Tariffs and Growth: Heterogeneous Effects by Economic Structure*

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Abstract

This article presents evidence that the impact of tariffs on GDP per capita is mediated by economic structure. I use a panel of 161 countries from 1960 to 2019 to study the impact of changes in average tariff rates on GDP per capita. Using a local projections difference-in-differences (LP-DiD) approach allows me to flexibly control for the surge in GDP that precedes tariff reductions, which if ignored could bias the estimates, and to estimate medium-term dynamic effects. The results, consistent with a specific strand of the trade theory literature, establish that the tariff-growth nexus is contingent on economic structure: tariff reductions led to lower GDP per capita for nonmanufacturer countries, but higher GDP per capita for manufacturers. Additionally, the effects are persistent even twenty years after tariff reductions. The validity of the baseline estimates is confirmed by several robustness checks, especially the control for relevant confounders in the tariffs-growth nexus and a clean controls analysis aimed to address biases from heterogeneity as highlighted by recent difference-in-differences literature. The results seem to be driven by heterogeneous effects in productivity and capital accumulation, in turn related to changes in the manufacturing share of GDP.

JEL codes: F14, F63, O24, O47.

Keywords: tariffs, trade liberalization, trade policy, economic growth, economic structure.

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1 Introduction

Is free trade good for economic growth? The dominant view in economics is that countries with lower barriers to trade tend to grow faster than countries with protectionist policies. Some even argue that support for free trade is the idea on which economists disagree least (Krugman, 1993; Furceri, Hannan, Ostry, & Rose, 2020, 2022). However, the theoretical literature does not provide unambiguous predictions on the nature of the trade policy-growth relationship. On the one hand, free trade may bring a scale effect in the sense that a larger market, associated with greater benefits for innovation, will boost growth for all countries involved. Trade may also enhance international technology diffusion. On the other hand, competition effects may lead backward countries to specialize in activities with lower innovation potential and therefore to experience lower growth rates (Grossman & Helpman, 2015; Melitz & Redding, 2021). The sign of the relationship is therefore an empirical question.

The empirical literature studying the trade policy-growth relationship deliver results that remain inconclusive. The seminal paper by Rodríguez and Rodrik (2001) revealed that most of the literature in the 1990s used independent variables capturing phenomena other than trade policy[1]. More importantly, the authors reanalyzed the estimates from that literature and showed, by carefully isolating trade policy from other phenomena, that the effect of trade policy on growth was not statistically significant other than zero. In other words, that free trade was neither good nor bad for growth. The authors conclude that the literature should study the heterogeneous effects of trade policy on growth, instead of focusing exclusively on a general, unambiguous relationship. For example, they suggest studying heterogeneous effects in relation to comparative advantage in manufacturing, what I call here economic structure. Although there have been new contributions since then[2], the results on a general relationship remain inconclusive—as discussed below—and there are no contributions to date that study the heterogeneity in relation to the economic structure.

In this article, I demonstrate that the relationship between trade policy and growth at the country level is characterized by sharp heterogeneous effects by economic structure. I do this by investigating the effects of tariffs on GDP per capita using a panel of 161 countries from 1960 to 2019[3]. I provide evidence that tariff reductions led to lower GDP per capita for nonmanufacturer countries, but higher GDP per capita for manufacturers. The estimates suggest that a one-standard-deviation

[1] For example, in the case of Dollar (1992), the variables used were exchange rate distortion and variability; in Sachs and Warner (1995), the Sachs-Warner (SW) dichotomous measure of liberalization used included trade policy information but also exchange rate distortions and state ownership of important sectors, among others; and the paper by Frankel and Romer (1999) used trade openness, which is an outcome variable but not a trade policy measure.

[2] Irwin (2019) provides a recent review on empirical contributions on the trade policy-growth nexus.

[3] Trade policy is also composed by nontariff barriers, export taxes, among others. Although my focus is on the effects of tariffs, I nonetheless control for nontariff barriers changes as a robustness check.

reduction in tariffs (i.e., 3.65 percentage points) leads to a fall (increase) of more than 2 percent in GDP per capita fifteen years later for nonmanufacturer (manufacturer) countries. The effects persist even after twenty years. These results may explain the apparent nonexistence of a general, unambiguous relationship. I further show that the results appear to be driven by heterogeneous effects on productivity and capital accumulation, in turn linked to changes on the manufacturing share of GDP.

To establish the baseline results, I show that tariff reductions are preceded by a surge in GDP, for which it is then necessary to control to avoid biased effect estimates. As shown in Figure 1, countries reducing tariffs (the treatment group) are on a different trajectory ex ante as compared to countries not changing tariffs (the control group): GDP of the former is increasing in relative terms before the decrease in tariffs (that is, the treatment date). To avoid biases, I use the local projections difference-in-differences (LP-DiD) estimator, that provides a flexible semiparametric approach to control for pre-treatment values, as in conditional parallel trends (Dube, Girardi, Jordà, & Taylor, 2022). Additionally, this approach allows me to estimate medium-term dynamic effects, contrary to most of the previous empirical literature in the tariffs-growth nexus. The underlying identification assumption of the baseline results is that, conditional on lags of growth rates, which successfully capture pretrends, changes in tariffs are as good as random.

I then demonstrate the validity of the baseline results to several robustness exercises, thus relaxing the previous identification assumption. First, I check the validity of the estimates after accounting for important confounding variables that are related to both tariff changes and growth, as well as for some common trends for different groups of countries. Second, cognizant of the problems highlighted in the recent difference-in-differences literature with estimates of average treatment effects due to effect heterogeneity and variation in treatment timing (de Chaisemartin & d'Haultfoeuille, 2020; Sun & Abraham, 2021; Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021), I provide a robustness exercise aimed to address these problems. I use LP-DiD to implement the idea of comparing movers, here countries experiencing *relevant* tariff changes, and quasi-stayers, here countries experiencing changes in tariffs virtually equal to zero, as recently proposed by de Chaisemartin, D'Haultfœuille, Pasquier, and Vazquez-Bare (2022). Reassuringly, the effect heterogeneity is robust to these checks.

I also provide evidence of potential mechanisms underpinning this heterogeneity in the effects of tariffs on growth. I show that for nonmanufacturer countries, tariff reductions lead to lower productivity levels, also accompanied by lower capital accumulation. For manufacturer countries, on the other hand, both productivity and capital accumulation increase after tariff reductions. These results seem to be driven in turn by changes in the manufacturing share of GDP: tariff reductions lead to lower (higher) manufacturing shares of GDP for nonmanufacturer (manufacturer) countries. In the case of nonmanufacturer countries, this can also be interpreted as empirical evidence in support of the premature deindustrialization story by Rodrik (2016), according to which developing countries deindustrialized due to globalization.

The results in this paper are novel in five aspects. First, in the empirical literature on the effects of trade policy (tariffs) on GDP (growth), this paper is the first, to the best of my knowledge, to test for heterogeneous effects related to the economic structure. Second, I study the effect of trade policy on growth by using tariffs, a measure that directly capture trade policy stances, different to significant previous contributions in this literature. Third, the effect heterogeneity documented in the paper provides an explanation for the apparent lack of a general, unambiguous relationship between tariffs and growth, that seems to emerge again from recent literature. Fourth, I use the local projections method for the first time in this literature to provides medium-term dynamic effects estimates that also address potential selection biases coming from pretrends. And finally, as already explained, I also provide evidence of the mechanisms that might explain the effect heterogeneity.

Although previous literature has studied heterogeneous effects effects of tariffs on growth, this paper is the first to study the hetereogeneity that may come from economic structures. First, Yanikkaya (2003) studied the relationship between growth and several different trade policies, among them tariffs, export taxes, and total taxes on international trade. His results showed that trade restrictions, particularly tariffs, encourage growth, especially in developing countries. Later, DeJong and Ripoll (2006) explicitly studied the heterogeneous effects of trade policy in relation to income per capita. They found that trade restrictions may encourage growth in developing countries but negatively impact growth in developed countries. Finally, Nunn and Trefler (2010) revealed that what matters is the skill bias of tariffs: higher tariffs in skill-intensive sectors are robustly associated with higher growth.

My contribution uses tariff changes as the independent variable of interest, directly capturing the effect of arguably the most important component of trade policy, contrary to some significant previous works. The studies by Wacziarg and Welch (2008) and Billmeier and Nannicini (2013) used a dichotomous measure taking value 1 for liberal countries and 0 for protectionist ones as independent variable. This dichotomous measure of liberalization is based on criteria including trade policy but also other phenomena related to market reforms, so it ends up identifying more than a change in trade policy. In fact, Rodríguez (2007) has argued that the results in Wacziarg and Welch (2008) are fundamentally driven by exchange rate black market premia, and not by trade policy. Using a dummy variable as the independent variable of interest also has the problem of assuming that the trade regime is defined by certain threshold in average tariff rates. For instance, there is no reason to think that a country has a liberal trade regime if its average tariff rate is lower than 40 percent and a protectionist one otherwise[4].

[4] Rodríguez (2007) also argued that the results in the paper by Wacziarg and Welch (2008) are not robust to changes in these thresholds.

This paper offers an explanation for the apparent lack of relationship between tariffs and growth, which is the message that emerges from some recent results. The study by Estevadeordal and Taylor (2013) revisited the question on the tariffs-growth nexus, focusing on the great liberalization of the 1990s and using continuous changes in tariff rates as the independent variable of interest[5]. The analysis is carried out through a difference regression with acceleration in average growth as the dependent variable. The difference regressions only consider averages of two periods, the pre- and post-1990, thus ending with only one observation per country with available data (averaging between 31 to 47 observations). The authors establish that tariff reductions specifically in capital and intermediate goods is what really increases growth. However, as demonstrated by Hoyos (2022), the results in that paper are not robust and again a general, unambiguous relationship between tariffs and growth seems not to exist. In this article I show that tariffs do impact GDP, but that they do so only once the heterogeneity by economic structures is considered.

And finally, this paper provides medium-term dynamic effects estimates that take into account pretrends, to avoid selection biases, a first in the tariffs-growth literature. The recent studies by Furceri et al. (2020, 2022) study yearly changes in average tariffs rates from 1960 to 2014 on growth and other macroeconomic variables at the country level[6]. Importantly, the authors make use of a new tariff dataset with the longest coverage to date, including general tariff rates for 161 countries, which is also the data I use here. The authors use the local projections method (Jordà, 2005) to estimate for the first time the dynamic effects of a one-percentage-point change in tariffs. Nevertheless, those papers did not test for pretrends, which is crucial to avoid selection biases. As shown later, countries that reduce their tariffs do so after experiencing higher GDP growth as compared to countries that do not change them. Additionally, the authors restricted the analysis to 5 years after tariff changes, while my analysis considers a longer analysis window, estimating dynamic effects even twenty years after tariff reductions.

The paper has six sections in addition to this introduction. In section 2, I provide a theoretical discussion to motivate the empirical investigation of heterogeneous effects of tariffs conditional on the economic structure and explain why I use the manufacturing share of exports as the measure of economic structure. In section 3, I present the data used and some descriptive statistics. In section 4, I present the baseline results, demonstrating heterogeneous effects of tariffs on growth depending on the initial economic structure. In section 5, I present several robustness checks. In section 6, I show the analysis on potential mechanisms underpinning the heterogeneous effects. Finally, in section 7, I conclude the paper.

[5]According to Irwin (2019), this is the only contribution (before his review) to use tariff rates directly.

[6]Their estimates used GDP, not GDP per capita, as the dependent variable.

2 Theory: Economic structure matters

Traditional trade theory emphasizes the gains from trade in a static framework. As countries specialize in sectors in which they are relatively more productive due either to natural/technological or endowment differences, following their comparative advantage, production expands, and through trade, countries can secure welfare gains. This strand of the literature deals in a sense with interindustry trade. New trade theory, which emerged to explain patterns of trade between developed economies or intraindustry trade, emphasizes scale economies as the source of gains from trade. As countries specialize in some varieties, increasing production in certain lines while allowing production of other lines to disappear within their borders, welfare ends up increasing due to the greater number of varieties that consumers can access and to improvements in productivity. Thus, there are good theoretical reasons to expect positive static gains from trade (Feenstra, 2015).

Although informative on the role of trade in production, the previous theories do not deliver insights about growth. These traditional theories are static in nature, and after specialization from trade has occurred, economies do not grow in equilibrium. In a sense, the theories point to positive growth in the transition to the trade equilibrium, assumed normally to be instantaneous, whereupon, growth becomes zero. Thus, these theories abstract from long-run growth and are not informative about the engines of growth, which is a crucial question for the inquiry on medium-term dynamic effects.

Analyzing trade (policy) and its impact on growth therefore implies dealing with conceptualizations of growth and its engines. The literature on trade and growth has dealt fundamentally with two types (or causes) of growth: learning-by-doing and innovation. Learning-by-doing refers to increases in productivity due to increased production, so that as time goes on, producers become more productive simply by being involved in production. Analyses of trade and learning-by-doing go back to important contributions in the 1980s like those by Krugman (1981, 1987) and A. K. Dutt (1986), among others. Later contributions in this tradition are those from Young (1991), Skott and Larudee (1998) and the more recent paper by Greenwald and Stiglitz (2006). Afterwards, with the emergence of endogenous growth theory, the analysis of trade and growth (innovation) gained new traction in the 1990s, especially due to the seminal work by Grossman and Helpman (1991)[7]. In endogenous growth theory, innovation is the outcome of R&D investments by private producers trying to increase their market shares.

Although the theoretical details in the two traditions may differ, they both convey the message that the effects of trade policy vary with economic structure. The idea is that trade leads economies to specialize in economic sectors they are relatively more

[7]The authors provided an in-depth theoretical analysis of the interactions between growth coming from innovation and trade in several different settings. Readers are encouraged to review this important work.

productive, but where those sectors may have now a differential impact on technological progress and thus on growth. Particularly, economies that end up specialized in less (more) dynamic economic activities due to trade liberalization (e.g., tariff reductions) will experience a reduction (increase) in growth rates[8]. According to Young (1991), "examining the interaction of an LDC [less developed country] and a DC [developed country], the latter distinguished by a higher initial level of knowledge, I find that under free trade the LDC (DC) experiences rates of technical progress and GDP growth less than or equal (greater than or equal) to those enjoyed under autarky" (p. 369). Because of the effect it has on comparative advantage specialization patterns, obstructing or facilitating their materialization, trade policy therefore has a significant effect on growth (Greenwald & Stiglitz, 2006).

There is a crucial assumption in this strand of the theoretical literature that drives the results, and differs to those of contributions delivering different conclusions. The models surveyed share the idea that the economy is characterized by qualitatively different economic sectors (i.e., less vs. more dynamic). Modern general equilibrium analyses of comparative advantage and growth, based mostly on the works by Melitz (2003) and Eaton and Kortum (2002), show that if sectors are qualitatively equal, trade liberalization might lead to higher economic growth for all countries engaged. However, the empirical evidence seems to back up the idea that economic sectors are different. Important work by Rodrik (2013) shows that manufacturing, unlike other sectors, experiences unconditional convergence. The author interpreted this evidence as suggesting that technological diffusion might be a property of particular relevance for the manufacturing sector, in contrast to other sectors[9].

A recent article by Atkin, Costinot, and Fukui (2021) provides both theory and evidence that support the idea that qualitative sectoral differences do exist and that trade can therefore lead to dynamic welfare losses for countries specializing in traditional sectors. The authors construct a model of trade and development where sectors differ in their economic complexity, which in turn exerts positive effects on the growth of the countries producing them. The authors demonstrate theoretically that if international competition is tougher in more complex goods, then trade leads to dynamic welfare losses for most countries in the globe, only excluding a few ones that remain specialized in the production of complex goods. They then provide causal evidence that growth (and thus welfare) of a country is indeed positively affected by the average level of complexity of the goods the country is specialized in. And they show crucial evidence that suggests competition is indeed tougher in more complex goods. They conclude that "[t]hrough the lens of our model, rather than pushing

[8] Highly dynamic activities, in comparison to less dynamic, refer to sectors characterized by greater learning-by-doing or innovative potential than other sectors.

[9] This can be interpreted as evidence supporting the models by Stiglitz (2015) and Hoyos (2021) where international knowledge spillovers exist, but they only materialize through the more dynamic sector, so trade leads to uneven growth.

countries up the development ladder, opening up to international trade tends to hold many of them back" (Atkin et al., 2021, p. 42).

In synthesis, the initial economic structure, as reflecting initial comparative advantage in more or less dynamic sectors, determines the direction of the impact tariffs have on growth. Countries with a comparative advantage in less (more) dynamic sectors that open to trade may experience GDP and welfare losses (gains).

How to account empirically for initial economic structures? For simplicity and ease of interpretation, I use the initial share of manufacturing exports as the variable to capture it. In other words, I assume that countries with high manufacturing exports have a comparative advantage in more dynamic goods and those with low exports have a comparative advantage in less dynamic sectors. This implies that manufacturing is understood to be in broad terms the relatively more dynamic sector and that the share of manufacturing exports captures comparative advantage in manufacturing. The first condition seems to be backed by the evidence provided by Rodrik (2013), as already mentioned, and the second is supported by the data used here[10].

3 Data and descriptive statistics

I put together a panel of 161 countries covering 1960 to 2019. For the outcome variable in the growth regressions, I use the data of GDP per capita in constant national prices in 2017 dollars taken from the Penn World Table (PWT) 10.0. The tariff data are taken from Furceri et al. (2022) and represent the average tariff rate applied to imports in each country on a given year, covering from 1960 to 2014. The coverage of tariff data is lower than that of the GDP data, so I end up using approximately 4,700 observations in the regressions.

To capture economic structure, I gather information on shares of manufacturing exports from COMTRADE data, cleaned by the Growth Lab at Harvard University. I calculate the share as follows. First, I exclude services exports and exports not elsewhere classified, ending up with a measure of total goods exports. And then, I get the shares by excluding exports in three broad categories of goods from the Standard International Trade Classification (SITC): (i) food and live animals chiefly for food; (ii) crude materials, inedible, except fuels; and (iii) mineral fuels, lubricants and related materials[11]. The data cover most countries in the sample and run from 1962 to 2019.

[10]The correlation between the share of manufacturing exports and revealed comparative advantage in manufacturing is 0.98. The results obtained by using revealed comparative advantage in manufacturing, Figure A6, are virtually the same as the baseline results, presented in Figure 3.

[11]Another important goods classifications is the one by Lall (2000), based on technological categories. I use this classification in a robustness check, Figure A5, and results remain basically the same.

Table 1: Summary statistics

Variables	**Observ.**	**Mean**	**St.Dev.**	**Observ.**	**Mean**	**St.Dev.**
		1960-1989			**1990-2019**	
GDP per capita	4,274	11,089.6	18,480.13	5,460	17,517.09	19,344.82
Tariff	1,675	17.73	20.27	3,367	8.01	7.06
Manufacturing share of exports	4,522	33.72	28.89	6,122	52.35	30.32
Trade share of GDP	2,999	62.68	46.19	5,173	86.69	56.36
Nontariff barriers	3,048	12.97	4.50	4,587	9.46	4.82
Polity score (institutional quality)	3,811	-1.58	7.41	4,504	3.25	6.57
Chinn-Ito Index (capital account openness)	2,465	0.35	0.32	4,945	0.50	0.36
Human capital index	3,644	1.76	0.60	4,350	2.40	0.69
Investment as a share of GDP	2,901	22.34	9.54	4,921	23.55	8.54
Gini index	1,553	34.31	10.47	2,826	38.29	9.18
Terms of trade (net export price index)	4,065	111.75	74.24	5,267	74.61	26.43
Real effective exchange rate	2,910	151.04	133.60	3,754	100.99	37.34
Growth forecast	0	-	-	5,353	3.25	5.96

Note: See the main text for a description of the variables. I present the descriptive statistics for two equal-sized periods of time for simplicity, one capturing years 1960-1989 and the second capturing 1990-2019.

I also gather information on important covariates to control for in the regressions. The dataset has country-year data on the trade share on GDP and investment as a share of GDP, taken from the World Development Indicators (WDI); the economic growth forecast, the net exports terms of trade, and the real effective exchange rate, taken from the IMF; the Gini index, taken from the Standardized World Income Inequality Database of Solt (2020); institutional quality, as measured by the Polity score; the Chinn-Ito index for capital account openness (Chinn & Ito, 2006); the human capital index in PWT, which improves on the traditional measure of years of schooling from Barro and Lee (2013) and has greater coverage; and a count variable that measures nontariff barriers, recently published by Estefania-Flores, Furceri, Hannan, Ostry, and Rose (2022). In a robustness check, I control for regional trends based on the World Bank classification: Africa, East Asia and the Pacific, Eastern Europe and Central Asia, Western Europe and other developed countries, Latin America and the Caribbean, the Middle East and the North of Africa, and South Asia.

Table 1 presents descriptive statistics of the variables that I use in the analysis. I present the summary dividing the data in two periods, 1960-1989 and 1990-2019, each capturing the same number of years and reflecting two different periods in terms of tariff levels. In the first period, tariffs are higher and more dispersed, with a mean of 18.43 percent and a standard deviation of 20.92, while in the second, the mean is 8.24 percent and the standard deviation 7.56. This grouping in two periods is made only to illustrate that the world has been moving towards a more liberal trade regime. The periods also reveal that the information on tariffs in the first period is scarcer than in the more recent one. Moreover, consistent with a more liberal regime, trade as a share of GDP has increased on average. Likewise, capital accounts have also moved towards liberalization, as captured by the Chinn-Ito index. GDP per capita, institutional quality, and human capital improved from the first to the second period. Inequality, as documented extensively elsewhere, increased. The growth forecast is available only from 1990 onward.

4 Baseline results

In this section, I establish the baseline results based on LP-DiD. I develop this section in three parts. First, I explain LP-DiD and its advantages and limitations. Second, I use LP-DiD to observe and then model pretrends to avoid clear violations of the parallel trends assumption. To this end, I abstract from heterogeneity and focus only on tariff changes in general. Third, I present the baseline results, according to which tariff reductions lead to lower (higher) GDP per capita for nonmanufacturer (manufacturer) countries.

4.1 Local projections difference-in-differences (LP-DiD)

The LP method, originally proposed by Jordà (2005), has become a well-known and widely used approach in macroeconometrics. Recent work by Dube et al. (2022) has advanced an estimator based on the seminal LP contribution but also going beyond by including a discussion of recent challenges of difference-in-differences literature, the LP-DiD estimator. LP-DiD is specifically useful for the question on the tariffs-growth nexus as it allows to estimate dynamic effects of tariffs and also capture pretrends by flexibly controlling on observables to avoid potential biases coming from violations of the parallel trends assumption. I explain these advantages in more detail below.

First, LP-DiD, although this applies for LP in general, provides a simpler form of estimating dynamic effects that arguably performs better in terms of biases as compared to VARs. LP capture the effect of a shock or a treatment on the outcome variable by estimating a regression for each horizon studied, while VARs estimate only one regression with the lags of the outcome variable as regressors, so that their coefficients capture a parametric dynamic relation. According to Ramey (2016) and Nakamura and Steinsson (2018), the advantage of LP over VARs is precisely that the former does not assume any structure for the data-generating process (semiparametric estimates), particularly regarding the dynamic relation between the treatment and the outcome. In the words of D. Li, Plagborg-Møller, and Wolf (2021), "empirically relevant DGPs are unlikely to admit finite-order VAR representations, so mis-specification of VAR estimators is a valid concern" (p. 31). These authors demonstrate that LP leads to lower biases but higher variance than VARs[12].

This ability estimate medium-term dynamic effects is advantageous with respect to previous estimates in the empirical literature. The literature has usually captured only instantaneous effects (as in Wacziarg and Welch (2008)) or captured medium-term effects by doing regression analyses on averages of GDP measures for long periods of time (i.e., between 12 to 28 years, in the case of Nunn and Trefler (2010), 15 years in the case of Estevadeordal and Taylor (2013), 10 years in the case of Yanikkaya (2003), and 5 years in DeJong and Ripoll (2006)). In the first case, capturing only instantaneous effects does not actually reflect the mechanisms derived from the reviewed theory on trade and growth, which points to a relocation of factors of production and technological changes, mechanisms that take time to emerge. The second operationalization, although arguably capturing medium-term effects, does not in fact capture dynamic effects and leads to regressions with small samples, ranging from 47 observations to a maximum of 260.

Second, LP-DiD allows to model pretrends and avoid biases coming from clear violations of the parallel trends assumption, as investigated and formalized by (Dube et al., 2022). Simple LP estimates allow to observe the trajectory of the outcome

[12] This feature is actually reassuring with respect to the validity of the estimates in the paper, as they are significant even under this problem of inefficiency of LP.

variable both after and before the treatment. In this setting, I observe GDP trends in countries that reduced tariffs in comparison to those of countries that did not. This pattern can be observed in Figure 1. The surge in GDP before tariff reductions constitutes a clear violation of the parallel trends assumption on which the difference-in-differences analysis is predicated. One of the main ideas behind LP-DiD is to use the flexible LP framework to model pretrends on observables, similar to what was done recently by Acemoglu, Naidu, Restrepo, and Robinson (2019). Particularly, the LP-DiD specification proposed by Dube et al. (2022) consists on modelling those pretrends through the inclusion of lags of first differences of the outcome variable (i.e., here, lags of growth rates). By doing this, they show that biases coming from pretrends can be effectively eliminated, so that in the case here I might be able to model the surge and eliminate the potential selection bias arising from it[13].

4.2 Pretrends to tariff changes

Are countries reducing tariffs on a different trajectory of GDP per capita than those not changing them? For now, I abstract from the heterogeneity in the tariffs-growth nexus linked to the economic structure and observe the trajectory of tariff changes in general. A LP equation to observe the evolution of (log) GDP per capita before and after a change in tariffs, based in Jordà (2005), is given by:

$$y_{c,t+h} - y_{c,t-1} = \beta_h \Delta TA_{c,t} + \alpha_t + \epsilon_{c,t} \tag{1}$$

where $y_{c,t+h}$ stands for (log) GDP per capita in country c in year $t+h$ and $\Delta TA_{c,t}$ refers to the change in the tariff level in year t with respect to year $t-1$, the variable of interest. To observe both the trajectory of GDP per capita before and after the treatment, I estimate this regression equation separately for each $h = -15, -14, ..., 0, ..., 19, 20$. In other words, this local projection equation basically regresses the cumulative change in (log) GDP per capita in year $t+h$ against the change in tariffs at time t. The cumulative change in GDP per capita in $t+h$ related to a one-percentage-point increase in tariffs is captured by β_h. Following Dube et al. (2022), I include only time fixed effects, as the equation is already in differences[14].

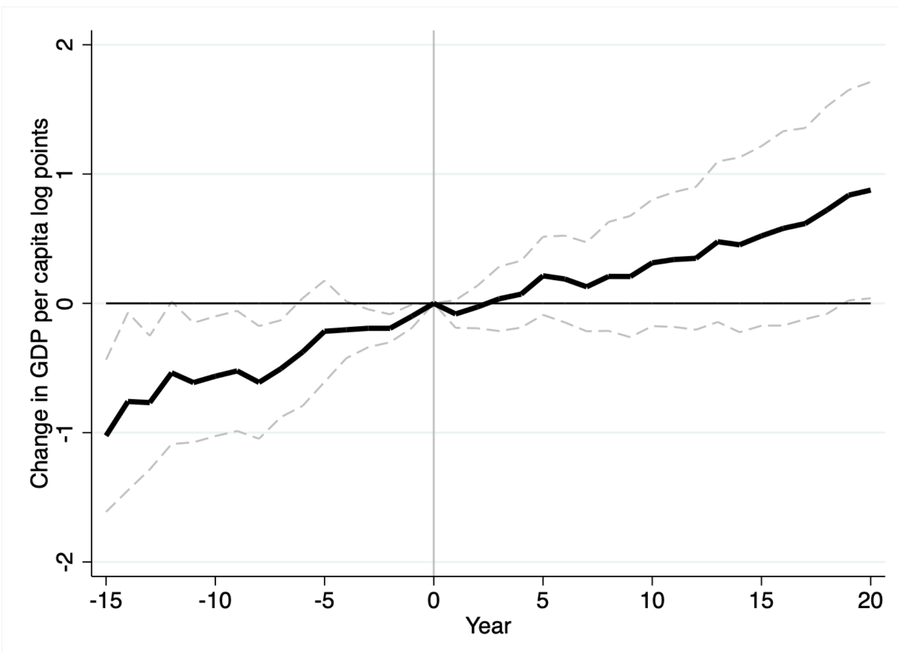
A couple of comments regarding the presentation of results are in order, as they will apply for all results presented in the paper unless otherwise specified. Instead of presenting results associated to an increase in one percentage point in tariffs, I present the results associated with a decrease in one-standard-deviation of the change in tariffs, $SD(\Delta TA)$, a decrease in 3.65 percentage points. For example, in terms

[13] Another crucial component of the LP-DiD estimator is to use clean controls to address the challenges identified by recent difference-in-differences literature. I discuss and develop this further in the next section.

[14] I include country fixed effects later as a robustness check, and the heterogeneity holds.

of equation 1, instead of plotting β_h I show $(-1) * SD(\Delta TA) * \beta_h$. And I also do the same for the heterogeneous results later shown. I do this for two reasons. First, most of the changes in tariffs in the data are decreases, consistent with the general trend towards liberal trade regimes in the last thirty years. Second, as shown in the Appendix in Figures A1 and A2, by separating the effects of both increases and decreases I only find significant effects for tariff reductions. This means that the average effect of tariffs presented in the paper are driven mainly by decreases in tariffs. And finally, I present the results scaled to one-standard-deviation, so they have an order of magnitude related to the changes in tariffs observed in the data. The other important aspect of the results presented across the text is that I use two-way cluster robust standard errors, in the country and year dimensions, making the inference even more robust (Thompson, 2011; Cameron, Gelbach, & Miller, 2011).

Figure 1: GDP per capita before and after a one-standard-deviation tariff reductions



Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

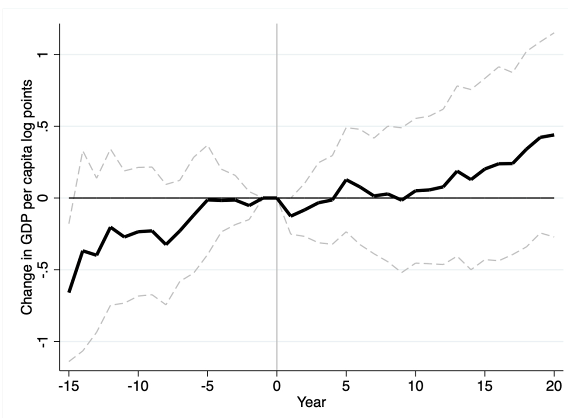
The results associated to equation 1 are presented in Figure 1. As can be observed, countries reducing their tariffs are on different pretrends from those not changing them. In particular, the former countries display a relative surge in GDP before tariff reductions as compared to the latter. In other words, tariff changes are endogenous to the evolution of GDP, such that countries that decide to decrease tariffs do so after GDP has been on a relative increase. Failure to control for this surge constitutes a clear violation of the parallel trends assumption and may lead to biases in the treatment effect estimates. How to deal with this violation of the parallel trends assumption? As mentioned before, following the approach by Dube et al. (2022) I model pretrends through lags of growth rates of GDP per capita.

Formally, the LP-DiD equation to control for pretrends is:

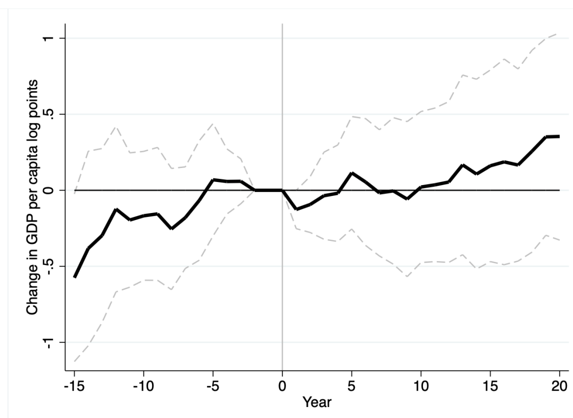
$$y_{c,t+h} - y_{c,t-1} = \beta_h \Delta TA_{c,t} + \sum_{j=1}^{1,2,4,8} \sigma_h^j g_{c,t-j} + \alpha_t + \epsilon_{c,t} \tag{2}$$

where, unlike in equation 1, I also include lags of the growth rate of GDP per capita to capture the surge in GDP preceding tariff reductions. The growth rate, $g_{c,t}$, is calculated simply as $y_{c,t} - y_{c,t-1}$, given that y already represents (log) GDP per capita. I use 1, 2, 4 or 8 lags of the growth of GDP per capita to test various alternatives to model effectively the surge in GDP.

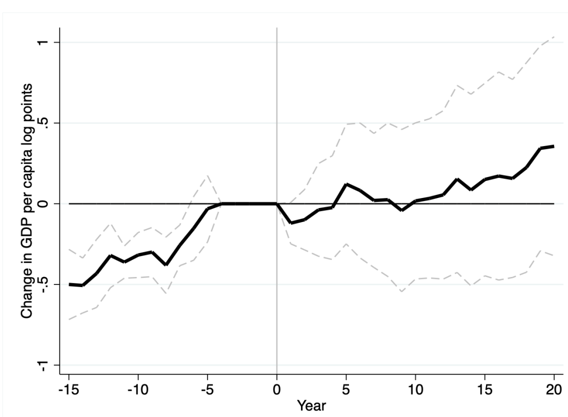
Figure 2: Modeling the surge in GDP per capita through lags in growth rates



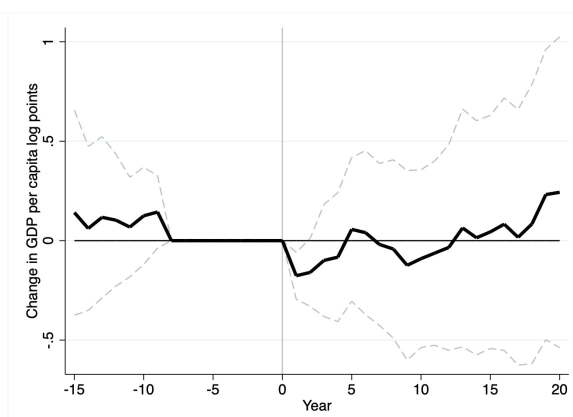
(a) 1 lag



(b) 2 lags



(c) 4 lags



(d) 8 lags

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

The results of the estimates of equation 2 are presented in Figure 2. Only in the case with 8 lags am I able to obtain equal trajectories for countries reducing tariffs and countries not changing them. More importantly, effects estimates change substantially when controlling for pretrends. While Figure 1 shows that GDP significantly increases twenty years after tariff reductions, Figure 2, with 8 lags, effectively modeling pretrends, shows that the effect estimates are less than half in magnitude and no longer significant. Therefore, from here onward, I add 8 lags of growth rates to avoid selection biases from the surge in GDP. If the researcher were to stop at this point, tariff changes and growth would appear to be uncorrelated, but that result would mask important heterogeneity, as I proceed to show below.

4.3 Results

I now return to the main question of interest: do tariff changes have different effects on countries in relation to their economic structure? More precisely, is there evidence that trade liberalization may differently nonmanufacturers and manufacturers?

To capture the heterogeneous effects of tariffs in relation to economic structures, I have to change the regression equation. The new LP-DiD equation is as follows:

$$y_{c,t+h} - y_{c,t-1} = \beta_h \Delta TA_{c,t} + \theta_h int_{c,t} + \phi_h m_{c,t} + \sum_{j=1}^{8} \sigma_h^j g_{c,t-j} + \alpha_t + \epsilon_{c,t} \tag{3}$$

where $m_{c,t}$ represents the initial share of manufacturing exports and $int_{c,t}$ represents the interaction (multiplication) between changes in tariffs $\Delta TA_{c,t}$ and the initial share of manufacturing exports $m_{c,t}$. The initial share of manufacturing exports, $m_{c,t}$, is calculated as the average of this variable in the five years before tariff reductions, to avoid contemporaneous endogeneity that may run from GDP to manufacturing exports. With this specification, the impact of tariff changes on growth varies with the initial level of the manufacturing share of exports. For example, if I want to calculate the cumulative change in GDP per capita at time $t + h$ in relation to a one-standard-deviation tariff reduction for a country with an initial manufacturing share of exports of 29 percent, I estimate it by calculating $(-1) * SD\,(\Delta TA) * (\beta_h + 29 * \theta_h)$.

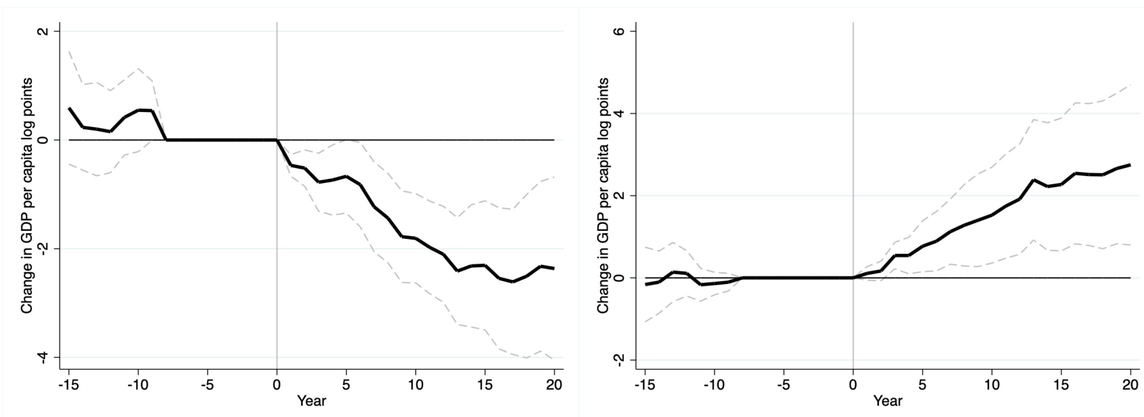
To display the significance of the heterogeneous effects of tariffs on growth, I plot the estimates for the 10th and the 90th percentiles of the share of manufacturing exports. In other words, I present the estimated impact on GDP per capita of a one-standard-deviation reduction in tariffs for a country with an initial share of manufacturing exports of 3.96 percent and a country with an initial share of 88.26 percent[15]. From now on, I refer to the former estimates as those of nonmanufacturer

[15] The reader may recall that the Appendix shows separate effects estimates for tariff increases and

countries and to the latter as the estimates of manufacturer countries[16].

Figure 3 reveals the results associated to equation 3, capturing average effects of tariff reductions for manufacturer and nonmanufacturer countries. The crucial result is that there is a significant heterogeneous effect of tariffs on GDP per capita associated with the initial share of manufacturing exports. For nonmanufacturer countries, the effect is negative, meaning that the liberalization of trade policy has affected them negatively. For manufacturer countries, on the other hand, liberalizing their trade regimes have affected them positively. Both subfigures in 3 also reveal that the pretrends are not different, which is reassuring on the specification with 8 lags of growth rates to avoid selection biases.

Figure 3: Average heterogeneous effects of tariff reductions on GDP per capita



(a) For nonmanufacturer countries

(b) For manufacturer countries

Note: The estimates presented are the predicted values for the 10th and 90th percentiles of the distribution of the share of manufacturing exports. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

The heterogeneity of the tariffs-growth nexus by economic structure is both statistically and economically meaningful. For nonmanufacturer countries, a one-standard-deviation reduction in tariffs leads to an average decrease of 2.31 percent in GDP per capita after 15 years. For manufacturer countries, on the other, a one-standard-deviation decrease in tariffs leads to an average increase in GDP after 15 years of approximately 2.32 percent. The effects seem to stabilize after ten years, but the difference in levels persists even twenty years after the tariff reductions. According to Estevadeordal and Taylor (2013), the median reduction in tariffs following the Washington Consensus of the 1990s was by 25 percentage points. Assuming a constant marginal effect of tariffs, a 25-percentage-point reduction in tariffs would imply a fall

tariff reductions, only the latter being significant.

[16]In Figures A3 and A4 in the Appendix, I show that for only two deciles—the 50th and 60th—I obtain results with no significant effect. The effect is thus stronger for nonmanufacturer countries.

in GDP per capita after 20 years of about 15.8 percent for nonmanufacturer countries. To illustrate how important these magnitudes are, the Norwegian economy grew by 15.9 percent between 2000 and 2019, virtually the same magnitude than the 20-year impact from tariffs that I obtain.

Throughout the rest of the paper, I use the specification of heterogeneous effects of tariffs on growth from equation 3. However, this specification is premised on two important assumptions that need to be examined. First, the baseline specification assumes that the impact of tariffs is a linear function of the share of manufacturing exports, but this is not guaranteed a priori. To test for a nonlinear relationship, I change the regression specification by introducing dummies for six quantiles of observations according to their initial share of manufacturing exports and the interactions between these dummies and the change in tariffs. The new equation is as follows:

$$y_{c,t+h} - y_{c,t-1} = \beta_h \Delta TA_{c,t} + \sum_{k=1}^{6} \theta_h^k intd_{c,t}^k + \sum_{k=1}^{6} \phi_h^k md_{c,t}^k + \sum_{j=1}^{8} \sigma_h^j g_{c,t-j} + \alpha_t + \epsilon_{c,t} \quad (4)$$

where k now refers to quantiles of manufacturing exports, so that $k = 1$ refers to observations in the bottom 16.6 percent of that variable. Also, $md_{c,t}^k$ refers to the manufacturing dummy taking value 1 if the observation belongs to the quantile k or zero otherwise. Finally, $intd_{c,t}^k$ represents the interaction between $\Delta TA_{c,t}$ and the dummy just explained, $md_{c,t}^k$. Thus, to calculate the one-standard-deviation decrease impact for each of the six quantiles of the distribution of manufacturing exports, I estimate $(-1) * SD\,(\Delta TA) * \left(\beta_h + \theta_h^k\right)$.

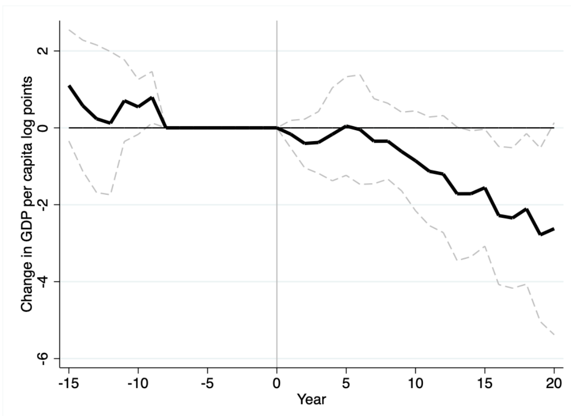
The results associated to the bottom ($k = 1, 2$) and top ($k = 5, 6$) two quantiles of estimating equation 4 are shown in Figure 4. For the first quantile of manufacturing exports, the impact on GDP per capita of reducing tariffs is negative in all the 20 years, although only statistically significant after 15 years. For the second quintile, tariff reductions lead to lower GDP per capita, with the impact being significant all 15 years after the decrease but not afterwards. For the fifth quantile, the relationship becomes positive and is significant only after 19 years of the decrease. For quantile number six, the estimates are positive and significant for all the period analyzed. Overall, the results with this specification are reassuring that there are indeed heterogeneous effects of tariffs on GDP per capita related to the initial share of manufacturing exports and that this relationship is not the outcome of the linearity assumption in the baseline results[17].

Second, in the baseline specification, I define the initial economic structure in a very specific way, namely, as the share of manufacturing exports in the five years

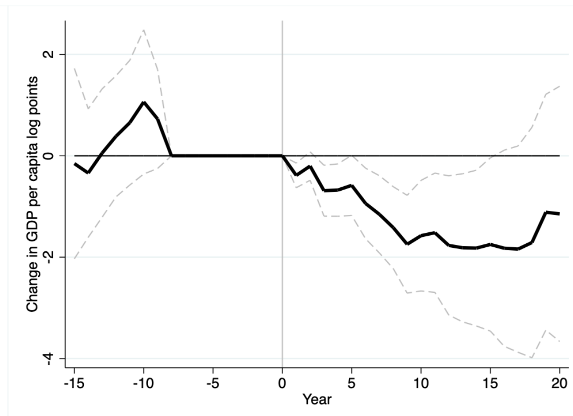
[17] I do not show the results for the third and fourth quantiles to keep the presentation simple, but they are both close to zero, consistent with the heterogeneity story.

before tariff reductions, and following the broad exports classification categories. Reassuringly, Figures A5, A6, A7 A8, A9 and A10 in the Appendix reveal that the effect heterogeneity is robust to several alternative specifications of the initial economic structure of countries, including Lall's classification of exports, revealed comparative advantage on manufacturing and a few alternatives to the lagged five-year average.

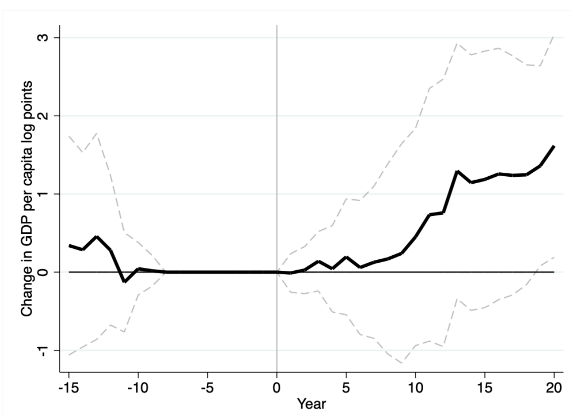
Figure 4: Average effects of tariff reductions on GDP per capita for quintiles of manufacturing exports



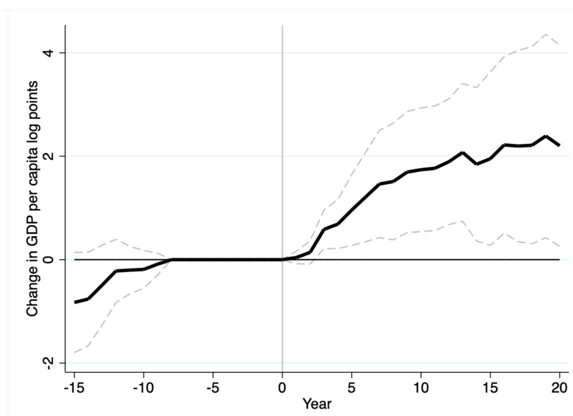
(a) First quantile



(b) Second quantile



(c) Fifth quantile



(d) Sixth quantile

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

In the Appendix, I further show that the baseline results are not driven by the specific GDP data on constant national prices from PWT that I use or by some leverage observations (or outliers). Figures A11, A12 and A13 provide robustness checks showing that the heterogeneity is also significant when using GDP per capita in constant national prices from other sources (either the World Development Indicators or the Maddison Project), and GDP per capita in constant PPP terms (from PWT). Figures A14, A15, A16, A17, A18 A19 and A20 show that the results are robust to the use of Huber (1964) weights, G. Li (1985)'s robust regression improvement on Huber weights and also hold with regressions without leverage points, following the methods proposed by Belsley, Kuh, and Welsch (1980).

5 Robustness

So far, I have shown that tariffs have different effects on GDP per capita for manufacturer and nonmanufacturer countries. I have also shown that the identifying assumption of parallel trends cannot be rejected, so the estimates may not be affected by biases from the surge in GDP that precedes tariff reductions. However, the validity of the baseline results still depends critically on the nonexistence of time-varying economic and/or political factors that might drive both changes in tariffs and changes in GDP (i.e., omitted variable biases) and thus potentially explain the estimates. Therefore, in this section I first investigate the validity of the results to important confounders in the tariffs-growth nexus.

Another source of potential concern is the biases that come from two-way fixed effects regressions, as highlighted by recent difference-in-differences literature. This literature has demonstrated that two-way fixed effect estimates under heterogeneous effects end up capturing terms beyond the causal effect of interest, so they might be severely biased (de Chaisemartin & d'Haultfoeuille, 2020; Sun & Abraham, 2021; Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Callaway, Goodman-Bacon, & Sant'Anna, 2021). To address this concern, I follow the recent work by de Chaisemartin et al. (2022) precisely designed for cases where the treatment is continuously distributed in every time period, as is here.

I end this section by providing some important additional robustness checks.

5.1 Confounders

I perform the robustness investigation on confounders in five steps. First, I show robustness checks related to variables identified as important determinants of tariffs, coming from the endogenous trade policy literature. Second, I show robustness checks with respect to other policy changes that might be associated to changes in tariffs. Third, I show the robustness of the results to consideration of economic phenomena that have been found to be important for explaining growth. For these first three steps of the robustness exercises, I simply add four lags of changes in the covariates as done by Acemoglu et al. (2019)[18]. These specifications have to be interpreted

[18] I use a different specification only for the growth forecast variable, as explained below.

with caution, since changes in these covariates may be endogenous to tariff changes, although using lags may relax this concern[19]. Fourth, I investigate the robustness of the effect heterogeneity to other possible heterogeneous effects from tariffs on growth. Finally, I investigate the robustness of the baseline results to different trends in GDP among groups of countries.

In short, this section confirms the validity of the baseline results after considering important covariates and thus confirms the existence of heterogeneity in the effects of tariffs on growth from initial economic structures. Instead of showing LP-DiD graphs for each robustness exercise, I summarize the results with Figure 5, which shows the average effect for both manufacturer and nonmanufacturer countries between 13 and 17 years after tariff reductions. Individual LP-DiD graphs for each robustness exercise can nonetheless be found in Appendix B.

Endogenous tariffs

Early in the 1980s, Findlay and Wellisz (1982) argued that trade policy in general and tariffs in particular are in practice set in response to political economy factors, particularly the active efforts or lobbying of interest groups. Important theoretical work by Mayer (1984) and Grossman and Helpman (1994) then provided formalization of this argument. These theoretical works triggered empirical work. The first factor identified to explain trade policy empirically was GDP growth. Bohara and Kaempfer (1991) presented evidence from the US that GDP growth leads to changes in tariffs—particularly, that high-growth export industries may lobby for lower tariffs to avoid future retaliatory trade policies abroad. The second factor identified was distribution itself. P. Dutt and Mitra (2002) provide evidence that higher inequality leads to higher trade protection in capital-abundant countries (arguably manufacturer countries) while lower protection in capital-scarce countries (arguably nonmanufacturer countries). And finally, Trefler (1993) shows that tariffs are particularly explained by import penetration. With data from US industries, the author provided empirical evidence that import penetration leads to lobbying and higher protection.

Given the determination of tariffs by growth, distribution itself and import penetration, the estimates might be biased if they fail to account for these potential channels of endogeneity. I explain below how I deal with these three factors.

Although the baseline framework already incorporates lags in growth rates, it might be that expectations on contemporaneous growth are what really drives tariff changes. To control for this possibility, I use growth forecast data from the World Economic Outlook of the IMF. Specifically, I calculate the change in the growth forecast for year t made in $t-1$ with respect to the growth forecast made in $t-2$.

[19] I also run the regressions with contemporaneous changes in covariates instead of lags. The results, summarized in Figure B18, are qualitatively the same: heterogeneity still holds.

This change in the forecast captures the change in expected contemporaneous growth and thus may capture the driver of tariff changes from the GDP side, as suggested by the endogenous trade policy literature. Robustness exercise number 1 in Figure 5 summarizes the results of including the change in growth forecasts in the baseline specification. As can be seen, the effect heterogeneity survives this first exercise, with the average impact on GDP 13-17 years after a tariff reduction still negative for nonmanufacturer countries but positive for manufacturer countries[20].

To control for the potential endogeneity of tariff changes arising from distribution itself, I use the Gini coefficient from the Standardized World Income Inequality Database (Solt, 2020). The results are presented in robustness exercise number 2 in Figure 5. The average effects 13-17 years after the decrease in tariffs are still significant and of different signs for manufacturer and nonmanufacturer countries.

Finally, to control for endogeneity that may arise from import penetration, I use the share of imports in GDP from the World Bank. The results are presented in robustness exercise number 3 in Figure 5. The identified heterogeneity holds. A very interesting result, not shown in the figure, is that the coefficients of the changes in the share of imports in GDP are positive and significant across the whole period considered. Importing more is associated with higher growth, but tariff reductions are still associated with lower GDP for nonmanufacturer countries[21]. This might mean that the negative impact of tariff reductions for nonmanufacturer countries might derive from a mechanism other than trade volume.

Other policies

Tariff changes are usually decided in settings where countries are also changing other types of policies. The trade liberalization of the 1990s, for instance, was part of a broad set of market reforms aimed at liberalizing economies generally—an agenda known as the Washington Consensus (Williamson, 1990). Thus, the baseline estimates can potentially be driven by other policy changes, and checking the robustness to those changes becomes necessary.

First, I consider nontariff barriers, another important component of the trade policy regime. Estefania-Flores et al. (2022) recently provided the literature with a new measure of trade restrictions in government policy, which specifically accounts for nontariff barriers[22]. The results are presented in robustness exercise number 4 in

[20] An important thing to note here is that the information on growth forecasts is available only from 1990. This is also reassuring of the validity of the baseline results, as the availability of data by country after 1990 becomes less biased towards developed countries. This also implies that the effect of tariff reductions that I estimate is essentially driven by the trade liberalization the 1990s.

[21] This result is actually in line with the finding by Yanikkaya (2003) where both tariffs and trade as a share of GDP are positively correlated with growth.

[22] The measure is a count variable made up of dummies for subcategories of trade policy, and although

Figure 5. The heterogeneity remains similar to that in the baseline results [23].

The second policy change that I test robustness for is capital account openness. Usually, trade liberalization occurs alongside capital account liberalization. The results are presented in robustness exercise number 5 in Figure 5. Reassuringly, the results again point to a significant effect heterogeneity.

Third, I test the robustness of the results to changes in institutional quality. As shown elsewhere, institutional quality is considered a fundamental to explain long-run economic outcomes (Acemoglu et al., 2019). The results are presented in robustness exercise number 6 in Figure 5. The effect heterogeneity holds.

Relevant variables that explain growth

Another threat to the validity of the baseline results comes from relevant covariates proven to affect GDP that might also be correlated with tariff changes. To provide reassurance on the validity of the baseline results, I control for each of them in turn.

First, I test for the possibility that the results might be affected by changes in human capital. The results are presented in robustness exercise number 7 in Figure 5. Changes in human capital do not drive the results, such that the heterogeneity of the effect of tariffs remains significant.

Second, I test the robustness of the results to changes in population size. The results are presented in robustness exercise number 8 in Figure 5. The heterogeneous effects of tariffs on GDP conditional on the initial economic structure remain similar to those found in the baseline.

Third, I test the robustness of the results to changes in trade as a share of GDP. Results are presented in robustness exercise number 9 in Figure 5. The heterogeneous effects of tariffs on GDP conditional on the initial economic structure once again remain significant. Additionally, changes in trade as a share of GDP are positively associated with GDP across the whole period studied, consistent with the finding regarding imports penetration.

Fourth, I consider changes in capital accumulation, usually the short-run driver

it does not capture how restrictive policies are in themselves (e.g., import tariffs are captured with a dummy, ignoring the tariff level), it does provide a novel measure of how many restrictive trade policies a country has in each year. For the exercise, I use the variable that counts only nontariff barriers, excluding the dummy on tariffs, as they are already captured in the regressions.

[23] Although not shown here, changes in nontariff barriers have no significant effect on GDP in the whole period studied. This result contrasts with that presented by Estefania-Flores et al. (2022), where changes in trade restrictions in general (including the dummy on tariffs) were found to relate to a fall in GDP. I do replicate that result when controlling for the contemporaneous change in nontariff barriers instead of the four lags that I originally use. The effect heterogeneity from tariffs holds even in that case, as shown in Figure B19.

of growth. According to standard trade theory, countries with less abundant capital might choose to protect capital-intensive sectors such that changes in investment levels might provide reasons to change tariffs, thus biasing the estimates. The results are presented in robustness exercise number 10 in Figure 5. The heterogeneous effects remain significant.

Fifth, I test the results to changes in the real exchange rate. Tariff changes can be related to real exchange rates changes, that have been in turn shown to affect GDP (Rodrik, 2008), such that the baseline estimates might be biased. The results are presented in robustness exercise number 11 in Figure 5. The identified heterogeneity is still significant.

Finally, I test the robustness of the results to changes in the terms of trade. It can bee thought that the relation between tariffs and terms of trade runs only from the former to the latter, but I cannot discard a priori that changes in the terms of trade lead to changes in tariffs, biasing the baseline results. The results are presented in robustness exercise number 12 in Figure 5. The heterogeneity is still significant.

Other heterogeneous effects

The main point of this paper is that there are heterogeneous effects of tariffs on GDP in relation to the initial economic structure. Nevertheless, there might be other relevant heterogeneities at play in the effects of tariffs that might drive the results, making the estimates invalid. Two heterogeneous effects might be important. First, although I interpret the theoretical literature mainly pointing to heterogeneity from economic structures, some works talk about distance to the frontier (see Acemoglu, Aghion, and Zilibotti (2006) for an example) as the source of heterogeneity, which might be more adequately captured by initial income. Second, according to one of the models developed by Lucas (1988), uneven development might be the outcome of free trade if economic sectors differ in terms of their potential for human capital accumulation. In other words, human capital, rather than the economic structure, might be the source of heterogeneous effects of tariffs.

I first test the robustness of the results to the inclusion of an interaction between the change in tariffs and initial GDP per capita. To do so, I include in the regression the average GDP per capita for the five years before the change in tariffs and the multiplication of this term with the change in tariffs as covariates. The results are presented in robustness exercise number 13 in Figure 5, where I assume the median level of income to calculate the predicted values. The heterogeneity in relation to the initial economic structure still holds.

As mentioned, I also test the robustness of the results to a possible heterogeneous effect based on human capital accumulation. I introduce this possible source of heterogeneity in the same way that I did with the one coming from income. I include the average value of human capital in the five years prior to the change in tariffs and its multiplication with the change in tariffs in the regression. The results are presented in robustness exercise number 14 in Figure 5, where I assume the median level of human capital to calculate the predicted values. The effect heterogeneity still holds.

Interestingly, although not shown here, I also find that the interactions between human capital and changes in tariffs are negative and significant for most of the years studied. In other words, for countries with low levels of human capital, tariff reductions may lead to lower growth, while countries with high levels of human capital will gain in GDP terms from tariff reductions. Although not the focus of the paper, Lucas (1988)'s hypothesis receives support from the evidence found here.

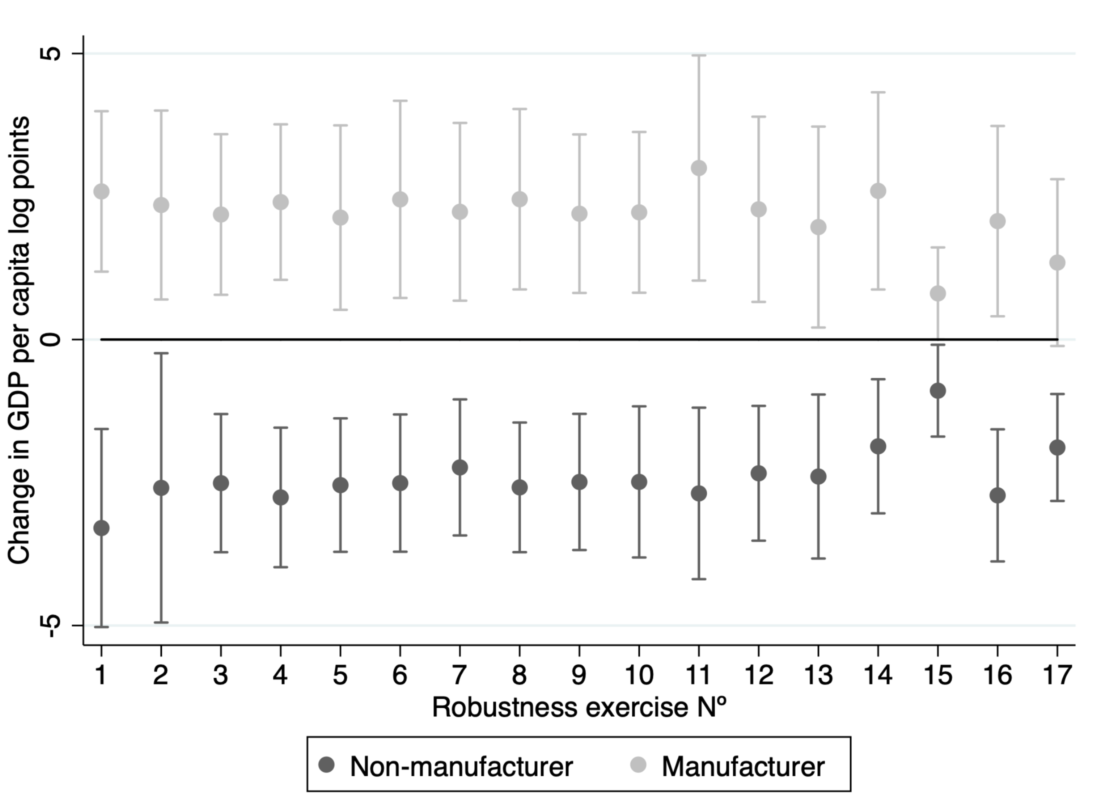
Different trends

Up to this point, the most important threats to the validity of the finding of heterogeneous effects could come from countries (and specific groups of them) with either different time-invariant average growth rates or different trends in GDP. First, I test the robustness of the results to the inclusion of country fixed effects. Second, I add specific time trends for countries in different income groups. Third, I control for trends of different regions of countries. Reassuringly, the effect heterogeneity is robust to these checks, as shown in robustness exercises 15, 16 and 17 in Figure 5.

Overall, the results in Figure 5 are reassuring that there is significant heterogeneity in the effect of tariffs on GDP per capita depending on initial economic structures. Reducing tariffs has been bad for growth in nonmanufacturer countries but good in manufacturer countries. Although claiming causality is always difficult, I think these estimates are suggestive of a causal relationship. It is important to clearly establish the assumption that allows me to suggest a causal effect. Conditional on the inclusion of lags of growth rates and consideration of important covariates, changes in tariffs are assumed as good as random. Although there might be other phenomena that could drive both tariff changes and GDP per capita changes, the robustness exercises that further relax this assumption suggest that this is not likely the case[24].

[24] In Figure B19, I also show results of the estimates including all control variables at the same time. Although this exercise is extremely demanding, and I lose a lot of statistical power, the direction of the heterogeneous effects still holds and with statistical significance around 13 years after tariff changes. Overall, this reassures that the heterogeneity is not being driven by correlations between covariates, which were not captured when controlling for each covariate in turn.

Figure 5: Robustness: average effect between 13-17 years after tariff reductions



Note: The estimates presented are the predicted values for the 10th and 90th percentiles of the distribution of initial manufacturing exports. The coefficients display the average of the average effect for each year between 13 and 17 years after tariff reductions. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level. Exercise 1 is the outcome of estimating equation 3 with the change in the growth forecast as a covariate. Exercise 2 is the outcome of estimating equation 3 with four lags of the change in the Gini coefficient. Exercise 3 is the outcome of estimating equation 3 with four lags of the change in import penetration. Exercise 4 is the outcome of estimating equation 3 with four lags of the change in nontariff barriers. Exercise 5 is the outcome of estimating equation 3 with four lags of the change in capital account openness. Exercise 6 is the outcome of estimating equation 3 with four lags of the change in Polity. Exercise 7 is the outcome of estimating equation 3 with four lags of the change in human capital. Exercise 8 is the outcome of estimating equation 3 with four lags of the change in the population size. Exercise 9 is the outcome of estimating equation 3 with four lags of the change in trade openness. Exercise 10 is the outcome of estimating equation 3 with four lags of the change in investment. Exercise 11 is the outcome of estimating equation 3 with four lags of the change in the real exchange rate. Exercise 12 is the outcome of estimating equation 3 with four lags of the change in the terms of trade. Exercise 13 is the outcome of estimating equation 3 with heterogeneous effects from income. Exercise 14 is the outcome of estimating equation 3 with heterogeneous effects from human capital. Exercise 15 is the outcome of estimating equation 3 with country fixed effects. Exercise 16 is the outcome of estimating equation 3 with different trends for country groups by income. Exercise 17 is the outcome of estimating equation 3 with different trends for country regions.

5.2 Clean controls analysis

Recent contributions on difference-in-differences have shown that standard estimates based on two-way fixed effects regressions under the parallel trends assumption are not entirely reliable (de Chaisemartin & d'Haultfoeuille, 2020; Goodman-Bacon, 2021). This literature has shown that under treatment heterogeneity and differential treatment timing, estimates might be biased. The biases arise from using units as part of the control group that, even though they may not receive any treatment in the period of interest, have been treated before. The solutions devised so far thus require the existence of "clean controls", that is, observations never treated or not treated before the time horizon at which the effect is estimated, which is the base for the new estimators that have been recently proposed (Callaway & Sant'Anna, 2021; Sun & Abraham, 2021; de Chaisemartin et al., 2022).

The baseline results can potentially be biased due to the use of "bad controls", as I used there all available country-year observations. In this setting, the treatment group comprised the observations with the largest changes in tariffs, in absolute value, while the control group was composed of countries with lower changes, in absolute value. Inference is thus made by exploiting variation in tariff changes. The problem, however, is that tariff changes at the country level occur every year, so heterogeneity in treatment timing is pervasive in this setting, and biases stemming from it could be as well. A country-year observation with a relatively low tariff change is a "bad control" because the effect can be larger for that country as compared to one with a large tariff change and also because that country might have experienced a tariff change before (de Chaisemartin & D'Haultfœuille, 2022). This problem is actually pervasive in difference-in-differences analyses with treatments continuously distributed every time period[25].

A solution to estimating treatment effects with treatments continuously distributed every time period has been recently proposed by de Chaisemartin et al. (2022), and we therefore follow it closely. The authors propose to use movers as treatment observations and quasi-stayers as control observations. A quasi-stayer is defined as an observation where changes in treatment intensity (i.e., tariff changes) are almost negligible, so that assuming treatment doesn't change is justifiable. It is actually easy to identify quasi-stayers in the tariffs-growth setting. In most years since 1960, countries do not really change their average tariffs, but slight variation still appears in the data, perhaps in some cases due to errors in the collection process. More specifically, the 25th percentile of tariff changes is -0.76 percentage points, and the 75th percentile is 0.35 percentage points, so that most tariff changes are relatively small. Therefore, to differentiate between movers and quasi-stayers, I propose a definition for *relevant* tariff changes. A tariff change is *relevant* if it is one-standard-deviation separated from the mean tariff change[26]. The implication of this definition

[25]The now widely used estimators proposed by Callaway and Sant'Anna (2021) or Sun and Abraham (2021) are not helpful for the tariffs-growth cross-country setting studied in this paper, as they are not suited to continuous treatments that might change every time period.

[26]This is in a sense similar to the LP application by Girardi, Paternesi Meloni, and Stirati (2020) analyzing dynamic effects of public spending.

is that quasi-stayers are those observations with tariff changes that are not *relevant* and the movers are those with *relevant* ones[27].

The previous definition is not enough to circumvent the problem of "bad controls". For example, an observation of a country in 1995 with no *relevant* tariff change, a quasi-stayer, is still a "bad control" if that country experienced a *relevant* tariff change in 1990. Moreover, tariffs have been in place way before 1960 and countries usually experience more than one *relevant* tariff change in the sample, so having "clean control" observations in this setting is almost impossible. Nevertheless, what matters to get a "clean control" country-year observation is not that the country never experienced a *relevant* tariff change before, but that the dynamic treatment effect of that previous treatment has stabilized at the moment of the analysis (Dube et al., 2022). In other words, what matters is that the *relevant* tariff change of 1990 led to a new GDP level that has stabilized in 1995, and thus the quasi-stayer observation in 1995 is not in a differential trend as compared to the movers in that year. When have the effects of tariff changes stabilized in this setting? By observing Figure 3, it seems treatment effects stabilize approximately ten years after tariff reductions. Based on that, I further assume that a quasi-stayer country-year observation can only be used as a control if the country has not experienced a *relevant* tariff changes in the previous ten years, what I call the ten-year rule[28].

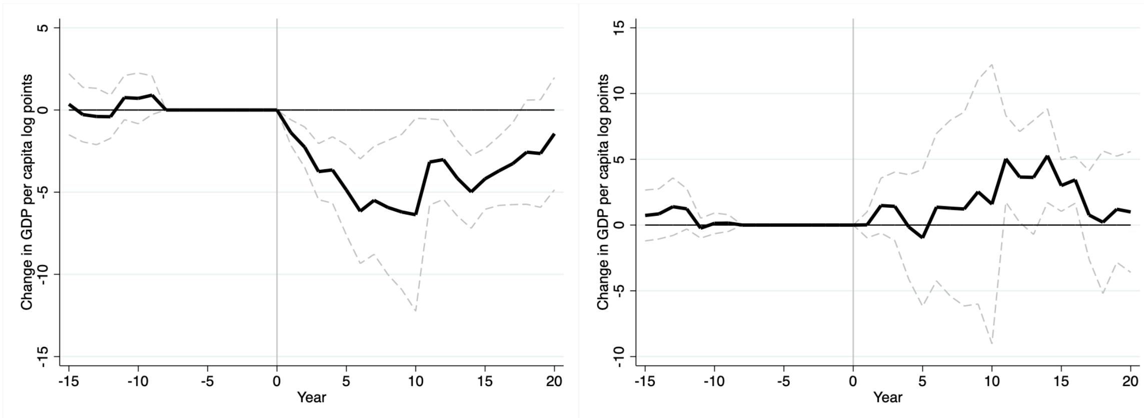
I thus implement a clean controls analysis following the idea by de Chaisemartin et al. (2022) by relying on the definition of quasi-stayers based on *relevant* tariff changes and the ten-year rule. In practice, that means estimating the LP-DiD specification from equation 3 but only including both mover and quasi-stayer observations that satisfy the ten-year rule.

The results of this clean controls analysis are shown in Figure 6. They are much noisier than those of the baseline, as I lose not only variation in tariffs (*relevant* tariff changes happening a couple years after another one are not included) but also observations to compare them with (quasi-stayer observations are also excluded as some of them might be "bad" by the effect of a previous treatment). Nevertheless, for nonmanufacturer countries the effect of reducing tariffs is negative in the whole period and significant for almost all of it. For manufacturer countries, on the other hand, the effect is positive almost for all the horizon analyzed, and significant from 10 to 17 years after tariff reductions. In short, the baseline results are not driven by the use of "bad controls".

[27] In Figures B20 and B21 in the Appendix, I verify the robustness of results to the use of different thresholds for defining *relevant* tariff changes, particularly half standard deviation and two standard deviations. The effect heterogeneity holds.

[28] In Figure B22 in the Appendix, I relax this assumption, by imposing that a quasi-stayer can only be part of the control group if the unit was not treated in the previous twenty years. Results still pinpoint an effect heterogeneity in the right direction, but significance is only preserved for nonmanufacturer countries.

Figure 6: Clean controls analysis of heterogeneous effects of tariff reductions on GDP per capita



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

5.3 Additional robustness

The empirical analysis so far may still be subject to criticism with respect to two issues. First, it could be the case that the correlations between past and future growth depend on whether a country is a manufacturer and that global shocks (captured by year fixed effects) might be also different depending on manufacturing status. Second, when regressing the cumulative change in GDP at time $t + h$ on the tariff change observed at time t, I ignore tariff changes occurring between $t + 1$ and $t + h$, which may lead to biases, as highlighted by Teulings and Zubanov (2014).

As mentioned, the relationship between past and future growth could depend on whether a country is a manufacturer. If so, then by estimating a single set of lagged growth controls for all countries, any heterogeneity in these correlations is effectively relegated to the error term. By the same token, it could be the case that the experience of global shocks, as captured by year fixed effects, might differ based on whether the country is a manufacturer. If this is the case, controlling for interactions between the initial economic structure and year fixed effects might capture potential biases from it. The results are presented in Figures B23 and B24 and confirm the baseline findings.

What if the impact of tariff changes that I estimate for the period $t{+}9$ is really the outcome of tariff changes happening not at t, the treatment year, but five years later? Although Teulings and Zubanov (2014) show that this effect might not be entirely ignored in the baseline specification, they show that ignoring all tariff changes can lead to biases. Thus, the robustness check is to include in the baseline framework, equation 3, all tariff changes occurring before $t+h$, not only that in time t, following their proposed solution. The results of this exercise are presented in Figure B25 in the Appendix. Although the estimates are less precise, as statistical power is lost, the effect heterogeneity holds.

6 Mechanisms

In this section, I explore the mechanisms by which tariff reductions may lead to lower GDP per capita for nonmanufacturer countries but higher for manufacturer ones. The evidence presented suggests that the mechanisms in the trade theory revised have empirical support, although this investigation can not rule other things might be also at work.

I particularly explore the impact of tariff reductions on four variables: i) productivity, ii) capital accumulation, iii) manufacturing share of GDP, and iv) share of imports in GDP. I use the following specification to analyze these potential channels:

$$y_{c,t+h} - y_{c,t-1} = \beta_h \Delta TA_{c,t} + \theta_h int_{c,t} + \phi_h m_{c,t} + \sum_{j=1}^{8} \sigma_h^j g_{c,t-j} + \sum_{j=1}^{8} \gamma_h^j \Delta y_{c,t-j} + \alpha_t + \epsilon_{c,t} \quad (5)$$

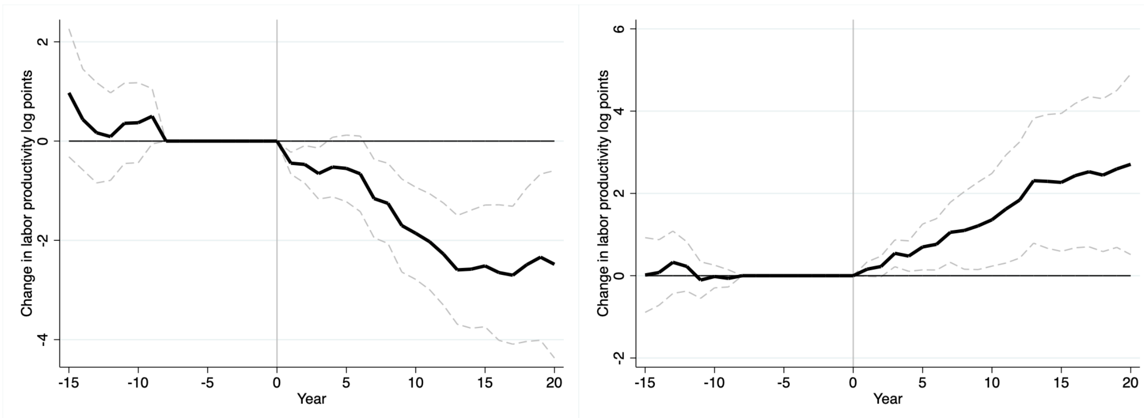
where, unlike in the baseline specification, $y_{c,t}$ refers to one of the four variables explored and also includes eight lags of the first difference in each of these variables. The regression preserves the lags in GDP growth rates and time fixed effects from the baseline regression. I once again predict the impact of a one-standard-deviation decrease in tariffs for nonmanufacturer and manufacturer countries, to graphically represent the results.

Tariff reductions lead to lower productivity in nonmanufacturer countries while higher for manufacturer ones, as shown in Figure 7[29]. According to the trade theory reviewed, that's precisely the effect heterogeneity expected in productivity terms. More deeply, reducing tariffs lead nonmanufacturer countries to specialize in the less dynamic sector, abandoning production in the more dynamic sector, so that productivity at the aggregate level ends up falling. In the same vein, reducing tariffs may increase productivity and growth in manufacturer countries, as it allows full specialization in the more dynamic sector and the associated productivity gains. The results in productivity are also statistically significant for all the horizon of analysis studied

[29] In Figure C1, I also show estimates of total factor productivity (TFP) dynamics after tariff reductions. The results point to the same heterogeneity for all the horizon of analysis but effects are only significant around 15 years after tariff reductions.

and economically meaningful (i.e., more than 2 percent reduction in productivity as the result of a one-standard-deviation decrease in tariffs).

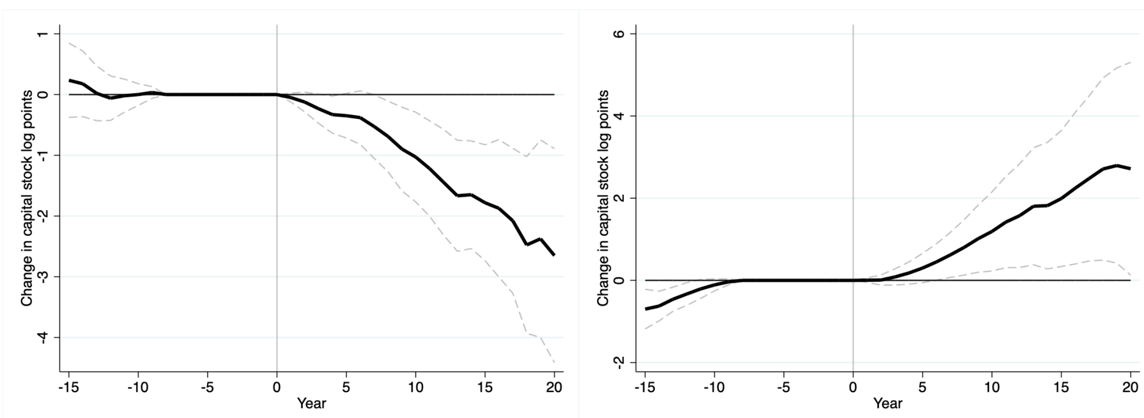
Figure 7: Average effects of tariff reductions on labor productivity



(a) Nonmanufacturer countries **(b)** Manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure 8: Average effects of tariff reductions on capital accumulation



(a) Nonmanufacturer countries **(b)** Manufacturer countries

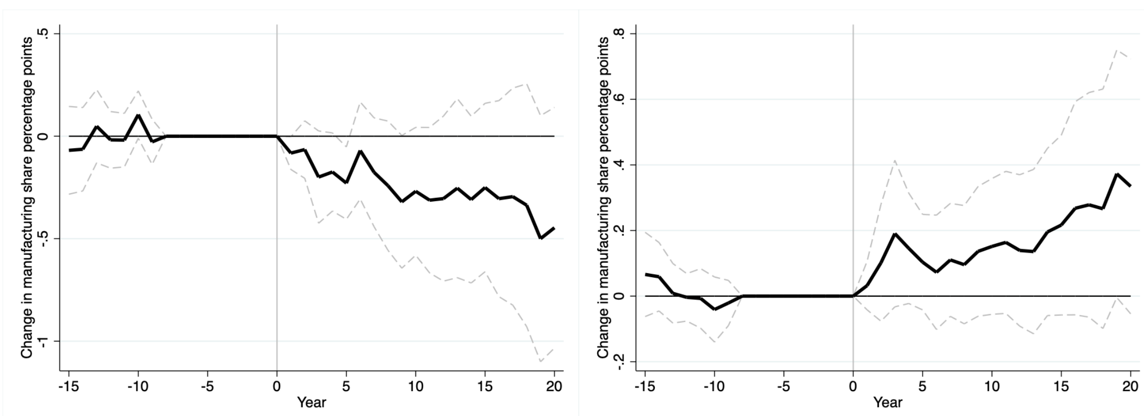
Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

As portrayed in Figure 8, the dynamics of capital accumulation after tariff reductions are also heterogeneous: falling stocks of capital for nonmanufacturer countries while increasing for manufacturers. Results are also statistically significant for all the horizon of analysis. In the same line as the previous results, as production in the more dynamic sector falls (increases) in nonmanufacturer (manufacturer) countries, capital accumulation might also fall (increase), given that the dynamic sector is more capital intensive than the average of the economy. One can also make sense of these results as they relate to the idea that capital accumulation moves in the same direction as productivity, as demonstrated extensively by the development accounting literature (Klenow & Rodriguez-Clare, 1997; Hsieh & Klenow, 2010)[30].

According to theory, the effect heterogeneity is ultimately driven by changes in the pattern of production specialization for each type of country. Figure 9 presents evidence in support of this mechanism. Tariff reductions lead to lower manufacturing shares of GDP for nonmanufacturer countries, but higher for manufacturer countries. Although the results are not significant, the direction of the effects is consistent across the whole horizon of analysis. These results suggest that tariff reductions make non-manufacturer countries to specialize more on non-manufacturing production, while manufacturer countries to strengthen its manufacturing specialization[31]. This respecialization mechanism can be also thought as the driver of the heterogeneous effects in both productivity and capital accumulation.

Figure 9: Average effects of tariff reductions on the manufacturing share of GDP

A. Manufacturing share of GDP



(a) Nonmanufacturer countries **(b)** Manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

The heterogeneous effects of tariff reductions on manufacturing shares of GDP also relate to other strands of the literature on macroeconomics of development. First,

[30]The effects on capital accumulation in this literature come from TFP changes, not labor productivity ones, which anyways is consistent with the results shown in Figure C1.

[31]Although manufacturing shares of GDP provide a good proxy, the ideal data to test the relocation mechanism are manufacturing shares of employment. Cross-country data on sectoral shares of employment is however scant.

developing economies have experienced premature reductions in their manufacturing shares of GDP in the last thirty years, arguably driven by globalization as suggested by Rodrik (2016). The evidence here presented for nonmanufacturer countries, arguably a similar group to developing countries, might be understood as backing this argument. Second, the evidence suggests manufacturing is the more dynamic sector in the economy, as analytically considered in theory. In that sense, the evidence might also be in line with that presented by Rodrik (2013), according to which manufacturing is different to all other broad economic sectors in that it is characterized by unconditional convergence at the cross-country level.

Finally, I also explore the dynamics of the share of imports in GDP after tariff reductions, as revealed in Figure C2. Results reveal that the share of imports in GDP does not significantly change after tariff reductions, for both nonmanufacturer and manufacturer countries. A priori, an increase in the share of imports is expected for both types of countries, given that imports are now relatively cheaper for both. The relocation mechanism discussed above might provide a way to understand why this is not the case. As nonmanufacturer countries deindustrialize, import demand for intermediate and capital goods might also fall, given the manufacturing sector is more reliant on them, so that even though imports of these type of goods are now cheaper the volume imported nonetheless falls. For manufacturer countries, on the other hand, the strengthening of the manufacturing sector might lead to a reduction of the import elasticity of demand, so that even though imports of manufacturing goods are now cheaper, the volume imported does not increase. Nevertheless, more work is needed to test the validity of this reasoning.

7 Conclusion

In this paper, I establish that the relationship between tariffs and growth is characterized by sharp heterogeneous effects by economic structure. In other words, I unveil the existence of heterogeneous effects of tariffs on GDP per capita depending on the initial share of manufacturing exports. More precisely, I show that the widespread reduction in tariffs around the world since 1960, particularly strong in the last 30 years, has reduced GDP per capita for nonmanufacturer countries, but increased GDP per capita for manufacturers. I establish this result by making use of a local projections difference-in-differences (LP-DiD) estimator, by which I am able to calculate the dynamic effects of tariff reductions and also control for the surge in GDP that precedes tariff reductions, to avoid it to bias the estimates. Overall, the estimates suggest that a one-standard-deviation reduction in tariffs (i.e., 3.65 percentage points) leads to an average fall (increase) of more than 2 percent in GDP per capita fifteen years later for nonmanufacturer (manufacturer) countries. The effects persist even twenty years after tariff reductions.

Although establishing causality is always difficult, the multiple robustness checks that I perform point to a solid heterogeneous relation running from tariffs to economic growth. I provide a detailed discussion of potential confounders that might be behind the effect heterogeneity documented in the paper, and reassuringly on all these robustenss the effect heterogeneity holds. Moreover, I also address recent challenges to estimating average treatment effects as highlighted in the recent difference-in-differences literature, deploying the idea by de Chaisemartin et al. (2022) of comparing movers and quasi-stayers through the LP-DiD specification.

I also show some evidence on the potential channels underpinning these heterogeneous effects of tariffs on growth. On the one hand, tariff reductions lead to lower productivity and capital accumulation for nonmanufacturer countries. On the other, tariff reductions lead to higher productivity and capital accumulation for manufacturer countries. I also show that both these changes and those on GDP might at the end be explained by changes in the manufacturing share in GDP, although results are not statistically significant. In particular, the evidence in this paper can be interpreted as supporting Rodrik (2016)'s story of premature deindustrialization, according to which developing countries have experienced early reductions—in relation to their status of development—in their manufacturing shares in GDP due to globalization in the last 30 years.

The empirical evidence that I find in this paper calls for a more nuanced view on the effects of tariffs on growth. The common view in economics, according to which a liberal trade regime is the best policy option, is not warranted. The evidence suggests that for nonmanufacturer countries trade liberalization has had a negative impact on their incomes. The paper suggests that trade protection would have impeded deindustrialization and allowed better productivity dynamics in these countries. Although the empirical evidence does not show any discernible effect of increasing tariffs, it might be possible that trade policy, hand in hand with other measures of so-called industrial policy, might encourage production in more dynamic sectors and thus higher productivity levels for nonmanufacturer countries. More work, however, is needed to clarify the validity of this argument. More generally, bridging this trade policy literature with the burgeoning one on industrial policy provides, in my opinion, an interesting venue for future research.

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Appendix

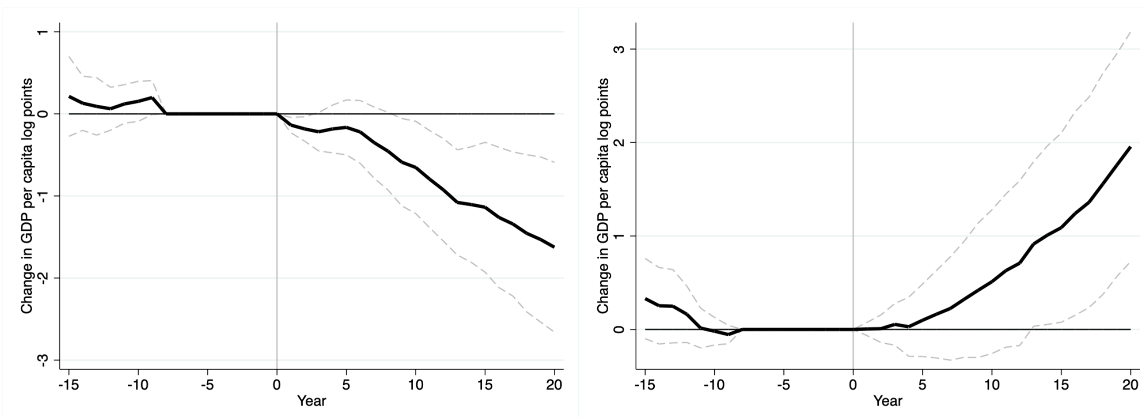
The Appendix is structured using the same section found in the main text, so that each one complements its corresponding one.

A Baseline results

Effects of increases and decreases of tariffs

The following two graphs present the average results associated to decreases of tariffs, on the one hand, and increases, on the other.

Figure A1: Average effects of tariff reductions on GDP per capita



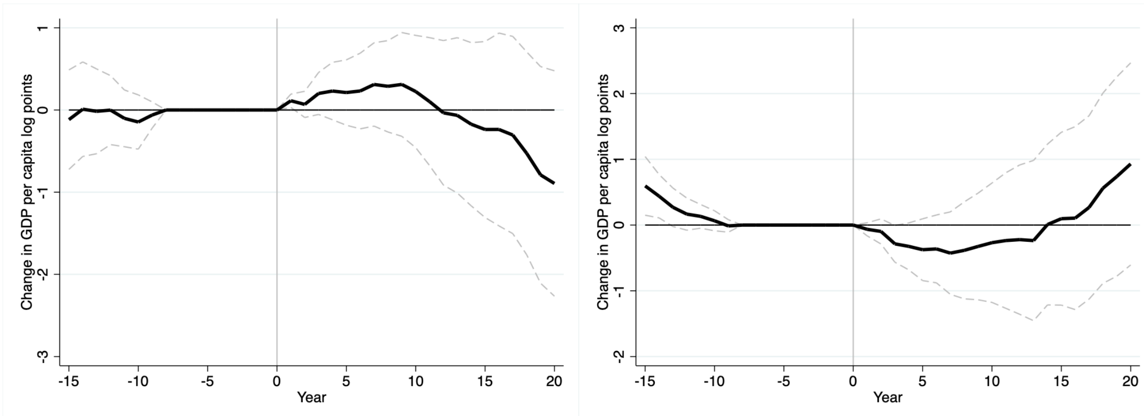
(a) For nonmanufacturer countries

(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

As it can be observed in Figure A1, tariff reductions are associated with GDP falls for nonmanufacturer countries and GDP increases for manufacturer countries. On the other hand, the effect of tariff increases, show in Figure A2, is not significant across the whole period for both type of countries.

Figure A2: Average effects of tariff increases on GDP per capita



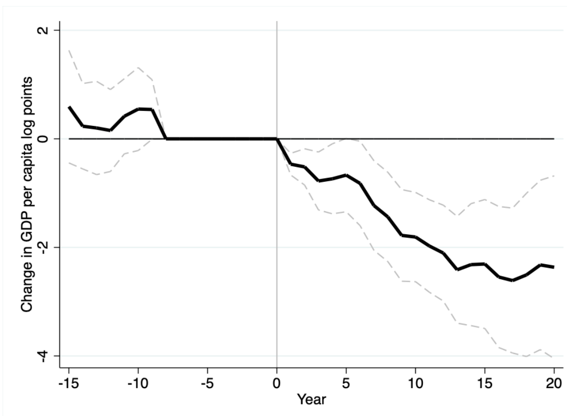
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

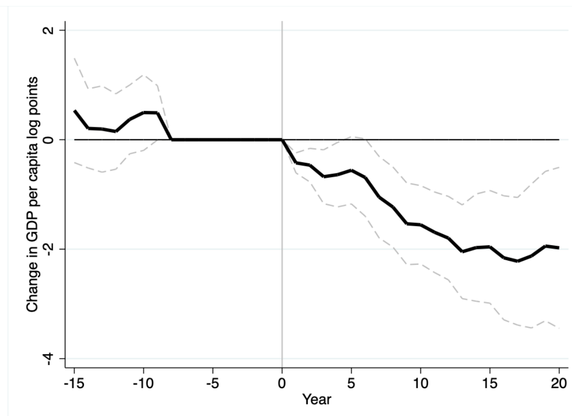
Effects at different level of initial shares of manufacturing exports

In the main text, I present the effects of a decrease in tariffs on growth for countries with two different levels of initial shares of manufacturing exports—what can be called manufacturer and nonmanufacturer countries. Here I show the impact for different levels of manufacturing exports, given the linear specification of the heterogeneous effects specified in equation 3.

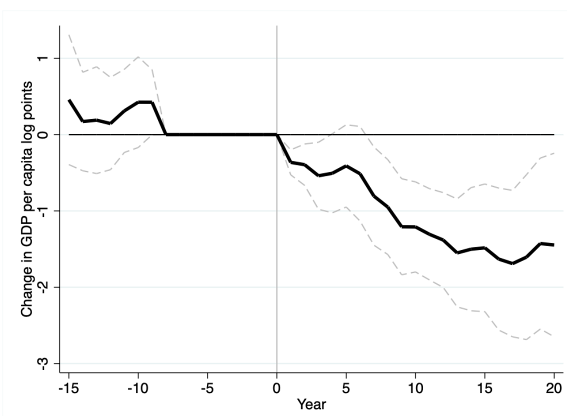
Figure A3: Average effects of decreases in tariffs on GDP per capita at different level of initial manufacturing exports, part 1



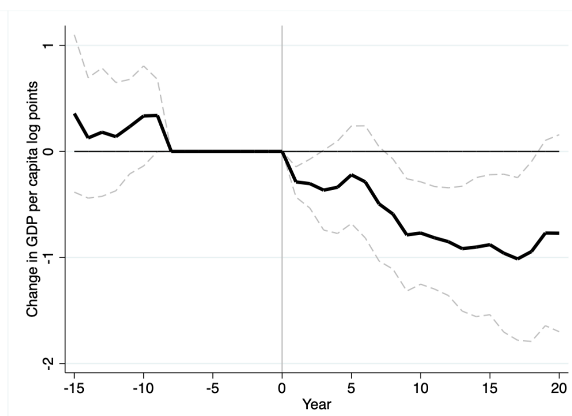
(a) 10th percentile



(b) 20th percentile



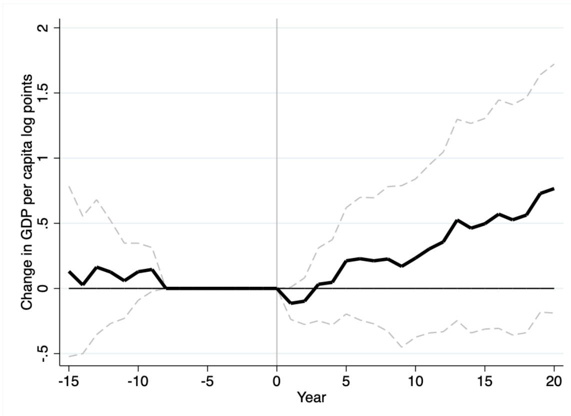
(c) 30th percentile



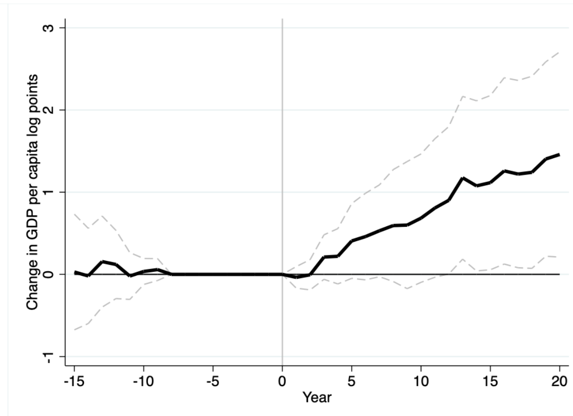
(d) 40th percentile

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

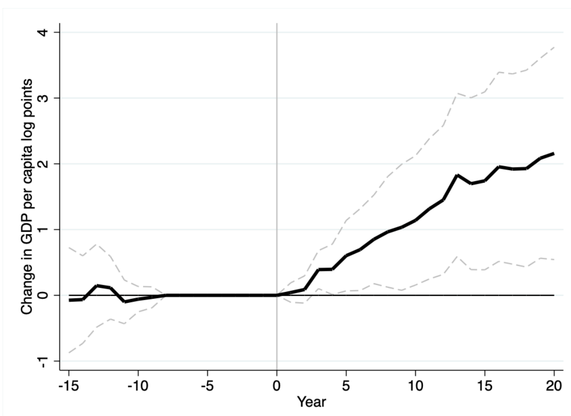
Figure A4: Average effects of tariffs on GDP per capita at different level of initial manufacturing exports, part 2



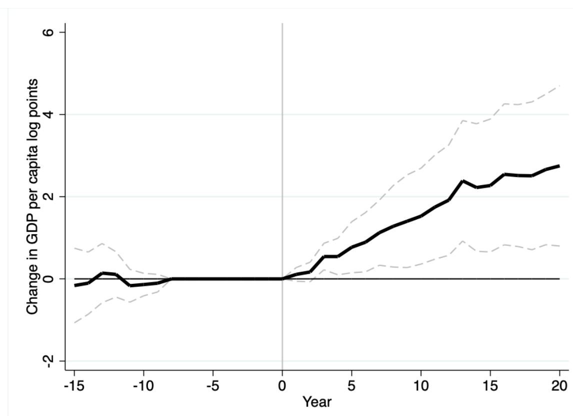
(a) 60th percentile



(b) 70th percentile



(c) 80th percentile



(d) 90th percentile

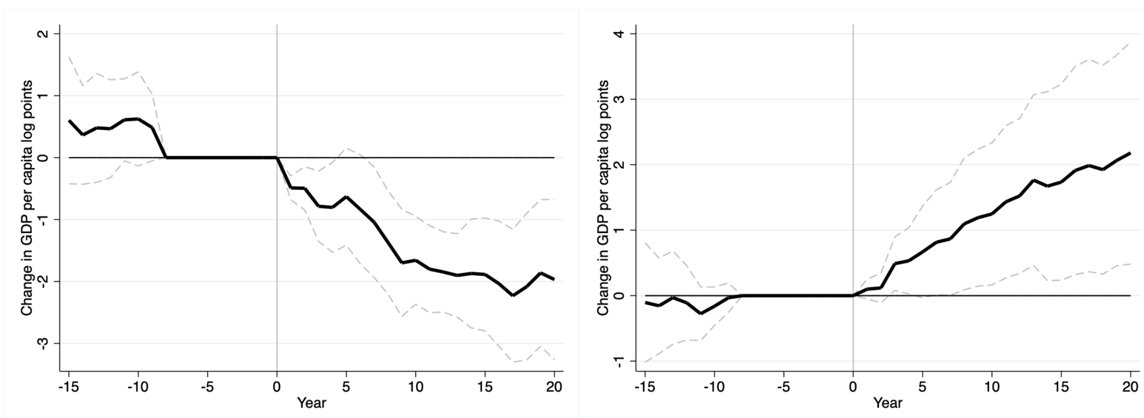
Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figures A3 and A4 show that at least for the top 30 percent of the distribution of manufacturing exports, there is a positive effect on GDP of tariff reductions , while for the bottom 40 percent of the distribution, the impact is negative.

Alternative specifications of initial economic structure

I show here that the results are robust to different specifications of the initial economic structure. In the baseline specification, I define the initial economic structure as the average of the previous five years of the share of manufacturing exports, following the broad classification of goods in the SITC. Here, I replace this definition with six alternative ones. First, I use the average of the previous five years of the share of manufacturing exports, following Lall's (2000) classification. Second, I use the average of the previous five years of the revealed comparative advantage in manufacturing exports, using the broad category classification. Then, following the specifications proposed by Acemoglu et al. (2019) in a similar exercise, I define the initial economic structure as the first lag of the share of manufacturing exports, the value of manufacturing exports in 1962 (the first year for which trade data are available), the value of manufacturing exports in 1970, and, finally, the value in 1980.

Figure A5: Average effects of tariff reductions on GDP per capita, using Lall's (2000) classification

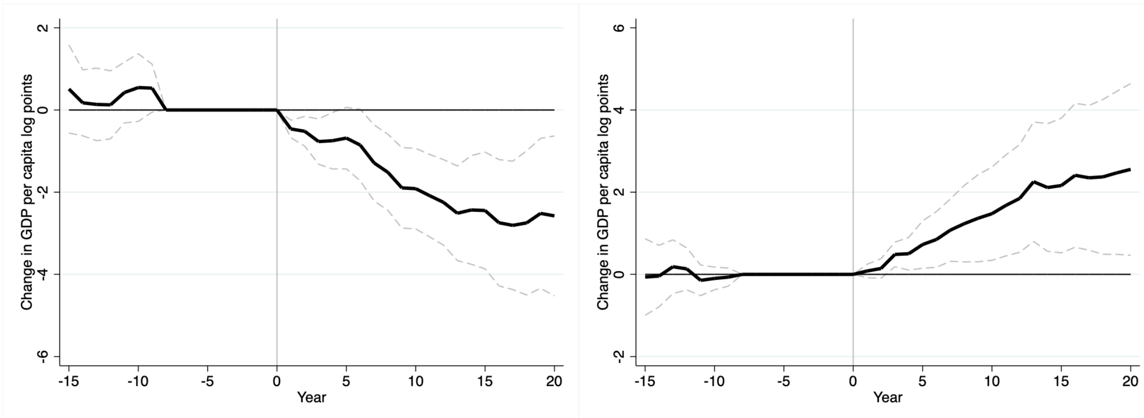


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the average of the previous five years of the share of manufacturing exports, using Lall's (2000) classification. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A5 reveals the result of using the initial economic structure defined using manufacturing exports with Lall's (2000) classification. The effect heterogeneity is still significant.

Figure A6: Average effects of tariff reductions on GDP per capita, using revealed comparative advantage

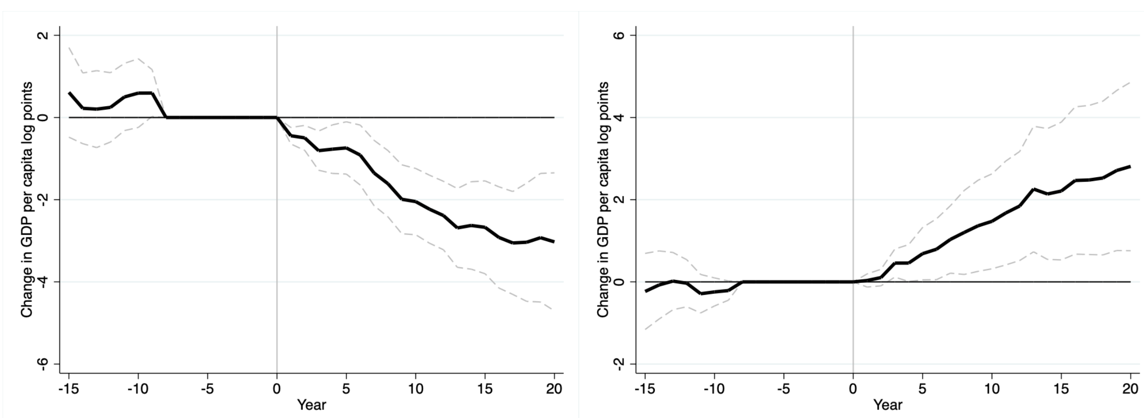


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the average of the previous five years of revealed comparative advantage in manufacturing exports. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A6 reveals the results when I use revealed comparative advantage instead of the share of manufacturing exports. The results are virtually the same as those in the baseline.

Figure A7: Average effects of tariff reductions on GDP per capita, 3rd alternative definition of initial economic structure

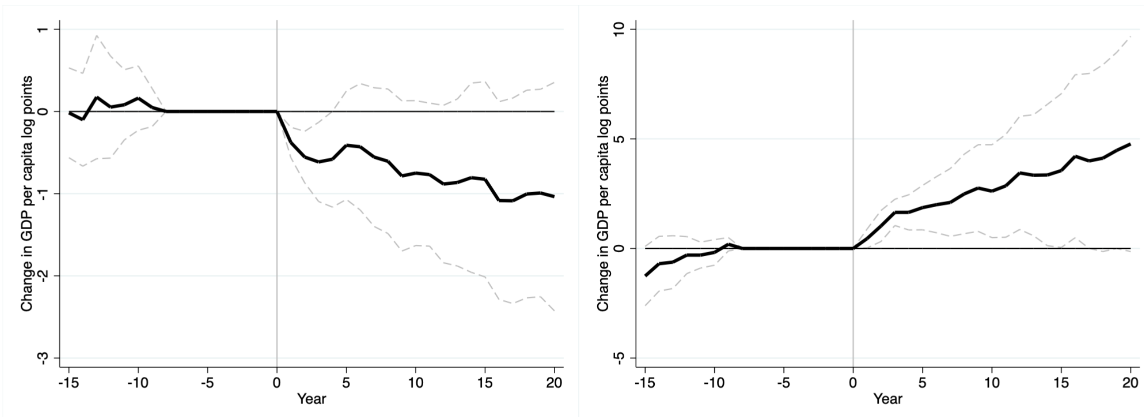


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the first lag of the share of manufacturing exports. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A7 reveals the results where the initial economic structure is defined by the first lag of the share of manufacturing exports. The heterogeneity in the results still holds.

Figure A8: Average effects of tariff reductions on GDP per capita, 4th alternative definition of initial economic structure

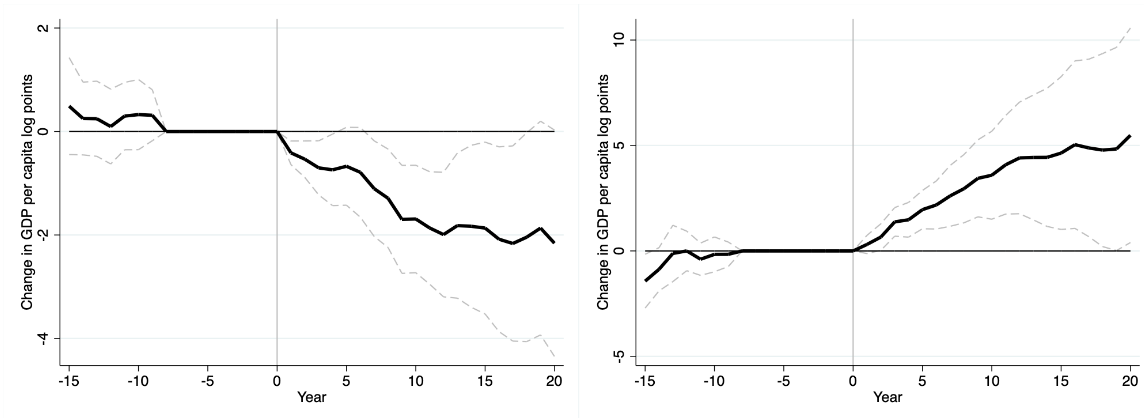


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the the share of manufacturing exports in 1962. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A8 reveals the results where the initial economic structure is the value of the share of manufacturing exports in 1962, the initial year of the trade data. The heterogeneity still holds, but the results are less precise, as the data for 1962 is scarcer.

Figure A9: Average effects of tariff reductions on GDP per capita, 5th alternative definition of initial economic structure

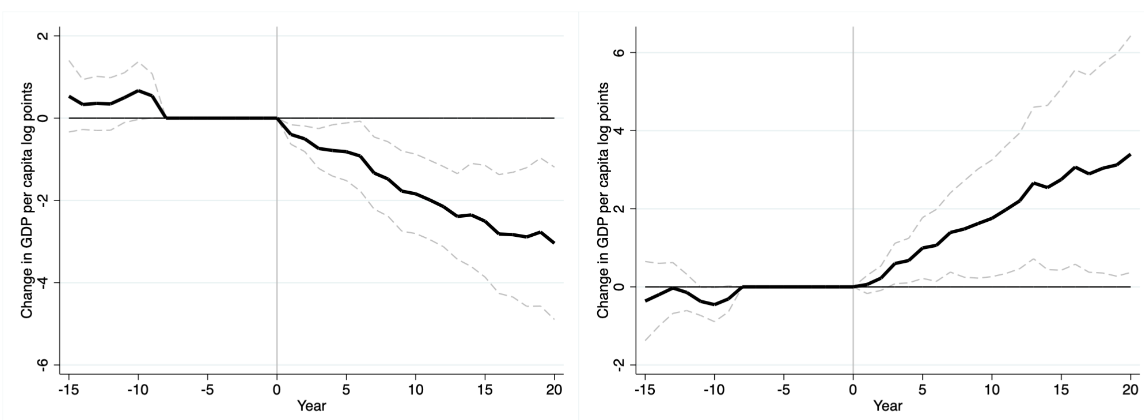


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the the share of manufacturing exports in 1970. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A9 reveals the results where the initial economic structure is the value of the share of manufacturing exports in 1970. The heterogeneity still holds.

Figure A10: Average effects of tariff reductions on GDP per capita, 6th alternative definition of initial economic structure



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: Initial economic structure is defined as the the share of manufacturing exports in 1980. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

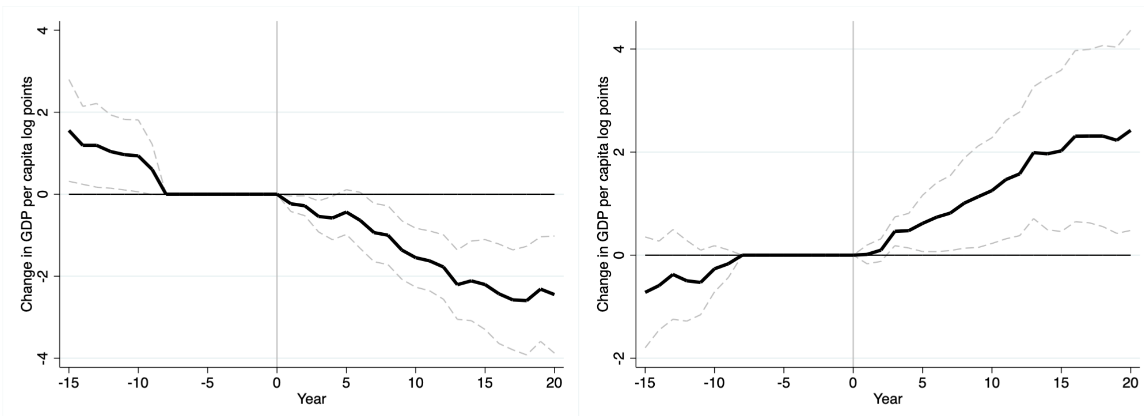
Figure A10 reveals the results where the initial economic structure is given by the value of the share of manufacturing exports in 1980. The heterogeneity in the results is still significant, and the magnitudes of the effects are even bigger.

Alternative GDP data for growth rates

I show here that the baseline results are robust to alternative GDP data and that the heterogeneous effects of tariffs do not rely on the specific data used in the baseline.

Figure A11 reveals the results when I use GDP per capita from the World Development Indicators (WDI) in constant national prices. The effect of reducing tariffs is negative and significant for nonmanufacturer countries and positive and significant for manufacturer countries.

Figure A11: Average effects of tariff reductions on GDP per capita, data from WDI

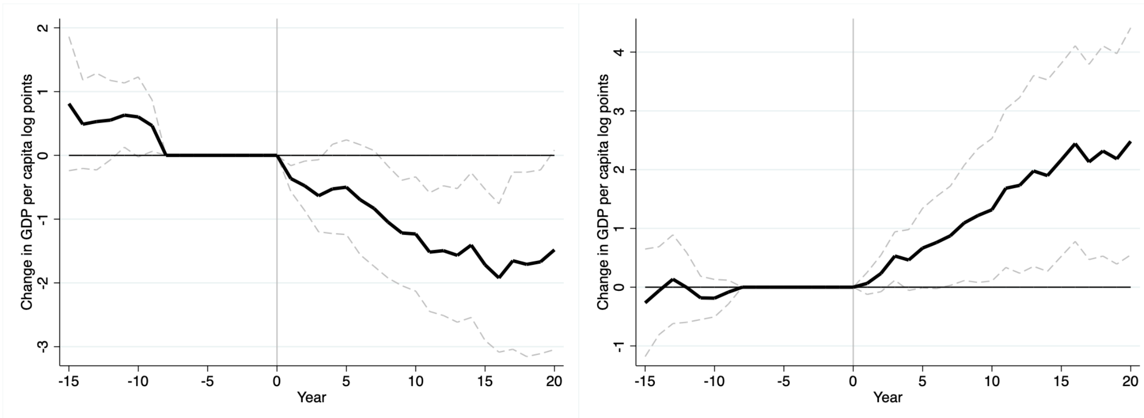


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The GDP per capita data used for this figure are in constant national prices from the WDI. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A12 reveals the results when I use data from the Maddison Project (Bolt & van Zanden, 2020). The estimates are more erratic but still point to significant heterogeneity in the effects of tariffs on growth depending on the initial economic structure.

Figure A12: Average effects of tariff reductions on GDP per capita, data from the Maddison Project

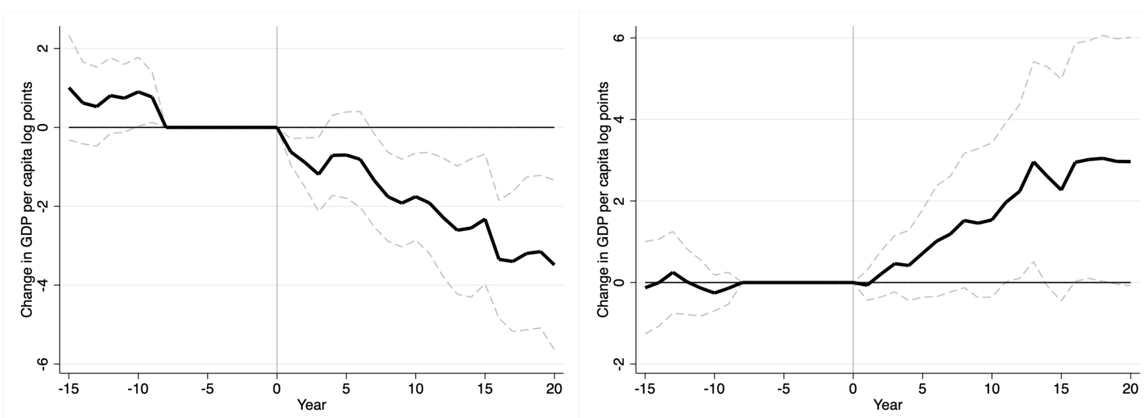


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The GDP per capita data used for this figure are in constant national prices from the Maddison Project. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Finally, in Figure A13 I present the results based on GDP per capita data in purchasing power parity (PPP) constant terms from Penn World Table (PWT) 10.0. The results are negative and significant for nonmanufacturer countries and positive but mostly insignificant for manufacturer countries.

Figure A13: Average effects of tariff reductions on GDP per capita, data in PPP from PWT



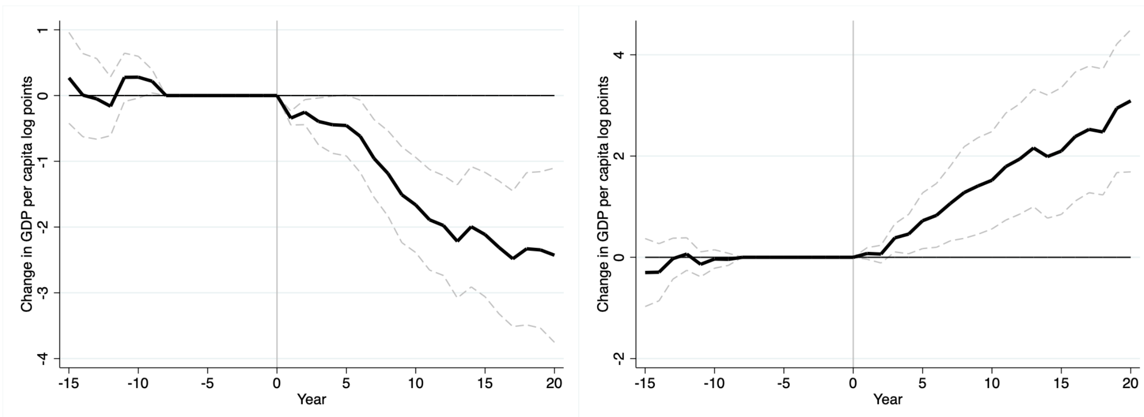
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The GDP per capita data used for this figure are in PPP constant terms from PWT 10.0 The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Robustness to outliers and leverage points

I show here that the results are robust to the use of robust regression methods and consideration of the influence of leverage points.

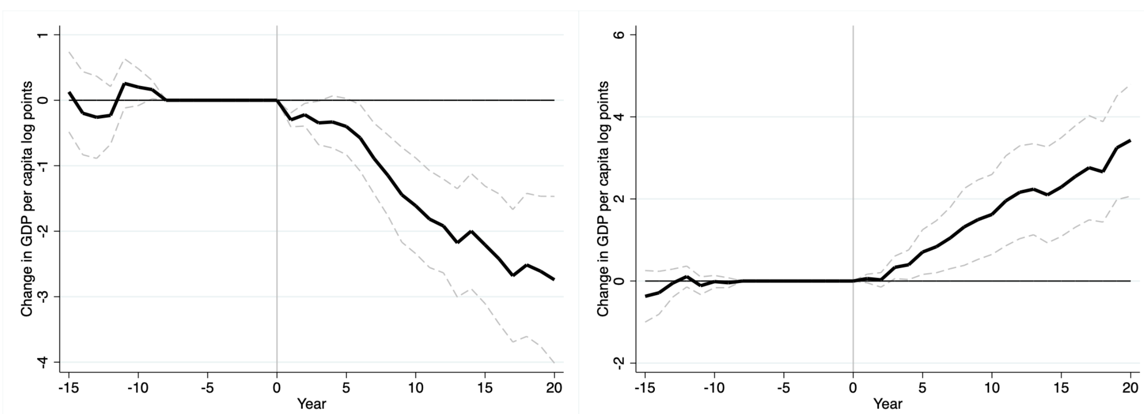
Figure A14: Average effects of tariff reductions on GDP per capita, regression with Huber weights



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A15: Average effects of tariff reductions on GDP per capita, Li's robust regression

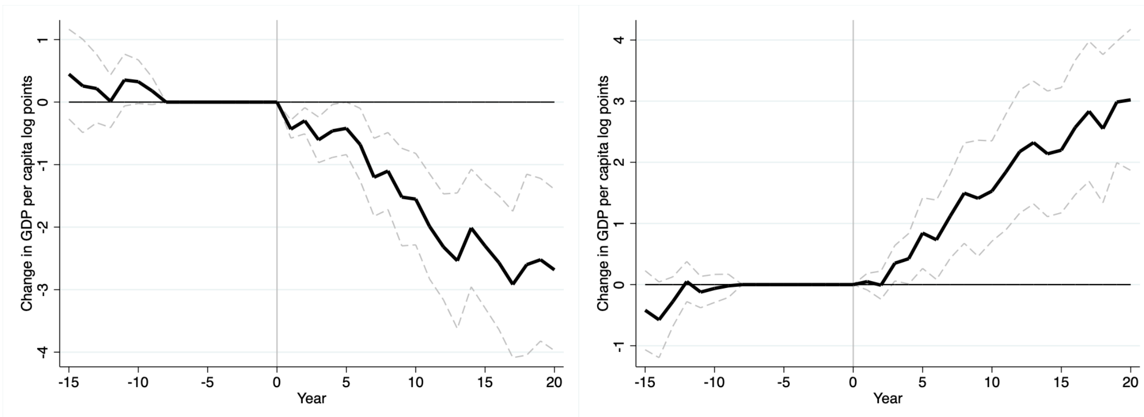


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A14 reveals the results of using Huber (1964) weights and Figure A15 shows the results of using G. Li (1985)'s robust regression, deemed an improvement on Huber weights. The heterogeneity in the results is still significant and the magnitude of effects is bigger.

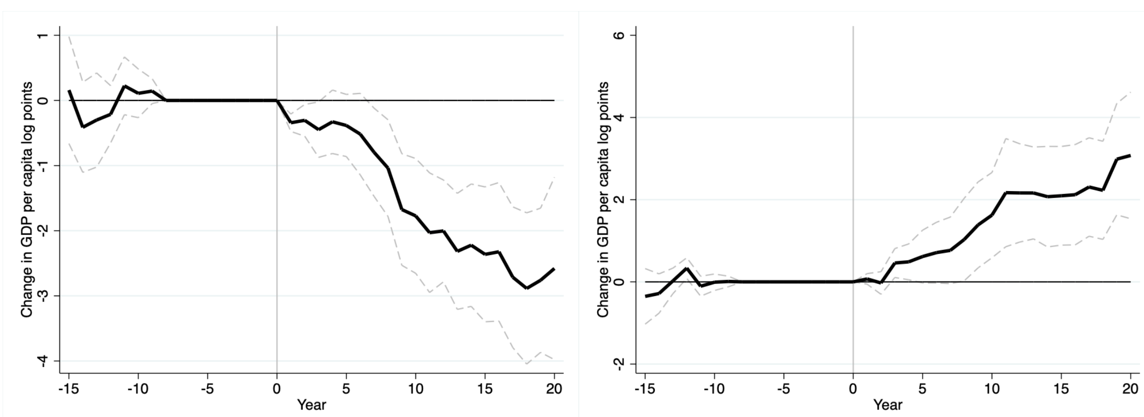
Figure A16: Average effects of tariff reductions on GDP per capita, removing Cook's distance leverage points



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A17: Average effects of tariff reductions on GDP per capita, removing R-standardized leverage points

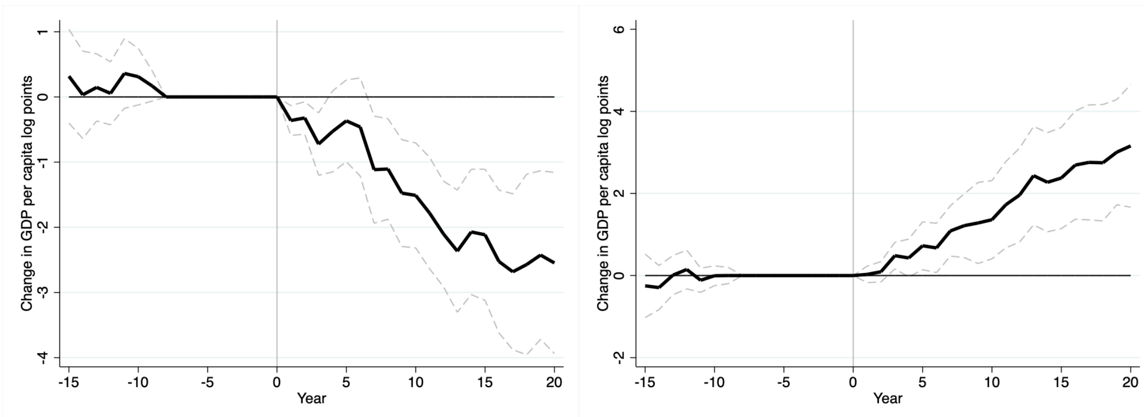


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

I also consider the influence of leverage points by following the methods of deletion proposed by Belsley et al. (1980). Figures A16, A17, A18, A19 and A20 reveal that the results are robust to deletion of Cook's, R-standardized, Dfits, Hat and Covratio outliers, respectively.

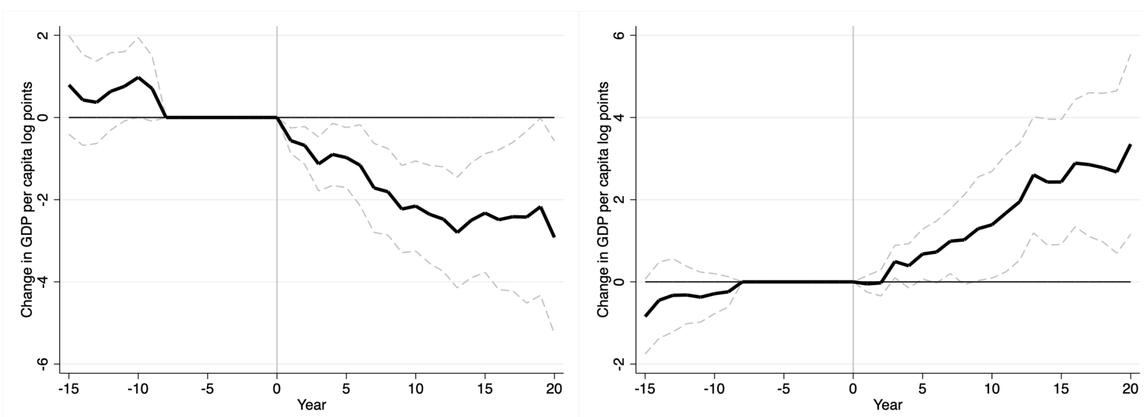
Figure A18: Average effects of tariff reductions on GDP per capita, removing Dfits leverage points



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

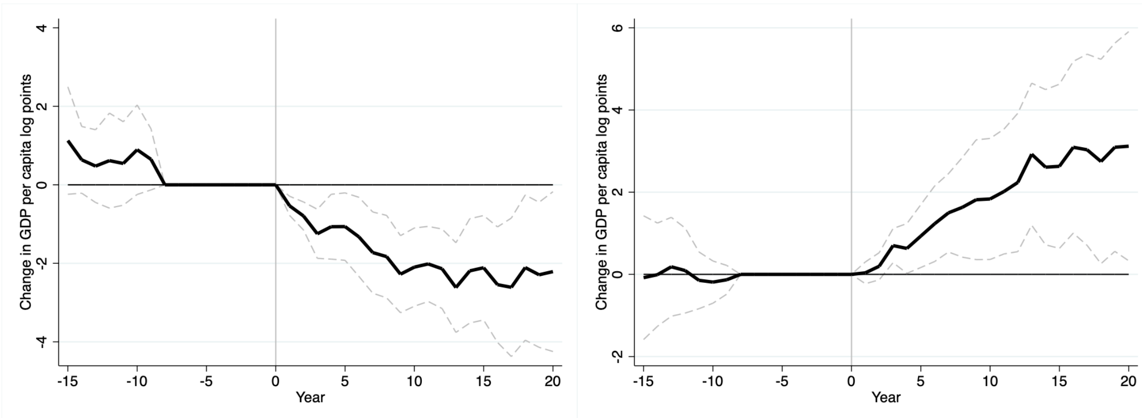
Figure A19: Average effects of tariff reductions on GDP per capita, removing Hat leverage points



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure A20: Average effects of tariff reductions on GDP per capita, removing Covratio leverage points



(a) For nonmanufacturer countries　　**(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

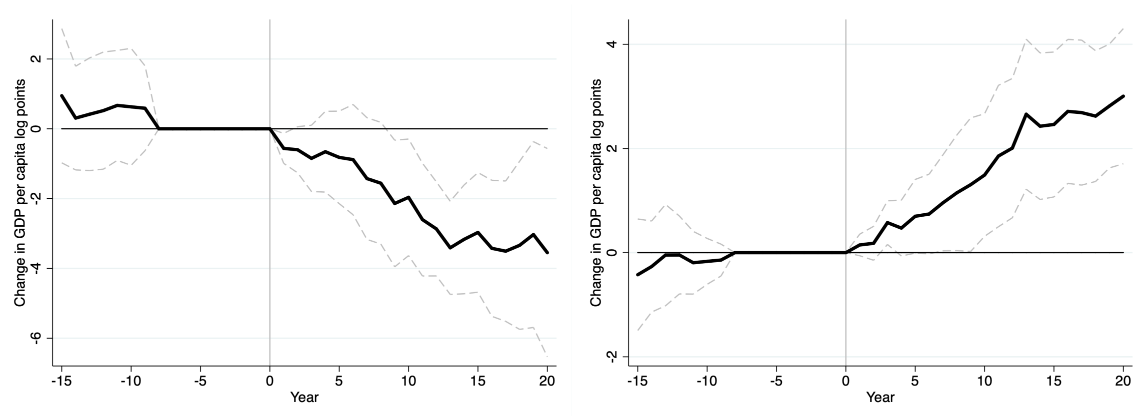
B Robustness

Confounders

The following graphs show the average effects of tariff reductions, controlling once at a time for all relevant covariates discussed in the main text, and as summarized in Figure 5. Effect heterogeneity is preserved in all cases.

Endogenous tariffs

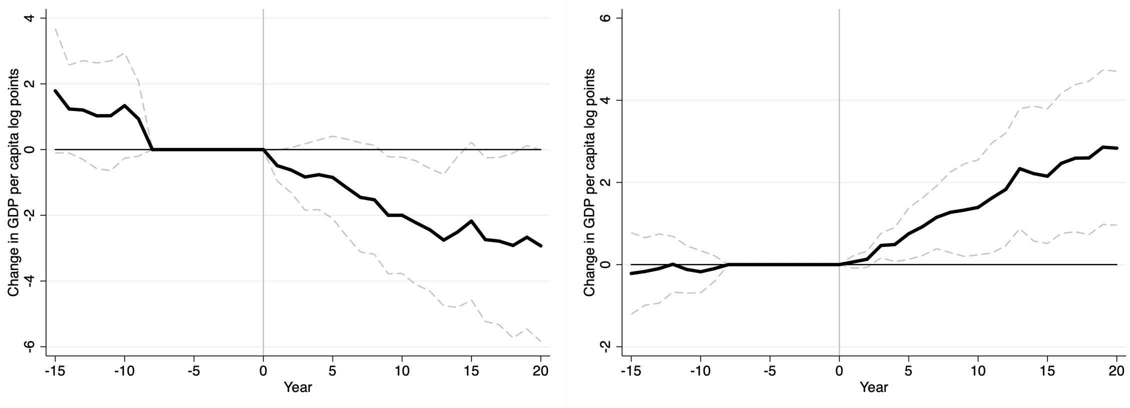
Figure B1: Average effects of tariff reductions on GDP per capita, controlling for the change in the growth forecast



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

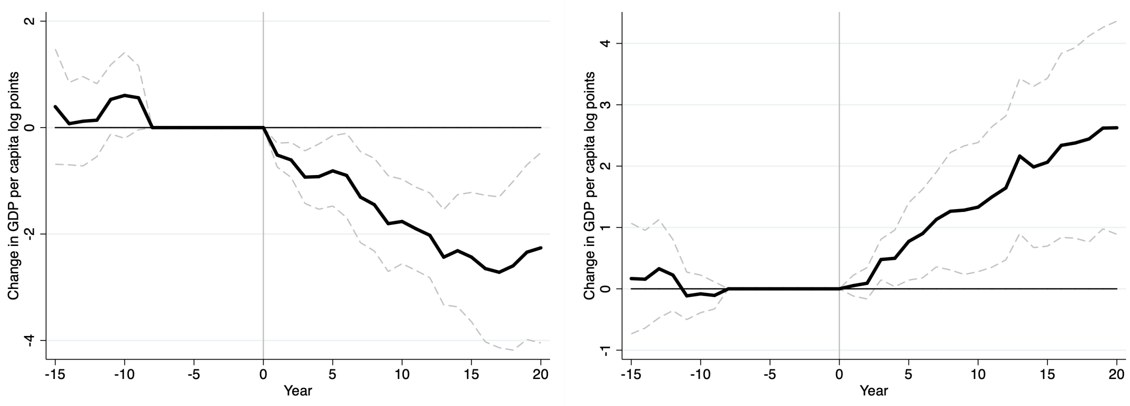
Figure B2: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in the Gini coefficient



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B3: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in import penetration

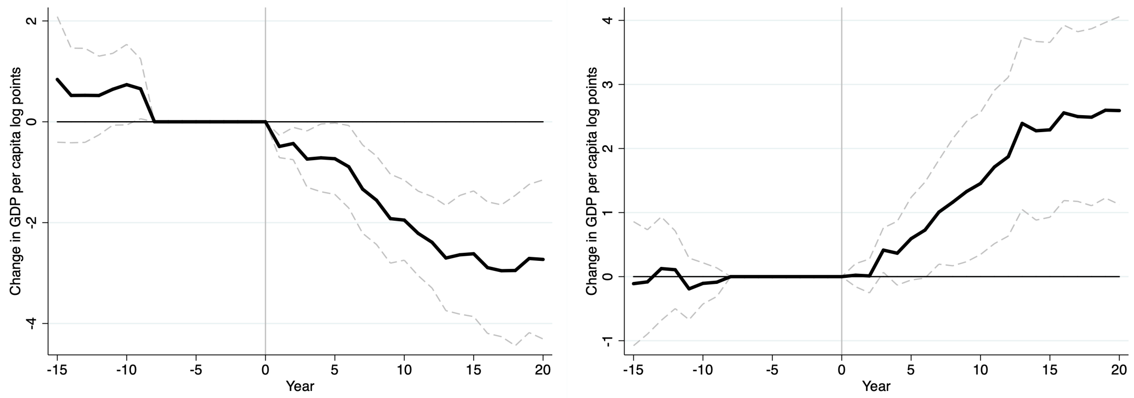


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Other policies

Figure B4: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in nontariff barriers

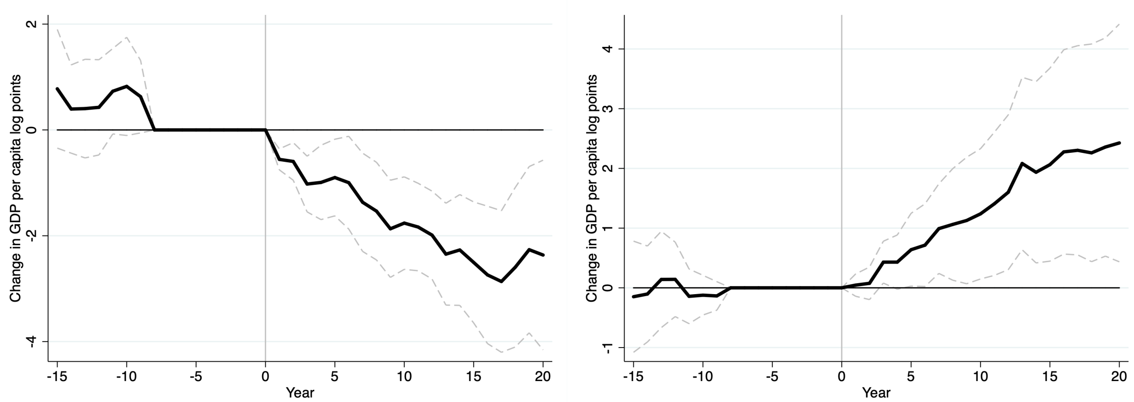


(a) For nonmanufacturer countries

(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B5: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in capital account openness

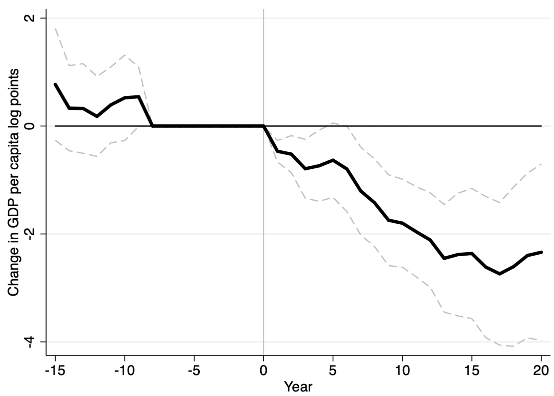


(a) For nonmanufacturer countries

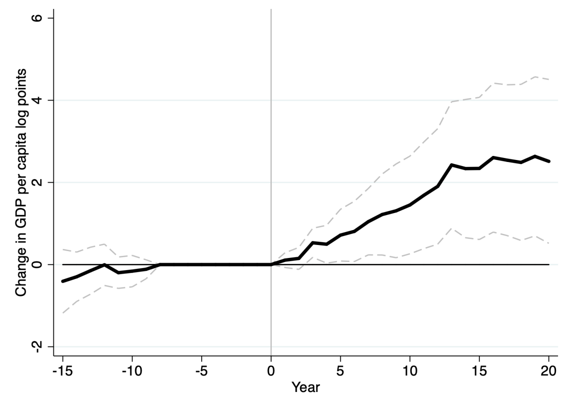
(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B6: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in Polity



(a) For nonmanufacturer countries

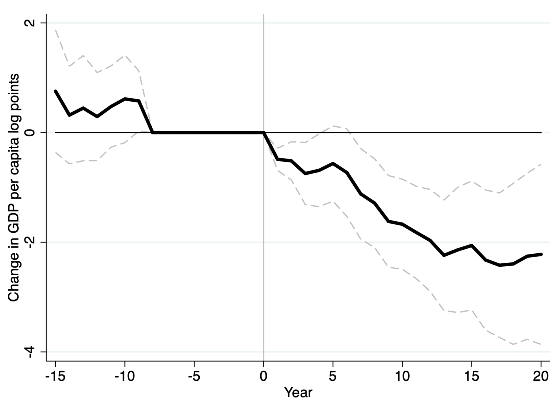


(b) For manufacturer countries

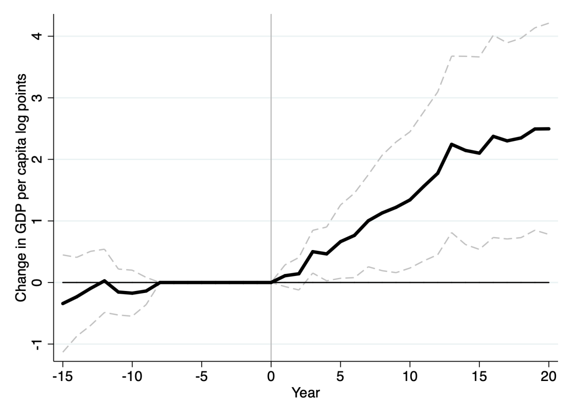
Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Relevant covariates

Figure B7: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in human capital



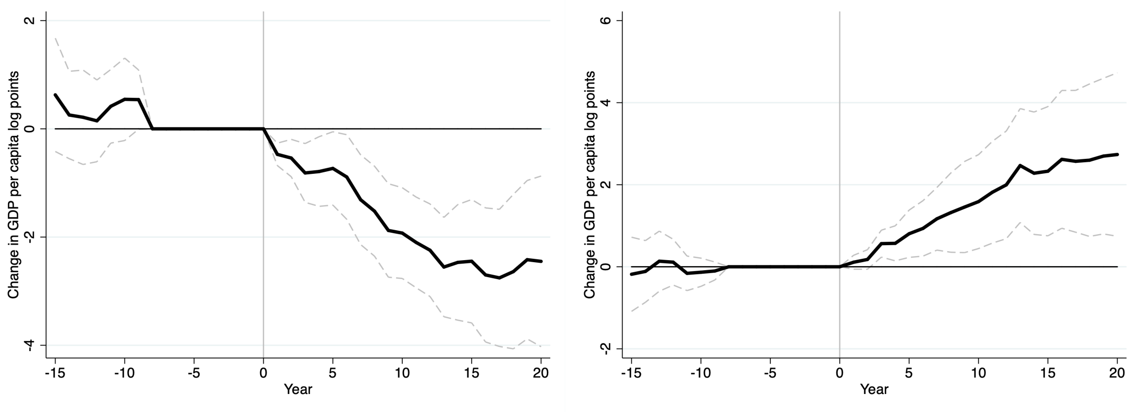
(a) For nonmanufacturer countries



(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

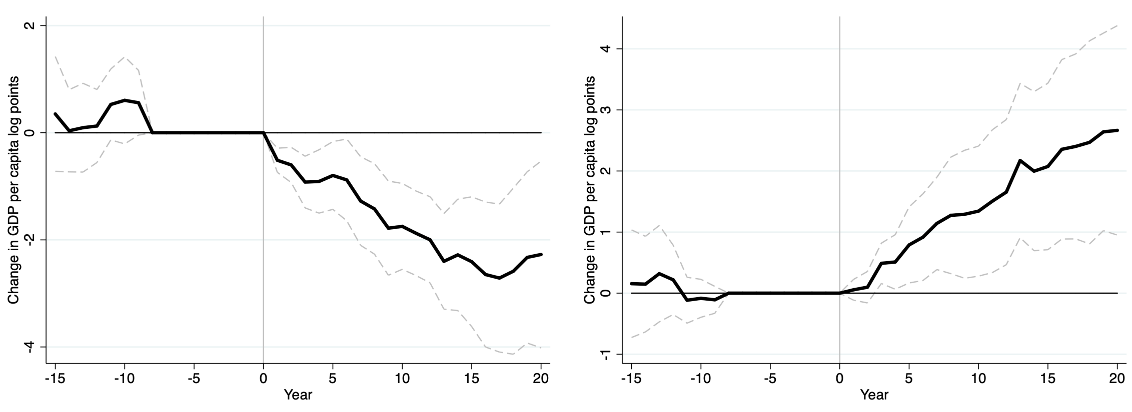
Figure B8: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in population size



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

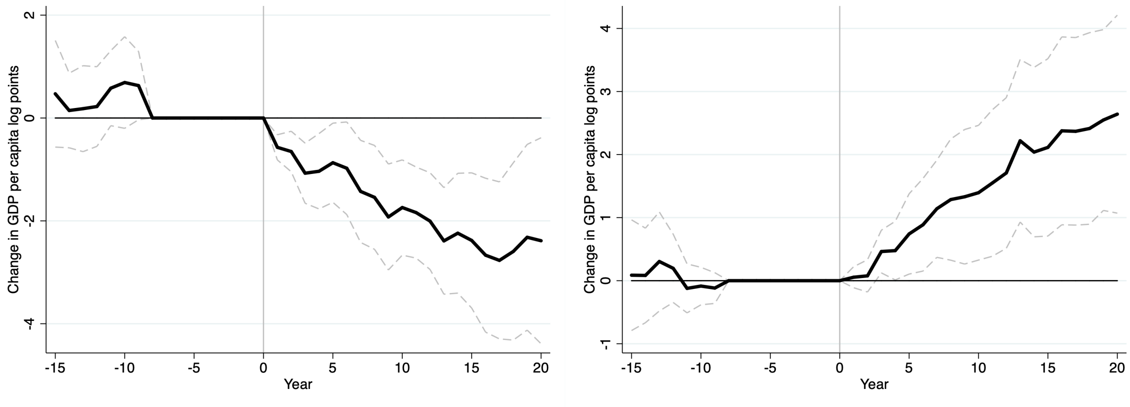
Figure B9: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in trade as share of GDP



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

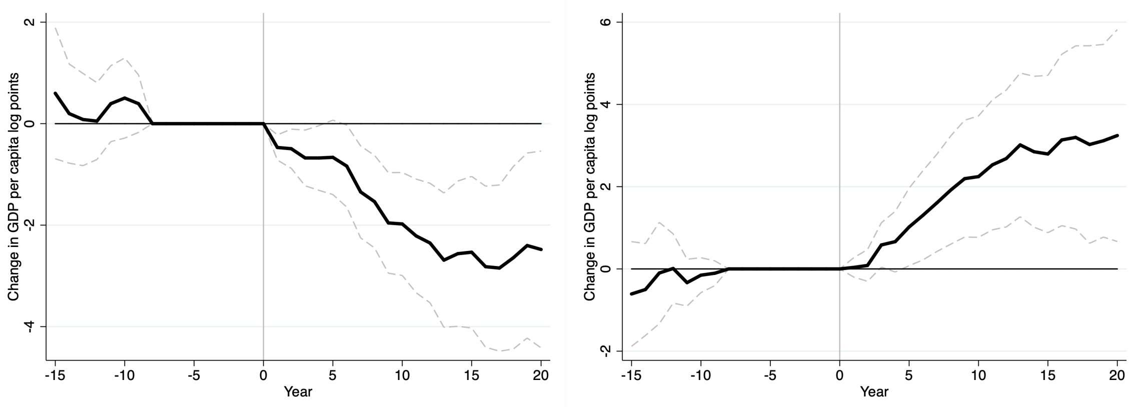
Figure B10: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in investment



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

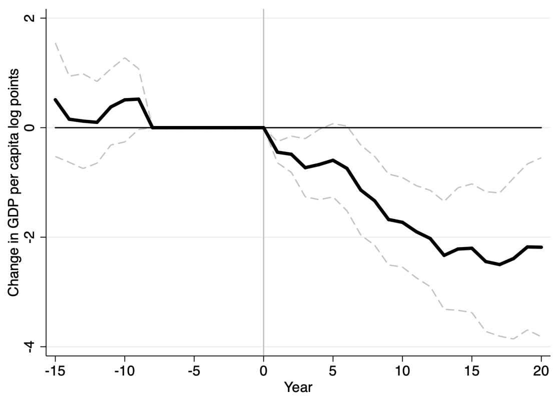
Figure B11: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in real exchange rates



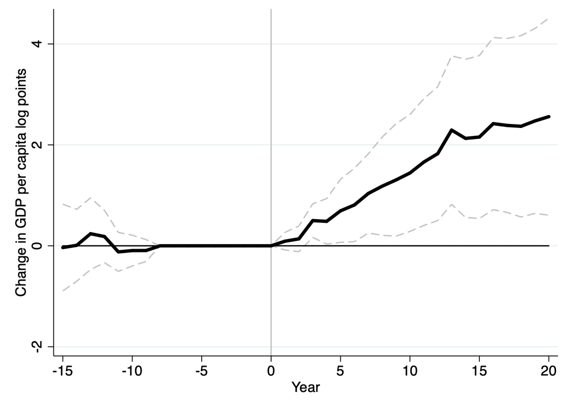
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B12: Average effects of tariff reductions on GDP per capita, controlling for four lags of the change in terms of trade



(a) For nonmanufacturer countries

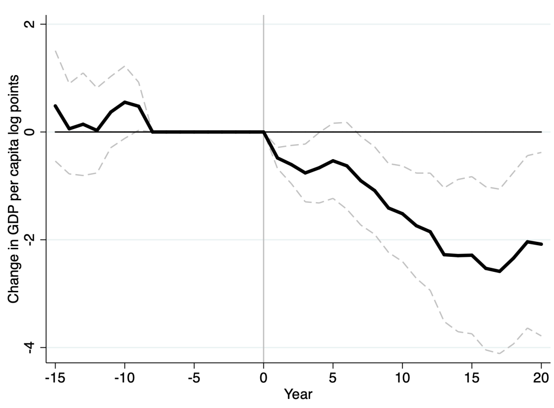


(b) For manufacturer countries

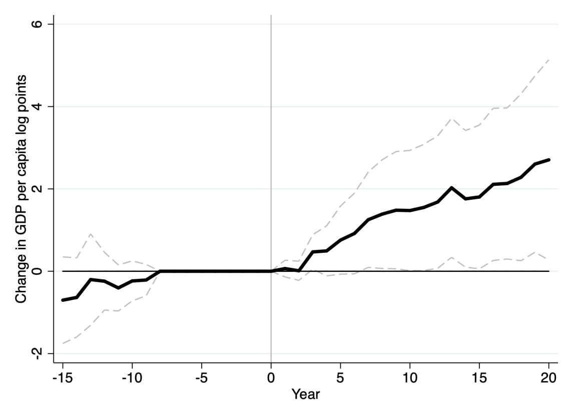
Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Other heterogeneous effects

Figure B13: Average effects of tariff reductions on GDP per capita, controlling for heterogeneous effects from income



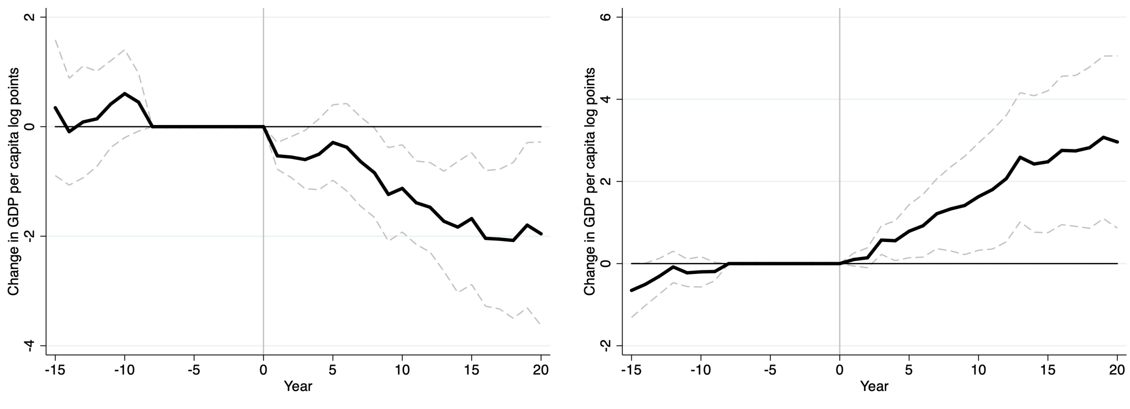
(a) For nonmanufacturer countries



(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B14: Average effects of tariff reductions on GDP per capita, controlling for heterogeneous effects from human capital

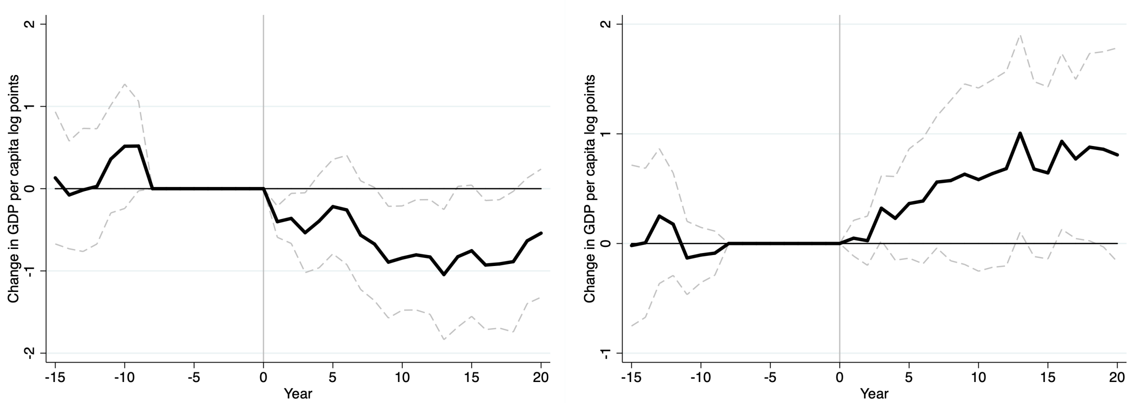


(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Different trends

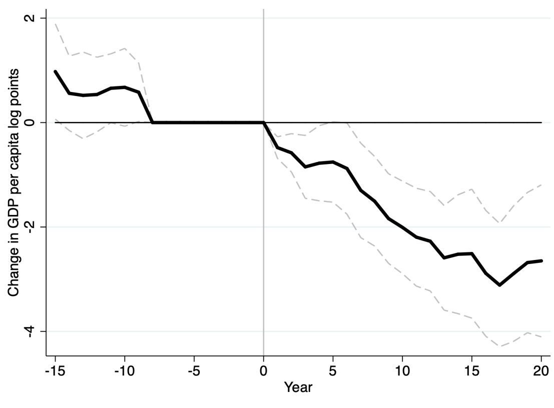
Figure B15: Average effects of tariff reductions on GDP per capita, with country fixed effects included



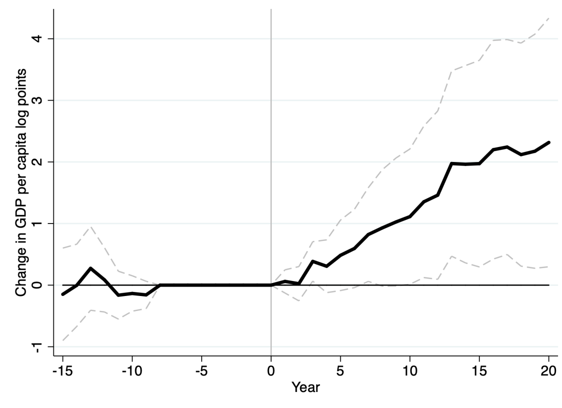
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B16: Average effects of tariff reductions on GDP per capita, controlling for trends in different country income groups



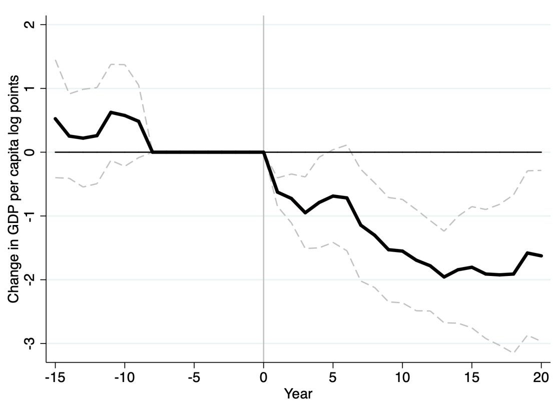
(a) For nonmanufacturer countries



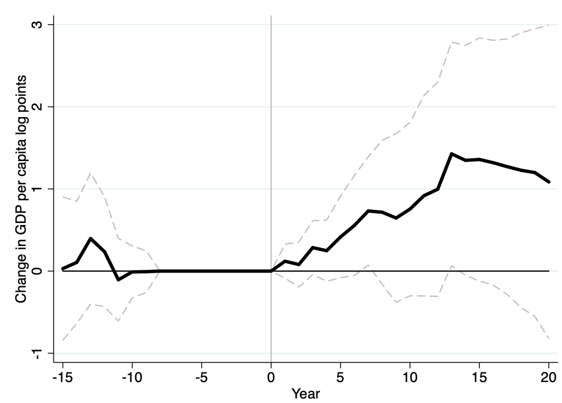
(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B17: Average effects of tariff reductions on GDP per capita, controlling for trends in different regions of countries



(a) For nonmanufacturer countries



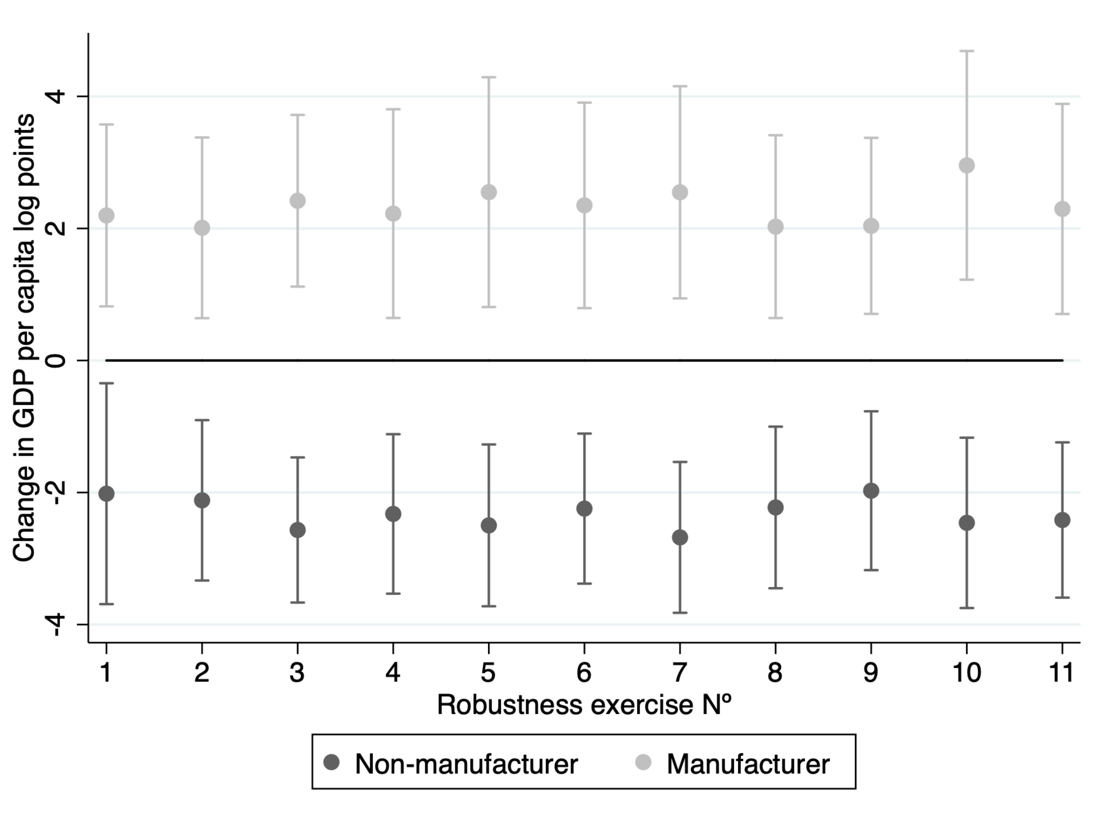
(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Robustness to contemporaneous changes in covariates

In the main text, I use a specification with four lags of the changes in covariates to account for potential confounding variables. Here, I simply summarize the results obtained if, instead, I include the contemporaneous change in each covariate. Figure B18 shows the results, confirming the effect heterogeneity of tariffs on growth.

Figure B18: Robustness of heterogeneous effects of tariff reductions on GDP per capita, average effect 13-17 years after, and based on contemporaneous changes in relevant covariates

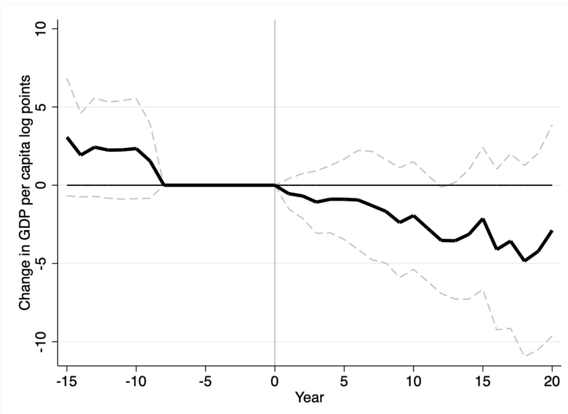


Note: The estimates presented are the predicted values for the 10th and 90th percentiles of the distribution of initial manufacturing exports. The coefficients show the average of the effect 10-14 years after the change in tariffs. The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level. Exercise 1 is the outcome of estimating equation 3 with the change in the Gini coefficient. Exercise 2 is the outcome of estimating equation 3 with the change in import penetration. Exercise 3 is the outcome of estimating equation 3 with the change in nontariff barriers. Exercise 4 is the outcome of estimating equation 3 with the change in capital account openness. Exercise 5 is the outcome of estimating equation 3 with the change in Polity. Exercise 6 is the outcome of estimating equation 3 with the change in human capital. Exercise 7 is the outcome of estimating equation 3 with the change in population size. Exercise 8 is the outcome of estimating equation 3 with the change in trade openness. Exercise 9 is the outcome of estimating equation 3 with the change in investment. Exercise 10 is the outcome of estimating equation 3 with the change in the real exchange rate. Exercise 11 is the outcome of estimating equation 3 with the change in the terms of trade.

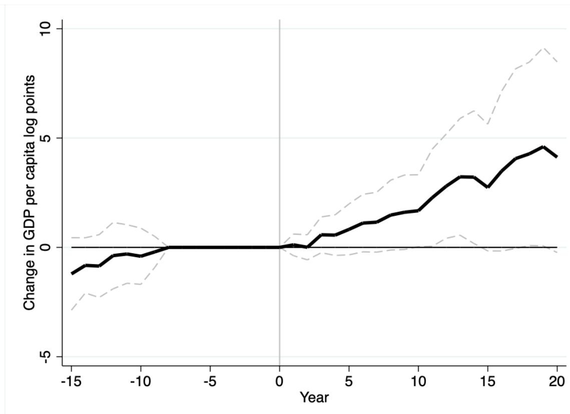
Robustness with all controls included at the same time

In the main text, I control for several covariates that might affect the validity of the estimates, by including each of them in turn. The validity of the results, therefore, may still be subject to the criticism that it is driven by correlations between covariates, not really captured in the regressions when controlling for each of them in turn. I now present the results of including all covariates at the same time. This exercise is extremely demanding in terms of statistical power, as the sample is importantly reduced, given that for each covariate I include four lags of first differences and information is not equally available for all countries. Results are presented in Figure B19. The direction of the heterogeneity is still in line with the main findings, and although significance is importantly decreased, I still observe a significant effect around 12-13 years after tariff reductions.

Figure B19: Average effects of tariff reductions on GDP per capita, all control variables included



(a) For nonmanufacturer countries

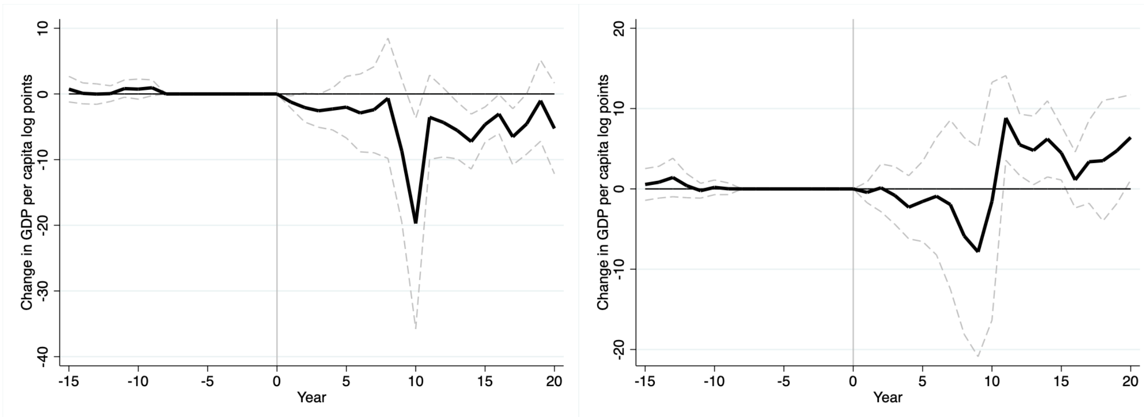


(b) For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Clean controls analysis

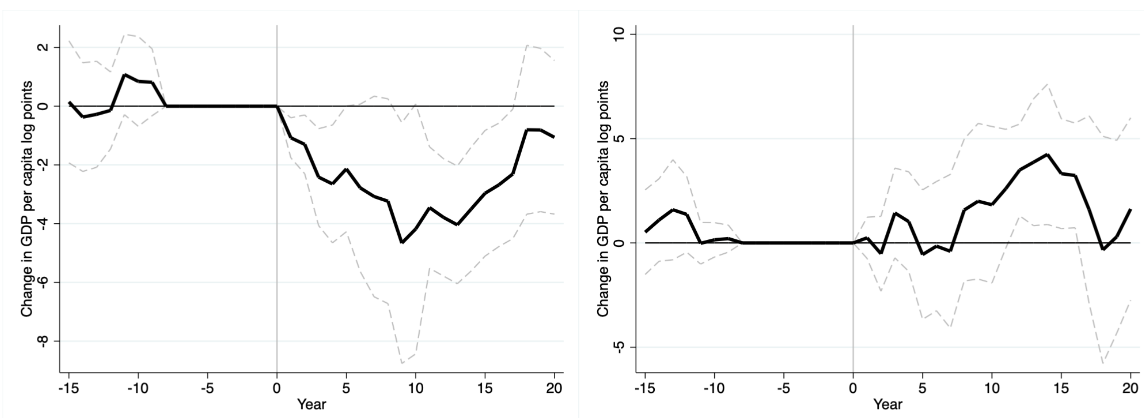
Figure B20: Clean controls analysis with threshold defined as half standard deviation from the mean tariff change



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

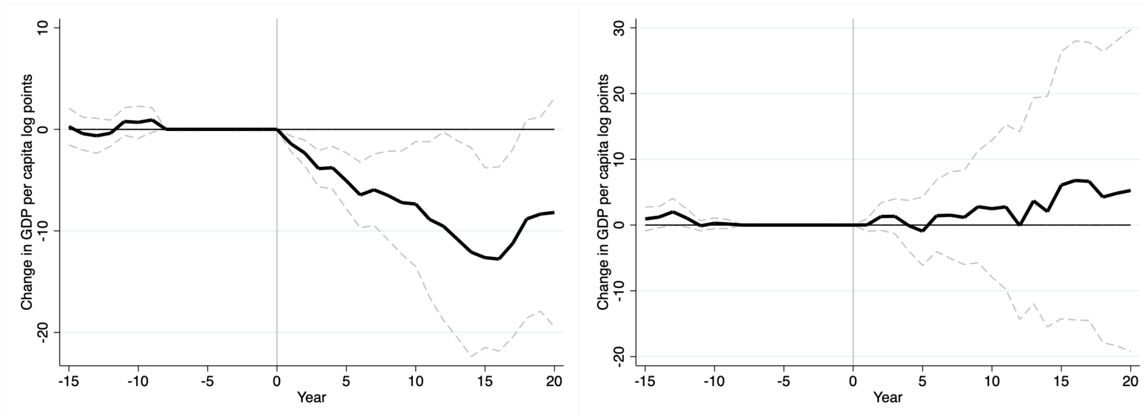
Figure B21: Clean controls analysis with threshold defined as two standard deviation from the mean tariff change



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B22: Clean controls analysis with a twenty-year rule for quasi-stayers



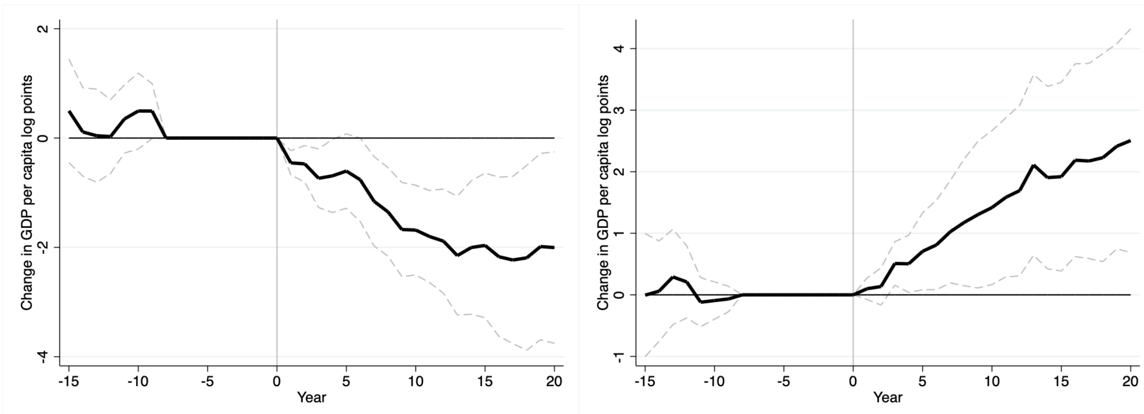
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Additional robustness

The following graphs reveal the results associated to the subsection in the main paper called additional robustness. The results presented confirm once again the robustness of the heterogeneous effects of tariffs on growth.

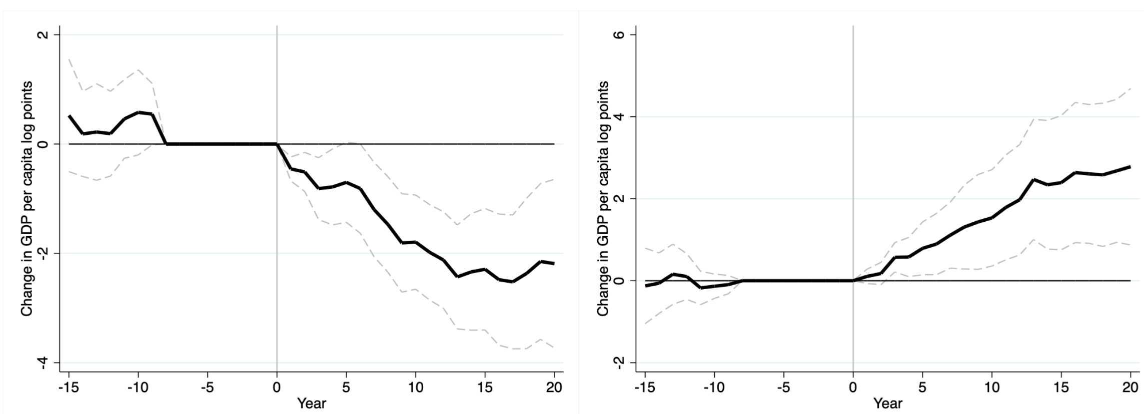
Figure B23: Average effects of tariff reductions on GDP per capita, controlling for interactions between past growth and the initial economic structure



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

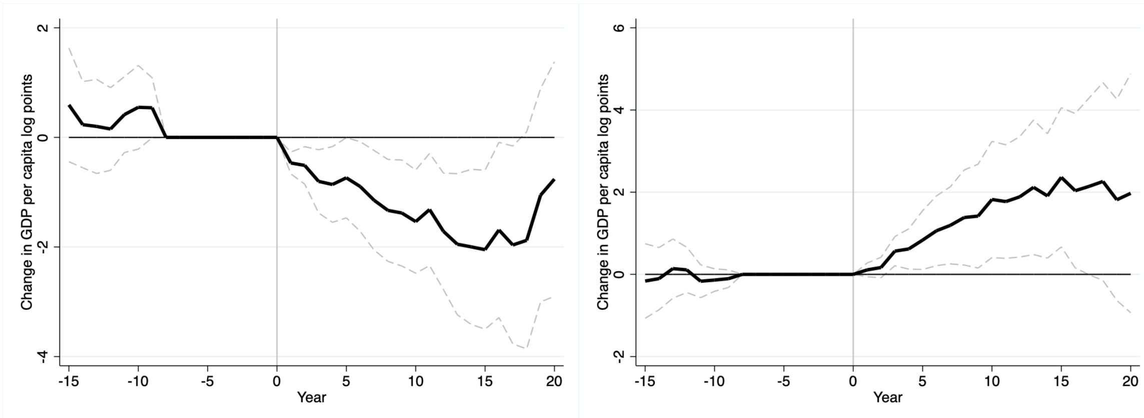
Figure B24: Average effects of tariff reductions on GDP per capita, controlling for interactions between year fixed effects and the initial economic structure



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure B25: Average effects of tariff reductions on GDP per capita, controlling for other tariff changes



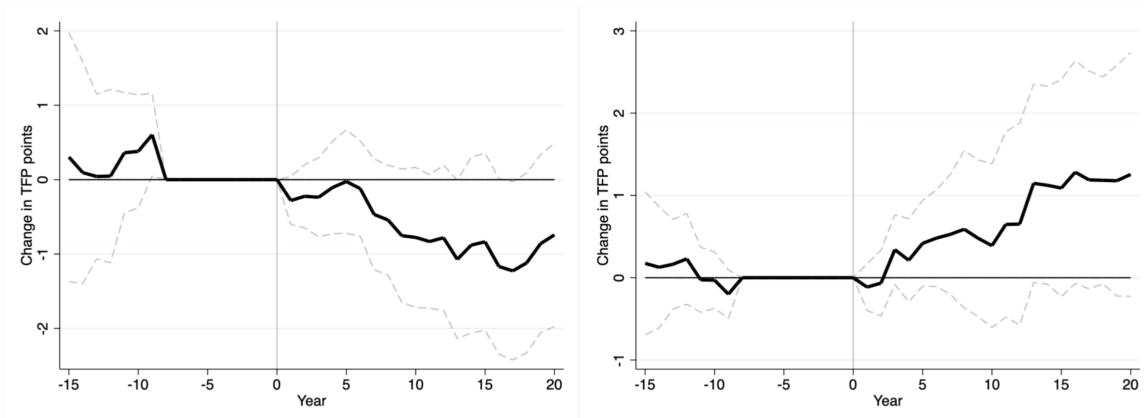
(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

C Mechanisms

Finally, I show results of effect estimates of tariff reductions on TFP, as an alternative to labor productivity, and on the share of imports in GDP. Direction of the effects for TFP go in line with the results documented with labor productivity, although the results are not significant at the 90 percent level of confidence. Results for the share of imports in GDP are not clearly different to zero, as discussed in the main text.

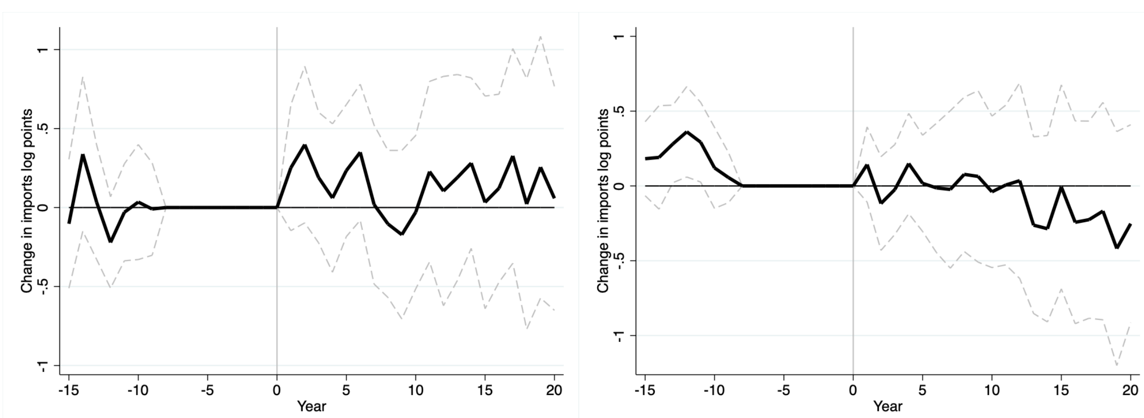
Figure C1: Average effects of tariff reductions on TFP



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.

Figure C2: Average effects of tariff reductions on the share of imports in GDP



(a) For nonmanufacturer countries **(b)** For manufacturer countries

Note: The standard errors used for the figure are two-way robust to heteroskedasticity and correlation on the country and year dimensions. Confidence intervals are calculated to the 90% significance level.