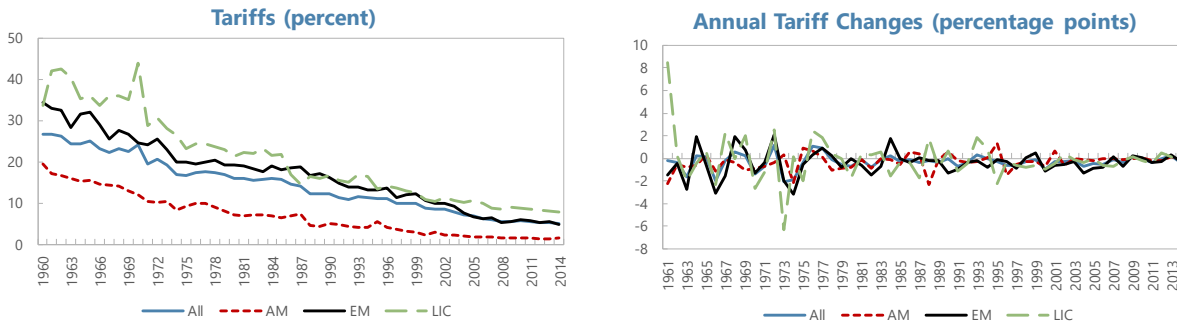
**Table S2.1.** Descriptive Statistics for Tariffs

	Number of observations	Mean	Standard Deviation	Minimum	Maximum
<b>Tariffs (%)</b>					
All	5042	11.2	13.8	0.0	161.6
AM	1427	5.7	7.5	0.0	99.2
EM	2161	12.5	11.6	0.0	91.4
LIC	1422	15.1	19.2	0.0	161.6
<b>Annual Tariff Changes (ppt)</b>					
All	4702	-0.3	3.6	-52.0	41.2
AM	1392	-0.3	2.2	-43.6	16.1
EM	1960	-0.4	3.5	-24.3	27.6
LIC	1320	-0.2	4.9	-52.0	41.2

*Source:* See Table S1.2.

*Note:* AM = advanced economies, EM = emerging economies, LIC = low income developing countries.

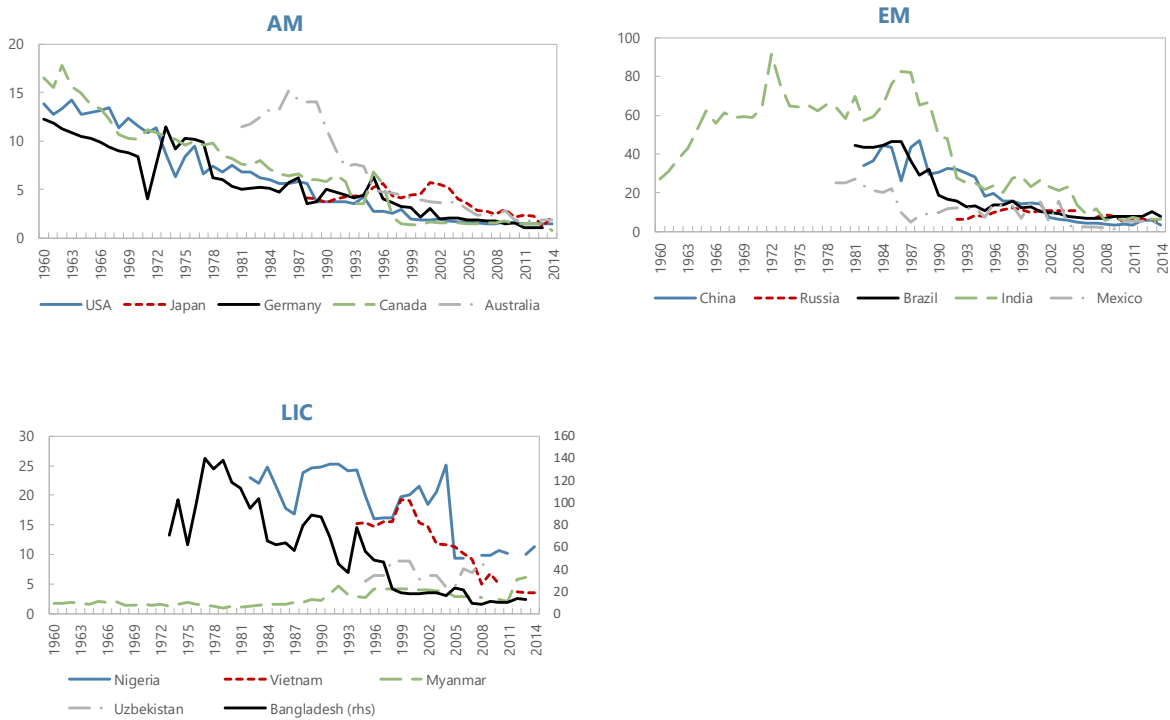
**Figure S2.1: Tariffs and Tariff Changes Across Income Groups**



Source: See Table S1.2.

Note: The income groups are equally weighted averages of the tariffs of countries belonging to the particular income group.

**Figure S2.2: Tariffs in Selected Countries Across Income Groups (percent)**



Source: See Table S1.2.

Note: AM = advanced economies, EM = emerging economies, LIC = low income developing countries.

### Appendix S3. Three Episodes of Tariff Hikes

In this appendix, we briefly describe three cases where tariffs rose in our sample. Without claiming these episodes represent all tariff variation, they seem typical to us. Tariffs rose in Denmark mostly because of a foreign shock, in Colombia because of overshooting in the foreign exchange market, and in India because of a war. In no case do domestic macroeconomic considerations seem to be overwhelming; in all cases, the primary causes seem wrapped up in the balance of payments.

#### Denmark 1971

Most advanced economies have tariffs that start relatively low and fall throughout most of the sample period. But there are some exceptions. Denmark's newly elected Social Democratic government moved to impose a ten percent import surcharge on two-thirds of the country's imports on its first day in office, Oct 19, 1971.<sup>1</sup> It was introduced to strengthen the currency and improve the balance of payments before the country joined the European Economic Community (the predecessor to the European Union) and was explicitly limited in duration. This surcharge was a partial response to the "Nixon Shock" of August 1971, which imposed a ten percent surcharge on all dutiable American imports, intended to force a real American depreciation.<sup>2</sup> In our data set, the jump in Danish tariffs shows up clearly:

Year	Tariff
1971	7.3%
1972	12.0%
1973	12.8%
1974	11.0%

#### Colombia 1964

A number of developing countries experienced extreme protectionism, especially countries pursuing import-substitution strategies. But there are other causes; some of the protectionist surges were triggered by balance of payments issues. In late 1964, the central bank of Colombia floated the over-valued exchange rate, which then depreciated excessively, by almost 90%. Colombia then moved to protect its international reserves by prohibiting the free import

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<sup>1</sup> <https://www.nytimes.com/1971/10/20/archives/denmark-moved-quickly-on-surtax.html>

<sup>2</sup> <https://www.nytimes.com/1971/10/20/archives/denmark-plans-surcharge-as-protectionist-measure-european-trading.html>

of almost all foreign products for a 90-day period, pursued a standby package with the IMF, and raised tariffs.<sup>3</sup>

Year	Tariff
1961	31.5%
1962	49.8%
1963	47.3%
1964	70.4%
1965	55.3%
1966	36.1%

#### India 1972

Indian development post-independence was guided by a series of five-year plans. By the fourth plan (covering 1969-73), there was a deliberate attempt to steer the economy towards self-reliance through import-substitution.<sup>4</sup> As part of the plan, tariffs were imposed on all goods other than grain and a few smaller exceptions. Still, the more immediate reason for the protectionist spike was undoubtedly the Indo-Pakistani war of December 1971.

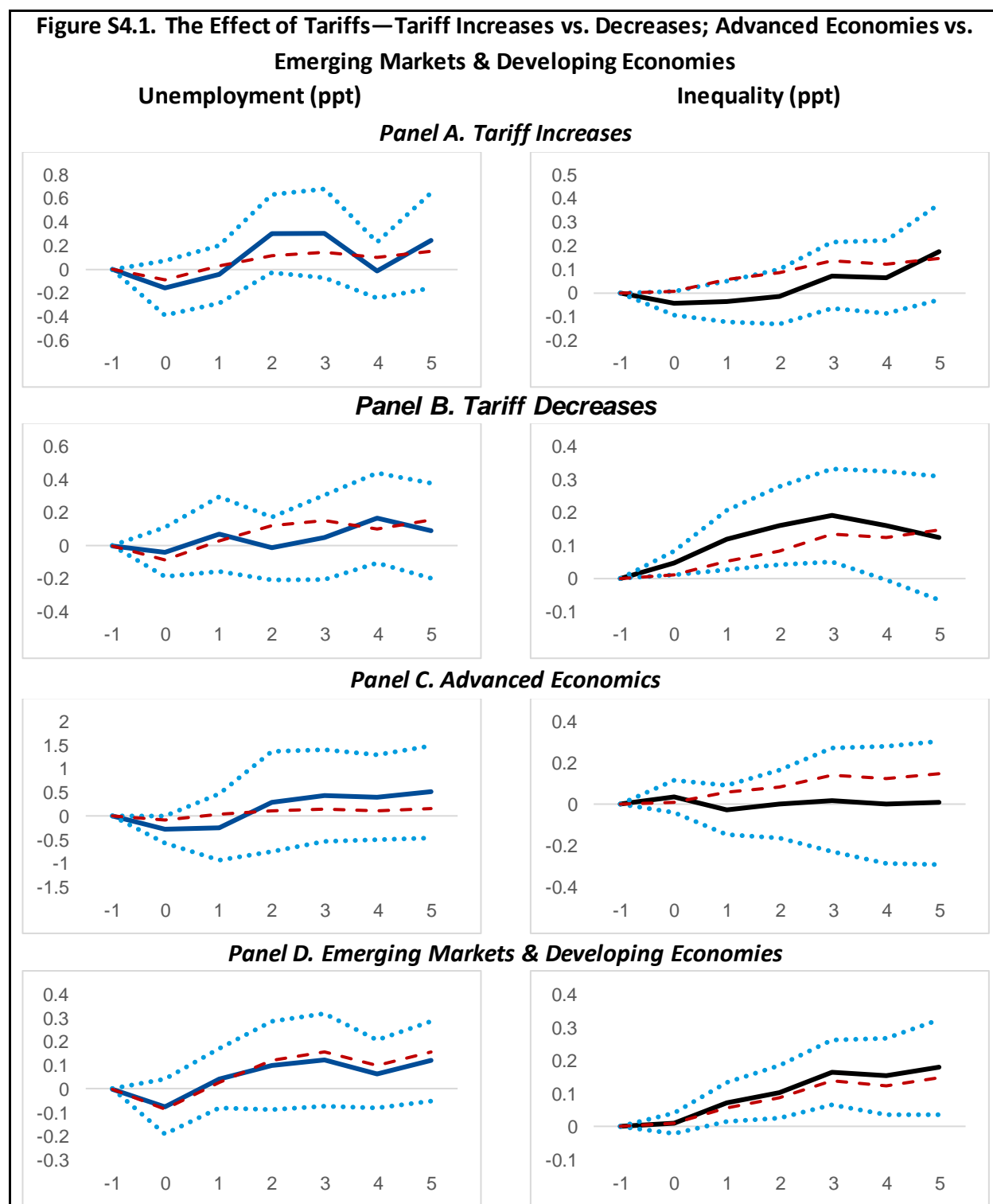
1969	59.4%
1970	58.7%
1971	63.8%
1972	91.4%
1973	76.2%
1974	64.9%

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<sup>3</sup> <https://www.nytimes.com/1964/12/02/archives/colombia-curbs-all-free-imports-90day-ban-is-imposedlatin-bloc.html>; also see “The Political Economy of Exchange Rate Policy in Colombia” by Jaramillo, Steiner and Salazar, [IDB Working Paper No. 102](#), 1999.

<sup>4</sup> [http://shodhganga.inflibnet.ac.in/bitstream/10603/32033/14/14\\_chapter%208.pdf](http://shodhganga.inflibnet.ac.in/bitstream/10603/32033/14/14_chapter%208.pdf)

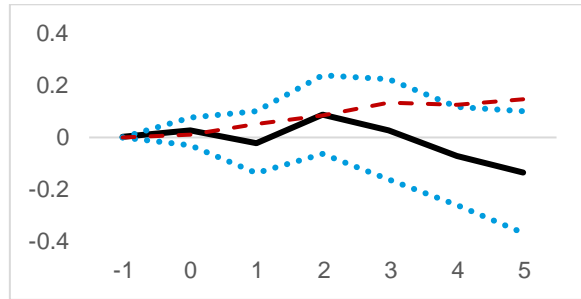
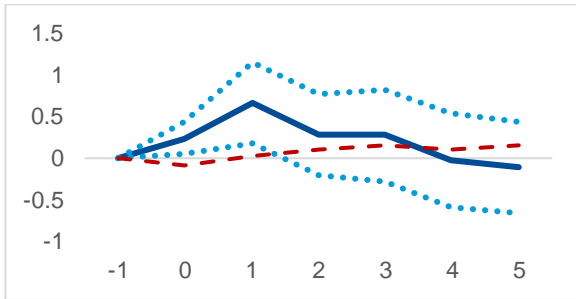
Appendix S4. Results for Unemployment, Inequality, Real exchange rate, and Trade balance



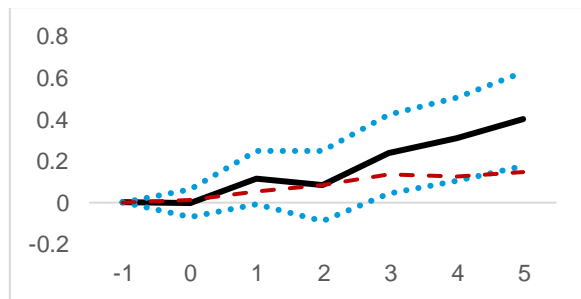
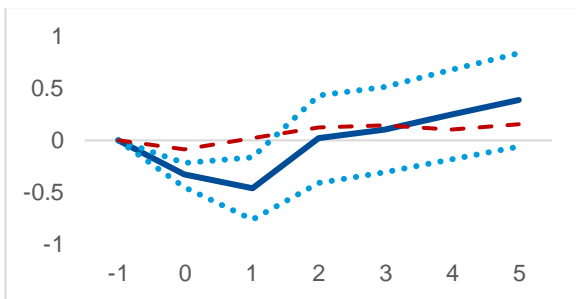
Source: Authors' estimations. Note: The solid black line indicates the response of unemployment (inequality) to a one standard deviation increase and decrease in tariff (advanced economies and emerging markets & developing economies); the dotted lines correspond to 90% confidence bands; estimates for Panel A and B are based on equation (2); estimates for Panel C and D are based on equation (3). Dashed red lines indicate the response of unemployment (inequality) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

**Figure S4.2. The Effect of Tariffs—Expansions vs. Recessions**  
**Unemployment (ppt)** **Inequality (ppt)**

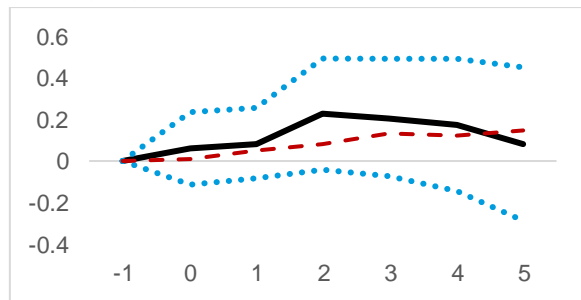
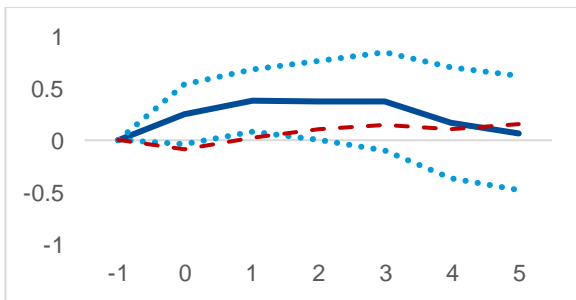
**Panel A. Expansions (based on GDP growth)**



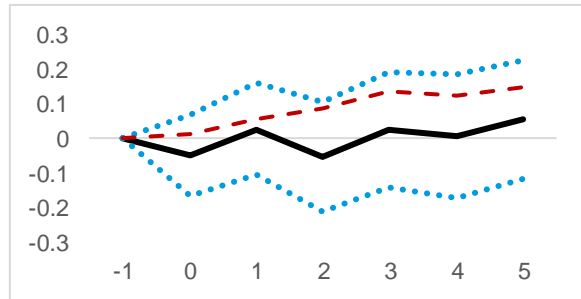
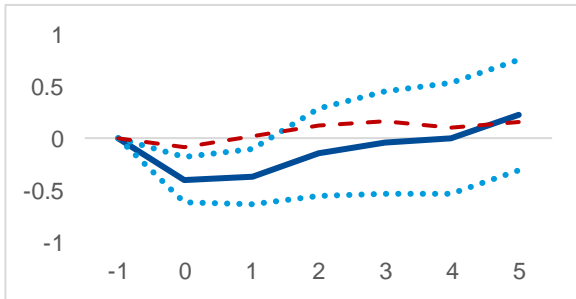
**Panel B. Recessions (based on GDP growth)**



**Panel C. Expansions (based on unemployment changes)**



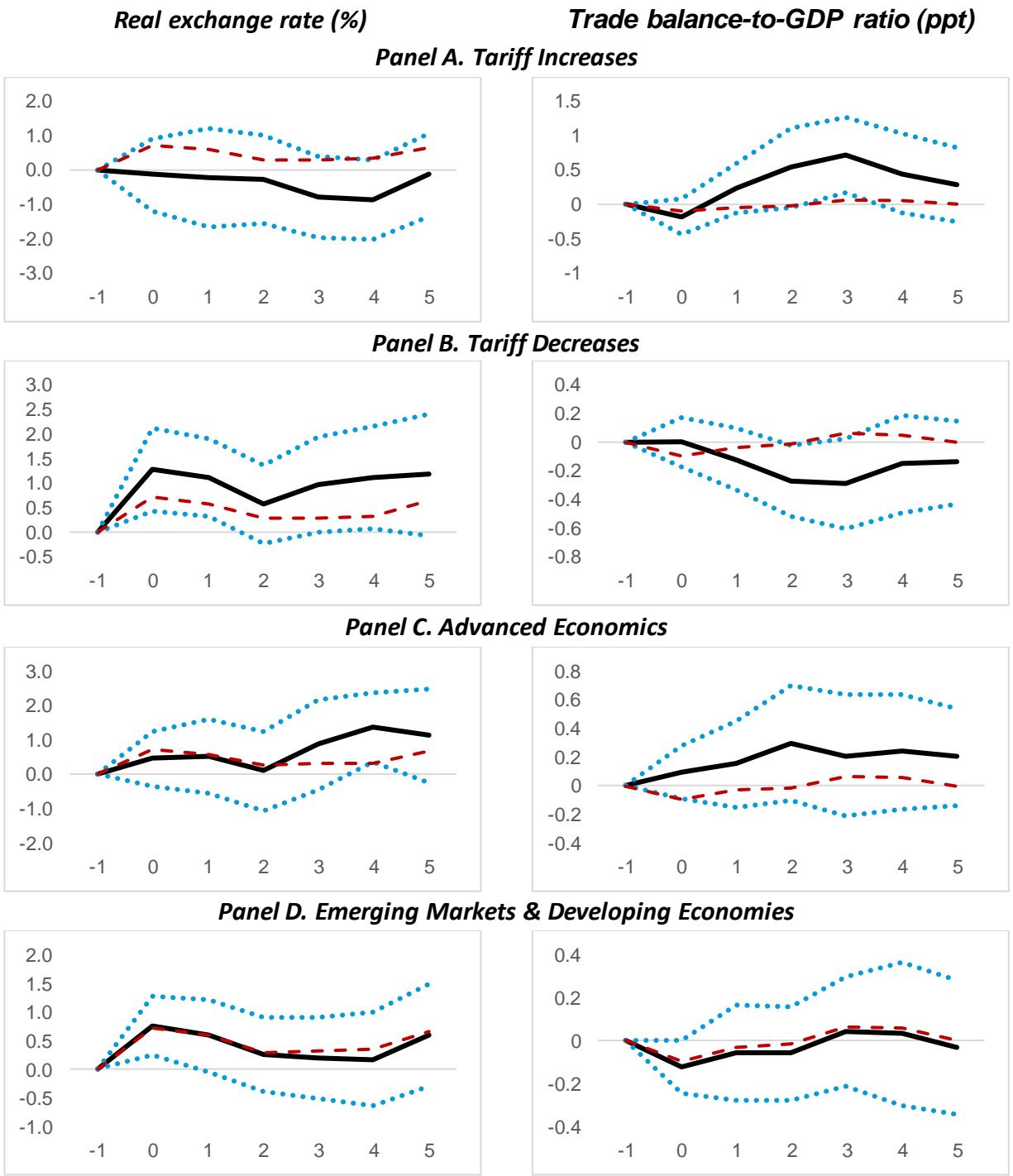
**Panel D. Recessions (based on unemployment changes)**



Source: Authors' estimations. Note: The solid black line indicates the response of unemployment (inequality) to a one standard deviation increase in tariff during expansions and recessions; the dotted lines correspond to 90% confidence bands; estimates based on equation (4); for Panel A and B expansions and recessions are identified using GDP growth; for Panel C and D using unemployment changes. Dashed red lines indicate the response of unemployment (inequality) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.



**Figure S4.3. The Effect of Tariffs—Tariff Increases vs. Decreases; Advanced Economies vs. Emerging Markets & Developing Economies**



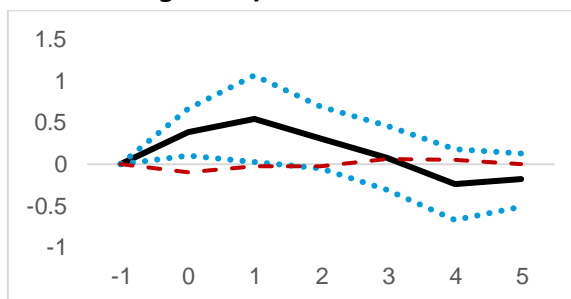
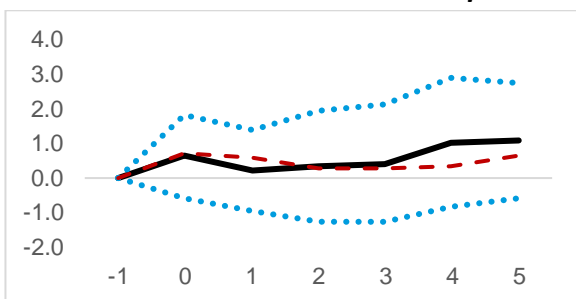
Source: Authors' estimations. Note: The solid black line indicates the response of real exchange rate (trade balance) to a one standard deviation increase and decrease in tariff (advanced economies and emerging markets & developing economies); the dotted lines correspond to 90% confidence bands; estimates for Panel A and B are based on equation (2); estimates for Panel C and D are based on equation (3). Dashed red lines indicate the response of real exchange rate (trade balance) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time. t=0 is the year of the tariff change.

**Figure S4.4. The Effect of Tariffs—Expansions vs. Recessions**

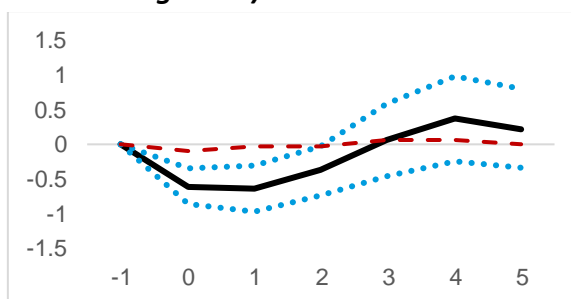
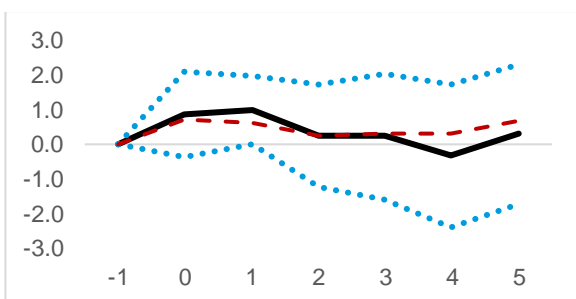
*Real exchange rate (%)*

*Trade balance-to-GDP ratio (ppt)*

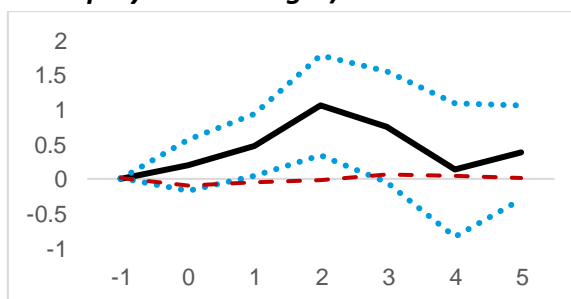
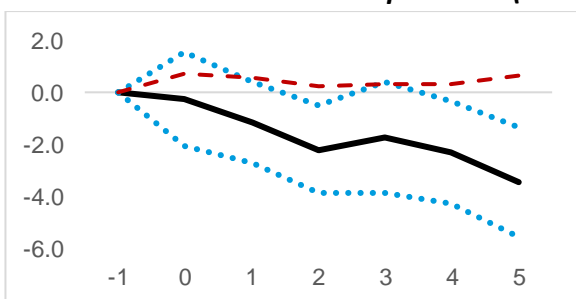
**Panel A. Expansions (based on GDP growth)**



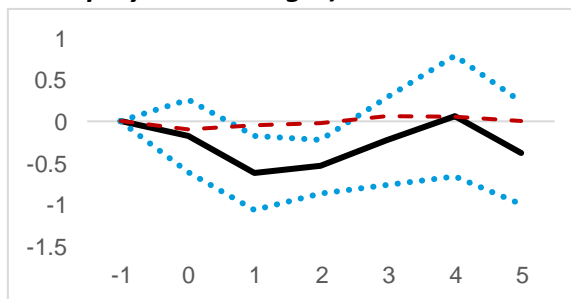
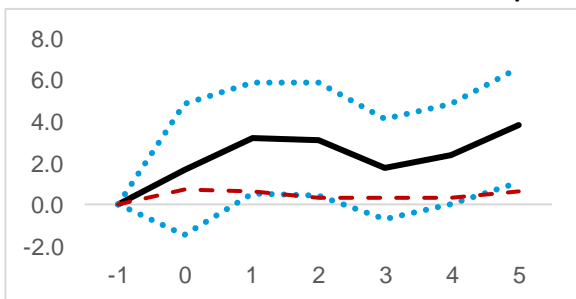
**Panel B. Recessions (based on GDP growth)**



**Panel C. Expansions (based on unemployment changes)**

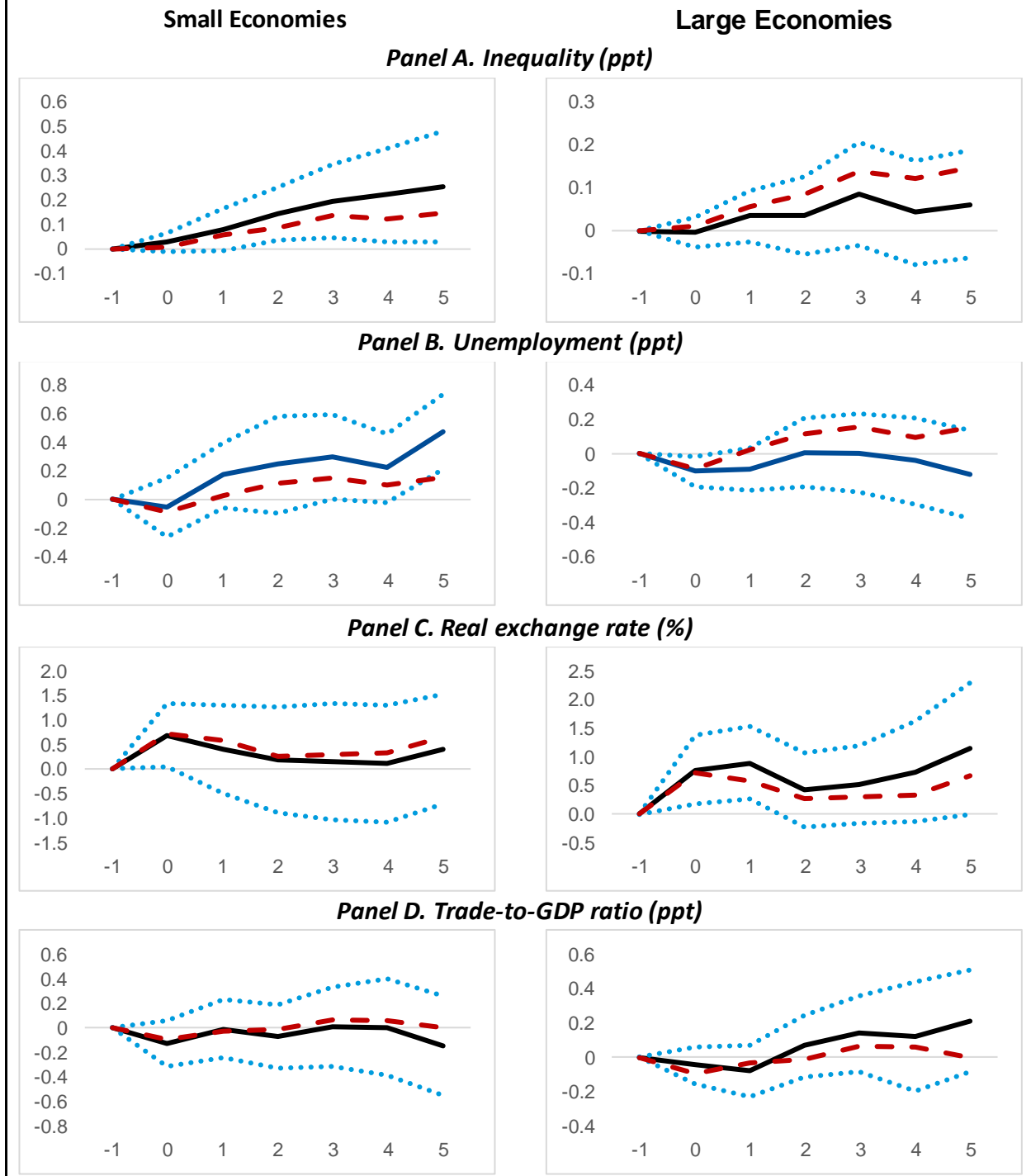


**Panel D. Recessions (based on unemployment changes)**



Source: Authors' estimations. Note: The solid black line indicates the response of real exchange rate (trade balance) to a one standard deviation increase in tariff during expansions and recessions; the dotted lines correspond to 90% confidence bands; estimates based on equation (4); for Panel A and B expansions and recessions are identified using GDP growth; for Panel C and D using unemployment changes. Dashed red lines indicate the response of real exchange rate (trade balance) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

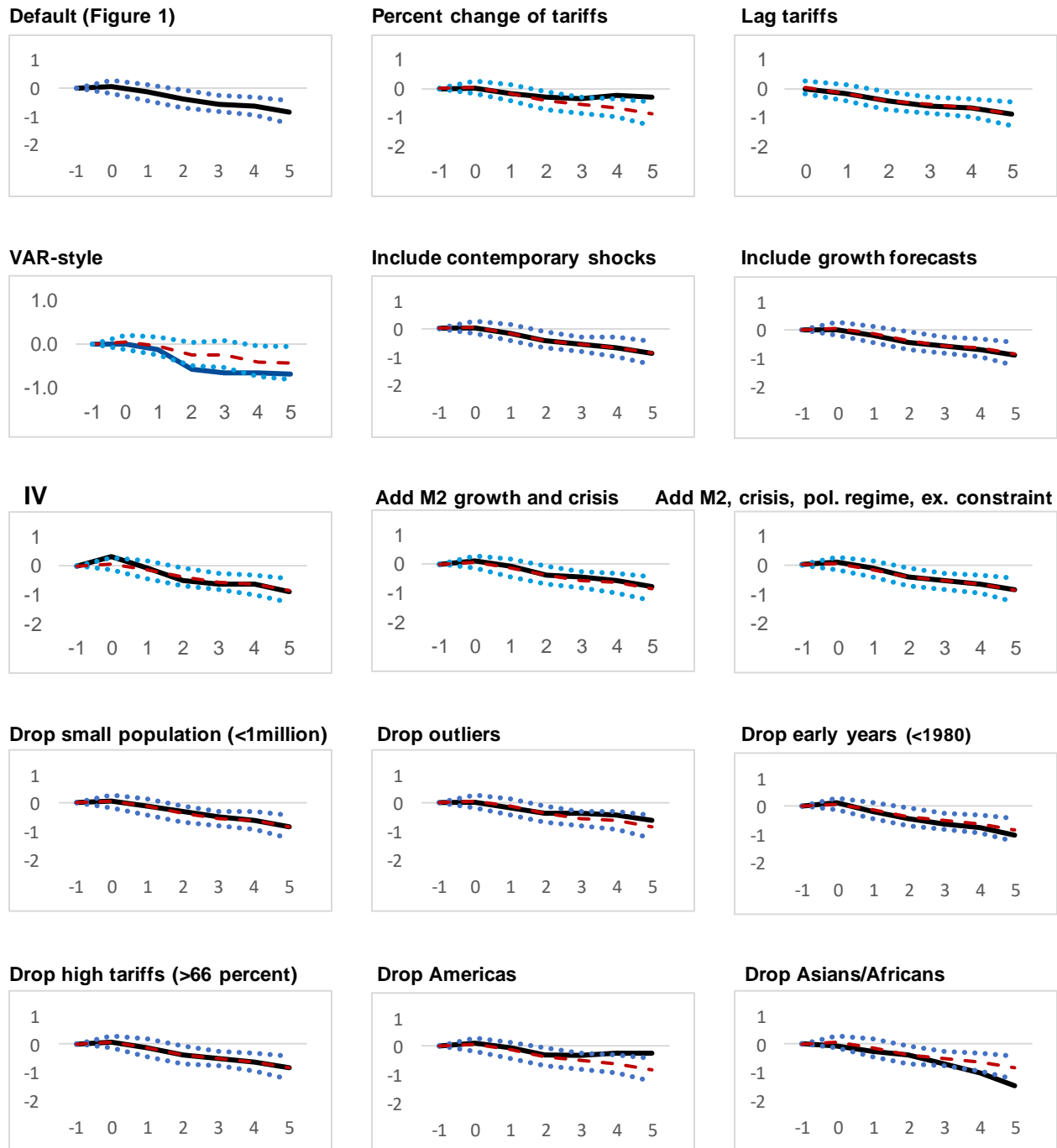
**Figure S4.5. The Effect of Tariffs—Small Economies vs. Large Economies**



Source: Authors' estimations. Note: The solid black line indicates the response of inequality (unemployment, real exchange rate, trade balance) to a one standard deviation increase in tariff; the dotted lines correspond to 90% confidence bands; estimates are based on equation (5); Dashed red lines indicate the response of the same variables to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

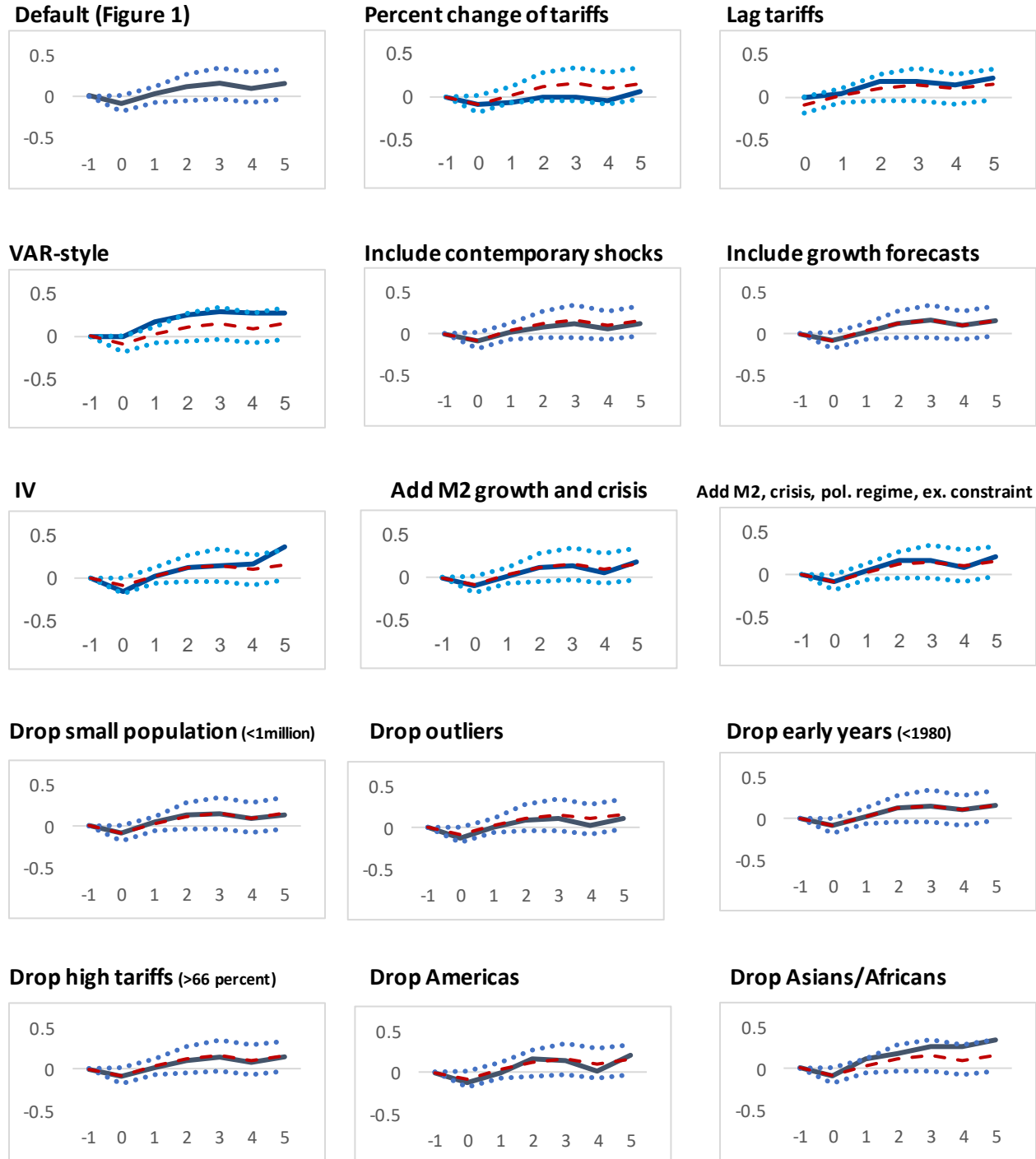
## Appendix S5. Robustness Results for Productivity, Unemployment, Inequality, Real exchange rate, and Trade balance

Figure S5.1. Robustness for Productivity



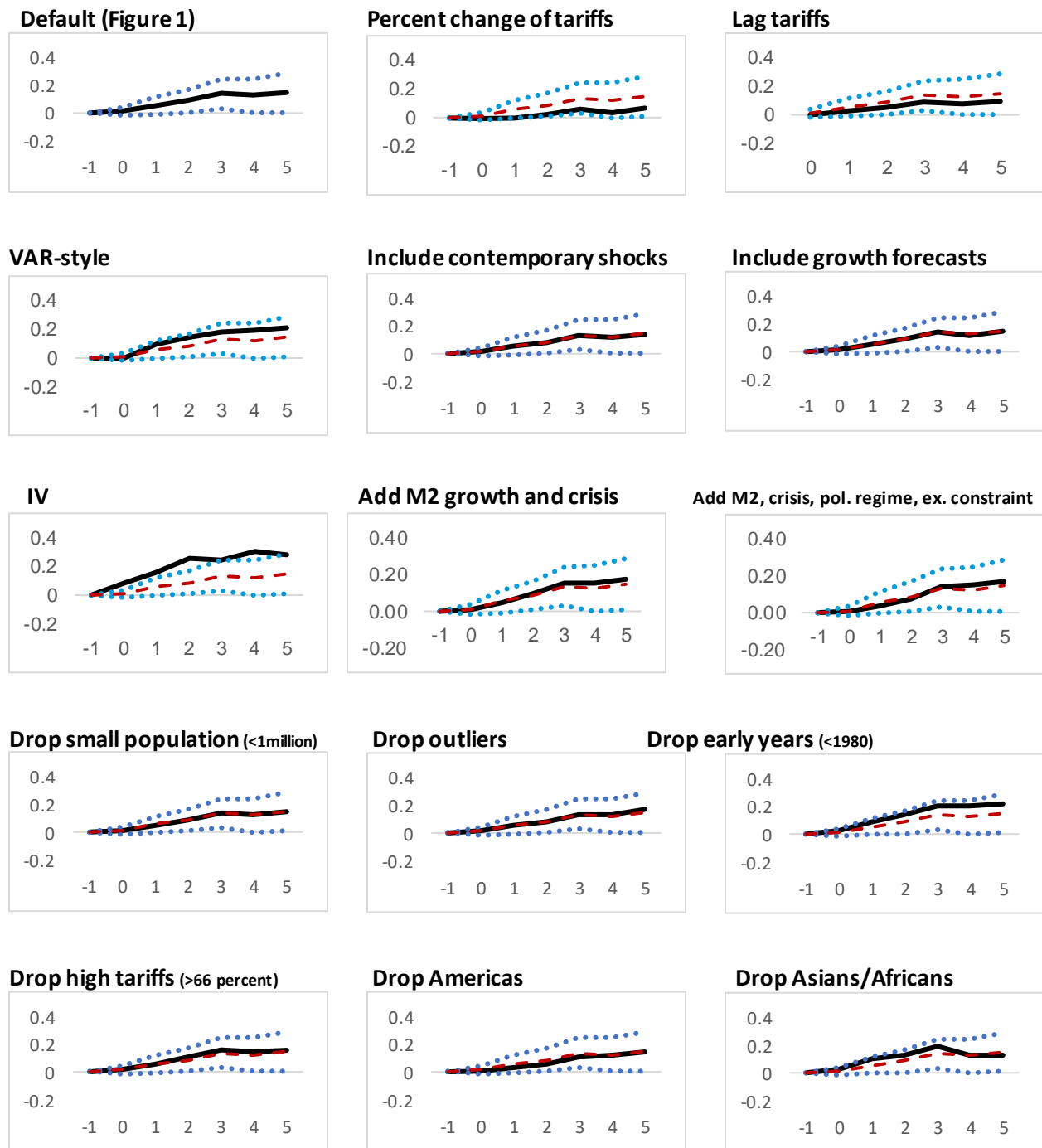
Source: Authors' estimations. Note: The black solid line indicates the response of productivity to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time.  $t=0$  is the year of the change.

**Figure S5.2. Robustness for Unemployment**



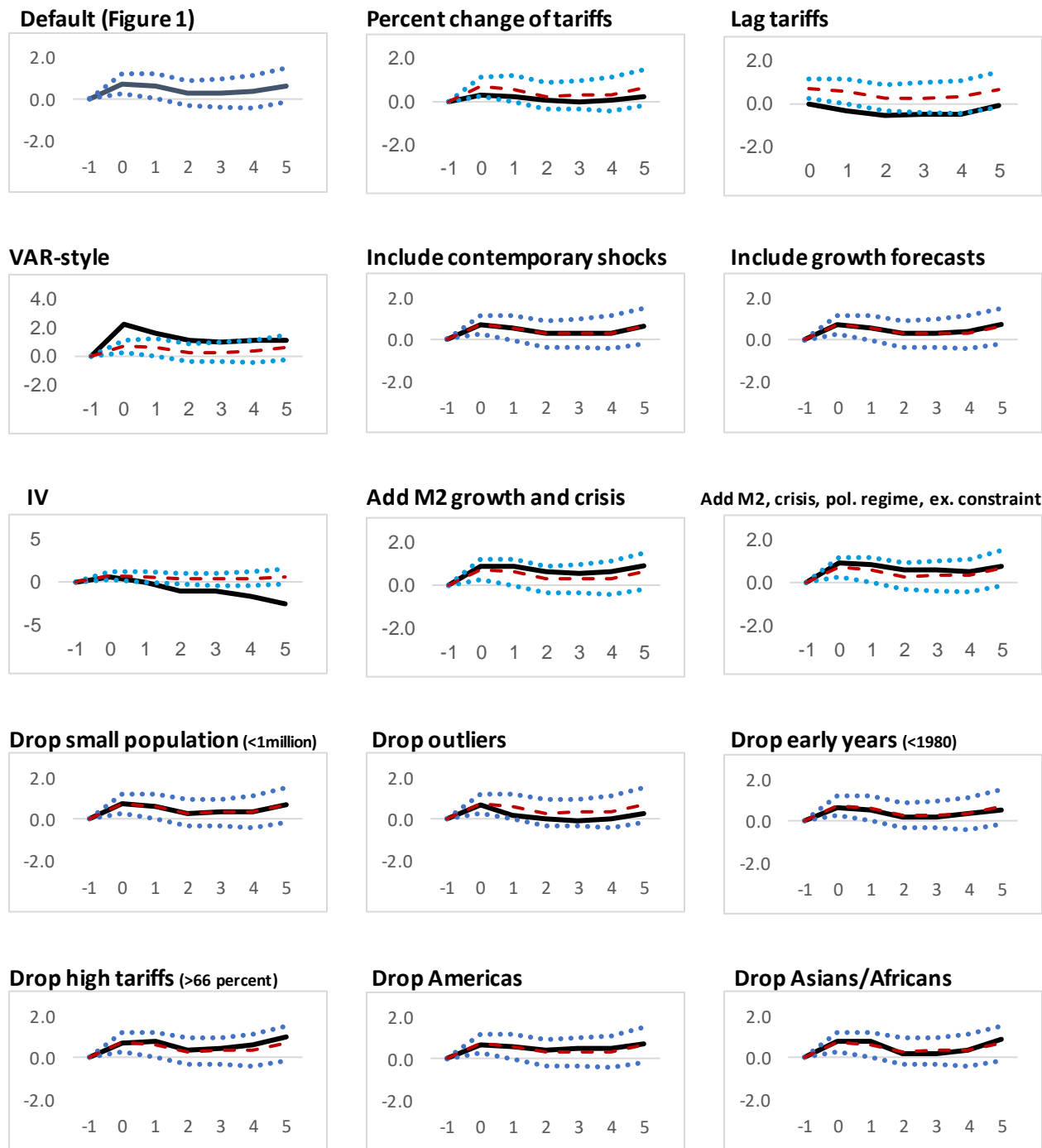
*Source:* Authors' estimations. *Note:* The black solid line indicates the response of unemployment to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the change.

**Figure S5.3. Robustness for Inequality**



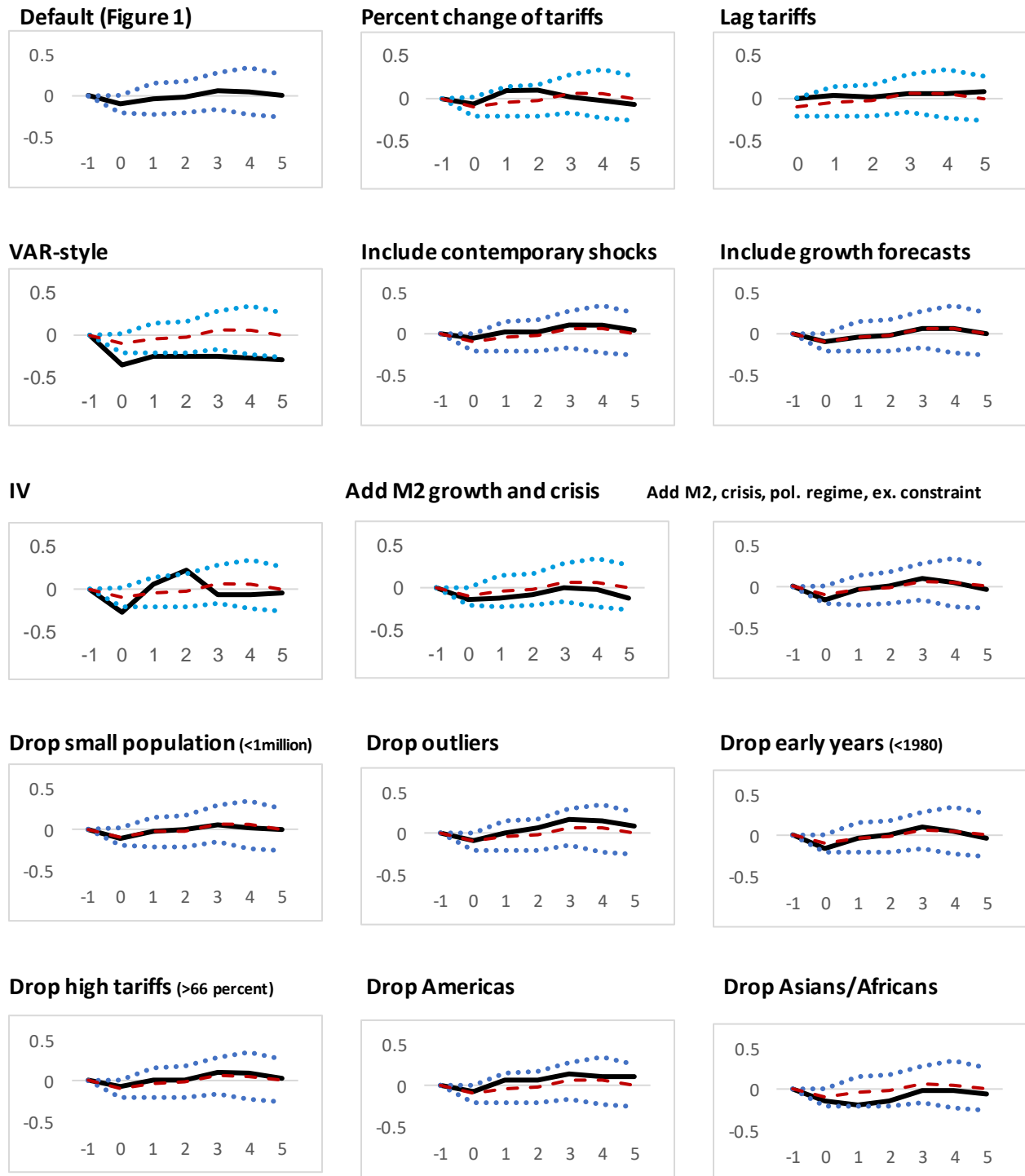
*Source:* Authors' estimations. *Note:* The black solid line indicates the response of inequality to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the change.

**Figure S5.4. Robustness for Real Exchange Rate**



*Source:* Authors' estimations. *Note:* The black solid line indicates the response of real exchange rate to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the change.

**Figure S5.5. Robustness for Trade Balance-to-GDP Ratio**



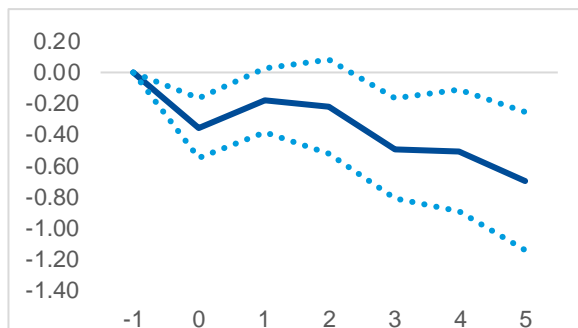
*Source:* Authors' estimations. *Note:* The black solid line indicates the response of trade balance to a one standard deviation increase in tariff using the scenarios described in each title of the chart. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the change.



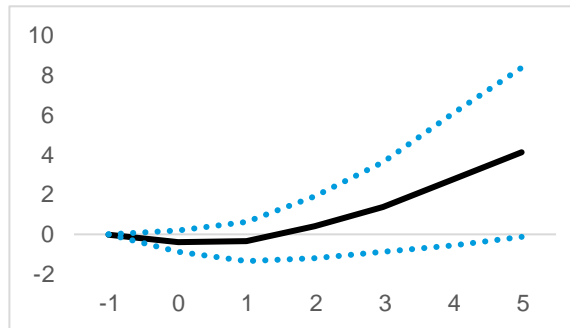
## Appendix S6. Results for Various Macroeconomic Indicators

**Figure S6.1: Baseline Results for Trade Balance and Inflation**

**Panel A: The Effect of Exchange Rate on Trade Balance-to-GDP (ppt)**



**Panel B: The Effect of Tariffs on Inflation (%)**

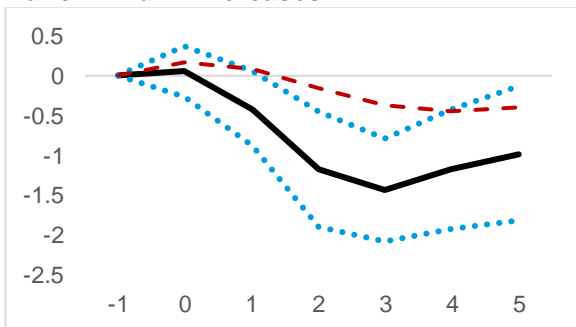


Source: Authors' estimations. Note: The solid line in Panel A indicates the response of trade balance-to-GDP to a one standard deviation increase in (one-year lagged) change in log real exchange rate (0.12). The solid line in Panel B indicates the response of inflation to a one standard deviation increase in tariff. The dotted lines in both panels correspond to 90% confidence bands. The x-axis denotes time.  $t=0$  is the year of the change. The estimates are based on equation (1).

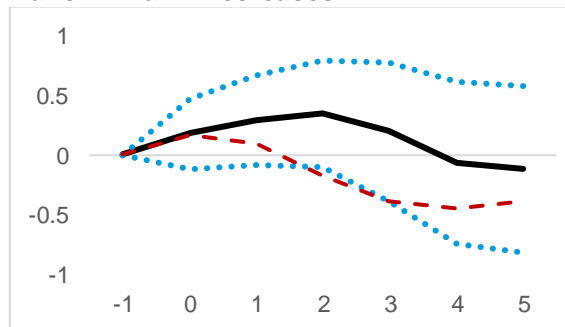
**Figure S6.2: Selected Asymmetric Results for Consumption and Investment**

**The Asymmetric Effect on Consumption**

**Panel A: Tariff Increases**

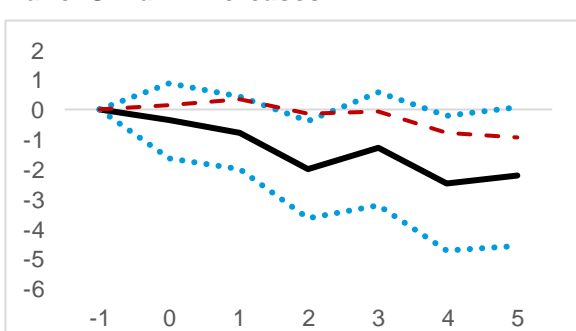


**Panel B: Tariff Decreases**

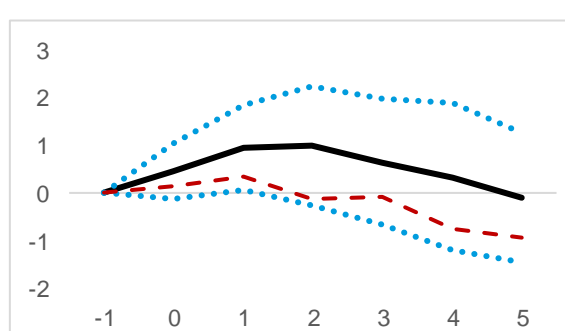


**The Asymmetric Effect on Investment**

**Panel C: Tariff Increases**



**Panel D: Tariff Decreases**

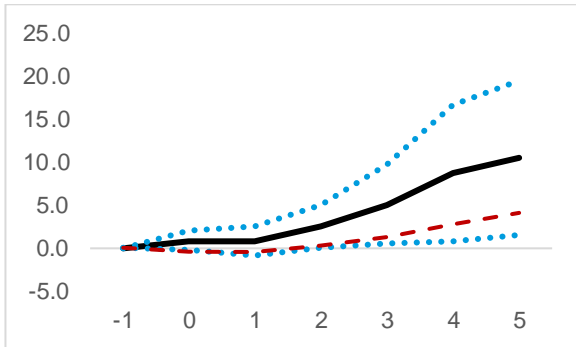


Source: Authors' estimations. Note: The solid black line indicates the response of consumption (investment) to a one standard deviation increase in tariff; the dotted lines correspond to 90% confidence bands; estimates are based on equation (2). Dashed red lines indicate the response of consumption (investment) to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time.  $t=0$  is the year of the tariff change.

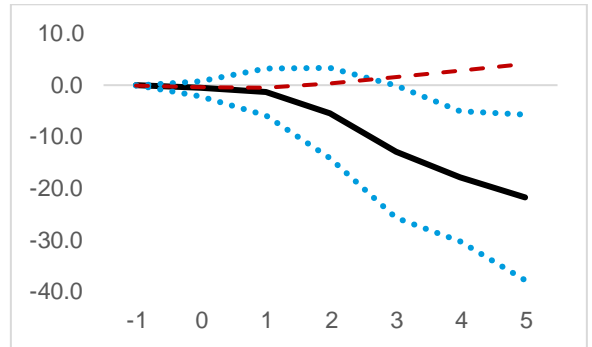
Figure S6.3: Selected Asymmetric Results for Inflation

**The Asymmetric Effect on Inflation**

**Panel A: Expansions (based on GDP growth)**



**Panel B: Recessions (based on GDP growth)**



Source: Authors' estimations. Note: The solid black line indicates the response of inflation to a one standard deviation increase in tariff; the dotted lines correspond to 90% confidence bands; estimates are based on equation (4). Dashed red lines indicate the response of investment to a one standard deviation increase in tariff in the baseline; estimates based on equation (1). The x-axis denotes time. t=0 is the year of the tariff change.

## Appendix S7. Instrumental Variable

To address the endogeneity concerns further, we implement an instrumental variable (IV) approach, using as an instrument the weighted-average of changes in the tariff in major (top 5) trading-partner countries, where the weights are determined by the strength of trade linkages with other countries. Specifically, the instrument is computed as follows:

$$I_{i,t} = \sum_{j=1,5 (j \neq i)} \Delta T_{j,t} w_{i,j,t} \quad (\text{A1})$$

where  $I_{i,t}$  is the instrument of tariff for country  $i$  at time  $t$ ;  $\Delta T_{j,t}$  is the change in the tariff for country  $j$  (up to the 5 largest trading partners) at time  $t$ ; and  $w_{i,j,t}$  is the share of total exports and imports between country  $i$  and country  $j$  in the total exports and imports for country  $i$ :

$$\frac{\text{Export}_{i,j,t} + \text{Import}_{i,j,t}}{\text{Export}_{i,t} + \text{Import}_{i,t}}$$

The first and second stage estimates for the output effect suggest that this instrument is “strong” and statistically significant (see Tables S7.1 and S7.2). In particular, The Kleibergen–Paap rk Wald F statistic—which is equivalent to the F-effective statistics for non-homoskedastic error in case of one endogenous variable and one instrument (Andrews, Stock and Su, 2018)—for each horizon of the IRF is higher than the associated Stock-Yogo critical values.<sup>i</sup>

What about the excludability of the instrument? To test the validity of our instrument, we run several checks. First, we regress the residual of the baseline against the instrument (Table S7.3). Second, we add the instrument in the baseline specification (Table S7.4). The results of these two exercises suggest that tariff changes in major trading partners do not have any effect on output or other outcome variables of interest in country  $i$  if not through tariff changes in country  $i$ . Interestingly, the effect of domestic tariffs on output and productivity remains similar to, and not statistically different from, the baseline results (Figure S7.1)

Another concern is that the instrument could be correlated with the error term to the extent that changes in tariff rates in main large trading partners could affect domestic output through contemporaneous changes in the real exchange rate. To address this issue, we modify the equation to control for the contemporaneous changes in other control variables, including the real exchange rates. The results are robust to this specification (Figure S7.2).

**Table S7.1.** First Stage estimates of Change in Tariffs on the Instrument (the weighted-average of changes in the tariff in major (top 5) trading-partner countries)

Instrument $(t)$	0.446*** (3.97)
Change in Tariff $(t-1)$	-0.160** (-9.79)
Change in Tariff $(t-2)$	-0.044*** (-2.82)
Output growth $(t-1)$	-1.400 (-0.94)
Output growth $(t-2)$	0.585 (0.40)
Change in REER $(t-1)$	0.001 90.09)
Change in REER $(t-2)$	0.005 (0.58)
Change in Trade Balance $(t-1)$	0.332 (0.64)
Change in Trade Balance $(t-2)$	0.031 (0.06)
N	3717
R <sup>2</sup>	0.08

Source: Authors' estimations.

Note: \*\*\*, \*\*, denote significance at 1 and 5 percent, respectively.

**Table S7.2.** Second Stage estimates of Output on the Change in Tariff Instrumented

	K=0	K=1	K=2	K=3	K=4	K=5
Change in Tariff_ Instrumented <sub>(t)</sub>	0.503* (1.78)	-0.001 (-0.00)	-0.785 (-1.07)	-0.770 (-1.29)	-1.295** (-1.97)	-1.235** (-1.97)
Change in Tariff <sub>(t-1)</sub>	0.069 (1.37)	-0.044 (-0.60)	-0.160 (-1.53)	-0.197** (-2.00)	-0.280*** (-2.45)	-0.280*** (-2.47)
Change in Tariff <sub>(t-2)</sub>	-0.011 (-0.64)	-0.036 (-1.49)	-0.106*** (-2.71)	-0.125*** (-3.46)	-0.144*** (-4.09)	-0.170*** (-6.74)
Output growth <sub>(t-1)</sub>	0.275*** (7.66)	0.329*** (8.94)	0.351*** (7.81)	0.332*** (5.34)	0.290*** (3.62)	0.277*** (3.06)
Output growth <sub>(t-2)</sub>	0.005 (0.19)	0.035 (0.66)	0.017 (0.20)	-0.007 (-0.07)	-0.026 (-0.26)	-0.025 (-0.25)
Change in REER <sub>(t-1)</sub>	-0.028* (-1.82)	-0.069*** (-4.29)	-0.099*** (-4.59)	-0.080** (-2.27)	-0.038 (-0.74)	-0.013 (-0.22)
Change in REER <sub>(t-2)</sub>	-0.027 (-1.39)	-0.055* (-1.75)	-0.034 (-0.69)	0.010 (0.15)	0.033 (0.42)	0.051 (0.68)
Change in Trade Balance <sub>(t-1)</sub>	-1.511** (-2.52)	-2.749** (-2.43)	-3.598* (-1.76)	-3.611* (-1.86)	-2.766* (-1.75)	-1.814 (-1.06)
Change in Trade Balance <sub>(t-2)</sub>	-1.001* (-1.84)	-2.298** (-2.13)	-2.221 (-1.50)	-1.231 (-0.61)	-0.013 (-0.06)	1.472 (0.75)
N	3716	3622	3502	3387	3265	3145
KP F-statistics (Stock-Yogo critical value 10%)	21.270 (16.38)	24.834 (16.38)	22.737 (16.38)	21.795 (16.38)	25.536 (16.38)	25.297 (16.38)

Source: Authors' estimations.

Note: t-statistic based on Driscoll-Kraay standard errors. \*\*\*, \*\*, \* denote significance at 1, 5 and 10 percent, respectively. Instrument computed as the weighted-average of changes in the tariff in major (top 5) trading-partner countries. Estimates based on equation (1).

**Table S7.3.** Exclusion-Restriction Test: Residuals of Baseline Output Growth Regressions on Instrument

VARIABLES	K=0	K=1	K=2	K=3	K=4	K=5
Instrument <sub>(t)</sub>	0.12 (0.90)	-0.06 (-0.26)	-0.30 (-0.96)	-0.36 (-0.95)	-0.61 (-1.17)	-0.60 (-1.01)
Observations	3,716	3,622	3,502	3,387	3,265	3,145

Source: Authors' calculations.

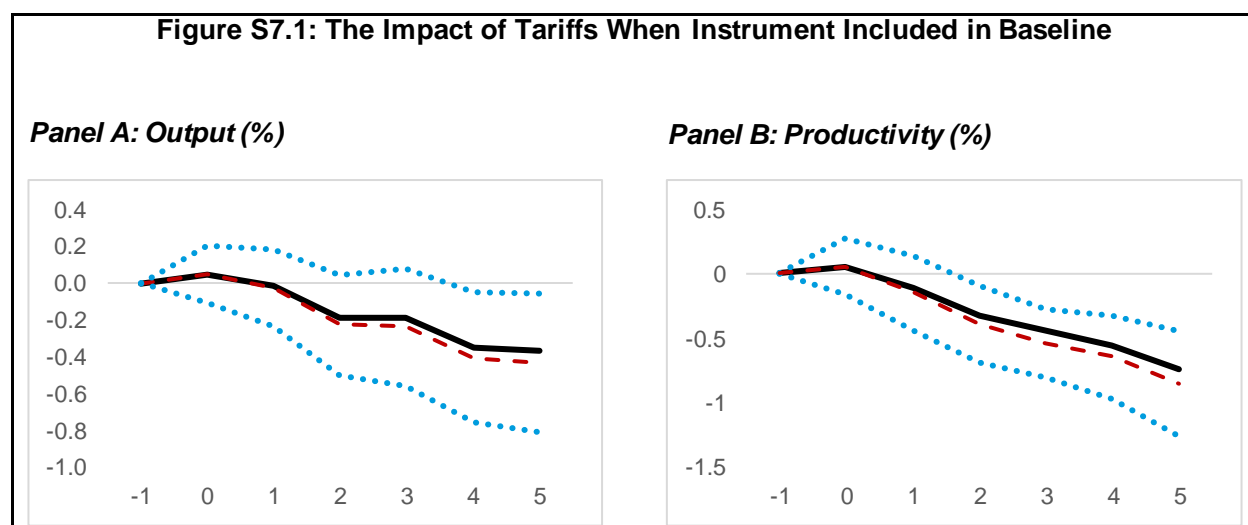
Note: t-statistics in bracket, based on Driscoll-Kraay standard errors. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table S7.4.** Exclusion-Restriction Test: Baseline Output Growth Regressions including Instrument

VARIABLES	K=0	K=1	K=2	K=3	K=4	K=5
Instrument <sub>(t)</sub>	0.22 (0.002)	0.00 (0.002)	-0.33 (0.004)	-0.32 (0.004)	-0.53 (0.005)	-0.52 (0.005)
Observations	3,716	3,622	3,502	3,387	3,265	3,145

Source: Authors' calculations.

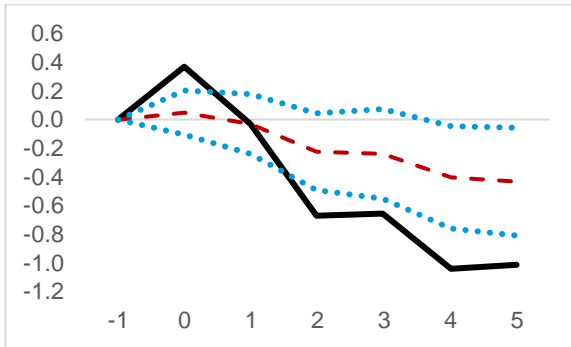
Note: Driscoll-Kraay standard errors in bracket. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.



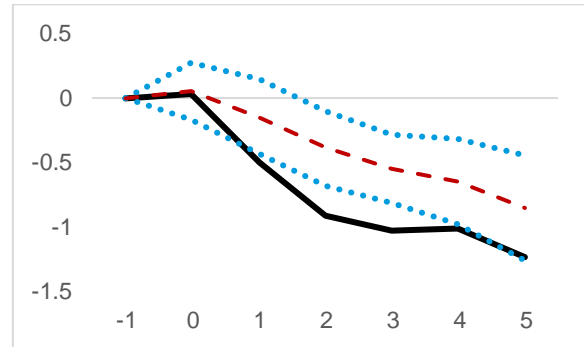
Source: Authors' estimations. Note: The solid black line indicates the response of output/productivity to a one standard deviation increase in tariff, estimated based on baseline plus the instrument. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time. t=0 is the year of the tariff change.

**Figure S7.2: The Impact of IV including Contemporaneous Changes of Control Variables**

**Panel A: Output (%)**



**Panel B: Productivity (%)**



Source: Authors' estimations. Note: The solid black line indicates the response of output/productivity to tariffs, estimated based on instrumenting tariffs and including contemporaneous changes of control variables. The red dotted line represents the baseline results, estimated based on equation (1). The blue dotted lines correspond to 90% confidence bands of the baseline. The x-axis denotes time.  $t=0$  is the year of the tariff change.

<sup>i</sup> Similar results are also obtained for productivity.