# Trade Shocks and Human Capital: Evidence from Brazil's Trade Liberalization *

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**Abstract**

This paper studies the medium- and long-run effects of Brazil's 1990s trade liberalization reform on child labor, schooling, and human capital accumulation. Our analysis leverages extensive census and administrative data spanning nearly three decades to examine the effects of two distinct components of the shock that differentially affected labor market opportunities for adults and children. We find that regions more exposed to child-specific tariff reductions experienced larger declines in child labor and greater increases in schooling, while regions more affected by adult-specific tariff reductions experienced the opposite effect. The impacts of the shocks are persistent and always larger in the long run. Specifically, we show that tariff reductions influenced the human capital accumulated by cohorts more exposed to trade liberalization during their formative years. Overall, our results highlight the role of human capital in amplifying the effects of economic shocks.

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# 1 Introduction

Child labor remains a significant challenge in many parts of the developing world. In 2020, approximately 160 million children were engaged in labor activities, representing nearly 10% of the global child population (ILO, 2021). The issue of child labor is of particular concern due to its detrimental impact on children's development, as it hinders their ability to accumulate human capital, exacerbating social inequalities and poverty (Heckman, 2006; Chetty et al., 2016). At the heart of this issue lies the critical decision faced by households—especially those from disadvantaged backgrounds—to either invest in their children's education or involve them in labor. These decisions have significant long-term consequences, due to their persistent influence on the returns to future human capital investments (Cunha and Heckman, 2007, 2008; Cunha et al., 2010).

A comprehensive understanding of the factors influencing household decisions is, therefore, of crucial importance for the design of policies aimed at combating inequality and poverty. Indeed, a substantial body of literature has examined the effects of economic shocks on human capital investments (Currie and Almond, 2011; Almond et al., 2018; Frankenberg and Thomas, 2017), with particular focus on child labor and schooling (Edmonds, 2007; Edmonds and Theoharides, 2020). The main conceptual challenge lies in the multiple channels through which shocks can influence family decisions. For instance, trade liberalization reforms may simultaneously impact household income as well as the opportunity cost of schooling. Consequently, it is not surprising that the literature finds contrasting results depending on the study-context.[1] We believe that a more systematic understanding of these issues remains necessary and could offer valuable insights.

This paper studies the medium- and long-term effects of Brazil's trade liberalization reform in the early 1990s on child labor, schooling, and human capital accumulation. The Brazilian trade reform entailed a significant reduction in protection across industries, with average nominal tariffs sharply declining from 30.5% in 1990 to 12.8% in 1995. Brazil offers a compelling context for studying the impact of trade-induced labor market shocks on households' human capital investment decisions for several reasons. First, child labor remains a persistent issue, particularly in the poorer and less developed regions of the country, with approximately 5.5% of children aged 10 to 14—or about 930,000 children—still engaged in paid or unpaid jobs as of 2010. Second, Brazil is a large developing country characterized by highly heterogeneous local labor markets in

[1]For example, while some papers find that positive (negative) income shocks lead to an increase in schooling (child labor) (Edmonds and Pavcnik, 2005; Beegle et al., 2006; Edmonds et al., 2010; Kis-Katos and Sparrow, 2011), other, particularly those focused Latin America, find the opposite (Duryea and Arends-Kuenning, 2003; Kruger, 2007; Carrillo, 2020).

terms of industry composition and child employment. Third, the Brazilian Census provides unique data on labor market participation, school attendance, and various other socioeconomic characteristics of children, with the key advantage of being representative at fine geographic levels. Crucially, it contains precise information about the sectors in which children are employed.

Following Topalova (2010), Kovak (2013), and Dix-Carneiro and Kovak (2017), our analysis exploits cross-industry variation in tariff changes between 1990 and 1995, combined with cross-regional variation in the industry composition of local employment, to estimate the causal effects of the trade liberalization reform on children's activities and human capital investments. Our study leverages three waves of Census data from 1991, 2000, and 2010, along with over 25 years of administrative data from the School Census, to provide a comprehensive investigation of the reform's dynamic effects. Moreover, since shocks to different industries affect the labor market opportunities for adults and children in different ways (Soares et al., 2012; Bai and Wang, 2020), our analysis also exploits cross-regional variation in the employment shares of adults and children in each sector to decompose the overall measure of local exposure to trade liberalization into two additive components that differentially impact the returns to adult and child labor.[2] By doing so, we are able to disentangle the effects of these two key components of tariff shocks, which are essential for understanding households' decisions.

We begin our analysis by examining the effects of the trade liberalization reform on child labor and schooling, focusing on changes in outcome variables between 1991-2000 (medium run) and 1991-2010 (long run), while controlling for state fixed effects, lag of the dependent variable, and various local characteristics of Brazilian regions. Our results show that an increase in the overall exposure to trade liberalization leads to smaller relative increases in school attendance, accompanied by larger relative increases in child labor. However, these general results conceal an important nuance. By splitting the overall measure of tariff reduction into two components that distinctly impact local labor market conditions for adults and children, we obtain estimates in opposite directions, consistent with income and substitution effects.[3] Specifically, we find that regions more exposed to child-specific tariff reductions experience larger relative increases in schooling, whereas regions more exposed to adult-specific tariff reductions experience larger relative increases (smaller declines) in child labor.

[2]Our approach is similar to that of Autor et al. (2019), who studied the gender-specific components of a large-scale demand shock on marriage and fertility decisions in the United States.

[3]In Section 2, we propose a simple theoretical framework showing that a negative shock to the demand for adult labor leads to an increase in the share of children who work (i.e. income effect), while a negative shock to the demand for child labor leads to an increase in the share of children attending school (i.e. substitution effect).

Furthermore, by comparing the medium- and long-term impacts of the trade liberalization, we find that the effects are persistent and always larger in the long run. Specifically, we show that school attendance never recovers in regions more affected by adult-specific tariff shocks, while it remains persistently higher in regions more affected by child-specific tariff shocks, even nearly two decades later. The effects are substantial. According to our preferred specification, a 0.003 log-point reduction in child-specific tariff protection−which is equivalent to moving a region from the 10th to the 90th percentile of the distribution−leads to a 3.1 percentage point (pp) larger relative increase in the share of children who exclusively attend school ("study only") in the long run, which corresponds to a growth 15.7% above the national trend between 1991 and 2010.[4] Our results are robust to controlling for differences in trends across regions, which are allowed to vary based on a range of demographic and socioeconomic characteristics. Interestingly, we show that the estimated effects are significantly more pronounced among children from socially disadvantaged backgrounds, particularly those from low-income and less-educated households.

We complement these results by leveraging annual administrative data from the Brazilian School Census, available for an extended period (1995 and 2020), to examine in more detail the evolution of the effects of trade liberalization on school enrollment and other educational outcomes, such as age-grade distortion and approval rates. Our results are consistent with previous findings, reinforcing that the effects are persistent and that the adjustment process occurs gradually over time. Specifically, our estimates suggest that during the period between 1995 and 2020 a decrease of 0.003 log-points in child-specific tariff protection led to a larger relative increase in school enrollment of approximately 2.3 pp, which corresponds to a growth 41.8% above the national trend.[5] Furthermore, we document that tariff shocks did not impact age-grade distortion or approval rates among elementary school students, suggesting that children induced to enroll as a result of the shocks were able to progress successfully through the school system. Finally, we show that our results cannot be explained by supply-side changes in the provision of education, as we find no systematic effects of the shocks on local school infrastructure.

Having established that the trade liberalization reform influenced children's allocation

[4]Conversely, a 0.104 log-point reduction in adult-specific tariff protection−which is equivalent to moving a region from the 10th to the 90th percentile of the distribution−leads to a 5.6 pp smaller relative increase in the share of children who "study only" in the long run, which corresponds to a growth 28.5% below the national trend between 1991 and 2010.

[5]Conversely, a 0.104 log-point reduction in adult-specific tariff protection led to a 2.8 pp smaller relative increase in school enrollment, which corresponds to a growth 51.4% below the national trend during the same period.

of time, we next turn to examining its long-term consequences for human capital accumulation. To do so, we leverage variation in tariff exposure across birth cohorts within the same region. Intuitively, we expect individuals in their formative years during the early 1990s to have been more impacted by the reform. Using data from the 2010 Census and the share of individuals in each birth cohort who completed elementary school, high school, or have some college education as proxies for the stock of human capital, we find that trade liberalization affected the educational attainment of the cohorts born after the mid-1980s, with no significant impact on older cohorts. Importantly, in line with our previous results, the effects of adult- and child-specific tariff reductions are always in opposite directions, with larger reductions in child-specific tariff protection leading to greater human capital accumulation in the long run.

Next, to better understand the effects of the shock and the mechanisms driving their persistent impact on educational outcomes and human capital accumulation, we examined how both adult- and child-specific tariff reductions impacted the structure of local economies. Previous research by Dix-Carneiro and Kovak (2017, 2019) and Ponczek and Ulyssea (2021) showed that regions facing larger overall tariff reductions experienced a steady decline in formal sector employment and earnings, as capital gradually reallocated away from the local manufacturing sector. Consistent with these findings, we show that adult-specific tariff reductions led to smaller relative increases in both overall earnings and the share of formal employment in the long run. Strikingly, we find that child-specific tariff reductions led to opposite results, with harder-hit regions experiencing improvements in formal labor market conditions. Interestingly, these findings suggest that adult- and child-specific tariff reductions triggered a process of gradual reallocation of resources across industries and sectors, accompanied by changes in educational investments and human capital accumulation that may have amplified the initial effects of the shocks.

Finally, to put our results into perspective and assess their broader applicability, we examine the effects of the import competition shock associated with the rise of Chinese manufacturing (the "China shock") on child labor and schooling in Brazil during the early 2000s. Following Autor et al. (2013), Costa et al. (2016) and Connolly (2022), we exploit cross-industry variation in Chinese imports between 2000 and 2010, combined with pre-existing regional differences in each industry's employment share, to construct a local measure of adult- and child-specific exposure to foreign imports. Consistent with our previous results, we find that regions more exposed to child-specific import competition experienced larger relative increases in schooling, while those more exposed to adult-specific import competition experienced larger relative increases in child labor. These findings further reinforce the robustness of our results, also lending external validity to our conclusions.

Our paper contributes to an extensive literature examining the effects of economic shocks on human capital, with a particular emphasis on child labor and schooling (Edmonds and Theoharides, 2020). Most previous research has focused on transitory shocks affecting specific commodities and sectors (Edmonds and Pavcnik, 2005; Kruger, 2007; Bai and Wang, 2020; Carrillo, 2020). Our study adds to this literature by providing a comprehensive examination of the impacts of a country-wide shock that affected all sectors of an economy. In this regard, our paper is closely related to Edmonds et al. (2010) and Kis-Katos and Sparrow (2011), who investigated the short- and medium-term effects of tariff reforms in India and Indonesia.[6] We contribute to these studies by leveraging data spanning almost three decades to examine the long-term impacts of Brazil's trade liberalization reform, as well as the dynamics of adjustment over time. Strikingly, we find that the effects of the shocks are persistent and always larger in the long run. Moreover, the richness of our data allows us to uncover heterogeneous effects that vary by households' socioeconomic characteristics and individuals' birth cohorts. In doing so, we provide further evidence reinforcing the importance of the early childhood environment for human capital formation (Currie and Almond, 2011; Almond et al., 2018).

Our paper also contributes to a related strand of the literature which has examined the effects of direct shocks to household income on human capital investment decisions (Thomas et al., 2004; Beegle et al., 2006; Edmonds, 2006; Duryea et al., 2007). The insights provided by these studies have led researchers to recognize the idea that such shocks may influence family decisions through a variety of channels, particularly via a combination of income and substitution effects (Soares et al., 2012). Our paper adds to this literature by extending the standard shift-share approach to empirically decompose a trade shock into two components that differentially affect the labor market opportunities for adults and children. In this respect, we complement the work of Bai and Wang (2020), who examined the effects of tariff reductions in crops categorized as intensive in either adult or child labor in the context of India's trade liberalization reform. Our paper, in turn, takes advantage of census data containing detailed information on the specific sector in which children are employed to implement a more precise decomposition of the tariff shock. We also conduct a systematic examination of the effects of both adult- and child-specific tariff reductions on various outcomes, showing that these shocks had persistent impacts on human capital accumulation.

[6]Relatedly, Atkin (2016) examined the medium-term effects (1986-2000) of a local expansion in export-manufacturing industries on skill acquisition in Mexico, showing that increased job opportunities led to higher school dropout rates among those eligible for employment (young adults above age 16), while Greenland and Lopresti (2016) documented significant increases in US high school graduation rates (2000-2007) in labor markets adversely affected by import competition. Both studies highlight how trade shocks affect human capital by altering the opportunity cost of schooling.

This paper also relates to a large literature examining the dynamics of labor market adjustments in response to trade shocks (Gonzaga et al., 2006; Acemoglu et al., 2016; Dix-Carneiro and Kovak, 2017; Autor et al., 2019). Specifically, Dix-Carneiro and Kovak (2017) document that formal sector employment and wages in Brazil continued to decline well after the country's trade liberalization reform was implemented (see also Kovak (2013); Dix-Carneiro and Kovak (2019); Ponczek and Ulyssea (2021)). In an environment with imperfect labor mobility and agglomeration economies, Dix-Carneiro and Kovak (2017) argue that the destruction of formal employment leads to a reduction in regional productivity, triggering a self-reinforcing process in which capital stocks slowly reallocate away from adversely impacted regions. Our paper contributes to this literature by providing novel evidence that adjustments in local labor markets were accompanied by persistent changes in human capital investments. In this respect, our analysis highlights the potential role of human capital in amplifying the initial effects of a trade shock.[7]

## 2 Theoretical Framework

In this section, we propose a simple theoretical framework to examine the general effects of an economic (trade) shock on children's activities, aiming to shed light on key theoretical mechanisms that may arise in the data. We consider an economy composed of $N$ households, each endowed with one unit of adult labor, supplied inelastically, and one unit of child labor. Each child may either work ($W$), study ($S$), or remain idle ($I$). For simplicity, we suppose that children cannot divide their time among different activities, allowing the household's problem to be modeled as a discrete choice problem with three alternatives.

In particular, our analysis is based on multinomial logit model, where the utility of household $i$ under choice $j \in \{W, S, I\}$ is given by:

$$U_{ij} = V_j + \epsilon_{ij},$$

where $\epsilon_{ij}$ is an iid random utility shock with Type I Extreme Value distribution. The term $V_j$ can be interpreted as the household's generalized consumption when alternative $j$ is chosen. We assume that:

$$V_S = w_A + \gamma_S$$

[7]Other studies have examined the impacts of Brazil's trade liberalization reform on labor market outcomes by gender (Gaddis and Pieters, 2017), crime (Dix-Carneiro et al., 2018), elections (Ogeda et al., 2024) and health (Charris et al., 2024). Our study makes a novel contribution to this literature by providing a comprehensive examination of the effects of the trade reform on child labor, schooling and human capital formation.

$$V_W = w_A + w_C$$

and

$$V_I = w_A,$$

where $w_A$ and $w_C$ denote adult and child wages, respectively, and the parameter $\gamma_S$ captures the overall net benefit of sending the child to school. For simplicity, and without loss of generality, we assume that the benefit of keeping the child idle is normalized to zero. Following the spirit of Basu and Van (1998)'s luxury axiom, we suppose that a household can afford to send its children to school only if their income from non-child labor sources is sufficiently large. In particular, we assume that children can attend school if, and only if:

$$w_A \geq \varphi_i,$$

where the term $\varphi_\iota$ represents a household-specific subsistence level, which we assume to be uniformly distributed over the interval $[0, \overline{\varphi}]$. Note that this formulation captures the potential heterogeneity in subsistence levels, which may vary according to geographic location and the availability of other household income sources, including rents, transfers, and returns on other assets. Our analysis focuses on the more interesting case where $w_A < \overline{\varphi}$, so that the probability of the subsistence condition being satisfied is always interior and given by $\Pr(w_A \geq \varphi_i) = w_A/\overline{\varphi}$.

Households take wages $w_A$ and $w_C$ as given, observe their idiosyncratic shocks $\epsilon_{ij}$ and $\varphi_i$, and choose the alternative $j \in \{W, S, I\}$ that maximizes their utility, subject to the subsistence condition. Under a multinomial logit model, the shares of households choosing to send their children to school, have them work, or keep them idle can be expressed as follows:

$$\varkappa_S(w_A, w_C) = \frac{w_A}{\overline{\varphi}} \frac{\exp(\gamma_S)}{\exp(\gamma_S) + \exp(w_C) + 1} \tag{1}$$

$$\varkappa_W(w_A, w_C) = \frac{w_A}{\overline{\varphi}} \frac{\exp(w_C)}{\exp(\gamma_S) + \exp(w_C) + 1} + \left(1 - \frac{w_A}{\overline{\varphi}}\right) \frac{\exp(w_C)}{\exp(w_C) + 1} \tag{2}$$

and

$$\varkappa_I(w_A, w_C) = \frac{w_A}{\overline{\varphi}} \frac{1}{\exp(\gamma_S) + \exp(w_C) + 1} + \left(1 - \frac{w_A}{\overline{\varphi}}\right) \frac{1}{\exp(w_C) + 1} \tag{3}$$

Note that whenever the subsistence condition is binding, which occurs with probability $1 - w_A/\overline{\varphi}$, households are limited to choosing between having their children work or keeping them idle. This intuitively explains the second term in the sum on the right-hand side of equations (2) and (3).

Our analysis investigates the effects of an economic shock on intra-household decision-making by decomposing it into two components that differentially affect adult and child wages. Conceptually, we suppose that fluctuations in general labor market conditions for adults and children are reflected in changes in their respective wages.[8] Formally, we provide a characterization of how children's activities respond to changes in adult and child wages, holding all other variables constant. The next proposition summarizes our main results.

**Proposition 1.** *Households respond to changes in adult and child wages in the following manner:*

*i.* ***Income Effect.*** *An increase in adult wages, $w_A$, leads to an increase in the share of children who attend school and to a reduction in the shares of children who work or who remain idle.*

*ii.* ***Substitution Effect.*** *An increase in child wages, $w_C$, leads to an increase in the share of children who work and to a reduction in the shares of children who attend school or who remain idle.*

Thus, an increase in adult wages is associated with a positive *income effect*, which allows more families to send their children to school, while an increase in child wages is associated with a negative *substitution effect*, which raises the returns to child labor (i.e. the opportunity cost of education), thereby reducing the share of children who attend school. In addition, idleness decreases in both cases. In practice, economic shocks typically affect labor markets conditions for adults and children simultaneously, leading to changes in both $w_A$ and $w_C$. Therefore, our framework suggests that changes in school attendance are driven by a combination of income and substitution effects, weighted by the magnitude of wage changes, $\Delta w_A$ and $\Delta w_C$, respectively.

Our analysis thus far has assumed that households are homogeneous in the sense that they all receive identical wages and are subject to the same identically distributed shocks. We now introduce some degree of heterogeneity by considering the existence of two types of households, rich ($R$) and poor ($P$). Specifically, rich households are defined as those for whom the subsistence condition is always satisfied, i.e. $w_A > \overline{\varphi}^R$, while poor households are those for whom this condition is binding with a strictly positive

[8] Intuitively, a shock that negatively impacts a sector such as the automotive industry—which typically employs very few children—should induce significant changes in adult wages, but have little to no effect on child wages. Conversely, a shock that negatively impacts sectors like apparel or textiles—which typically employ larger fractions of children—should result in changes in both adult and child wages.

probability, i.e. $w_A < \overline{\varphi}^P$. Our goal is to understand how the magnitude of the effects of the shocks differs between these two income groups. The next proposition summarizes our results.

**Proposition 2.** *In a model with rich and poor households, with* $\overline{\varphi}^R < w_A < \overline{\varphi}^P$*, the following results hold:*

*i. The effect of a change in adult wages on the share of children who work is always larger for poor households relative to rich households,* $|\frac{\partial \varkappa_W^P}{\partial w_A}| > |\frac{\partial \varkappa_W^R}{\partial w_A}|$.

*ii. The effect of a change in child wages on the share of children who work is larger for poor households relative to rich households,* $|\frac{\partial \varkappa_W^P}{\partial w_C}| > |\frac{\partial \varkappa_W^R}{\partial w_C}|$*, provided that* $w_C < \frac{1}{2}\log(1 + e^{\gamma_S})$.

Hence, we find that the impact of an economic shock on child labor is more pronounced among children from socially disadvantaged backgrounds. Specifically, the magnitude of the income effect is always larger for poor households. Moreover, the substitution effect is also larger for poor households, provided that child wages are sufficiently low relative to the returns to schooling $\gamma_S$—a condition typically satisfied in most real-world settings. Overall, our theoretical framework provides general predictions about the effects of economic shocks on children's activities, which we can use to guide our investigation of Brazil's trade liberalization reform.

# 3 Institutional Background

## 3.1 Brazil's Trade Reform of the 1990s

For over five decades following the 1930s, Brazil pursued a state-led industrialization policy centered on import substitution and a complex system of protections against foreign competition. In addition to the high nominal tariffs, a protective structure consisting of non-tariff barriers and special regimes was in place, which included lists of banned products, quantity controls, and government procurement restrictions (Kume et al., 2003). By the mid-1970s, signs of financial unsustainability began to emerge, and throughout the 1980s, Brazil experienced successive financial and economic crises, accompanied by escalating social problems. In this context, the election of Fernando Collor de Mello in 1990 marked a significant shift towards a more liberal approach to economic policy-making.

In a move towards greater transparency, the Collor administration unexpectedly implemented a reform in 1990 that eliminated all non-tariff barriers, replacing them with

higher import tariffs designed to maintain the overall level of protection unchanged. Importantly, from that moment on, tariffs began to reflect the actual degree of protection received by each industry, thereby becoming the primary instrument of trade policy.[9] Between 1990 and 1995, the trade liberalization process gained momentum, with average nominal tariffs falling from 30.5% to 12.8%, and then remaining relatively stable thereafter.[10] In Figure 1, we plot the percentage change in tariffs by industry, aggregated at the *Nível 50* classification level, from 1990 to 1995, measured by the variation in $\log(1 + tariff)$. Notably, there is substantial heterogeneity in tariff reductions across sectors, with tariffs declining by about 0.25 log points in Rubber and Apparel, but only 0.03 log points in Petroleum, Gas, and Coal−while in Agriculture tariffs actually experienced a slight increase.

Another important goal of Brazil's trade liberalization reform was to reduce the cross-industry variation in tariffs in an attempt to minimize economic distortions (Kume et al., 2003). Consistent with this objective, the dispersion of protection across industries decreased substantially between 1990 and 1995, with the standard deviation of tariffs dropping from 14.9 percentage points (pp) to 7.4 pp. Moreover, and crucial to our empirical strategy, the industries that were most protected prior to the reform experienced the largest tariff reductions (Kovak, 2013). As shown in Figure 2, there is a strong negative correlation (−0.90) between changes in tariffs and pre-liberalization tariff levels imposed decades earlier (Kume et al., 2003). This pattern helps mitigate potential concerns that tariff cuts may have been influenced by industry-specific characteristics. As we discuss in detail below, our analysis carefully controls for potential factors that could be correlated with the implemented tariff cuts.

## 3.2 Child Labor in Brazil

Child labor remains a major issue in Brazil, a source of significant concern given the well-established role of basic education and human capital as key drivers of economic development, as well as social and intergenerational mobility. As reported in Panel A of Table 1, while the percentage of children who work has steadily declined since the 1980s, approximately 5.5% of children aged 10 to 14 were still engaged in paid or unpaid jobs in 2010. This amounts to more than 930,000 children participating in the labor market during a period of their lives considered critical for the development of essential cognitive and social skills. Moreover, among the children working in 2010, approximately 46% held

[9]For a detailed description of the trade liberalization reform in Brazil, see Kume et al. (2003), Kovak (2013) and Dix-Carneiro and Kovak (2017).

[10]Figure A1 depicts the dynamics of nominal tariffs from 1987 to 1998 across the ten largest industries.

paid jobs, suggesting that a significant fraction of these children work to supplement their family's income.

In Panel B of Table 1, we show that the proportion of working children is considerably higher in the poorer and more rural regions of the country, defined respectively as the microregions with per capita income below the median and rural population above the median. Furthermore, not only is the share of child labor consistently higher in these regions, but its rate of reduction has been slower over time. Indeed, from 1980 to 2010, the proportion of children who work decreased by about 64.5% in urban areas but by only 46% in rural areas. A similar pattern is observed when comparing large and small microregions, defined as those with populations above and below the median, respectively.

Moreover, from Panel B of Table 1, we observe that the share of child labor tends to be lower in the wealthier states of the South, while it is more evenly distributed across other regions of the country. Moreover, conditional on working, child labor is significantly more prevalent in agricultural and extractive sectors than in manufacturing and non-tradable sectors. Specifically, in 2010, within the subsample of working children, approximately 52% were employed in agriculture and extractive sectors, while 40.3% and 7.7% were employed in non-tradable and manufacturing sectors, respectively.

In Figure A2, we take a closer look at the intensity of child labor across sectors by reporting the ratio of child labor to total labor in each industry, using Census data from 1991, the baseline period for our empirical analysis. The figure reveals substantial heterogeneity across industries, with agriculture standing out as the most child-intensive sector. In the manufacturing sector, industries such as non-metallic mineral manufacturing, footwear, wood and furniture, food processing, textiles, and apparel appear as particularly intensive in child labor. Finally, in Figure A3, we show a strong negative correlation between child labor and formal employment (i.e. the proportion of workers with formal labor contracts), further reinforcing the notion that children are more likely to work in industries with low skill requirements.

# 4 Data

## 4.1 Child Labor and Schooling Data

Our main source of data on child labor and schooling comes from the Brazilian Demographic Censuses for 1980, 1991, 2000, and 2010. These datasets provide detailed information on labor market participation, school attendance, and various socioeconomic characteristics of children, with the key advantage of being representative at fine geographic levels. Specifically, our analysis exploits information on whether children attend

school, work, or remain idle (i.e. neither work nor study).[11] Moreover, for the subsample of employed children, we also observe whether their work is paid or unpaid. Importantly, the dataset contains information on the sector of employment for each child, classified according to the 5-digit CNAE Domiciliar system.[12]

Our analysis focuses on children aged 10 to 14, as information on labor market participation is unavailable for children under 10, and the Brazilian legislation permits work as an "apprentice" for those over 14. Moreover, in line with the literature on local labor markets, our analysis is conducted at the microregion level—a level of aggregation defined by the Brazilian Institute of Geography and Statistics (IBGE) that includes neighboring municipalities with similar geographic and productive characteristics.[13] Similar to Costa et al. (2016) and Dix-Carneiro et al. (2018), our final sample consists of 411 microregions with boundaries that remained constant between 1980 and 2010 based on the definition of "minimally comparable areas" by Reis et al. (2008).[14]

Our analysis focuses on changes in child labor, schooling, and other educational and labor market outcomes between 1991 and 2000 ("medium run") and between 1991 and 2010 ("long run"). Furthermore, we use information from the 1980 Census to account for pre-existing trends potentially related to future tariff reductions, and census data to construct demographic control variables at the microregion level for the baseline year of 1991. We also exploit annual information from Brazil's School Censuses between 1995 and 2020 to assess the effects of the trade liberalization reform on the dynamics of school enrollment, age-grade distortion, and other educational indicators. Finally, we use detailed administrative data from Relação Anual de Informações Sociais (RAIS), available annually from 1986 to 2018, to examine the evolution of the effects of tariff reductions on formal labor markets.

[11] To facilitate the discussion, we define working children as those who either "work only" or "work and study". Our results remain robust when analyzing these two groups separately, though the effects are stronger for children who "work and study", as they represent the majority of working children, particularly in the later years of the sample.

[12] The CNAE Domiciliar classification system provides a categorization of economic activities and is used in demographic censuses and household surveys in Brazil.

[13] Brazil's federal system is composed of 27 states, each subdivided into municipalities—the smallest administrative units with autonomous political and administrative organization. For statistical purposes, the IBGE classifies municipalities into microregions and mesoregions. Microregions consist of neighboring municipalities within the same state that share similar geographic and productive characteristics, whereas mesoregions represent a larger subdivision, encompassing multiple microregions with comparable geographic, social, and economic features.

[14] As in other studies, we do not consider the microregion containing the Free Trade Area of Manaus, as it was not affected by the trade liberalization reform of the 1990s. Moreover, we also exclude the archipelago of Fernando de Noronha, for which no information is available prior to the 1991 census.

## 4.2 Local Exposure to Trade Liberalization

Following the empirical literature on the regional effects of foreign competition, we construct a measure of local exposure to trade liberalization by leveraging two main sources of variation in a shift-share design. Specifically, we exploit cross-industry variation in protection arising from distinct changes in nominal tariffs between 1990 and 1995, combined with cross-regional variation in industry composition across the country. Intuitively, although tariff cuts were uniform across all regions for a given industry, exposure to the reform varied among microregions depending on their prior sectoral specialization.

In particular, we follow Kovak (2013) and Dix-Carneiro and Kovak (2017), who propose a measure of regional tariff change based on average tariff reduction across industries, weighted by each industry's share in the local labor market. Formally, the exposure of microregion $m$ to trade liberalization is given by:

$$\Delta Tariff_m = -\sum_{j \in S} \omega_{mj} \times \Delta \log(1 + \tau_j), \tag{4}$$

where $\tau_j$ represents the nominal tariff in industry $j$, $\Delta \log(1+\tau_j)$ denotes the log difference in tariff rates for industry $j$ between 1990 and 1995, and $S$ represents the set of all tradable industries.[15] Tariff changes are calculated using data on industry-specific tariff rates from 1987 to 1998 provided by Kume et al. (2003).[16] The term $\omega_{mj}$ captures the relative importance of industry $j$ in microregion $m$'s employment and is defined:

$$\omega_{mj} = \frac{\lambda_{mj}/\varphi_j}{\sum_{j' \in S} \lambda_{mj'}/\varphi_{j'}} \tag{5}$$

where $\lambda_{mj} = L_{mj}/L_m$ represents the share of workers in microregion $m$ employed in industry $j$, measured at the baseline year of 1991, and $\varphi_j$ is defined as one minus the wage bill share of industry $j$, calculated based on information from the Brazilian national accounts. To facilitate interpretation, we multiply the tariff exposure measure by minus one, so that microregions experiencing larger tariff cuts receive higher positive values for $\Delta Tariff_m$.

While the $\Delta Tariff_m$ index reflects each microregion's overall exposure to trade liberalization, it does not account for differences in how tariff reductions affect labor market

[15] Following Kovak (2013), we exclude the non-tradable sector from our analysis. Kovak (2013) shows that since the price of non-tradable goods moves together with the price of locally produced tradable goods, the magnitude of the local tariff shock depends exclusively on the tradable sector.

[16] We apply the same methodology as Dix-Carneiro and Kovak (2017) to aggregate information at the *Nível 50* industry classification level into a system compatible with the sector coding in Brazilian census data, resulting in 20 tradable sectors.

opportunities for adults and children. To capture this particular aspect of tariff changes, we decompose the aggregate measure of local tariff exposure by leveraging the fact that different industries and microregions employ varying proportions of adults and children. Specifically, for each industry $j$ and microregion $m$, we calculate the share of child labor in the baseline year of 1991, $Ch_{mj} = L_{mj}^{Ch}/L_{mj}$, and then split the aggregate measure of tariff exposure into two additive components:[17]

$$\Delta Tariff_m^{Child} = -\sum_{j \in S} Ch_{mj} \times \omega_{mj} \times \Delta \log(1 + \tau_j) \tag{6}$$

and

$$\Delta Tariff_m^{Adult} = -\sum_{j \in S} (1 - Ch_{mj}) \times \omega_{mj} \times \Delta \log(1 + \tau_j) \tag{7}$$

Intuitively, our measures of adult- and child-specific tariff reductions consist of three elements: $\Delta \log(1 + \tau_j)$ represents the tariff reduction in sector $j$, $\omega_{mj} \times \Delta \log(1 + \tau_j)$ reflects the exposure of microregion $m$ to tariff reductions in sector $j$, and $Ch_{mj} \times \omega_{mj} \times \Delta \log(1 + \tau_j)$ and $(1 - Ch_{mj}) \times \omega_{mj} \times \Delta \log(1 + \tau_j)$ approximate, respectively, the exposure of children and adults in microregion $m$ to tariff reductions in sector $j$.[18]

Figure 3 plots the spatial distribution of adult- and child-specific tariff exposures across Brazilian microregions, with darker shades indicating higher exposure to tariff cuts. Note that there is substantial variation in both measures, even within states. Importantly, Figure A4 shows that while the relationship between the overall measure of tariff exposure and the adult-specific component is nearly perfect ($\rho = 0.99$), the correlation with the child-specific component is significantly smaller ($\rho = 0.60$).[19] As we discuss below, our empirical strategy will exploit precisely these within-state variations in adult- and child-specific tariff exposures.

## 4.3 Summary Statistics

Our main dataset consists of information at the microregion level on changes in child labor and schooling over the periods 1991-2000 ("medium run") and 1991-2010 ("long run"), along with measures of local exposure to tariff reductions calculated based on tariff changes between 1990 and 1995. Table 2 provides summary statistics for the main

[17] Autor et al. (2019) use a similar strategy to decompose a labor demand shock into gender-specific components.

[18] Note that while the shares in each group-specific measure do not sum to one, their combined total equals unity. Our regression analysis includes both measures in all specifications, thus mitigating potential issues related to the incomplete share problem, as pointed out by Borusyak et al. (2022). In Section 7, we follow the exact approach proposed by these authors to check the robustness of our results.

[19] The correlation between the measures of adult- and child-specific tariff reduction measures is 0.58.

variables employed in our analysis. Panel A reports descriptive statistics for our measures of local exposure to trade liberalization. Note that, as expected, the average adult-specific tariff shock is significantly larger than the average child-specific tariff shock, reflecting the greater participation of adults in the workforce. Importantly, there is substantial variation in both indexes across microregions. For reference, the difference between microregions in the 90th and 10th percentiles of the distributions of overall and adult-specific tariff exposures is 0.107 and 0.104 log points, respectively, while the corresponding difference for the child-specific tariff exposure is 0.003 log points. Moreover, the average tariff change is about 0.043 log points for the adult-specific shock and 0.001 log points for the child-specific shock.

Next, in Panel B, we report descriptive statistics for changes in schooling and child labor between 1991 and 2000 ("medium run"). During this period, the share of children who attend "school only" increased by 15.7 percentage points (pp), accompanied by a 13.3 pp decrease in the fraction of children who remain "idle" and a more modest 2.3 pp reduction in the share of children who "work". A similar pattern is observed in Panel C, which reports summary statistics between 1991 and 2010 ("long run"). During this period, the fraction of children who attend "school only" increased even further by 19.6 pp, accompanied by a 15.6 pp reduction in the share of children who remain "idle" and a 4.0 pp decrease in the fraction of children who "work". Finally, in Panel D, we report descriptive statistics for selected socioeconomic characteristics of microregions for the baseline year of 1991. Remarkably, the average poverty rate in these microregions−defined as the fraction of the population living on less than 1/2 minimum wage per month−was 71.9%. Moreover, the mean share of urban population was 61.2%, while the average illiteracy rate was 30.3%. Overall, Brazil in 1991 was a country marked by significant poverty and inequality.[20]

# 5 Empirical Strategy

Our empirical analysis consists of four parts, focusing on the effects of the trade liberalization reform on: (*i*) child labor and schooling, (*ii*) school enrollment and age-grade distortion, (*iii*) human capital accumulation, and (*iv*) structural transformation.

**Child Labor and Schooling.** We begin our analysis by examining the impact of overall exposure to trade liberalization on child labor and schooling by estimating the following

[20]In Table A1, we report additional summary statistics for our analyses on school enrollment, human capital accumulation, and structural transformation, as we shall discuss in subsequent sections.

regression:

$$\Delta y_m^{\tau-1991} = \beta \Delta Tariff_m + \theta \Delta y_m^{1991-1980} + W_m\gamma + \delta_s + \epsilon_m \tag{8}$$

where $\Delta y_m^{\tau-1991}$ represents the first-difference of the variable $y_{m,t}$ for microregion $m$ between $\tau \in \{2000, 2010\}$ and the baseline year of 1991, i.e. $\Delta y_m^{\tau-1991} \equiv y_{m,\tau} - y_{m,1991}$. We estimate the above equation separately for the short and long differences, i.e. using $\tau = 2000$ and 2010 to investigate the medium and long-term effects of tariff reductions. The main outcomes considered in our analysis are the shares of children who attend "school only", "work" and neither work nor study ("idle"). Moreover, we also examine the impact of trade liberalization on the share of children employed in paid jobs. Our parameter of interest is $\beta$, which captures the effect of the overall tariff shock on children's activities.

Our identification strategy relies crucially on accounting for potential trends in outcome variables that might be correlated with regional exposure to trade liberalization. To do so, our basic specification includes state fixed effects $\delta_s$ to account for distinct state-specific trends, as well as a vector of microregion characteristics $W_m$ measured at the baseline year. Specifically, using data from the 1991 Census, we control for the logarithm of population, share of the population aged 10 to 14, share of urban population, poverty rate, illiteracy rate, and income inequality (Gini index). Additionally, we include the share of child labor in 1980. By controlling for these variables, we account for potential differences in trends across microregions, allowing them to vary based on their initial demographic and socioeconomic characteristics. Moreover, we include the lag of the dependent variable, $\Delta y_m^{1991-1980} \equiv y_{m,1991} - y_{m,1980}$, to control for preexisting trends. All regressions are weighted by population size in 1991, and standard errors are clustered at the mesoregion level to allow for spatial correlation among neighboring microregions.[21]

Next, we examine the distinct effects of adult and child-specific tariff reductions by estimating the following regression:

$$\begin{aligned}\Delta y_m^{\tau-1991} = \beta^{Adult} \Delta Tariff_m^{Adult} + \beta^{Child} \Delta Tariff_m^{Child} \\ + \theta \Delta y_m^{1991-1980} + W_m\gamma + \delta_s + \epsilon_m,\end{aligned} \tag{9}$$

where, as before, we control for state fixed effects, the lag of the dependent variable and the same microregion-specific characteristics measured at or before the baseline year. All regressions are weighted by population size in 1991, with standard errors clustered at the mesoregion level. Our parameters of interest in this case are $\beta^{Adult}$ and $\beta^{Child}$, which

[21] Our sample includes 91 mesoregions. Moreover, to account for correlation across regions with similar levels of exposure, we compute standard errors following the procedures proposed by Adão et al. (2019) and Borusyak et al. (2022), as reported in Section 7.

capture the effects of adult- and child-specific tariff reductions. In line with theoretical predictions, we expect the estimates associated with these two parameters to have opposite signs.[22]

We perform a number of robustness checks by controlling for various factors, including longer pre-trends, higher-order polynomials in income per capita, local labor markets characteristics, exposure to social programs such as *Bolsa Familia*, local educational infrastructure and public spending, as well as other regional shocks that might have contemporaneously affected Brazilian microregions during our study period.[23] We also conduct heterogeneous effects analyses by splitting the sample according to household income, educational level of the head of the household, and children's gender and race. In doing so, our aim is to investigate whether the estimated effects are more pronounced among children from socially disadvantaged backgrounds.

**School Enrollment, Age-Grade Distortion and Other Educational Measures.** Next, we use administrative data from the Brazilian School Census to examine in more detail the evolution of the effects of adult- and child-specific tariff reductions on school enrollment, age-grade distortion and approval rates. Data from the School Census has the advantage of being reported directly by schools on an annual basis and is available for a longer period, from 1995 to 2020. We begin our analysis by focusing on the share of children aged 10 to 14 enrolled in school using 1995 as the baseline−the first year of the School Census.[24,25] Specifically, we estimate a linear regression model similar to that specified in Equation (9) separately for each year $\tau \in \{1996, ..., 2020\}$, controlling for state fixed effects and microregion-specific characteristics. Moreover, while we are unable to directly control for the lag of the dependent variable due to the absence of school enrollment data prior to 1995, we proxy it by including the difference in the share of children attending school between 1980 and 1991 using information from the Demographic Census.

[22]Specifically, adult-specific tariff reductions are expected to lead children to move out of school and into the labor market, due to their negative impact on household income. Conversely, child-specific tariff shocks are expected to lead children to move in the opposite direction (i.e. towards schooling), by reducing the opportunity cost of education.

[23]Furthermore, in Section 7 we follow the approach suggested by Goldsmith-Pinkham et al. (2020) to provide additional support for our identification strategy.

[24]While information on school enrollment is obtained directly from the School Census, data on population size for children aged 10 to 14 is available only for the Census years of 1991, 2000, 2010, and 2022. Following standard practice in the literature, we project the population of children for non-census years using a linear interpolation method.

[25]We note that information on school enrollment by age group was not reported by the School Census of 1997. Thus, for that particular year, we employ a simple interpolation to project the enrollment of children aged 10 and 14 in each microregion. As shall become clear below, none of our findings depend on the results obtained specifically for 1997.

Furthermore, to check whether children entering school as a result of the shocks are actually able to progress through the school system−or conversely, whether those dropping out of school are precisely those who would not have been able to progress anyway−we complement our analysis by examining the effects of tariff reductions on age-grade distortion rates for elementary school students. This measure is defined as the share of children enrolled in a school grade two or more years below that which would be expected based on their age. We then estimate a regression for each year $\tau \in \{1996, ..., 2020\}$ using the same specification described above for school enrollment. Moreover, in a complementary analysis, we examine the impact of trade shocks on approval rates in elementary school, defined as the share of students who are able to successfully advance to the next grade at the end of the school year.[26]

Finally, in order to check whether our main results are not being driven by differential changes in the supply of school infrastructure, we estimate the effect of both tariff reduction shocks on the number of schools and teachers in elementary schools per 1,000 inhabitants, using School Census data.

**Human Capital Accumulation.** Next, we investigate how local exposure to trade liberalization affected human capital accumulation in the long run. Since the effects in this case are likely to be concentrated in specific age groups, our analysis employs an alternative specification, conducted at the 'year-of-birth cohort'-'microregion' level, using the shares of individuals who completed elementary school, high school and have some college education as proxies for the stock of human capital. In line with existing research on early childhood environments (Currie and Almond, 2011; Almond et al., 2018), we expect cohorts of individuals in their formative years during the early 1990s to have been most impacted by the trade reform.

Specifically, using data from the 2010 Census, we estimate the following regression:

$$y_{cm}^{2010} = \sum_{\substack{j=1950 \\ j\neq 1973}}^{1992} \beta_j^{Adult}(\mathbb{1}\{c=j\} \times \Delta Tariff_m^{Adult}) + \sum_{\substack{j=1950 \\ j\neq 1973}}^{1992} \beta_j^{Child}(\mathbb{1}\{c=j\} \times \Delta Tariff_m^{Child}) + \sum_{\substack{j=1950 \\ j\neq 1973}}^{1992} \gamma_c(\mathbb{1}\{c=j\} \times W_m) + \sum_{\substack{j=1950 \\ j\neq 1973}}^{1992} \theta_c(\mathbb{1}\{c=j\} \times \tilde{y}_{cm}^{1991}) + \lambda_m + \mu_c + \delta_{cs} + \epsilon_{cm}, \tag{10}$$

where $y_{cm}^{2010}$ is a measure of the human capital stock of cohort $c$ in microregion $m$ in 2010.

[26] We note that due to methodological changes, data on approval rates were not reported in the School Census of 2006. Thus, for that particular year, we use simple interpolation to project approval rates for each microregion.

Our specification controls for microregion fixed effects $\lambda_m$, year-of-birth cohort fixed effect $\mu_c$, cohort-state fixed effects $\delta_{cs}$, and the interaction between cohort fixed effects and the same microregion-specific characteristics $W_m$ considered in previous specifications, all measured at or before the baseline year of 1991. Moreover, we include the lag of the dependent variable $\tilde{y}_{cm}^{1991}$, defined as stock of human capital of the cohort which, in 1991, was the same age as cohort $c$ in 2010.[27] Our approach enables us to control for potential 'cohort'-'microregion'-specific confounders whose effects are allowed to vary flexibly across cohorts. As before, all regressions are weighted by population size in 1991, and standard errors are clustered at the mesoregion level.

Our analysis focuses on cohorts born from 1950 to 1992, whose members were aged 18 to 60 in 2010. We consider the cohort born in 1973−whose members were 18 years old in 1991−as the baseline (omitted) group. Our parameters of interest are $\beta_c^{Adult}$ and $\beta_c^{Child}$, which capture the cohort-specific effects of adult- and child-specific tariff reductions on the stock of human capital accumulated by cohort $c$ by the Census year of 2010. Note that, since individuals born in 1973 or earlier were not exposed to the trade liberalization shock during their formative years, we expect the estimates for $\beta_c^{Adult}$ and $\beta_c^{Child}$ to be close to zero and statistically insignificant for $c \leq 1973$. Conversely, since individuals born after 1973 were progressively more exposed to the shock, we expect the estimated effects to increase in magnitude and become statistically significant for those born after 1973.

**Structural Transformation.** Finally, in order to better understand the mechanisms driving the persistent effects of the shocks, we investigate how exposure to trade liberalization affected the structure of local economies. In particular, we focus on the medium- and long-term effects of trade shocks on changes in several key characteristics of local labor markets, including the share of formal employment (i.e. the fraction of private sector workers with a formal labor contract), the logarithm of average individual earnings, and distribution of the workforce across agriculture/mining, manufacturing, and the non-tradable sector.[28] As before, our analysis is based on estimating linear regression models similar to that specified in Equation (9), controlling for state fixed effects, lag of the dependent variable, and microregion-specific characteristics, with standard errors clustered

[27]For instance, for the cohort born in 1992, which was 18 years old in 2010, we use the human capital stock of the cohort born in 1973, which was 18 years old in 1991.

[28]While other studies have examined the overall effect of Brazil's trade liberalization reform on some of these outcomes (Dix-Carneiro and Kovak, 2017, 2019; Ponczek and Ulyssea, 2021), our analysis adds to the literature by disentangling the effects of adult- and child-specific tariff reductions.

at the mesoregion level.[29] Finally, we complement our study by leveraging over 30 years of administrative data from the Relação Anual de Informações Sociais (RAIS) to examine the evolution of the effects of both adult- and child-specific tariff reductions on formal sector employment and earnings in a manner similar to Dix-Carneiro and Kovak (2017).

# 6 Main Results

## 6.1 Child Labor and Schooling

**Main Estimates.** We begin our discussion by reporting in Table 3 the effects of local exposure to trade liberalization on changes in child labor and schooling between 1991 and 2000 (columns 1, 3, 5 and 7) and between 1991 and 2010 (columns 2, 4, 6 and 8). In Panel A, we report coefficient estimates for the specification in Equation (8) focusing on the impact of overall tariff reductions on children's activities. Our results indicate that an increase in exposure to trade liberalization leads to smaller increases in the share of children who "study only" over the medium and long run, relative to the national trend (columns 1 and 2). This effect is accompanied by larger relative increases (smaller declines) in the share of children who "work" (columns 3 and 4). Conversely, we find no significant effect on the share of children who remain "idle" (columns 5 and 6). Our results also suggest that the larger relative increases in child labor observed in microregions more heavily exposed to tariff reductions are primarily driven by larger increases (smaller declines) in the share of children engaged in paid employment (columns 7 and 8).

Interestingly, we find that the estimated effects are persistent and always larger in the long run (columns 2, 4, and 8). Specifically, our point estimates suggest that reducing overall local tariff exposure by 0.107 log points−which is equivalent to moving a microregion from the 10th to the 90th percentile of the distribution of overall tariff reductions−leads to a smaller relative increase in the share of children who "study only" of about 0.5 percentage points (pp) ($0.048 \times 0.107$) in the medium run and 3.6 pp ($0.338 \times 0.107$) in the long run. This is accompanied by a larger relative increase

[29] Our analysis employs a two-step approach similar to the one used by Dix-Carneiro and Kovak (2017) to net out social and demographic characteristics of the local workforce from the dependent variables prior to conducting our main analysis. Specifically, we regress individual labor market outcomes on demographic characteristics (age, age squared, and dummies for gender and years of schooling) and microregion fixed effects to obtain the average of the logarithm of earnings and formal employment rates net of worker composition. We then use the microregion fixed effects estimates to construct our dependent variables, taking differences between census years. The second-stage regressions are performed at the local labor market level, weighted by the inverse of the first-stage standard errors.

(smaller decline) in the share of children who "work" of about 1.2 pp ($0.116 \times 0.107$) in the medium run and 3.2 pp ($0.302 \times 0.107$) in the long run. To put these figures into perspective, note that the fraction of children who "study only" in Brazil increased by 19.6 pp between 1991 and 2010 (see Table 2, panel C). Thus, a microregion exposed to an overall tariff reduction of 0.107 log points is estimated to have experienced an increase in the share of "study only" approximately 18.5% ($3.6 \div 19.6$) below the national trend.

Next, we disentangle the effects of adult- and child-specific tariff reductions on children's activities by estimating the specification in Equation (9) for both the medium and long run. The results reported in Panel B of Table 3 show that the estimates for adult-specific tariff reductions closely mirror those obtained for the overall measure−with the same sign, but consistently larger in magnitude. In contrast, the estimates associated with child-specific tariff reductions have always the opposite sign, in a manner consistent with substitution effects. In particular, we find that an increase in local exposure to child-specific tariff reductions leads to larger relative increases in the share of children who "study only" over the medium and long run (columns 1 and 2). This is accompanied by smaller relative increases (larger declines) in the proportion of children who "work" (columns 3 and 4) and who have paid employment (columns 7 and 8), with no significant effects observed on the share of children who remain "idle" (columns 5 and 6).

As before, we find that the estimated effects of both adult- and child-specific tariff shocks are persistent and always larger in the long run. Specifically, focusing on child-specific tariff reductions, our point estimates suggest that a decrease in tariff exposure of 0.003 log points−which is equivalent to moving a microregion from the 10th to the 90th percentile of the distribution of child-specific tariff reductions−leads to a larger relative increase in the share of children who "study only" of about 2.1 pp ($7.038 \times 0.003$) in the medium run and 3.1 pp ($10.229 \times 0.003$) in the long run. This is accompanied by a smaller relative increase (larger decline) in the share of children who "work" of about 1.7 pp ($5.817 \times 0.003$) in the medium run and 2.1 pp ($6.941 \times 0.003$) in the long run.[30] To put these figures into perspective, a microregion exposed to a local child-specific tariff reduction of 0.003 log points is estimated to have experienced an increase in the share of children who "study only" approximately 15.8% ($3.1 \div 19.6$) above the national trend between 1991 and 2010.[31] Interestingly, while child-specific tariff reductions are much

[30]For adult-specific tariff reductions, a decrease in exposure of 0.104 log points−which is equivalent to moving a microregion from the 10th to the 90th percentile of the distribution of adult-specific tariff reductions−leads to a smaller relative increase in the share of children who "study only" of about 1.9 pp ($0.181 \times 0.104$) in the medium run and 5.6 pp ($0.537 \times 0.104$) in the long run, accompanied by a larger relative increase (smaller decline) in the share of children who "work" of about 2.3 pp ($0.217 \times 0.104$) and 4.4 pp ($0.425 \times 0.104$), respectively.

[31]Similarly, a microregion exposed to a local adult-specific tariff reduction of 0.104 log points is

smaller in magnitude compared to adult-specific tariff reductions, our results suggest that the impacts of both shocks are substantial and economically significant.

**Robustness Checks.** In order to check the robustness of our main findings, we estimate several alternative specifications for the model in Equation (9), controlling for additional socioeconomic characteristics that could potentially be correlated with adult- and child-specific tariff reductions. Tables 4 and 5 report the results of these robustness checks focusing on the two main outcomes of our analysis, namely the share of children who "study only" and the share of children who "work", respectively.

We begin by discussing the results for the share of children who "study only", as reported in Table 4, for both the medium run (panel A) and the long run (panel B). To facilitate comparison, we present in column 1 the estimates from our baseline specification (Table 3, panel B, columns 1 and 2), and in column 2 we report estimates from a specification that includes state fixed effects but omits all other controls. We then report coefficient estimates for a number of different specifications, where we control for additional microregion-specific characteristics beyond those already included in the baseline regression. Specifically, in column 3 we account for longer pre-liberalization trends by including the change in the dependent variable between 1970 and 1980, $\Delta y_m^{1980-1970}$, while in column 4 we add a cubic polynomial in the logarithm of per capita income in 1991. Additionally, in column 5 we control for several characteristics of the local labor markets, including the share of unskilled workers (i.e. fraction of workers who did not complete high school), share of informal employment, and the shares of the workforce in agriculture/mining and manufacturing, all measured in the baseline year of 1991.

Next, in column 6 we account for the local exposure to key social programs by including the share of the microregion's population in 2000 impacted by PETI—a program for the eradication of child labor—and the share of the population receiving benefits from the conditional cash transfer program *Bolsa Família* as of December 2004, following Almeida and Carneiro (2012). Moreover, in column 7 we control for the local supply of public goods and educational infra-structure by adding the logarithm of the microregions' total per capita spending in 1991, the number of primary school teachers per 1,000 inhabitants in 1995, and the number of schools per 1,000 inhabitants in 1995. Finally, in column 8 we account for macroeconomic shocks that occurred during the post-liberalization period by including, similarly to Dix-Carneiro and Kovak (2017), microregion-specific changes in import tariffs during 1995-2000 (for medium-run analysis, panel A) and 1995-2010 (for

estimated to have experienced an increase in the share of children who "study only" approximately 28.6% ($5.6 \div 19.6$) below the national trend.

long-run analysis, panel B), microregion-specific changes in real exchange rates (both import- and export-weighted) during 1991-2000 (panel A) and 1991-2010 (panel B), as well as microregion-specific changes in commodity prices during 1991-2000 (panel A) and 1991-2010 (panel B), using a measure proposed by Adão (2016).[32]

Note that the point estimates reported in Table 4 remain stable across the various specifications. The long-run effects (panel B) are particularly large in magnitude and always statistically significant, with the point estimates associated with adult-specific tariff shocks ranging from $-0.377$ to $-1.354$, and those associated with child-specific tariff shocks ranging from 8.387 to 15.859. Next, in Table 5 we report the results of the same robustness checks for the share of children who "work". As before, we show that our main results are robust to the inclusion of various additional controls. In particular, we find that in the long run (panel B) the point estimates associated with adult-specific tariff shocks range from 0.334 to 0.591, while those associated with child-specific tariff shocks range from $-4.767$ to $-11.479$, with all estimates being statistically significant at conventional levels. Additionally, in Tables A2 and A3 we report the results of similar exercises for the shares of children who remain "idle" and those who have a "paid employment", respectively, showing that our main findings hold across the different specifications.

**Heterogeneous Effects.** We complement our analysis by examining whether the estimated effects vary according to the characteristics of children and households. Intuitively, we expect the mechanisms underlying our main results to be more pronounced among children from disadvantaged backgrounds, particularly those in low-income and less-educated families. In Table 6, we report separate estimates based on our main specification for subsamples of children from "poor" (columns 1, 3, 5, and 7) and "non-poor" households (columns 2, 4, 6, and 8). A household is classified as "poor" if its income per household member falls below the 75th percentile of the income distribution within its microregion.[33] Note that, as expected, the estimated effects are much larger for the

[32]The changes in post-liberalization tariffs were computed using the UNCTAD TRAINS tariff database. To calculate microregion-specific changes in real exchange rates, we first computed industry-specific real exchange rates by averaging the real exchange rates between Brazil and its trade partners, weighted by the shares of exports to (or imports from) each country in a specific industry based on trade data from 1989. We then calculated microregion-specific changes in real exchange rates by taking the difference in the logarithm of industry-specific real exchange rates during 1991-2000 and 1991-2010, weighting each industry by its labor market share as in Equation (4).

[33]The decision to divide the sample at the 75th percentile of the income distribution reflects the widespread poverty and marked income inequality prevalent across Brazilian regions. For instance, in 2010, this threshold corresponded to R$ 652.50, or just about 25% above the minimum wage at the time. In any case, our results remain robust to using the median income as the cutoff for classifying "poor" and "non-poor" households, although the differences between the estimates for these two groups become slightly less pronounced.

subsample of children from "poor" households. Specifically, focusing on child-specific tariff reductions, we find that the long-run impact of a decrease in tariff exposure of 0.003 log points leads to a larger relative increase in the share of children who "study only" of about 3.8 pp ($12.808 \times 0.003$) among "poor" households, compared to just 0.6 pp ($1.852 \times 0.003$) among "non-poor" households (panel B, columns 1 and 2). This effect is accompanied by a smaller relative increase (larger decline) in the share of children who "work" of about 2.4 pp ($7.976 \times 0.003$) among "poor" households, compared to 1.0 pp ($3.339 \times 0.003$) among "non-poor" households (panel B, columns 3 and 4).[34] Consistent with these findings, we obtain similar results for the share of children who have a "paid employment" (columns 7 and 8). Overall, our results indicate that children from "poor" households are significantly more sensitive to trade shocks.

Next, in Table 7, we report the results of an additional heterogeneous effects analysis, where we estimate our basic specification separately for households with different educational levels. Specifically, we classify a household as "low education" if the highest level of schooling attained by the head of the household or their spouse is elementary or less.[35] Conversely, a household is categorized as "medium/high education" if the highest level of schooling is above elementary. Consistent with previous results, we find that the estimated effects are always more pronounced among "low education" households. In particular, the long-run effect of a decrease of 0.003 log points in child-specific tariff protection is estimated to lead to a larger relative increase in the share of children who "study only" of about 3.7 pp ($12.338 \times 0.003$) among "low education" households, compared to just 1.2 pp ($3.867 \times 0.003$) among "medium/high education" households (panel B, columns 1 and 2).[36] Consistent with these results, we observe effects in the opposite direction for the share of children who "work" (columns 3 and 4) and who have a "paid employment" (columns 7 and 8).

We further report in Table A4 the results of a similar exercise where we compare the

[34]Interestingly, the long-run impact of a reduction in adult-specific tariff exposure on the share of children who "study only" is negative and statistically significant only among "poor" children. Specifically, a reduction of 0.104 log points is estimated to lead to a smaller relative increase in the share of "study only" of about 7.7 pp ($0.744 \times 0.104$) (panel B, column 1). This is accompanied by a larger relative increase (smaller decline) in the share of children who "work" of about 5.8 pp ($0.554 \times 0.104$) (panel B, column 3).

[35]Similarly as before, the decision to split the sample based on completion of elementary school reflects the remarkably low levels of education of Brazilian households. For instance, in 2010, about 75% of households were classified as "low education" according to our criteria.

[36]Note that the long-run impact of a reduction in adult-specific tariff exposure on the share of children who "study only" is negative and statistically significant only for "low education" households. Specifically, a reduction in protection of 0.104 log points is estimated to lead to a smaller relative increase in "study only" of about 6.7 pp ($0.641 \times 0.104$) (panel B, column 1), accompanied by a larger relative increase in the share of children who "work" of 5.0 pp ($0.476 \times 0.104$) (panel B, column 3).

effects of tariff shocks on "black" and "non-black" children.[37] Consistent with previous findings, we observe that the impact on "black" children is larger−although the estimated differences are not as pronounced as those obtained in the analyses discussed above. Finally, we also perform a heterogeneity analysis by gender. The results reported in Table A5 suggest that the estimated effects are slightly stronger for boys, particularly with respect to the share of children who attend "school only". Overall, our results are consistent with the idea that individuals from disadvantaged backgrounds−particularly poor and black children with less-educated parents−are much more vulnerable to economic shocks.

## 6.2 School Enrollment, Age-Grade Distortion and Other Educational Measures

Next, we proceed to examine the dynamic effects of adult- and child-specific tariff reductions on school enrollment, age-grade distortion, and approval rates across Brazilian microregions. As noted earlier, school enrollment data have the advantage of being reported annually by the School Census and covering a longer period, providing an alternative way to assess the impact of tariff shocks on educational outcomes. In Figure 4, we plot point estimates of the effects of both adult- and child-specific tariff reductions obtained from estimating separate regressions based on the specification in Equation (9), with the dependent variable corresponding to changes in school enrollment between year $\tau \in \{1996, ..., 2020\}$ and the baseline year of 1995. The estimates connected by the solid line represent the dynamic effects of child-specific tariff shocks, while those connected by the dashed line represent the effects of adult-specific tariff shocks.[38] The shaded areas in Figure 4 depict the 90% confidence intervals computed based on standard errors clustered at the mesoregion level.

Consistent with our previous results, we find that an increase in local exposure to child-specific tariff reductions leads to larger relative increases in school enrollment. Conversely, an increase in exposure to adult-specific tariff reductions generates the opposite effect. Interestingly, our findings suggest that the impact of both shocks gradually increase over time, with enrollment rates taking about a decade to fully adjust to the trade liberalization reform. Specifically, our point estimates suggest that between 1995 and 2020 a decrease of 0.003 log points in child-specific tariff exposure led to a larger relative increase in school enrollment of approximately 2.3 pp ($7.506 \times 0.003$), while a decrease of 0.104 log points in adult-specific tariff exposure was associated with a smaller relative

[37] A child is classified as "black" if identified as "*preto*" or "*pardo*" in the Brazilian Census.

[38] To facilitate the visualization of the effects, the estimates associated with child-specific tariff reductions are scaled down by a factor of 10.

increase in school enrollment of about 2.8 pp ($0.272 \times 0.104$).[39] Overall, the impact of the trade liberalization reform on enrollment is consistent with our previous findings on child labor and schooling, reinforcing the robustness to our main results. Interestingly, our findings also provide novel insights into the dynamics of human capital adjustments in response to trade shocks.

A potential concern related to the evidence presented so far is that, while we have shown that school enrollment and attendance increased more rapidly in microregions more affected by child-specific tariff reductions, it remains unclear whether the children induced to enroll as a result of these shocks were actually able to successfully advance through the school system. Similarly, the children induced to drop out as a result of adult-specific tariff reductions may have been precisely those least likely to advance. These issues are crucial from a policy perspective, given our ultimate interest in understanding how these shocks impacted human capital accumulation.

To assess the relevance of these potential concerns, we examine the impact of tariff reductions on age-grade distortion rates among children enrolled in elementary school. Figure 5a reports the effects of adult- and child-specific tariff shocks obtained from estimating the specification in Equation (9) separately for each year between 1996 and 2020. Interestingly, neither adult- nor child-specific tariff shocks appear to have any effect on children's progression through the school system, with the point estimates being always small and statistically insignificant. Moreover, in Figure 5b, we plot the results of an additional analysis on approval rates among elementary school students. As before, the point estimates are small and statistically insignificant, suggesting that tariff shocks had no discernible effect on the school progression of children in Brazil.

Finally, we examine whether our main findings could simply reflect differential changes in the supply of school infrastructure across regions more or less affected by the trade liberalization reform−in other words, we investigate whether increases in school enrollment cannot be attributed simply to more schools opening in certain regions.[40] To do so, we report in Figure A5 the evolution of the effects of adult- and child-specific tariff reductions on changes in the number of schools and elementary school teachers per 1,000 inhabitants. Our results suggest that neither shock had a systematic effect on school infrastructure over time.

[39] These effects are substantial, considering that proportion of children aged 10 to 14 enrolled in school increased 5.5 pp between 1995 and 2020 (see Table A1, panel A).

[40] Indeed, this is a relevant concern, given that Brazil has made substantial progress in expanding access to public education over the past decades.

## 6.3 Human Capital Accumulation

In previous subsections, we have shown that adult- and child-specific tariff reductions affected significantly—and in opposite directions—children's allocation of time, particularly influencing household's decision between work and study. We now investigate whether these changes impacted their educational attainment in the long run, focusing specifically on the stock of human capital accumulated by individuals from different year-of-birth cohorts. To do so, we estimate the specification in Equation (10) using data from the 2010 Census, employing the share of individuals in each cohort who completed elementary school, high school, or have some college education as proxies for the stock of human capital. Intuitively, our analysis compares different year-of-birth cohorts within the same microregion to examine whether the trade liberalization reform had a more pronounced effect on the human capital of individuals more exposed to it during their early childhood.

In Figure 6, we report the point estimates associated with the effects of both adult- and child-specific tariff reductions for each year-of-birth cohort, normalizing the coefficients for the cohort born in 1973 to zero (omitted group)—members of this group were exactly 18 years old in 1991. Our results show that the trade liberalization reform did not have any impact on the educational outcomes of individuals born around 1980 or earlier, which is consistent with our expectation, given that these individuals were already adolescents or young adults when the reform took place. However, beginning with the cohorts born in the mid to late-1980s, the estimates for both shocks become statistically significant, with the magnitude of the effects progressively increasing over time. Thus, in line with the literature on early childhood environments, our results suggest that the effects of the shocks are more pronounced for individuals exposed to the impact of the trade reform earlier in their childhood.

Moreover, consistent with our previous results, we find that child-specific tariff reductions lead to relative increases in the stock of human capital (as indicated by the solid lines in Figure 6), while adult-specific tariff reductions are associated with effects in the opposite direction (as indicated by the dashed lines). Specifically, our point estimates suggest that for the cohort born in 1992, a decrease of 0.104 log points in adult-specific tariff exposure is associated with a 4.1 pp relative decrease in the share of individuals who completed elementary school by 2010. This effect is accompanied by a reduction in the proportion of individuals who completed high school of about 6.5 pp and a decrease in the share with some college education by 2010 of approximately 5.0 pp.

Conversely, we find that a decrease of 0.003 log points in child-specific tariff exposure leads to a 2.5 pp relative increase in the share of the individuals born in 1992 who com-

pleted elementary school by 2010. This is accompanied by an increase in the proportion of individuals who completed high school of about 3.7 pp and a rise in the share of those with some college education by 2010 of approximately 2.3 pp. These effects are quite substantial, considering that for the cohort born in 1992 the sample mean for elementary school completion is 69.1 pp (see Table A1, panel B), while the sample means for high school completion and some college education are 28.7 pp and 9.6 pp, respectively.

Finally, we check the robustness of our findings by reporting in Figure A6 the results of a placebo exercise, where we estimate a similar specification but now focusing on the stock of human capital accumulated by cohorts born between 1931 and 1973 as of the census year of 1991.[41] Intuitively, we expect to find no impact of tariff shocks on educational outcomes determined entirely prior to their occurrence. Indeed, our results suggest that there is no relationship between adult- and child-specific tariff reductions in the early 1990s and the shares of individuals across cohorts who completed elementary school, high school, or had some college education by 1991, with the point estimates being generally small and very imprecisely estimated.

## 6.4 Structural Transformation

Our analysis thus far has shown that the trade liberalization reform had a lasting impact on educational outcomes and human capital accumulation, with the effects always more pronounced in the long run. To better understand the mechanisms underlying the persistent impact of these shocks, we now investigate how adult- and child-specific tariff reductions affected the structure of local economies. In doing so, we also aim to connect our findings to the broader literature on the dynamics of labor market adjustments.

In Table 8, we report point estimates of the effect of tariff shocks on the share of formal employment, logarithm of average earnings, and the distribution of the workforce across sectors obtained from estimating the specification in Equation (9). The analysis draws on census data, which encompasses both formal and informal sectors. Consistent with previous literature (Dix-Carneiro et al., 2018; Dix-Carneiro and Kovak, 2019; Ponczek and Ulyssea, 2021), we find that larger adult-specific tariff reductions lead to smaller relative increases in the share of formal sector employment.[42] Furthermore, we find that adult-specific tariff shocks are associated with changes in the structure of local economic activity, with harder-hit regions experiencing a transition of their workforce

[41] To ensure that the analysis is symmetric, we focus on cohorts born in the period 1931-1973, since their members were exactly between 18 and 60 years old in 1991.

[42] Similarly to Dix-Carneiro et al. (2018), we also find a negative but statistically insignificant impact of adult-specific tariff shock on the logarithm of average earnings.

from manufacturing to agriculture. As before, the estimated effects are persistent and always larger in the long run. Specifically, our point estimates suggest that in the long run (panel B), a reduction of 0.104 log points in adult-specific tariff exposure leads to a smaller relative increase in formality rate of approximately 14.3 pp (1.375 $\times$ 0.104). Moreover, we find that harder-hit regions experience a smaller increase (larger decline) in the share of the workforce in manufacturing of about 9.0 pp (0.862 $\times$ 0.104), accompanied by a larger increase (smaller decline) in the share of the workforce in agriculture of 9.3 pp (0.892 $\times$ 0.104).

Conversely, we find that child-specific tariff reductions are associated with effects in the opposite direction, leading to larger relative increases in the share of formal sector employment and logarithm of average earnings. Moreover, we observe a reallocation of adult labor away from the non-tradable sector and into manufacturing. Specifically, our point estimates suggest that in the long run (panel B) a reduction of 0.003 log points in child-specific tariff exposure leads to a larger relative increase in formality rate of approximately 4.5 pp (14.841 $\times$ 0.003) and log earnings of about 0.033 log points (11.164 $\times$ 0.003). Moreover, we find that harder-hit regions experience a larger relative increase in the share of the workforce in manufacturing of about 2.1 pp (6.885 $\times$ 0.003), accompanied by a smaller relative increase (larger decline) in the share of the workforce in the non-tradable sector of 2.3 pp (7.671 $\times$ 0.003).

Our findings suggest that adult- and child-specific tariff reductions gave rise to a process of reallocation of resources both across industries and between formal and informal sectors, resulting in persistent impacts on earnings. Interestingly, as we have shown before, this process was accompanied by changes in educational investments and human capital accumulation that potentially amplified the initial effects of the shocks.[43] To further examine the differential impacts of adult- and child-specific tariff reductions on formal labor markets in Brazil, we leverage data from Relação Anual de Informações Sociais (RAIS) to analyze how both shocks influenced the dynamics of formal sector employment and earnings.

In Figure 7a, we plot the impact of tariff reductions on the logarithm of the number of formal employees, where each point estimate is obtained from a separate regression based on a specification similar to that in Equation (9), for each year between 1987 and

[43]The slow process of adjustment in human capital is consistent with the *gradual* deterioration of formal labor market outcomes observed by Dix-Carneiro and Kovak (2017) in places more severely impacted by overall tariff reductions. Since regional measures of capital stock are unavailable in Brazil, our analysis provides compelling evidence supporting the hypothesis that agglomeration economies are a potential mechanism behind the persistent effect of the trade liberalization reform (Autor et al., 2020). Indeed, our findings suggest that the initial shock set in motion a self-reinforcing process that affected both formal employment and human capital accumulation.

2018. For the pre-liberalization period (1987-1991), the changes are calculated relative to 1986, while for the post-liberalization period (1992-2018), the changes are calculated relative to 1991.[44] Consistent with our previous results, we find that larger child-specific tariff reductions are associated with larger relative increases in formal employment, with adult-specific tariff reductions leading to results in the opposite direction. Moreover, in Figure 7b, we find similar results for the logarithm of formal earnings (adjusted for composition effects), with regions harder-hit by child-specific tariff reductions experiencing significantly faster formal earnings growth over the long run. Strikingly, the effects of the liberalization on both formal employment and earnings gradually increase before beginning to level-off in the late 2010s.[45]

# 7 Additional Robustness Checks

In this section, we probe the robustness of our main findings by conducting a detailed investigation of the assumptions underlying our identification strategy. As discussed in Section 5, the validity of our research design relies on the assumption that the shares of adult and child workers in each industry are not systematically correlated with other factors that could potentially influence the evolution of child labor and schooling over time. To better understand the sources of identification behind our strategy, we begin by computing the Rotemberg weights associated with our estimates, following an approach proposed by Goldsmith-Pinkham et al. (2020). Intuitively, Rotemberg weights measure each industry's contribution to identification, providing a sensitivity-to-misspecification index that indicates the degree to which our estimates could be influenced by potential endogeneity in each share.[46]

In Figure A7, we present the estimated Rotemberg weights for both adult- and child-specific tariff exposure across the 20 industries considered in our analysis (see Table A6

[44] As before, we control for microregion-specific characteristics measured in 1991 across all specifications. However, the lag of the dependent variable—computed as the change in the outcome variable between 1986 and 1990—is included only in the regressions for the post-liberalization period.

[45] Overall, our estimates suggest that child-specific tariff reductions led to an immediate reduction in child labor and triggered a reallocation of the workforce from less formal sectors, such as non-tradables, to more formal capital-intensive sectors, such as manufacturing, resulting in an increase in formal employment and average earnings in the short and medium run. Over time, these effects appear to have been reinforced by an increase in human capital accumulation and continued resource reallocation across sectors, thus amplifying their long-run impact.

[46] While Goldsmith-Pinkham et al. (2020) primarily focus on the case where an instrumental variable approach is used, their framework also extends to settings like ours, where Bartik instruments are employed in a reduced-form fashion. Thus, following their insights, we compute Rotemberg weights separately for both measures of adult- and child-specific tariff exposure using, in each case, the corresponding shares of adult and child labor in each industry as instruments.

for additional details).[47] Observe that nearly all industries display a positive weight, with the exception of footware and leather in the case of adult-specific tariff exposure. Importantly, no single sector dominates the others as a source of variation, with no industry accounting for more than 40% of positive weights. Specifically, we find that the top five industries contributing most to adult-specific tariff exposure are: $(i)$ apparel, $(ii)$ metals, $(iii)$ auto, transport, and vehicles, $(iv)$ agriculture, and $(v)$ textiles. For child-specific tariff exposure the top five industries are: $(i)$ apparel, $(ii)$ footwear and leather, $(iii)$ non-metallic mineral manufacturing, $(iv)$ wood, furniture and peat, and $(v)$ textiles.

These results suggest that our main source of identification comes from comparing microregions with high and low employment shares in the industries listed above, particularly apparel, which stands out as the sector with highest Rotemberg weight for both measures. Indeed, the apparel industry experienced one of the largest tariff cuts among all sectors (see Figures 1 and A1). Moreover, it is a sector distinguished by its highly labor-intensive nature and characterized by a substantial fraction of informal employment and child labor (see Figure A3). According to Gorini (2000), shielded from foreign competition, the apparel industry in the early 1990s was marked by low productivity, reliance on outdated technology, and geographically dispersed production.[48]

Since our identification strategy relies on the exogeneity of employment shares across regions, we probe the robustness of our findings by re-estimating our main specification, exploiting only variation in adult and child labor within specific industries−one at a time−focusing on the top five sectors for each measure. In particular, we re-estimate the model in Equation (9) replacing our main measures with the shift-share terms $Ch_{mj} \times \omega_{mj} \times \Delta log(1+\tau_j)$ and $(1-Ch_{mj}) \times \omega_{mj} \times \Delta log(1+\tau_j)$ for a given industry $j$. Note that these expressions are part of the summands for adult- and child-specific tariff exposures in Equations (6) and (7), and intuitively capture the variation in local exposure to trade liberalization specific to industry $j$ for adults and children.

In Figure A8, we plot the point estimates associated with the effects of these industry-specific tariff exposures on changes in the shares of children who attend "school only" and "work" between 1991 and 2010. Consistent with our previous results, we find that an increase in adult-specific tariff exposure in each of the top five industries consistently leads to smaller relative increases in the share of children who "study only" (panel a), accompanied by larger relative increases (smaller declines) in the share of children who

[47] We note that the Rotemberg weights are not influenced by the dependent variable and vary only with the set of controls used in the regressions. In our analysis, we include state fixed effects and the microregion-specific characteristics considered in our main specification (Equation 9), along with the change in the share of children who "study only" between 1980 and 1991.

[48] The apparel sector was significantly impacted by the trade liberalization, particularly due to competition from cheaper and higher-quality imports from Asia (Gorini, 2000).

"work" (panel b). Importantly, the point estimates for each industry have always the same sign and similar magnitude, except for agriculture, where the estimates—despite having the expected sign—are larger in absolute terms and less precisely estimated.

Moreover, we also find that an increase in child-specific tariff exposure in each of the top five industries leads to larger relative increases in the share of children who "study only" (panel c)—except for footwear and leather, and textiles, both non-statistically significant—accompanied by smaller relative increases (larger declines) in the share of children who "work" (panel d). Note that, in this case, the point estimates exhibit greater variability in magnitude and are less precisely estimated—which is expected given the generally smaller geographic variation in child labor within specific industries. Importantly, the estimated coefficients always have the same sign, indicating an effect in the expected direction. Thus, our main results remain consistent even when the analysis is restricted to exploiting variation within specific sectors.

Next, we further complement our analysis by assessing the sensitivity of our findings to the influence of each specific industry. To do so, we estimate a version of the specification in Equation (9) that, in addition to all other controls, sequentially includes, one at a time, the shares of adults and children working in each industry in the baseline year of 1991. In Figure A9, we report the point estimates obtained from each separate regression focusing on the changes in the shares of children who attend "school only" and "work" between 1991 and 2010, alongside our baseline estimates. Note that the point estimates are remarkably stable across all specifications, suggesting that our results are not driven by any single sector in particular.[49] Moreover, as an additional robustness check, we construct alternative measures of adult- and child-specific tariff exposures, as defined in Equations (6) and (7), using employment shares from the 1980 Census. By doing so, we leverage differences in production location that existed a decade prior to the implementation of the trade liberalization reform. The results reported in Table A7 show that our main findings remain largely robust to the use of these alternative measures, although the estimated effects of child-specific tariff exposure become slightly smaller in magnitude.

Finally, we implement the procedure proposed by Borusyak et al. (2022), which draws on an alternative framework where the identifying assumption is based on the exogeneity of shocks rather than shares.[50] This approach yields standard errors robust to correlation

[49] In a complementary analysis (available upon request), we show that our results are also robust to an alternative exercise where we exclude each industry, one at a time, from our measures of adult- and child-specific tariff exposures.

[50] Borusyak et al. (2022) propose transforming the original microregion-level specification into an equivalent industry-level regression, using tariff shocks as instruments. Their approach entails averaging (partialled-out) outcomes and treatment variables at the industry level, weighting them by microregion-

across similarly exposed regions and is particularly appropriate when units experience multiple independent shocks. Moreover, since the shares in each of our group-specific measures do not sum to one, we normalize them to unity to address any potential issues related to the incomplete share problem, as recommended by Borusyak et al. (2022). The results reported in Table A8 show that our main findings are robust to changes in estimation approach and renormalization of shares in our group-specific measures.[51] Moreover, in Table A9 we report estimates with standard errors computed following Adão et al. (2019). Overall, our results are robust to using alternative inference procedures.

# 8 The China Shock: Effects on Child Labor and Schooling

Our analysis thus far has shown that Brazil's trade liberalization reform had a significant impact on children's allocation of time, particularly on their decisions between work and study. In this section, we provide additional support for the main mechanism underlying our findings by exploiting the import competition shock driven by the rise of Chinese manufacturing in the early 2000s—commonly known as the "China shock". Between 2000 and 2010, China's share of the world's manufacturing exports more than tripled, increasing from 4.8% to 15.1%. This remarkable growth was driven by the country's rapid economic expansion and increasing participation in international trade, particularly following its accession to the World Trade Organization in 2001.[52]

In order to examine the impact of increased exposure to Chinese import competition on child labor and schooling, we employ a shift-share methodology similar to that in our main analysis. Specifically, following Autor et al. (2014) and Costa et al. (2016), we exploit pre-existing differences in the employment shares in each industry across Brazilian microregions to construct local measures of adult- and child-specific exposure to Chinese

level employment shares.

[51] Because our empirical strategy estimates the effects of two shift-share variables, the industry-level point estimates differ slightly from those obtained at the microregion level. Our analysis applies Borusyak et al. (2022)'s procedure—originally developed for a single shift-share variable—separately to adult- and child-specific shocks, controlling for the other shock in each case.

[52] The rise in Chinese competition has been shown to have significantly impacted several countries. For instance, Autor et al. (2014), Acemoglu et al. (2016), Pierce and Schott (2016), Autor et al. (2019) and Autor et al. (2020) show that the China shock is associated with higher unemployment, lower wages, and increased political polarization in the US. Similarly, Costa et al. (2016) show that Brazilian manufacturing wages experienced slower growth due to Chinese competition, while Paz and Ssozi (2021) and Connolly (2022) show that regions more exposed to imports from China experienced a rise in the share of female employment in the formal sector and a reduction in the male-female wage gap, suggesting a reduction in labor market barriers and discrimination in response to the shock.

imports. Similarly to Equations (6) and (7), our main measures are defined as follows:

$$\Delta IS_m^{Child} = \sum_j Ch_{mj} \times \omega_{mj} \times \frac{\Delta I_j}{L_j} \tag{11}$$

and

$$\Delta IS_m^{Adult} = \sum_j (1 - Ch_{mj}) \times \omega_{mj} \times \frac{\Delta I_j}{L_j}, \tag{12}$$

where the term $\Delta I_j / L_j$ represents the change in the value of Brazilian imports from China in industry $j$ between 2000 and 2010, denominated in thousands of 2010 US dollars and normalized by the total workforce in sector $j$.[53] As before, the term $\omega_{mj}$ captures the relative importance of industry $j$ in microregion $m$'s employment (see Equation (5)), while $Ch_{mj}$ represents the share of child labor in microregion $m$ and industry $j$. To maintain symmetry with the previous analysis and facilitate comparison of results, we use employment shares from the Census of 1991, allowing us to exploit the exact same variation in geographic location of employment as before.[54]

We investigate the effects of adult- and child-specific exposure to Chinese import competition by estimating a regression similar to that specified in Equation (9), using the measures $\Delta IS_m^{Child}$ and $\Delta IS_m^{Adult}$ defined above and controlling for the same microregion-specific characteristics as before based on information from the 1991 Census.[55] Our main outcomes are the differences in the shares of children who attend "school only", "work", neither work nor study ("idle"), or have a paid employment between 2000 and 2010. All regressions are weighted by population size in 1991 and standard errors are clustered at the mesoregion level.[56] Moreover, given that changes in Brazilian imports from China

[53] Our analysis uses trade data from CEPII BACI, which covers over 200 countries and provides detailed product information (6-digit Harmonized System codes). To assign each product in the trade database to a specific industry, we combine the approaches proposed by Costa et al. (2016) and Dix-Carneiro and Kovak (2017), mapping products into a system compatible with the sector coding in the Brazilian census. This results in 20 tradable sectors−the same used in the trade liberalization analysis.

[54] Moreover, for consistency, using employment shares from the pre-liberalization period is preferred, given that we showed that tariff shocks affect the production structure of local economies. The correlation between adult-specific measures of tariff reduction and exposure to Chinese competition is 0.69, while for child-specific measures, it is 0.59. In Table A10, we report the results of a robustness exercise where we add the measures of adult- and child-specific exposure to import competition from China as controls to the baseline specification in Equation (9). In spite of the relatively high correlation across measures, our main results on the effects of trade liberalization remain unchanged.

[55] We also control for a measure of overall exposure to Chinese exports, defined as $XS_m = \sum_j \omega_{mj} \times \Delta X_j / L_j$, where $\Delta X_j$ represents the change in the value of Brazilian exports to China in industry $j$ between 2000 and 2010. We do so in order to account for the positive shock experienced by several Brazilian regions due to increased Chinese demand for commodities during this period. We note that our results remain unchanged regardless of whether or not this variable is included in the analysis.

[56] In an unreported analysis (available upon request), we show that our results are robust to adjusting standard errors following the procedure proposed by Adão et al. (2019).

could potentially reflect Brazil-specific shocks (such as sector-specific productivity shocks) not directly related to China's rising comparative advantage, we follow Costa et al. (2016) by also running an additional specification where we instrument our measures of adult- and child-specific exposure to Chinese imports with similar measures constructed using, for each industry, the predicted growth in imports from China to all other countries excluding Brazil, $\widehat{\Delta I}_j^{world}$ (see Costa et al. (2016) for details).

In Table 9, we report estimates obtained from both OLS (columns 1, 3, 5, and 7) and 2SLS (columns 2, 4, 6, and 8) regressions. Note that the results are in line with our previous findings presented in Subsection 6.1. Specifically, we find that an increase in exposure to adult-specific Chinese import competition leads to smaller relative increases in the share of children who "study only" (columns 1 and 2), accompanied by larger increases (smaller declines) in the share of children who "work" (columns 3 and 4). In contrast, the estimates associated with child-specific Chinese import competition always have the opposite sign, with an increase in local exposure leading to larger relative increases in the share of children who "study only" (columns 1 and 2), accompanied by smaller increases (larger declines) in the share of children who "work" (columns 3 and 4).

Observe that the point estimates obtained from both OLS and 2SLS are quite similar, with the first-stage being strong across all IV specifications (columns 2, 4, 6, and 8). In particular, the 2SLS estimates suggest that an increase of US$ 370 per worker in adult-specific exposure to Chinese import competition−which corresponds to moving a microregion from the 10th to the 90th percentile of the distribution of the adult-specific import competition shock (see panel D of Table A1)−leads to a smaller relative increase in the share of children who "study only" of about 0.11 pp ($0.003 \times 0.37$) (non-significant estimate), accompanied by a larger relative increase (smaller decline) in the share of children who "work" of approximately 0.22 pp ($0.006 \times 0.37$). Conversely, we find that an increase of US$ 10 per worker in child-specific exposure to Chinese imports−which corresponds to moving a microregion from the 10th to the 90th percentile of the distribution of the child-specific import competition shock−leads to a larger relative increase in the share of children who "study only" of about 0.47 pp ($0.473 \times 0.01$), accompanied by a smaller relative increase (larger decline) in child labor of 0.5 pp ($0.497 \times 0.01$).[57]

In Figure A10, we present the Rotemberg weights associated with both measures of import competition from China for the 20 industries in our analysis. Note that the top three sectors for the adult-specific measure are electric and electronic equipments (49.0%), machinery and equipments (19.2%), and metals (8.4%). For the child-specific measure,

[57] Although the magnitude of these effects seem small at face value, they are, in fact, relevant considering that the fraction of children who "study only" increased by 4.0 pp between 2000 and 2010, while the fraction of children who "work" declined by 1.7 pp.

the leading sectors are other manufacturing (40.2%), textiles (18.9%), and electric and electronic equipments (14.7%). Contrarily to the trade liberalization reform, the effects of the China shock appear to be more concentrated in specific industries−a pattern consistent with the fact that electronics, machinery, and electrical equipment accounted for approximately 40% of Brazil's import growth from China between 2000 and 2010 (Costa et al., 2016). Finally, we check the robustness of our findings by re-estimating our main specification including sequentially, one at a time, the shares of adults and children working in each industry in 1991. Figure A11 plots the 2SLS estimates from these regressions alongside the point estimates from the baseline model. Remarkably, the estimated effects remain quite stable across all specifications, suggesting that our results are not driven by any sector in particular.

# 9 Conclusion

This paper examines the medium- and long-term effects of Brazil's trade liberalization reform on child labor, schooling, and human capital accumulation. Using comprehensive census and administrative data spanning nearly three decades, we study the effects of age-specific components of the trade shock that differentially affected the labor market opportunities for adults and children. Our findings reveal that regions with greater exposure to child-specific tariff reductions experienced significantly larger declines in child labor, accompanied by corresponding increases in schooling. Remarkably, individuals in these regions accumulate more human capital and achieve better educational outcomes in the long-run, especially younger cohorts who were in their formative years during the early 1990s. In contrast, regions with greater exposure to adult-specific tariff reductions experienced significantly larger increases in child labor, accompanied by smaller increases in school attendance, and relative declines in human capital accumulation. These effects are persisted and always more pronounced in the long run. Our findings also indicate that adult- and child-specific tariff reductions triggered a gradual process of resource reallocation across industries and between formal and informal sectors−though in opposite directions. Interestingly, these effects are consistent with the slow adjustment dynamics observed in educational investments, highlighting the potential role of human capital in amplifying the initial economic impact of the shocks.

# References

Acemoglu, D., Autor, D., Dorn, D., Hanson, G. H., and Price, B. (2016). Import competition and the great us employment sag of the 2000s. *Journal of Labor Economics*,

34(S1):S141–S198.

Adão, R., Kolesár, M., and Morales, E. (2019). Shift-Share Designs: Theory and Inference. *The Quarterly Journal of Economics*, 134(4):1949–2010.

Adão, R. (2016). Worker heterogeneity, wage inequality, and international trade: Theory and evidence from brazil. Unpublished paper, MIT.

Almeida, R. and Carneiro, P. (2012). Enforcement of labor regulation and informality. *American Economic Journal: Applied Economics*, 4(3):64–89.

Almond, D., Currie, J., and Duque, V. (2018). Childhood circumstances and adult outcomes: Act ii. *Journal of Economic Literature*, 56(4):1360–1446.

Atkin, D. (2016). Endogenous skill acquisition and export manufacturing in mexico. *American Economic Review*, 106(8):2046–85.

Autor, D., Dorn, D., and Hanson, G. (2019). When work disappears: Manufacturing decline and the falling marriage market value of young men. *American Economic Review: Insights*, 1(2):161–78.

Autor, D., Dorn, D., Hanson, G., and Majlesi, K. (2020). Importing political polarization? the electoral consequences of rising trade exposure. *American Economic Review*, 110(10):3139–3183.

Autor, D. H., Dorn, D., and Hanson, G. H. (2013). The china syndrome: Local labor market effects of import competition in the united states. *The American Economic Review*, 103(6):2121–2168.

Autor, D. H., Dorn, D., Hanson, G. H., and Song, J. (2014). Trade adjustment: Worker-level evidence. *The Quarterly Journal of Economics*, 129(4):1799–1860.

Bai, J. and Wang, Y. (2020). Returns to work, child labor and schooling: The income vs. price effects. *Journal of Development Economics*, 145:102466.

Basu, K. and Van, P. H. (1998). The economics of child labor. *The American Economic Review*, 88(3):412–427.

Beegle, K., Dehejia, R. H., and Gatti, R. (2006). Child labor and agricultural shocks. *Journal of Development Economics*, 81(1):80–96.

Borusyak, K., Hull, P., and Jaravel, X. (2022). Quasi-Experimental Shift-Share Research Designs. *The Review of Economic Studies*, 89(1):181–213.

Carrillo, B. (2020). Present bias and underinvestment in education? long-run effects of childhood exposure to booms in colombia. *Journal of Labor Economics*, 38(4):1127–1265.

Charris, C., Branco, D., and Carrillo, B. (2024). Economic shocks and infant health: Evidence from a trade reform in brazil. *Journal of Development Economics*, 166:103193.

Chetty, R., Hendren, N., and Katz, L. F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment. *American Economic Review*, 106(4):855–902.

Connolly, L. (2022). The effects of a trade shock on gender-specific labor market outcomes in brazil. *Labour Economics*, 74.

Costa, F., Garred, J., and Pessoa, J. P. (2016). Winners and losers from a commodities-for-manufactures trade boom. *Journal of International Economics*, 102:50–59.

Cunha, F. and Heckman, J. (2007). The technology of skill formation. *American Economic Review*, 97(2):31–47.

Cunha, F. and Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources*, 43(4):738–782.

Cunha, F., Heckman, J. J., and Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3):883–931.

Currie, J. and Almond, D. (2011). Human capital development before age five. In *Handbook of labor economics*, volume 4, pages 1315–1486. Elsevier.

Dix-Carneiro, R. and Kovak, B. K. (2017). Trade liberalization and regional dynamics. *American Economic Review*, 107(10):2908–46.

Dix-Carneiro, R. and Kovak, B. K. (2019). Margins of labor market adjustment to trade. *Journal of International Economics*, 117:125–142.

Dix-Carneiro, R., Soares, R. R., and Ulyssea, G. (2018). Economic shocks and crime: Evidence from the brazilian trade liberalization. *American Economic Journal: Applied Economics*, 10(4):158–95.

Duryea, S. and Arends-Kuenning, M. (2003). School attendance, child labor and local labor market fluctuations in urban brazil. *World Development*, 31(7):1165–1178.

Duryea, S., Lam, D., and Levison, D. (2007). Effects of economic shocks on children's employment and schooling in brazil. *Journal of Development Economics*, 84(1):188–214.

Edmonds, E. and Theoharides, C. (2020). The short term impact of a productive asset transfer in families with child labor: Experimental evidence from the philippines. *Journal of Development Economics*, 146:102486.

Edmonds, E. V. (2006). Child labor and schooling responses to anticipated income in south africa. *Journal of development Economics*, 81(2):386–414.

Edmonds, E. V. (2007). Child labor. *Handbook of development economics*, 4:3607–3709.

Edmonds, E. V. and Pavcnik, N. (2005). The effect of trade liberalization on child labor. *Journal of International Economics*, 65(2):401–419.

Edmonds, E. V., Pavcnik, N., and Topalova, P. (2010). Trade adjustment and human capital investments: Evidence from indian tariff reform. *American Economic Journal: Applied Economics*, 2(4):42–75.

Frankenberg, E. and Thomas, D. (2017). Human capital and shocks: Evidence on education, health, and nutrition. In *The Economics of Poverty Traps*, pages 23–56. University of Chicago Press.

Gaddis, I. and Pieters, J. (2017). The gendered labor market impacts of trade liberalization: Evidence from brazil. *Journal of Human Resources*, 52(2):457–490.

Goldsmith-Pinkham, P., Sorkin, I., and Swift, H. (2020). Bartik instruments: What, when, why, and how. *American Economic Review*, 110(8):2586–2624.

Gonzaga, G., Menezes Filho, N., and Terra, C. (2006). Trade liberalization and the evolution of skill earnings differentials in brazil. *Journal of International Economics*, 68(2):345–367.

Gorini, A. P. F. (2000). Panorama do setor têxtil no brasil e no mundo: Reestruturação e perspectivas. Technical report, Banco Nacional de Desenvolvimento Econômico e Social.

Greenland, A. and Lopresti, J. (2016). Import exposure and human capital adjustment: Evidence from the us. *Journal of International Economics*, 100:50–60.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science*, 312(5782):1900–1902.

ILO (2021). Child labour: Global estimates 2020, trends and the road forward.

Kis-Katos, K. and Sparrow, R. (2011). Child labor and trade liberalization in indonesia. *Journal of Human Resources*, 46(4):722–749.

Kovak, B. K. (2013). Regional effects of trade reform: What is the correct measure of liberalization? *American Economic Review*, 103(5):1960–76.

Kruger, D. I. (2007). Coffee production effects on child labor and schooling in rural brazil. *Journal of Development Economics*, 82(2):448–463.

Kume, H. G., Piani, G., and Souza, C. F. B. (2003). A política brasileira de importação no período 1987-1998: Descrição e avaliação. In Courseil, C. H. and Kuma, H., editors, *A Abertura Comercial Brasileira nos Anos 1990: Impactos sobre Emprego e Salário*. IPEA, Rio de Janeiro.

Ogeda, P., Ornelas, E., and Soares, R. R. (2024). Labor Unions and the Electoral Consequences of Trade Liberalization. *Journal of the European Economic Association*, page jvae020.

Paz, L. S. and Ssozi, J. (2021). The effects of chinese imports on female workers in the brazilian manufacturing sector. *Journal of Development Studies*, 57(5):807–823.

Pierce, J. R. and Schott, P. K. (2016). The surprisingly swift decline of us manufacturing employment. *American Economic Review*, 106(7):1632–1662.

Ponczek, V. and Ulyssea, G. (2021). Enforcement of Labour Regulation and the Labour Market Effects of Trade: Evidence from Brazil. *The Economic Journal*, 132(641):361–390.

Reis, E., Pimentel, M., Alvarenga, A. I., and Santos, M. (2008). Áreas mínimas comparáveis para os períodos intercensitários de 1872 a 2000.

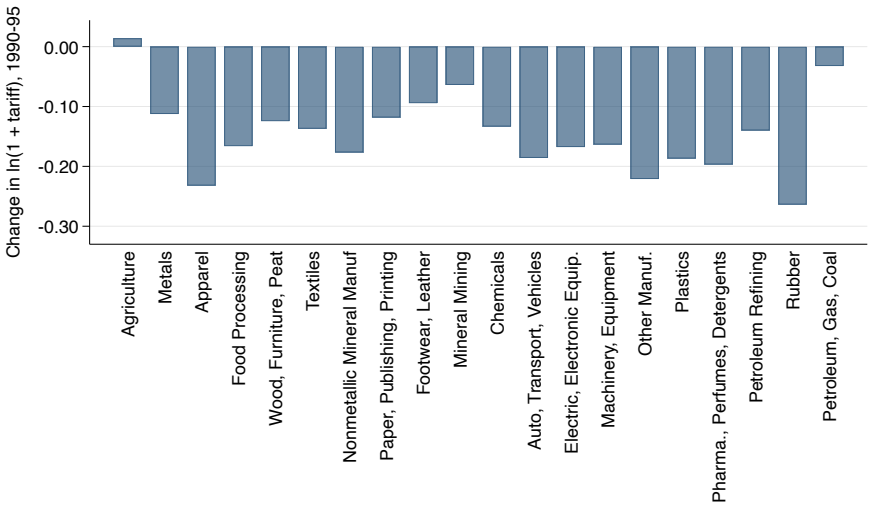
Soares, R. R., Kruger, D., and Berthelon, M. (2012). Household choices of child labor and schooling a simple model with application to brazil. *Journal of Human Resources*, 47(1):1–31.

Thomas, D., Beegle, K., Frankenberg, E., Sikoki, B., Strauss, J., and Teruel, G. (2004). Education in a crisis. *Journal of Development economics*, 74(1):53–85.

Topalova, P. (2010). Factor immobility and regional impacts of trade liberalization: Evidence on poverty from india. *American Economic Journal: Applied Economics*, 2(4):1–41.

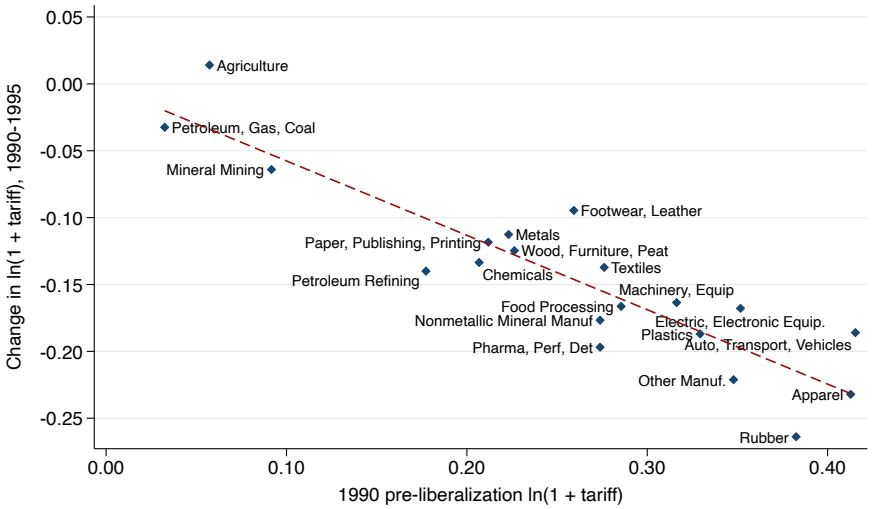
# Figures

Figure 1: Tariffs Changes by Industry, 1990-1995




*Notes:* This figure plots percentage tariff changes by industry from 1990 to 1995, measured as the variation in $\log(1 + tariff)$. Tariff data come from Kume et al. (2003) and are aggregated at the *Nível 50* industry classification level into a system compatible with the sector coding available in the Brazilian census data resulting in 20 tradable sectors.

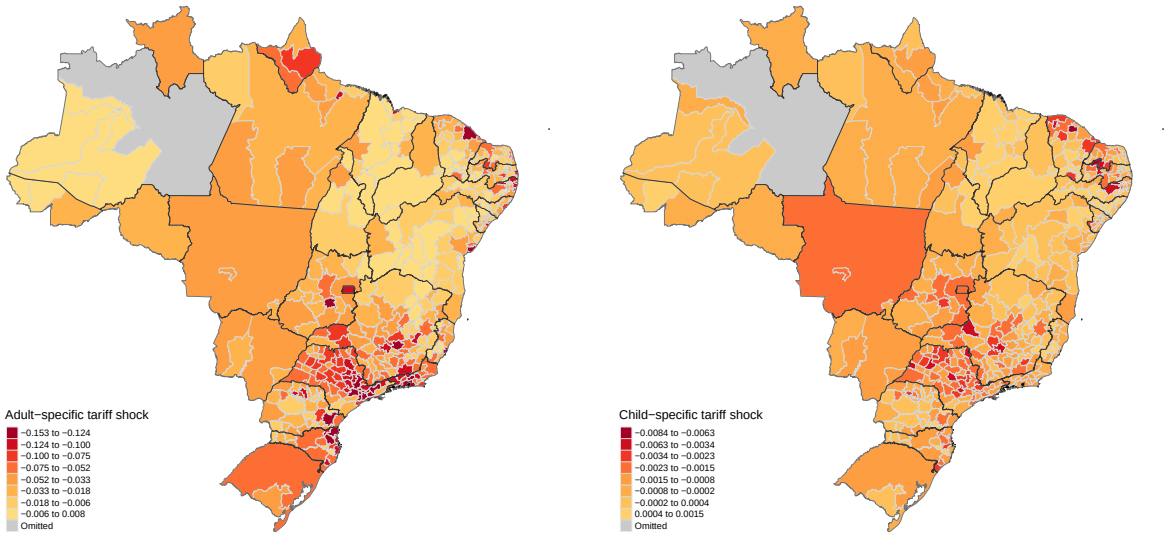
Figure 2: Tariff Changes vs Pre-Liberalization Tariff Levels




*Notes:* This figure plots the relationship across industries between tariff changes from 1990 to 1995 and pre-liberalization tariff levels in 1990. The correlation between both variables is $-0.90$.

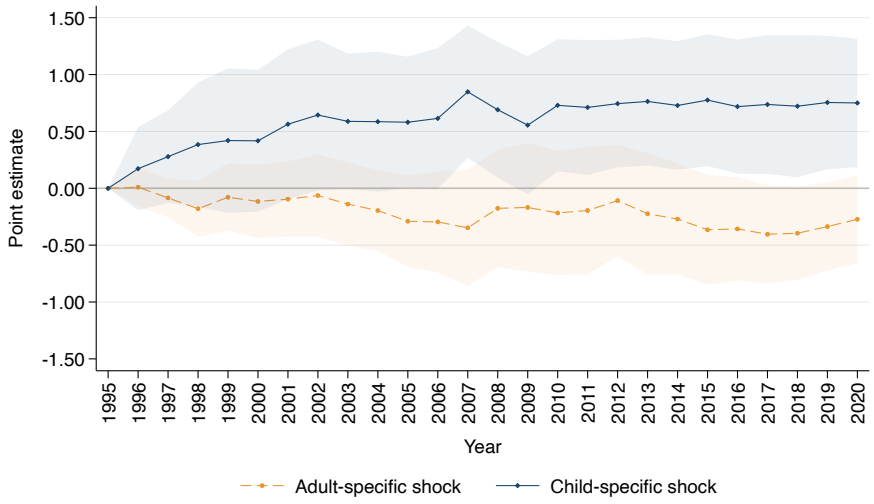
Figure 3: Spatial Distribution of Tariff Shocks

(a) $\Delta Tariff_m^{Adult}$ (b) $\Delta Tariff_m^{Child}$




*Notes:* These maps show the spatial distribution of adult- and child-specific tariff exposures across Brazilian microregions, calculated using Equations (6) and (7). Darker shades indicate higher exposure to tariff cuts; the gray area, which includes the Free Trade Area of Manaus, is excluded from the analysis.

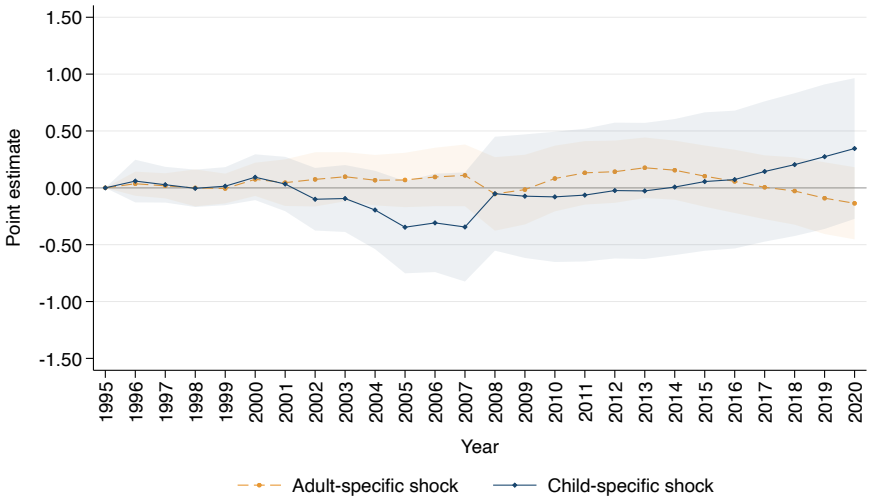
Figure 4: Dynamic Effects on School Enrollment



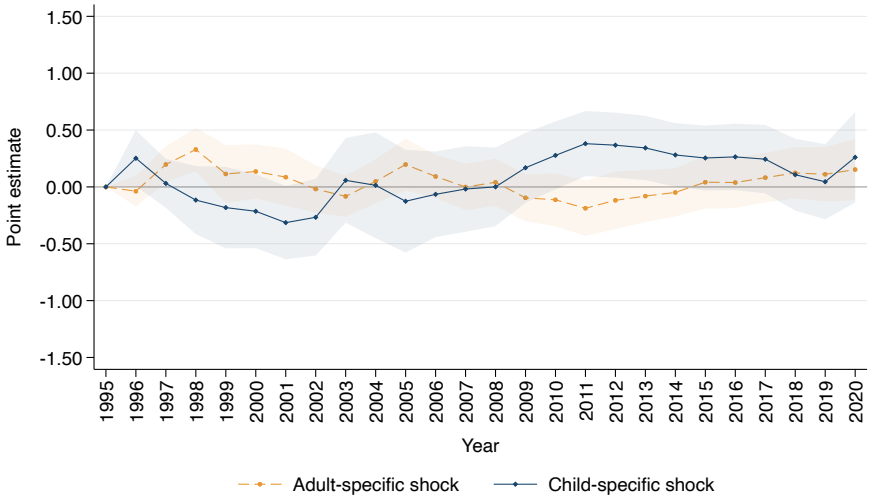

*Notes:* This figure plots the dynamic effects of adult- and child-specific tariff reductions on school enrollment. Each point estimate is obtained from a separate regression based on Equation (9). The dependent variable represents changes in school enrollment rates between year $\tau \in \{1996, ..., 2020\}$ and the baseline year of 1995. The estimates connected by the solid line represent the dynamic effects of child-specific tariff shocks, while those connected by the dashed line represent the dynamic effects of adult-specific tariff shocks. The shaded areas indicate the 90% confidence intervals computed based on standard errors clustered at the mesoregion level. To facilitate visualization, the point estimates for child-specific tariff reductions are divided by 10.

Figure 5: Dynamic Effects on School Performance

(a) Age-Grade Distortion Rates



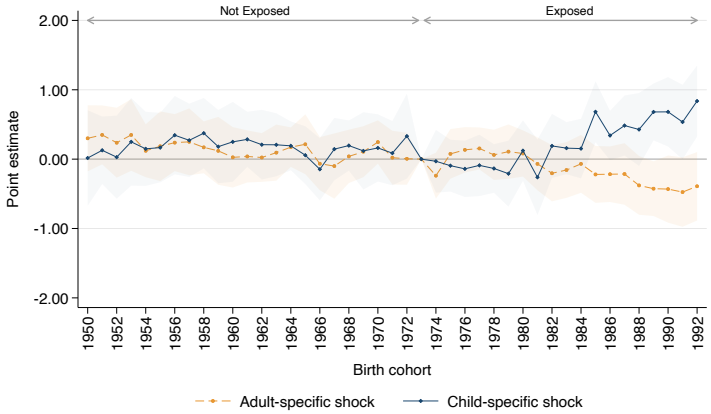

(b) Approval Rates



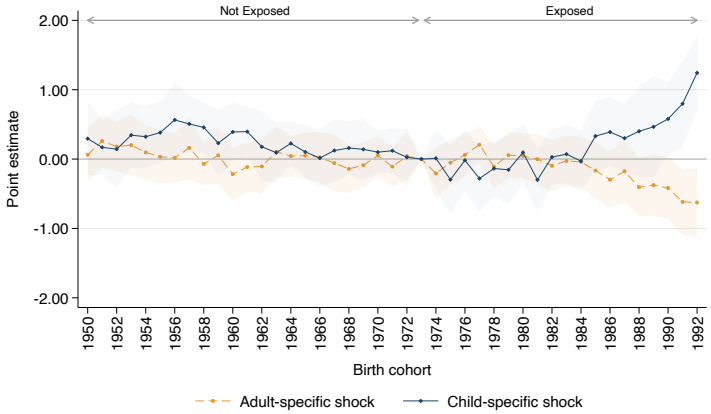

*Notes:* These figures plot the dynamic effects of adult- and child-specific tariff reductions on two measures of school performance. Each point estimate is obtained from a separate regression based on Equation (9). The dependent variables represent changes in age-grade distortion rates (panel a) and approval rates (panel b) among elementary school students between year $\tau \in \{1996, ..., 2020\}$ and the baseline year of 1995. The estimates connected by the solid line represent the dynamic effects of child-specific tariff shocks, while those connected by the dashed line represent the dynamic effects of adult-specific tariff shocks. The shaded areas indicate the 90% confidence intervals computed based on standard errors clustered at the mesoregion level. To facilitate visualization, the point estimates for child-specific tariff reductions are divided by 10.

Figure 6: Effects on Human Capital Accumulation

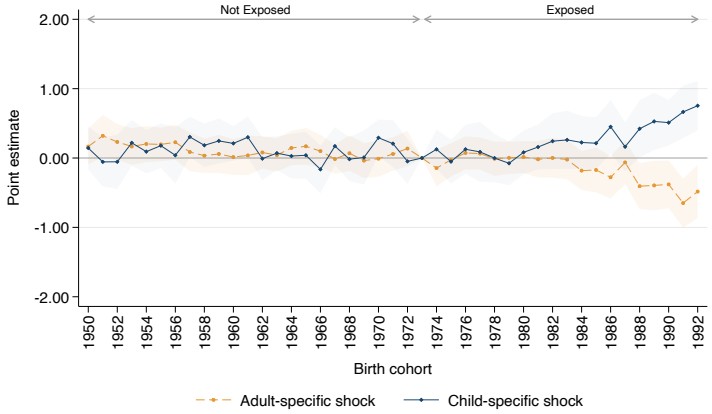
(a) Elementary School in 2010




(b) High School in 2010



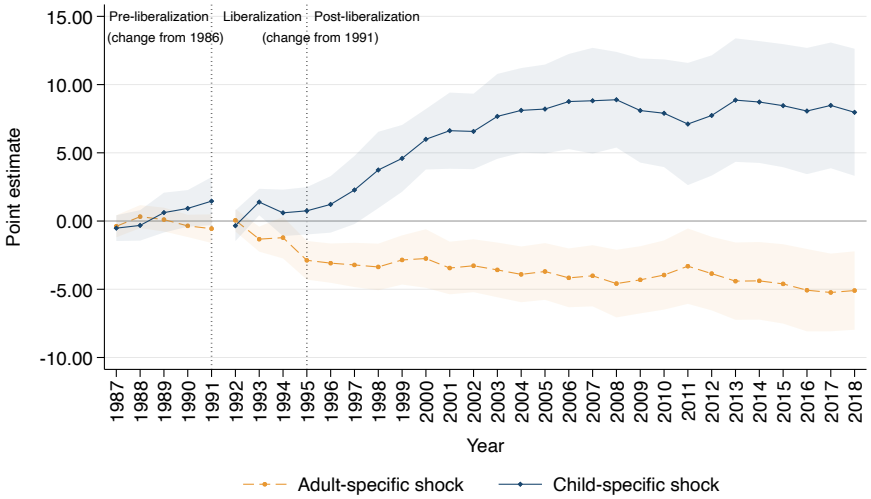

(c) Some College in 2010



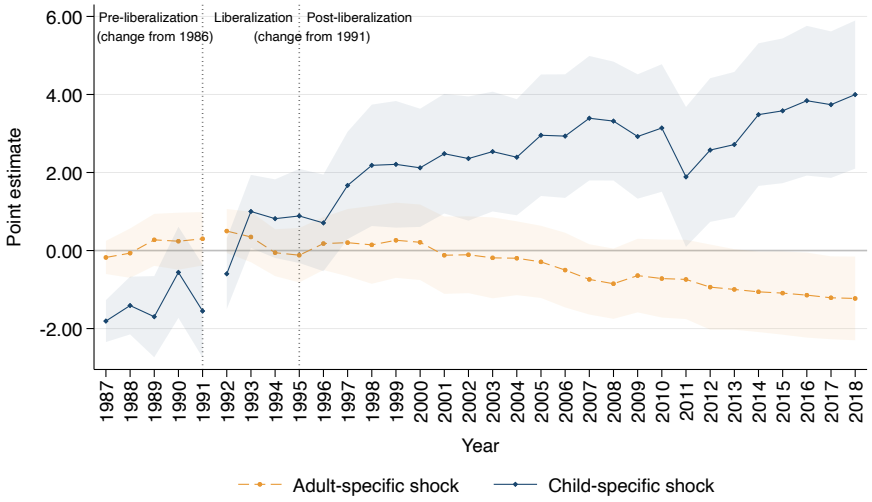

*Notes:* These figures plot the cohort-specific effects of adult- and child-specific tariff reductions on human capital accumulation using data from the 2010 Census. The point estimates in each figure are obtained from the specification in Equation (10). The dependent variables represent the shares of individuals in each birth cohort who completed elementary school (panel a), high school (panel b), or have some college education (panel c). The analysis focuses on cohorts born between 1950 and 1992. The omitted group is the cohort born in 1973, whose members were 18 years old in 1991. The shaded areas indicate the 90% confidence intervals computed based on standard errors clustered at the mesoregion level. To facilitate visualization, the point estimates for child-specific tariff reductions are divided by 10.

Figure 7: Effects on Formal Labor Market

(a) Log of Formal Employment




(b) Log of Formal Earnings




*Notes:* These figures plot the dynamic effects of adult- and child-specific tariff reductions on formal sector employment (panel a) and earnings (panel b) using data from RAIS for the period 1986-2018. To account for social and demographic characteristics of the local workforce, we apply the two-step approach proposed by Dix-Carneiro and Kovak (2017) and outlined in Section 5 ("Structural Transformation"). Each point estimate is obtained from a separate regression based on Equation (9). For the pre-liberalization period 1987-1991, the changes are calculated relative to 1986, while for the post-liberalization period 1992-2018, the changes are calculated relative to 1991. The estimates connected by the solid line represent the dynamic effects of child-specific tariff shocks, while those connected by the dashed line represent the dynamic effects of adult-specific tariff shocks. The shaded areas indicate the 90% confidence intervals computed based on standard errors clustered at the mesoregion level. To facilitate visualization, the point estimates for child-specific tariff reductions are divided by 10.

# Tables

Table 1: Child Labor in Brazil

| | 1980 | 1991 | 2000 | 2010 |
|---|---|---|---|---|
| **Panel A. Children's activities** | | | | |
| % School only | 0.652 | 0.765 | 0.892 | 0.916 |
| % Work | 0.128 | 0.084 | 0.064 | 0.055 |
| % Idle | 0.220 | 0.151 | 0.043 | 0.029 |
| % Paid employment | 0.079 | 0.057 | 0.030 | 0.025 |
| **Panel B. Child labor (% Work)** | | | | |
| *By per capita income* | | | | |
| Low | 0.163 | 0.109 | 0.104 | 0.087 |
| High | 0.111 | 0.072 | 0.046 | 0.040 |
| *By rural population* | | | | |
| Urban | 0.107 | 0.070 | 0.044 | 0.038 |
| Rural | 0.174 | 0.113 | 0.114 | 0.094 |
| *By population size* | | | | |
| Small | 0.158 | 0.117 | 0.100 | 0.080 |
| Large | 0.123 | 0.079 | 0.059 | 0.051 |
| *By region* | | | | |
| Center-West | 0.118 | 0.091 | 0.063 | 0.063 |
| North | 0.105 | 0.068 | 0.089 | 0.088 |
| Northeast | 0.143 | 0.103 | 0.099 | 0.081 |
| Southeast | 0.155 | 0.123 | 0.092 | 0.088 |
| South | 0.104 | 0.078 | 0.046 | 0.040 |
| *By sector (conditional on working)* | | | | |
| Agriculture/Extractive | 0.602 | 0.506 | 0.532 | 0.520 |
| Manufacturing | 0.106 | 0.106 | 0.083 | 0.077 |
| Nontradable | 0.292 | 0.388 | 0.385 | 0.403 |

*Notes:* This table reports descriptive statistics on child labor in Brazil using data from the 1980, 1991, 2000, and 2010 Censuses. Panel A provides information on the allocation of time of children aged 10 and 14. Panel B reports the percentage of children who work, disaggregated by microregions below and above the median for per capita income, rural population, and population size, as well as by region and sector of activity.

Table 2: Summary Statistics

| | Mean | Std. Dev. | Min | Max | 10th | 90th |
|---|---|---|---|---|---|---|
| **Panel A. Tariff changes (Δ 1991-1995)** | | | | | | |
| $\Delta Tariff_m$ | 0.044 | 0.040 | -0.010 | 0.154 | 0.001 | 0.108 |
| $\Delta Tariff_m^{Adult}$ | 0.043 | 0.039 | -0.008 | 0.153 | 0.002 | 0.106 |
| $\Delta Tariff_m^{Child}$ | 0.001 | 0.001 | -0.002 | 0.008 | -0.001 | 0.002 |
| **Panel B. Children's activities (Δ 1991-2000)** | | | | | | |
| % School only | 0.157 | 0.062 | 0.001 | 0.397 | 0.087 | 0.244 |
| % Work | -0.023 | 0.040 | -0.150 | 0.121 | -0.075 | 0.028 |
| % Idle | -0.133 | 0.071 | -0.401 | -0.033 | -0.237 | -0.059 |
| % Paid employment | -0.034 | 0.027 | -0.125 | 0.029 | -0.072 | -0.004 |
| **Panel C. Children's activities (Δ 1991-2010)** | | | | | | |
| % School only | 0.196 | 0.077 | 0.035 | 0.446 | 0.103 | 0.294 |
| % Work | -0.040 | 0.044 | -0.207 | 0.131 | -0.093 | 0.011 |
| % Idle | -0.156 | 0.085 | -0.492 | -0.031 | -0.277 | -0.064 |
| % Paid employment | -0.042 | 0.033 | -0.133 | 0.085 | -0.088 | -0.007 |
| **Panel D. Demographic controls (1991 Census)** | | | | | | |
| Log population | 12.064 | 0.995 | 9.452 | 16.275 | 10.921 | 13.298 |
| Share children 10-14 | 0.123 | 0.014 | 0.094 | 0.164 | 0.105 | 0.141 |
| Share urban pop. | 0.612 | 0.198 | 0.160 | 0.997 | 0.352 | 0.887 |
| Illiteracy rate | 0.303 | 0.166 | 0.051 | 0.696 | 0.116 | 0.538 |
| Poverty rate | 0.719 | 0.191 | 0.204 | 0.968 | 0.434 | 0.927 |
| Gini index | 0.552 | 0.040 | 0.438 | 0.720 | 0.499 | 0.601 |

*Notes:* This table reports summary statistics at the microregion level for the main variables in our analysis. Panel A presents descriptive statistics on the measures of local exposure to trade liberalization, calculated based on Equations (4), (6), and (7). Panels B and C provide descriptive statistics on changes in the shares of children aged 10 to 14 engaged in various activities for the periods 1991-2000 and 1991-2010. Panel D reports summary statistics on various socioeconomic characteristics of microregions based on 1991 Census data. The sample includes 411 microregions whose boundaries remained unchanged from 1980 to 2010. For additional summary statistics, see Table A1.

Table 3: Effects on Child Labor and Schooling

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Overall tariff reduction** | | | | | | | | |
| $\Delta Tariff_m$ | −0.048 | −0.338* | 0.116 | 0.302*** | −0.005 | 0.041 | 0.197** | 0.303*** |
| | (0.171) | (0.188) | (0.105) | (0.099) | (0.124) | (0.149) | (0.078) | (0.097) |
| R-squared | 0.81 | 0.87 | 0.59 | 0.69 | 0.91 | 0.92 | 0.67 | 0.64 |
| **Panel B. Adult and child-specific tariff reductions** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.181 | −0.537** | 0.217* | 0.425*** | 0.035 | 0.111 | 0.315*** | 0.472*** |
| | (0.188) | (0.209) | (0.114) | (0.108) | (0.150) | (0.182) | (0.079) | (0.093) |
| $\Delta Tariff_m^{Child}$ | 7.038* | 10.229** | −5.817*** | −6.941*** | −1.975 | −3.404 | −6.867*** | −9.722*** |
| | (3.959) | (3.936) | (2.111) | (2.311) | (2.523) | (2.675) | (1.666) | (1.944) |
| R-squared | 0.81 | 0.88 | 0.61 | 0.72 | 0.91 | 0.92 | 0.71 | 0.71 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.157 | 0.196 | -0.023 | -0.040 | -0.133 | -0.156 | -0.034 | -0.042 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on changes in child labor and schooling for the periods 1991-2000 ("medium run") and 1991-2010 ("long run"). Panel A presents the effects of overall tariff reductions, estimated using the specification in Equation (8), while Panel B presents the effects of adult- and child-specific tariff reductions estimated using the specification in Equation (9). The regressions include state fixed effects and control for microregion-specific characteristics measured at the baseline year of 1991, including logarithm of population, share of population aged 10-14, share of urban population, poverty rate, illiteracy rate, Gini index, lag of the dependent variable, and share of child labor in 1980. All regressions are weighted by population size in 1991, and standard errors are clustered at the mesoregion level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effects on Child Labor and Schooling: Robustness Checks ("Study Only")

| | Baseline | No controls | Longer pre-trends | Income per capita | Labor market | Social programs | Educ./Pub. spending | Macro shocks |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.181 | −0.967*** | −0.147 | −0.246 | −0.260 | −0.143 | −0.259 | −0.095 |
| | (0.188) | (0.073) | (0.174) | (0.175) | (0.222) | (0.161) | (0.184) | (0.149) |
| $\Delta Tariff_m^{Child}$ | 7.038* | 9.724*** | 6.217 | 5.178 | 13.169*** | 5.921* | 6.971* | 6.542** |
| | (3.959) | (2.521) | (3.972) | (3.691) | (3.673) | (3.247) | (3.855) | (3.012) |
| R-squared | 0.81 | 0.74 | 0.82 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.537** | −1.354*** | −0.479*** | −0.591*** | −0.519* | −0.483*** | −0.620*** | −0.377** |
| | (0.209) | (0.069) | (0.172) | (0.205) | (0.265) | (0.166) | (0.211) | (0.151) |
| $\Delta Tariff_m^{Child}$ | 10.229** | 12.498*** | 8.852** | 8.387** | 15.859*** | 8.701*** | 10.462*** | 9.791** |
| | (3.936) | (2.498) | (3.871) | (3.807) | (3.912) | (2.931) | (3.861) | (3.875) |
| R-squared | 0.88 | 0.82 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.90 |
| Observations | 411 | 411 | 411 | 411 | 411 | 396 | 409 | 411 |

*Notes:* This table reports robustness checks on the effects of local exposure to trade liberalization on the share of children who attend "school only". Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For a description of the controls in each specification, see discussion in Section 6.1. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Effects on Child Labor and Schooling: Robustness Checks ("Work")

| | Baseline | No controls | Longer pre-trends | Income per capita | Labor market | Social programs | Educ./Pub. spending | Macro shocks |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.217* | 0.174*** | 0.222** | 0.201 | 0.396*** | 0.191* | 0.221** | 0.087 |
| | (0.114) | (0.062) | (0.109) | (0.127) | (0.110) | (0.109) | (0.103) | (0.108) |
| $\Delta Tariff_m^{Child}$ | −5.817*** | −9.581*** | −5.727*** | −3.754 | −6.071*** | −5.242*** | −4.913** | −4.606** |
| | (2.111) | (2.967) | (2.060) | (2.458) | (2.161) | (1.800) | (2.105) | (1.875) |
| R-squared | 0.61 | 0.48 | 0.61 | 0.65 | 0.62 | 0.62 | 0.65 | 0.65 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.425*** | 0.364*** | 0.434*** | 0.396*** | 0.591*** | 0.396*** | 0.414*** | 0.334*** |
| | (0.108) | (0.072) | (0.101) | (0.133) | (0.107) | (0.107) | (0.104) | (0.108) |
| $\Delta Tariff_m^{Child}$ | −6.941*** | −11.479*** | −6.790*** | −4.767 | −6.517** | −6.243*** | −5.938** | −6.074** |
| | (2.311) | (3.119) | (2.228) | (2.943) | (2.812) | (1.961) | (2.410) | (2.678) |
| R-squared | 0.72 | 0.51 | 0.73 | 0.74 | 0.73 | 0.74 | 0.75 | 0.75 |
| Observations | 411 | 411 | 411 | 411 | 411 | 396 | 409 | 411 |

*Notes:* This table reports robustness checks on the effects of local exposure to trade liberalization on the share of children who "work". Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For a description of the controls in each specification, see discussion in Section 6.1. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Effects on Child Labor and Schooling: Heterogeneity by Income

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | Poor | Non-poor | Poor | Non-poor | Poor | Non-poor | Poor | Non-poor |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.311 | 0.328** | 0.283** | −0.086 | 0.108 | −0.260*** | 0.380*** | 0.070 |
| | (0.220) | (0.159) | (0.125) | (0.112) | (0.172) | (0.099) | (0.088) | (0.079) |
| $\Delta Tariff_m^{Child}$ | 8.654* | 1.522 | −6.039** | −3.616* | −3.394 | 2.289* | −7.244*** | −4.162** |
| | (4.517) | (2.842) | (2.316) | (1.930) | (2.925) | (1.370) | (1.986) | (1.620) |
| R-squared | 0.80 | 0.76 | 0.67 | 0.31 | 0.91 | 0.85 | 0.73 | 0.41 |
| Mean dep. var. | 0.172 | 0.077 | -0.020 | -0.015 | -0.152 | -0.062 | -0.034 | -0.029 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.744*** | 0.273* | 0.554*** | −0.026 | 0.205 | −0.313*** | 0.558*** | 0.141 |
| | (0.244) | (0.147) | (0.116) | (0.124) | (0.208) | (0.102) | (0.100) | (0.104) |
| $\Delta Tariff_m^{Child}$ | 12.808*** | 1.852 | −7.976*** | −3.339 | −5.183* | 2.062 | −10.239*** | −6.457*** |
| | (4.421) | (3.151) | (2.476) | (2.478) | (3.069) | (1.279) | (2.252) | (2.062) |
| R-squared | 0.87 | 0.81 | 0.75 | 0.43 | 0.92 | 0.88 | 0.72 | 0.45 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.221 | 0.079 | -0.041 | -0.009 | -0.179 | -0.069 | -0.046 | -0.024 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on child labor and schooling, separately for children from "poor" and "non-poor" households. A household is classified as "poor" if its income per household member falls below the 75th percentile of the income distribution within a microregion. Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Effects on Child Labor and Schooling: Heterogeneity by Education

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | Low educ. (1) | Medium/ High educ. (2) | Low educ. (3) | Medium/ High educ. (4) | Low educ. (5) | Medium/ High educ. (6) | Low educ. (7) | Medium/ High educ. (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.246 | 0.064 | 0.254* | −0.014 | 0.083 | −0.052 | 0.364*** | 0.048 |
| | (0.203) | (0.111) | (0.129) | (0.084) | (0.158) | (0.053) | (0.090) | (0.079) |
| $\Delta Tariff_m^{Child}$ | 8.700* | 1.583 | −6.740*** | −2.645** | −2.925 | 0.960 | −7.987*** | −2.429** |
| | (4.454) | (1.760) | (2.459) | (1.256) | (2.700) | (0.872) | (2.057) | (1.013) |
| R-squared | 0.77 | 0.40 | 0.64 | 0.25 | 0.91 | 0.48 | 0.72 | 0.36 |
| Mean dep. var. | 0.165 | 0.029 | -0.024 | -0.006 | -0.141 | -0.023 | -0.036 | -0.016 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.641*** | −0.010 | 0.476*** | 0.009 | 0.186 | −0.004 | 0.540*** | 0.041 |
| | (0.233) | (0.113) | (0.124) | (0.078) | (0.198) | (0.059) | (0.110) | (0.079) |
| $\Delta Tariff_m^{Child}$ | 12.338*** | 3.867** | −7.938*** | −3.872*** | −4.709 | −0.046 | −10.816*** | −3.988*** |
| | (4.630) | (1.723) | (2.802) | (1.182) | (2.895) | (0.889) | (2.413) | (1.012) |
| R-squared | 0.85 | 0.39 | 0.72 | 0.30 | 0.92 | 0.55 | 0.71 | 0.46 |
| Observations | 411 | 410 | 411 | 410 | 411 | 410 | 411 | 410 |
| Mean dep. var. | 0.205 | 0.026 | -0.040 | -0.002 | -0.165 | -0.023 | -0.044 | -0.018 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on child labor and schooling, separately for children from "low education" and "medium/high education" households. A household is classified as "low education" if the highest level of schooling attained by the head of household or their spouse is elementary or less. Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Effects on Structural Transformation

| | | | Conditional on work | | |
|---|---|---|---|---|---|
| | Formal Emp. | Log Earnings | Agro./mining | Manuf. | Non-tradable |
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A. Medium run (1991-2000)** | | | | | |
| $\Delta Tariff_m^{Adult}$ | $-0.979^{***}$ | $-0.021$ | $0.409^{***}$ | $-0.558^{***}$ | $0.215^{*}$ |
| | (0.160) | (0.263) | (0.118) | (0.073) | (0.119) |
| $\Delta Tariff_m^{Child}$ | $11.618^{***}$ | 4.974 | $-1.676$ | $5.335^{**}$ | $-6.133^{**}$ |
| | (2.010) | (4.080) | (2.250) | (2.064) | (2.425) |
| R-squared | 0.68 | 0.73 | 0.52 | 0.60 | 0.28 |
| Mean dep. var. | -0.019 | 0.006 | -0.087 | 0.037 | 0.043 |
| **Panel B. Long run (1991-2010)** | | | | | |
| $\Delta Tariff_m^{Adult}$ | $-1.375^{***}$ | $-0.451$ | $0.892^{***}$ | $-0.862^{***}$ | 0.056 |
| | (0.209) | (0.366) | (0.178) | (0.104) | (0.162) |
| $\Delta Tariff_m^{Child}$ | $14.841^{***}$ | $11.164^{*}$ | $-2.482$ | $6.885^{**}$ | $-7.671^{**}$ |
| | (2.484) | (5.649) | (3.403) | (2.724) | (3.411) |
| R-squared | 0.69 | 0.80 | 0.63 | 0.63 | 0.49 |
| Observations | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.086 | 0.810 | -0.223 | 0.066 | 0.070 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on structural transformation. To account for social and demographic characteristics of the local workforce, we apply the two-step approach proposed by Dix-Carneiro and Kovak (2017) and outlined in Section 5 ("Structural Transformation"). Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For additional details, see footnote to Table 3. $^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table 9: China Shock: Effects on Child Labor and Schooling

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | OLS | 2SLS | OLS | 2SLS | OLS | 2SLS | OLS | 2SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\Delta IS_m^{Adult}$ | −0.005 | −0.003 | 0.009** | 0.006* | 0.000 | −0.000 | 0.000 | −0.001 |
| | (0.004) | (0.004) | (0.004) | (0.003) | (0.002) | (0.002) | (0.003) | (0.003) |
| $\Delta IS_m^{Child}$ | 0.589** | 0.473* | −0.597** | −0.497** | −0.244 | −0.202 | −0.215 | −0.147 |
| | (0.271) | (0.284) | (0.245) | (0.250) | (0.154) | (0.150) | (0.152) | (0.161) |
| KP-F | | 184.179 | | 185.211 | | 188.887 | | 177.479 |
| R-squared | 0.684 | 0.684 | 0.492 | 0.491 | 0.771 | 0.771 | 0.486 | 0.486 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.040 | 0.040 | -0.017 | -0.017 | -0.023 | -0.023 | -0.008 | -0.008 |

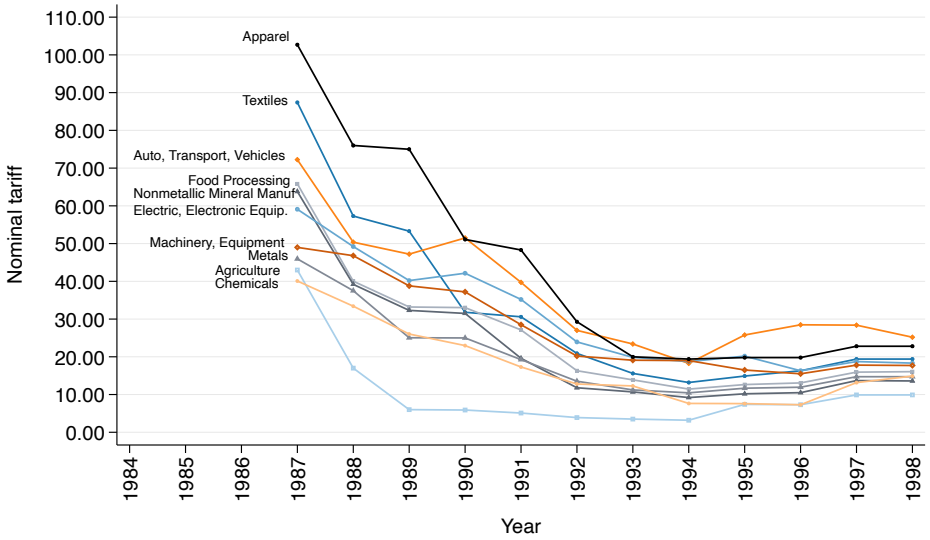
*Notes:* This table reports OLS and 2SLS estimates of the effects of local exposure to Chinese import competition on changes in child labor and schooling between 2000 and 2010. In columns 2, 4, 6 and 8, we report 2SLS estimates using as instruments two measures of adult- and child-specific exposure to Chinese imports constructed using the predicted growth in imports from China to all other countries excluding Brazil. The regressions include the same set of controls as the benchmark specification in Equation 9, in addition to a measure of overall exposure to Chinese exports. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ONLINE APPENDIX
(NOT FOR PUBLICATION)

# Trade Shocks and Human Capital: Evidence from Brazil's Trade Liberalization

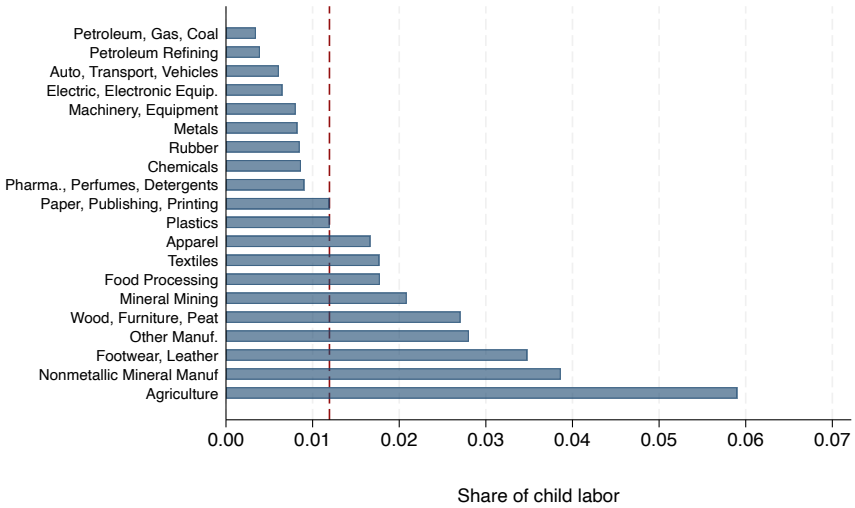
Marcos Y. Nakaguma and Arthur A. Viaro

Figure A1: Dynamics of Nominal Tariffs (1987-1998)



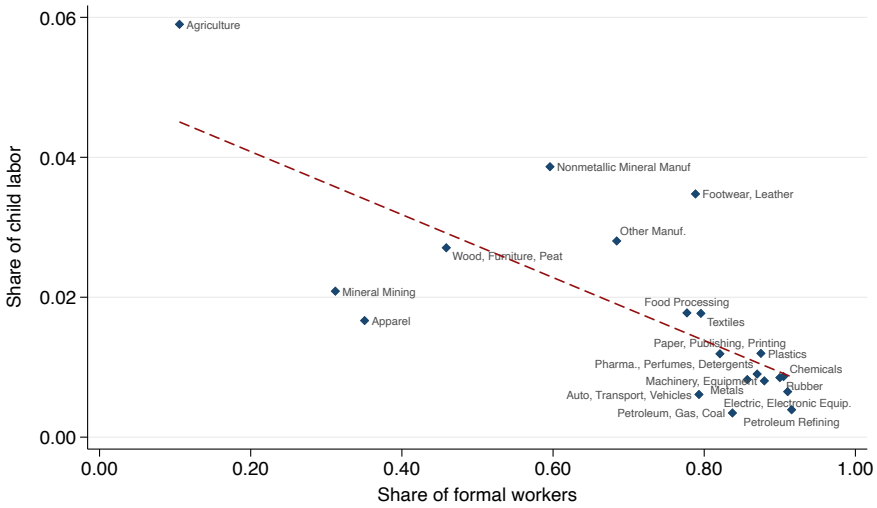

*Notes:* This figure plots the evolution of nominal tariffs from 1987 to 1998 for the ten largest industries ranked by value added in 1990. Tariff data come from Kume et al. (2003). Source: Dix-Carneiro and Kovak (2017).

Figure A2: Child Labor by Industry




*Notes:* This figure reports the share of child labor by industry, measured as the ratio of child labor to total labor within each industry, based on data from the 1991 Census.

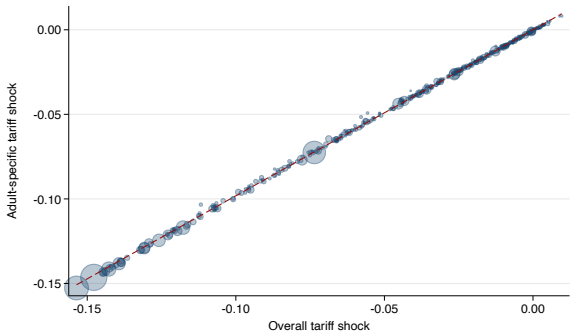
Figure A3: Child Labor vs Formal Employment



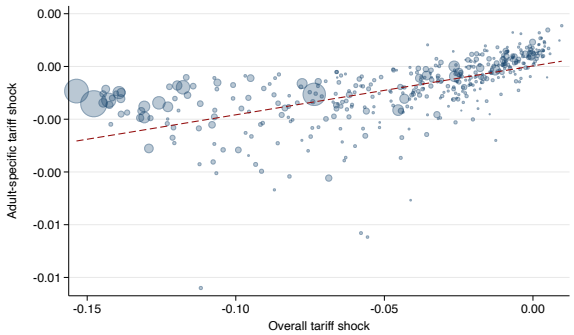

*Notes:* This figure plots the relationship across industries between the share of child labor and the percentage of formal employment based on data from the 1991 Census. A formal worker is defined as an employee with a signed booklet.

Figure A4: Measures of Local Tariff Exposure

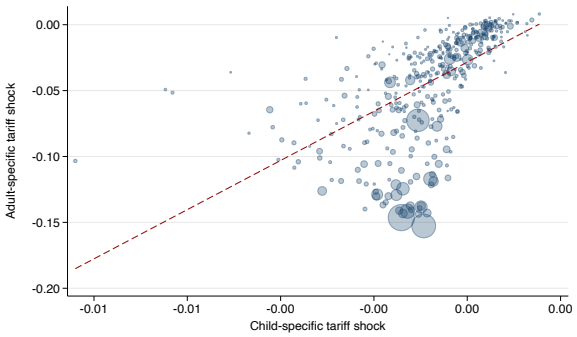
(a) $\Delta Tariff_m^{Adult}$ vs $\Delta Tariff_m$




(b) $\Delta Tariff_m^{Child}$ vs $\Delta Tariff_m$



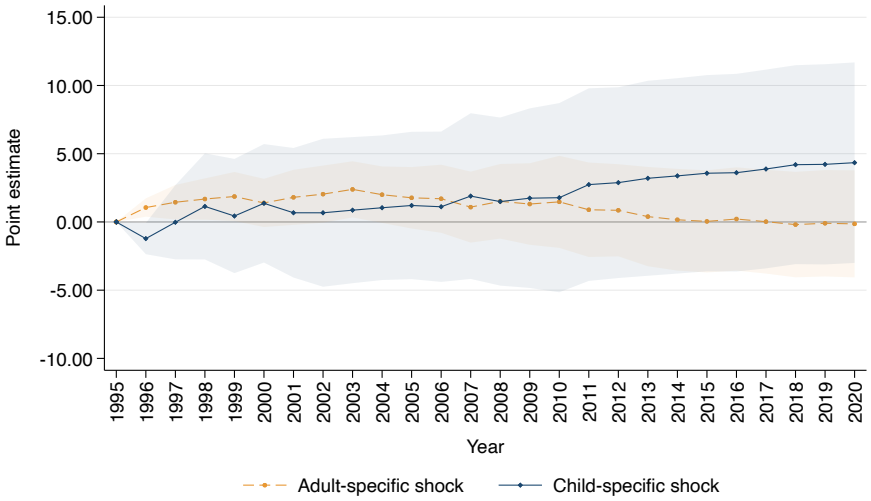

(c) $\Delta Tariff_m^{Adult}$ vs $\Delta Tariff_m^{Child}$



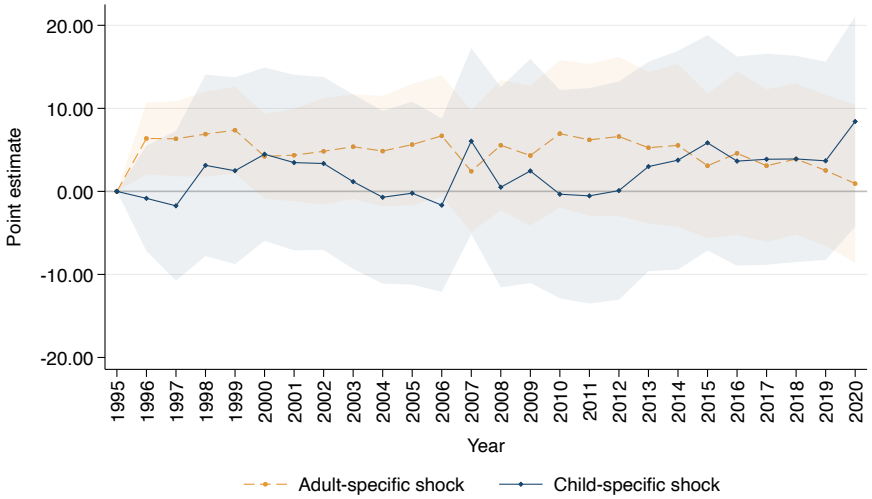

*Notes:* These figures plot the relationship between the overall measure of tariff exposure and its adult- and child-specific components, computed based on Equations (4), (6), and (7), respectively. Each circle represents a microregion, with size proportional to the population in 1991.

Figure A5: Effects on School Infrastructure

(a) Number of Schools per 1,000



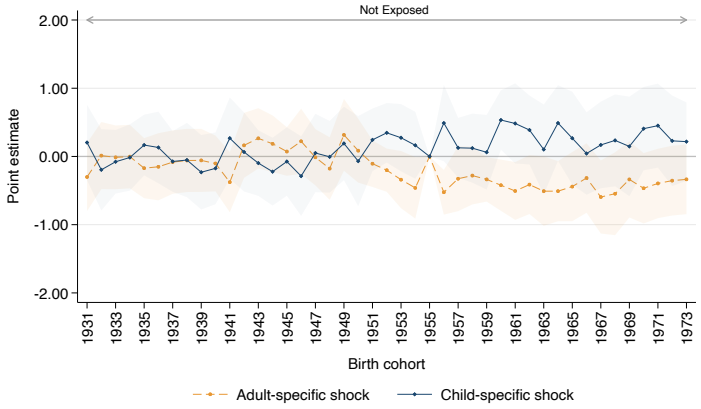

(b) Number of Elementary Schools Teachers per 1,000



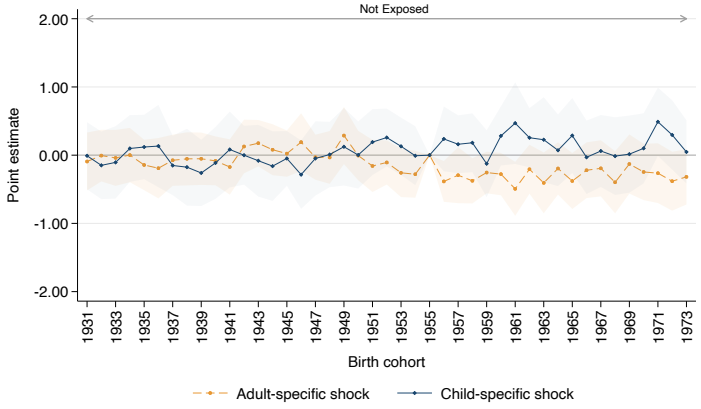

*Notes:* These figures plot the dynamic effects of adult- and child-specific tariff reductions on school infrastructure. Each point estimate is obtained from a separate regression based on Equation (9). The dependent variables represent changes in the number of schools per 1,000 inhabitants (panel a) and the number of elementary school teachers per 1,000 inhabitants (panel b) between year $\tau \in \{1996, ..., 2020\}$ and the baseline year of 1995. The estimates connected by the solid line represent the dynamic effects of child-specific tariff shocks, while those connected by the dashed line represent the dynamic effects of adult-specific tariff shocks. The shaded areas indicate the 90% confidence intervals computed based on standard errors clustered at the mesoregion level. To facilitate visualization, the point estimates for child-specific tariff reductions are divided by 10.

Figure A6: Effects on Human Capital Accumulation: Placebo

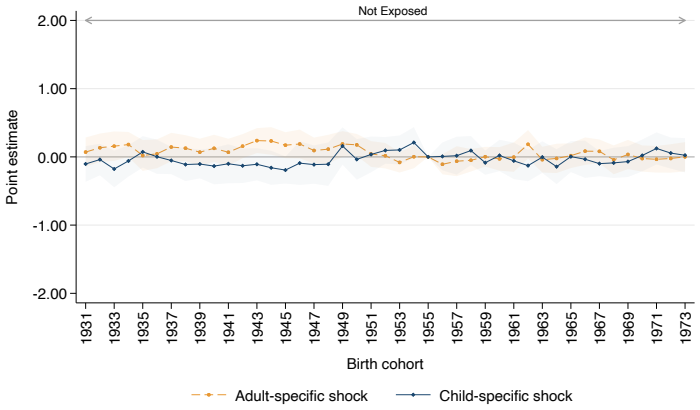
(a) Elementary School in 1991




(b) High School in 1991



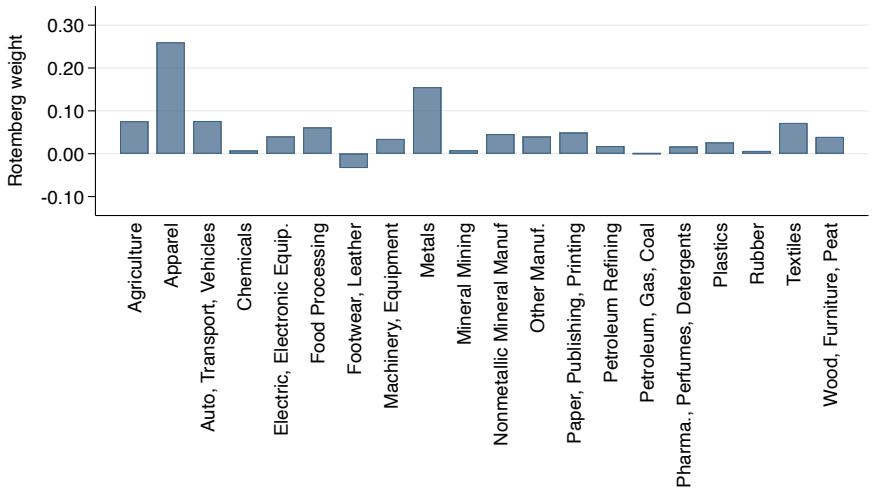

(c) Some College in 1991



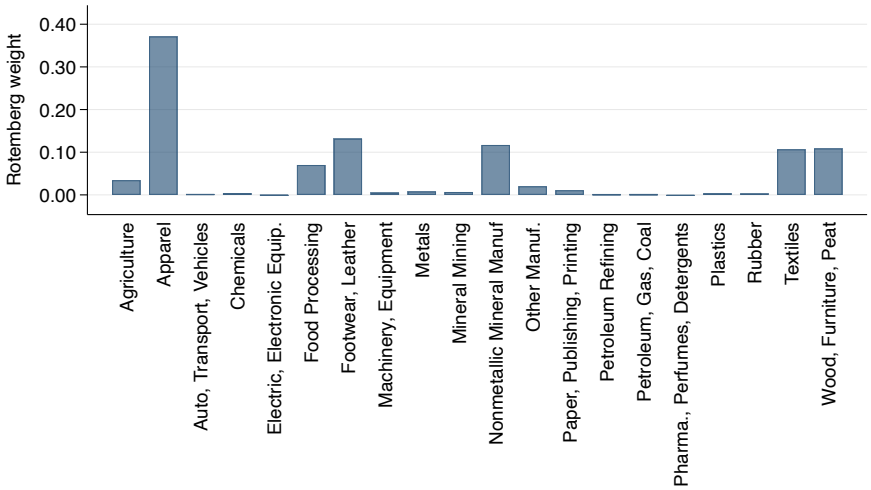

*Notes:* These figures plot the results of a placebo exercise examining the cohort-specific effects of adult- and child-specific tariff reductions on the stock of human capital accumulated by cohorts born between 1931 and 1973 using data from the 1991 Census. The point estimates in each figure are obtained from the specification in Equation (10). The dependent variables represent the shares of individuals in each birth cohort who completed elementary school (panel a), high school (panel b), or have some college education (panel c). The omitted group is the cohort born in 1955, whose members were 18 years old in 1973. For additional details, see footnote to Figure 6.

Figure A7: Rotemberg Weights

(a) Adult-Specific Tariff Reductions



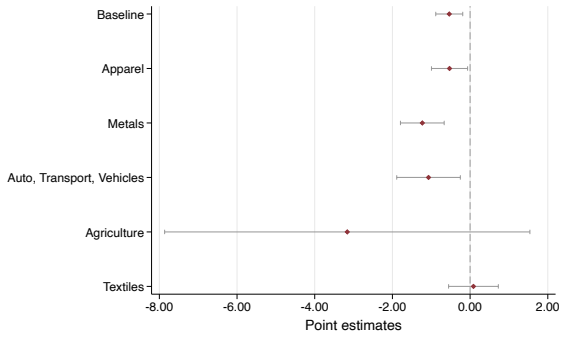

(b) Child-Specific Tariff Reductions



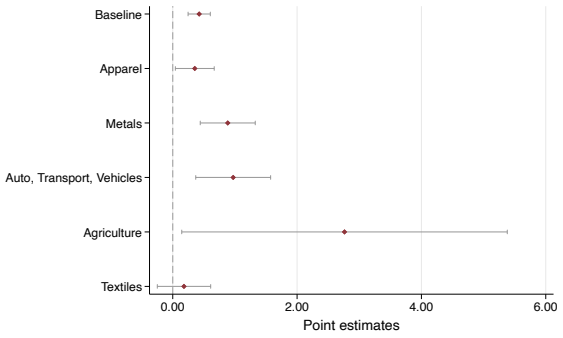

*Notes:* These figures report Rotemberg weights for adult- (panel a) and child-specific (panel b) tariff reductions across the 20 industries in our analysis. The top five industries associated with the adult-specific tariff shock are: apparel (25.2%), metals (15.0%), auto, transport and vehicles (7.4%), agriculture (7.3%), and textiles (7.0%). For the child-specific tariff shock, the top five industries are: apparel (37.0%), footwear and leather (13.1%), nonmetallic mineral manufacturing (11.7%), wood, furniture and peat (10.8%), and textiles (10.6%). For additional details, see Table A6.

Figure A8: Industry-Specific Effects

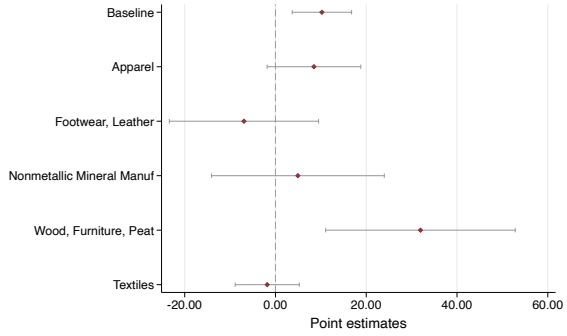
(a) Adult-Specific Shock ("School Only")



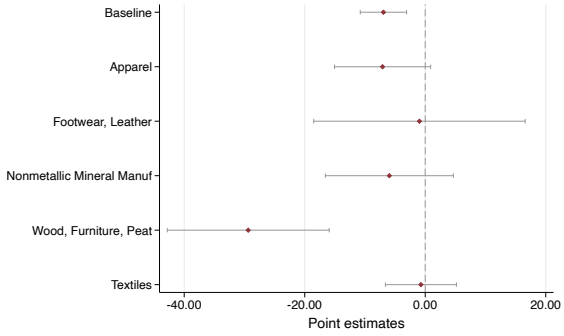

(b) Adult-Specific Shock ("Work")




(c) Child-Specific Shock ("School Only")



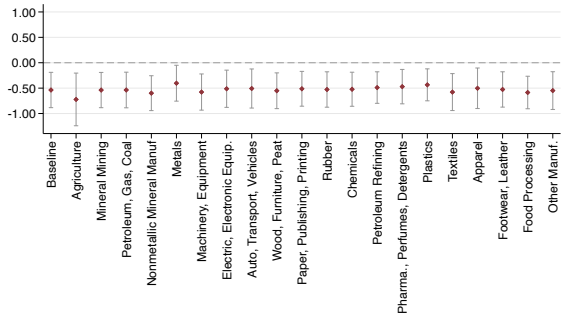

(d) Child-Specific Shock ("Work")



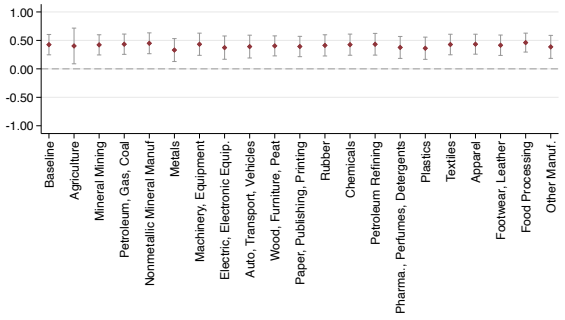

*Notes:* These figures plot the effects of industry-specific tariff reductions on changes in the shares of children who attend "school only" and "work" for the period 1991-2010 ("long run"). The analysis focuses on the five sectors with the largest Rotemberg weights for each measure of tariff exposure. Each point estimate is obtained from a separate regression based on Equation (9), including the shift-share terms $Ch_{mj} \times \omega_{mj} \times \Delta log(1+\tau_j)$ and $(1-Ch_{mj}) \times \omega_{mj} \times \Delta log(1+\tau_j)$ for a specific industry $j$. The effects of adult-specific tariff shocks on "school only" and "work" are shown in panels a and b, while the effects of child-specific tariff shocks are shown in panels c and d. All figures display 90% confidence intervals computed based on standard errors clustered at the mesoregion level.

Figure A9: Additional Robustness Checks: Controlling for Industry Shares

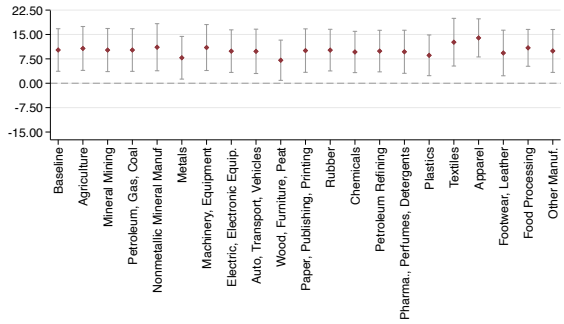
(a) $\Delta Tariff_m^{Adult}$ ("School Only")



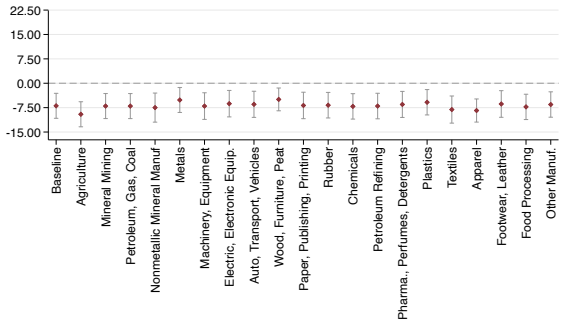

(b) $\Delta Tariff_m^{Adult}$ ("Work")




(c) $\Delta Tariff_m^{Child}$ ("School Only")



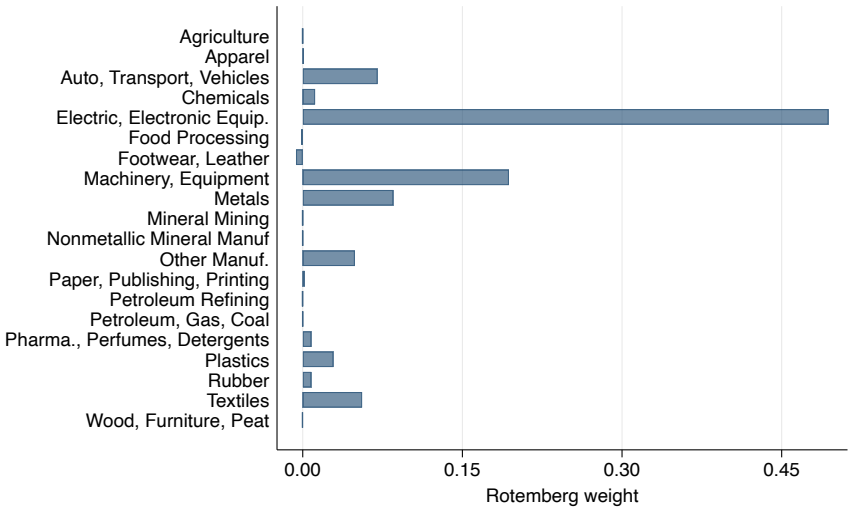

(d) $\Delta Tariff_m^{Child}$ ("Work")



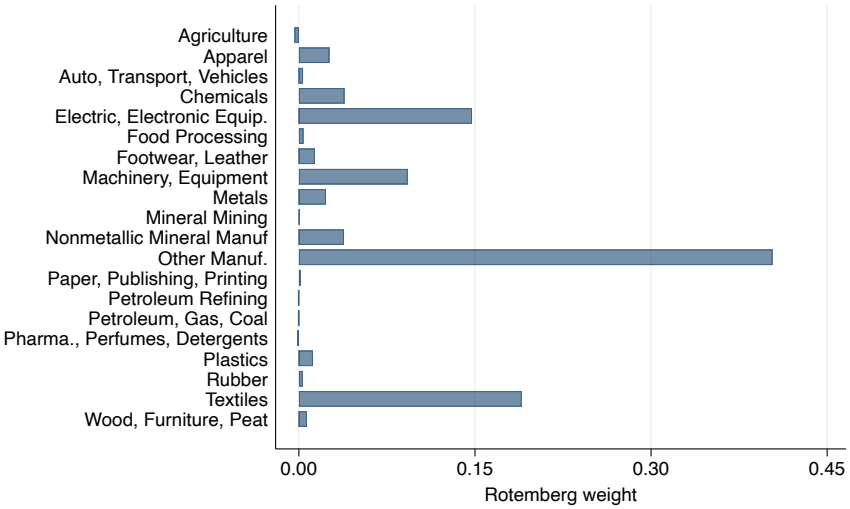

*Notes:* These figures plot the effects of adult- and child-specific tariff reductions on changes in the shares of children who attend "school only" and "work" for the period 1991-2010 ("long run"). Each point estimate is obtained from a separate regression based on Equation (9), sequentially including, one at a time, the shares of adults and children working in each industry in the baseline year of 1991. The baseline estimates (first point on the left-hand side of each panel) are the same as those reported in Table 3. All figures display 90% confidence intervals computed based on standard errors clustered at the mesoregion level. For additional details, see Table A6.

Figure A10: China Shock: Rotemberg Weights

(a) Adult-Specific Exposure to Chinese Imports



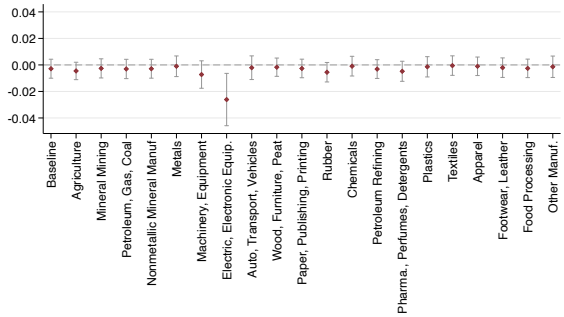

(b) Child-Specific Exposure to Chinese Imports



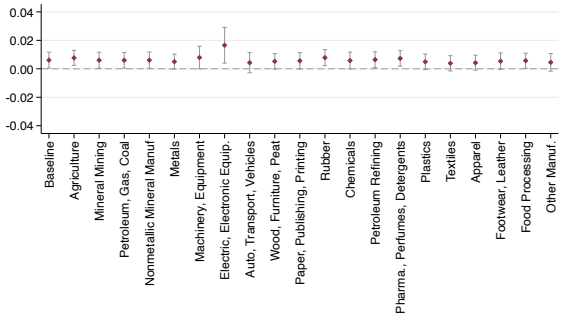

*Notes:* These figures report Rotemberg weights for adult- (panel a) and child-specific (panel b) exposure to Chinese import competition across the 20 industries in our analysis. The top five industries associated with the adult-specific shock are: electric and electronic equipments (49.0%), machinery and equipments (19.2%), metals (8.4%), auto, transport and vehicles (7.0%), and textiles (5.5%). For the child-specific shock, the top five industries are: other manufacturing (40.1%), textiles (18.9%), electric and electronic equipments (14.7%), machinery and equipments (9.2%), and chemicals (3.9%).

Figure A11: China Shock: Controlling for Industry Shares (2SLS Estimates)

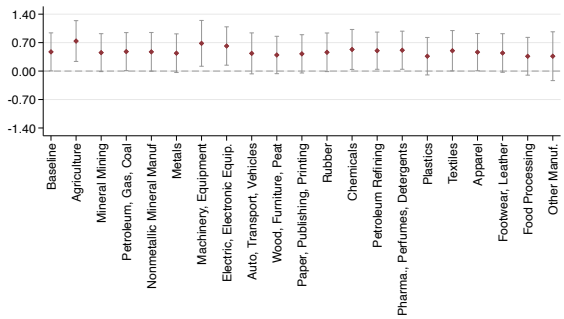
(a) $\Delta IS_m^{Adult}$ ("School Only")



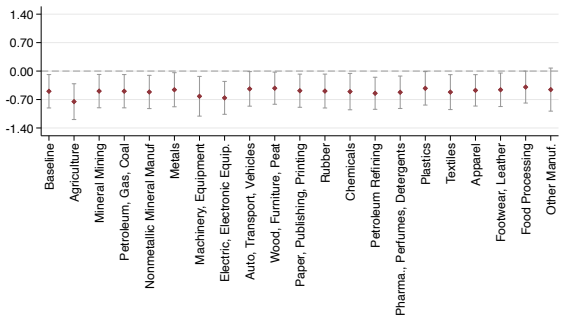

(b) $\Delta IS_m^{Adult}$ ("Work")




(c) $\Delta IS_m^{Child}$ ("School Only")




(d) $\Delta IS_m^{Child}$ ("Work")




*Notes:* These figures plot the effects of adult- and child-specific exposure to Chinese import competition on changes in the shares of children who attend "school only" and "work" for the period 2000-2010. Each point estimate is obtained from a separate 2SLS regression, sequentially including, one at a time, the shares of adults and children working in each industry in 1991. The estimates for the baseline specification (first point on the left-hand side of each panel) are the same as those reported in Table 9. All figures display 90% confidence intervals computed based on standard errors clustered at the mesoregion level.

Table A1: Additional Summary Statistics

| | Mean | Std. Dev. | Min | Max | 10th | 90th |
|---|---|---|---|---|---|---|
| **Panel A. School census** | | | | | | |
| Δ *1995-2010* | | | | | | |
| School enrollment | 0.053 | 0.091 | -0.190 | 0.373 | -0.054 | 0.175 |
| Age-grade distortion rate | -0.156 | 0.109 | -0.485 | 0.066 | -0.306 | -0.025 |
| Approval rate | 0.160 | 0.053 | 0.019 | 0.302 | 0.096 | 0.233 |
| Δ *1995-2020* | | | | | | |
| School enrollment | 0.055 | 0.088 | -0.174 | 0.384 | -0.039 | 0.168 |
| Age-grade distortion rate | -0.243 | 0.147 | -0.673 | 0.027 | -0.433 | -0.066 |
| Approval rate | 0.277 | 0.096 | -0.018 | 0.525 | 0.166 | 0.418 |
| **Panel B. Human capital accumulation** | | | | | | |
| *Cohort born in 1992 (2010 Census)* | | | | | | |
| Share elementary education | 0.691 | 0.118 | 0.324 | 0.957 | 0.521 | 0.830 |
| Share high school | 0.287 | 0.118 | 0.030 | 0.617 | 0.132 | 0.443 |
| Share college degree | 0.096 | 0.061 | 0.000 | 0.339 | 0.023 | 0.176 |
| *Cohort born in 1973 (1991 Census)* | | | | | | |
| Share elementary education | 0.238 | 0.118 | 0.021 | 0.551 | 0.097 | 0.406 |
| Share high school | 0.058 | 0.044 | 0.000 | 0.214 | 0.012 | 0.125 |
| Share college degree | 0.004 | 0.005 | 0.000 | 0.026 | 0.000 | 0.012 |
| **Panel C. Structural transformation (net of composition)** | | | | | | |
| Δ *1991-2000* | | | | | | |
| Formal employment | -0.019 | 0.048 | -0.183 | 0.139 | -0.081 | 0.039 |
| Log-earnings | 0.006 | 0.123 | -0.517 | 0.371 | -0.143 | 0.165 |
| Share agriculture/mining | -0.087 | 0.044 | -0.303 | 0.015 | -0.144 | -0.036 |
| Share manufacturing | 0.037 | 0.032 | -0.082 | 0.123 | 0.003 | 0.072 |
| Share non-tradable | 0.043 | 0.036 | -0.060 | 0.218 | 0.002 | 0.084 |
| Δ *1991-2010* | | | | | | |
| Formal employment | 0.086 | 0.074 | -0.103 | 0.354 | 0.000 | 0.189 |
| Log-earnings | 0.810 | 0.170 | 0.140 | 1.270 | 0.587 | 1.006 |
| Share agriculture/mining | -0.223 | 0.063 | -0.439 | -0.050 | -0.300 | -0.146 |
| Share manufacturing | 0.066 | 0.048 | -0.099 | 0.233 | 0.020 | 0.131 |
| Share non-tradable | 0.070 | 0.050 | -0.065 | 0.237 | 0.009 | 0.136 |
| **Panel D. China Shock (Δ 2000-2010)** | | | | | | |
| $\Delta IS_m^{Adult}$ | 0.215 | 0.247 | 0.037 | 2.241 | 0.049 | 0.420 |
| $\Delta IS_m^{Child}$ | 0.005 | 0.005 | 0.000 | 0.024 | 0.001 | 0.011 |

*Notes:* This table reports additional summary statistics at the microregion level for the main variables in our analysis. Panel A presents descriptive statistics on changes in school enrollment for children aged 10 to 14, as well as age-grade distortion and approval rates in elementary schools for the periods 1995-2010 and 1995-2020, based on School Census data. Panel B provides descriptive statistics on the educational attainment of the cohorts born in 1992 and 1973, based on data from the 2010 and 1991 Censuses, respectively. Panel C reports summary statistics (adjusted for compositional effects) on changes in the share of formal employment, logarithm of average earnings, and the distribution of the workforce across agriculture/mining, manufacturing, and the non-tradable sector, during the periods 1991-2000 and 1991-2010. Panel D presents descriptive statistics on the measures of local import competition from China. The sample includes 411 microregions whose boundaries remained unchanged from 1980 to 2010.

Table A2: Effects on Child Labor and Schooling: Robustness Check ("Idle")

| | Baseline | No controls | Longer pre-trends | Income per capita | Labor market | Social programs | Educ./Pub. spending | Macro shocks |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.035 | 0.793*** | 0.017 | 0.095 | −0.138 | −0.007 | 0.096 | 0.018 |
| | (0.150) | (0.102) | (0.142) | (0.135) | (0.152) | (0.132) | (0.154) | (0.135) |
| $\Delta Tariff_m^{Child}$ | −1.975 | −0.143 | −1.588 | −2.022 | −6.859*** | −1.174 | −2.855 | −2.062 |
| | (2.523) | (2.524) | (2.801) | (2.094) | (2.460) | (2.175) | (2.576) | (2.201) |
| R-squared | 0.91 | 0.79 | 0.92 | 0.92 | 0.93 | 0.92 | 0.93 | 0.92 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.111 | 0.990*** | 0.089 | 0.155 | −0.094 | 0.052 | 0.195 | 0.028 |
| | (0.182) | (0.115) | (0.170) | (0.167) | (0.200) | (0.154) | (0.190) | (0.137) |
| $\Delta Tariff_m^{Child}$ | −3.404 | −1.019 | −2.950 | −3.001 | −9.250*** | −2.270 | −4.534 | −3.262 |
| | (2.675) | (2.894) | (2.939) | (2.242) | (2.534) | (2.188) | (2.734) | (2.663) |
| R-squared | 0.92 | 0.81 | 0.93 | 0.93 | 0.94 | 0.93 | 0.94 | 0.93 |
| Observations | 411 | 411 | 411 | 411 | 411 | 396 | 409 | 411 |

*Notes:* This table reports robustness checks on the effects of local exposure to trade liberalization on the share of children who remain "idle" (i.e. neither work nor study). Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For a description of the controls in each specification, see discussion in Section 6.1. For additional details, see footnote to Table 3 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Effects on Child Labor and Schooling: Robustness Check ("Paid Work")

| | Baseline | No controls | Longer pre-trends | Income per capita | Labor market | Social programs | Educ./Pub. spending | Macro shocks |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.315*** | 0.237*** | 0.253*** | 0.335*** | 0.433*** | 0.323*** | 0.329*** | 0.291*** |
| | (0.079) | (0.048) | (0.065) | (0.086) | (0.093) | (0.077) | (0.074) | (0.070) |
| $\Delta Tariff_m^{Child}$ | −6.867*** | −10.469*** | −4.757*** | −5.856*** | −6.787*** | −6.417*** | −6.214*** | −6.287*** |
| | (1.666) | (2.870) | (1.760) | (1.745) | (1.705) | (1.336) | (1.632) | (1.348) |
| R-squared | 0.71 | 0.55 | 0.76 | 0.74 | 0.72 | 0.73 | 0.74 | 0.74 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | 0.472*** | 0.312*** | 0.394*** | 0.490*** | 0.712*** | 0.487*** | 0.484*** | 0.473*** |
| | (0.093) | (0.058) | (0.081) | (0.104) | (0.110) | (0.093) | (0.086) | (0.086) |
| $\Delta Tariff_m^{Child}$ | −9.722*** | −13.924*** | −7.100*** | −8.480*** | −9.507*** | −9.239*** | −8.828*** | −9.002*** |
| | (1.944) | (3.298) | (2.140) | (2.065) | (1.928) | (1.589) | (1.900) | (2.103) |
| R-squared | 0.71 | 0.56 | 0.75 | 0.74 | 0.73 | 0.72 | 0.74 | 0.71 |
| Observations | 411 | 411 | 411 | 411 | 411 | 396 | 409 | 411 |

*Notes:* This table reports robustness checks on the effects of local exposure to trade liberalization on the share of children who have a paid work. Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For a description of the controls in each specification, see discussion in Section 6.1. For additional details, see footnote to Table 3 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Effects on Child Labor and Schooling: Heterogeneity by Race

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | Black | Non-black | Black | Non-black | Black | Non-black | Black | Non-black |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.497** | −0.070 | 0.433*** | 0.130 | 0.169 | −0.027 | 0.478*** | 0.259*** |
| | (0.222) | (0.186) | (0.134) | (0.114) | (0.173) | (0.155) | (0.104) | (0.080) |
| $\Delta Tariff_m^{Child}$ | 10.242** | 8.081** | −7.422*** | −5.557*** | −3.719 | −2.884 | −8.446*** | −6.490*** |
| | (4.984) | (3.437) | (2.550) | (2.109) | (3.039) | (2.224) | (2.524) | (1.632) |
| R-squared | 0.73 | 0.72 | 0.67 | 0.58 | 0.87 | 0.84 | 0.70 | 0.65 |
| Mean dep. var. | 0.183 | 0.127 | -0.035 | -0.014 | -0.148 | -0.113 | -0.045 | -0.025 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.951*** | −0.357** | 0.707*** | 0.350*** | 0.319 | 0.000 | 0.690*** | 0.402*** |
| | (0.268) | (0.156) | (0.137) | (0.095) | (0.216) | (0.146) | (0.121) | (0.099) |
| $\Delta Tariff_m^{Child}$ | 15.263*** | 10.061*** | −9.459*** | −6.536*** | −6.502** | −3.350 | −11.663*** | −9.458*** |
| | (5.054) | (2.969) | (2.752) | (2.114) | (3.209) | (2.125) | (2.862) | (1.833) |
| R-squared | 0.82 | 0.82 | 0.74 | 0.69 | 0.89 | 0.87 | 0.71 | 0.65 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.232 | 0.157 | -0.056 | -0.026 | -0.176 | -0.132 | -0.056 | -0.031 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on child labor and schooling, separately for "black" and "non-black" children. A child is classified as "black" if identified as "*preto*" or "*pardo*" in the Brazilian Census. Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Effects on Child Labor and Schooling: Heterogeneity by Gender

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Medium run (1991-2000)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.296 | −0.105 | 0.158 | 0.270*** | 0.207 | −0.099 | 0.355*** | 0.284*** |
| | (0.207) | (0.176) | (0.146) | (0.086) | (0.165) | (0.141) | (0.112) | (0.061) |
| $\Delta Tariff_m^{Child}$ | 8.941* | 5.638* | −5.262* | −6.098*** | −4.586 | 0.078 | −7.377** | −6.297*** |
| | (4.873) | (3.174) | (2.986) | (1.450) | (2.849) | (2.275) | (2.895) | (1.126) |
| R-squared | 0.80 | 0.79 | 0.57 | 0.64 | 0.91 | 0.89 | 0.66 | 0.68 |
| Mean dep. var. | 0.162 | 0.152 | -0.039 | -0.007 | -0.123 | -0.144 | -0.049 | -0.019 |
| **Panel B. Long run (1991-2010)** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.748*** | −0.347* | 0.425*** | 0.431*** | 0.313 | −0.062 | 0.523*** | 0.428*** |
| | (0.217) | (0.203) | (0.130) | (0.094) | (0.201) | (0.171) | (0.132) | (0.067) |
| $\Delta Tariff_m^{Child}$ | 12.231*** | 8.631** | −5.754** | −7.791*** | −6.400** | −0.958 | −11.049*** | −8.290*** |
| | (4.405) | (3.435) | (2.660) | (1.827) | (3.006) | (2.393) | (3.169) | (1.277) |
| R-squared | 0.91 | 0.81 | 0.77 | 0.68 | 0.93 | 0.90 | 0.67 | 0.67 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.215 | 0.177 | -0.071 | -0.009 | -0.144 | -0.169 | -0.058 | -0.025 |

*Notes:* This table reports estimates of the effects of local exposure to trade liberalization on child labor and schooling, separately boys and girls. Panels A and B report the effects of adult- and child-specific tariff reductions for the medium run (1991-2000) and long run (1991-2010), respectively. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: Additional Robustness Checks: Controlling for Industry Shares

| Industry | Rotemberg weights | | Estimate of $\beta$ controlling for industry shares | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | School only | | | | Work | | | |
| | | | 1991-2000 | | 1991-2010 | | 1991-2000 | | 1991-2010 | |
| | Adult | Child | Adult | Child | Adult | Child | Adult | Child | Adult | Child |
| Baseline | . | . | -0.181 | 7.038 | -0.537 | 10.229 | 0.217 | -5.817 | 0.425 | -6.941 |
| Apparel | 0.260 | 0.371 | -0.225 | 11.974 | -0.503 | 13.949 | 0.268 | -8.552 | 0.433 | -8.385 |
| Metals | 0.155 | 0.008 | -0.046 | 4.730 | -0.403 | 7.837 | 0.110 | -4.009 | 0.331 | -5.146 |
| Auto, Transport, Vehicles | 0.076 | 0.002 | -0.134 | 6.365 | -0.508 | 9.820 | 0.171 | -5.202 | 0.391 | -6.478 |
| Agriculture | 0.076 | 0.034 | -0.387 | 5.932 | -0.722 | 10.705 | 0.146 | -6.934 | 0.403 | -9.535 |
| Textiles | 0.072 | 0.107 | -0.240 | 9.443 | -0.577 | 12.632 | 0.229 | -6.776 | 0.428 | -8.088 |
| Food Processing | 0.061 | 0.070 | -0.266 | 8.582 | -0.586 | 10.890 | 0.268 | -6.650 | 0.461 | -7.265 |
| Paper, Publishing, Printing | 0.049 | 0.011 | -0.125 | 6.646 | -0.513 | 10.044 | 0.174 | -5.570 | 0.393 | -6.824 |
| Nonmetallic Mineral Manuf | 0.046 | 0.117 | -0.217 | 7.469 | -0.599 | 11.083 | 0.235 | -5.994 | 0.449 | -7.487 |
| Electric, Electronic Equip. | 0.040 | -0.001 | -0.098 | 5.932 | -0.513 | 9.875 | 0.139 | -4.824 | 0.373 | -6.276 |
| Other Manuf. | 0.040 | 0.020 | -0.155 | 6.716 | -0.549 | 9.932 | 0.155 | -5.354 | 0.386 | -6.539 |
| Wood, Furniture, Peat | 0.040 | 0.109 | -0.218 | 4.647 | -0.551 | 7.081 | 0.217 | -4.252 | 0.404 | -4.966 |
| Machinery, Equipment | 0.035 | 0.005 | -0.170 | 6.940 | -0.577 | 10.986 | 0.198 | -5.454 | 0.433 | -7.019 |
| Plastics | 0.026 | 0.003 | -0.058 | 5.325 | -0.435 | 8.590 | 0.134 | -4.578 | 0.362 | -5.841 |
| Petroleum Refining | 0.018 | -0.000 | -0.118 | 6.578 | -0.489 | 9.899 | 0.193 | -5.618 | 0.432 | -7.007 |
| Pharma., Perfumes, Detergents | 0.017 | -0.002 | -0.080 | 6.215 | -0.470 | 9.683 | 0.145 | -5.216 | 0.376 | -6.515 |
| Mineral Mining | 0.008 | 0.007 | -0.183 | 7.101 | -0.538 | 10.211 | 0.215 | -5.816 | 0.422 | -7.006 |
| Chemicals | 0.007 | 0.004 | -0.167 | 6.522 | -0.522 | 9.617 | 0.214 | -5.910 | 0.425 | -7.111 |
| Rubber | 0.007 | 0.003 | -0.152 | 6.624 | -0.527 | 10.193 | 0.190 | -5.367 | 0.413 | -6.749 |
| Petroleum, Gas, Coal | -0.000 | -0.000 | -0.183 | 7.044 | -0.537 | 10.219 | 0.222 | -5.870 | 0.433 | -7.016 |
| Footwear, Leather | -0.034 | 0.132 | -0.167 | 5.964 | -0.526 | 9.308 | 0.204 | -5.085 | 0.415 | -6.375 |

*Notes:* This table reports Rotemberg weights for each industry and the estimated effects of adult- and child-specific tariff reductions on changes in the shares of children who attend "school only" and "work" for the periods 1991-2000 ("medium-run") and 1991-2010 ("long-run"). Each point estimate is obtained from a separate regression based on the specification in Equation (9), sequentially including, one at a time, the shares of adults and children working in each industry in the baseline year of 1991. The estimates for changes in "school only" and "work" for the period 1991-2010 are the same as those reported in Figure A9.

Table A7: Additional Robustness Checks: Employment Shares from the 1980 Census

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Overall tariff shock** | | | | | | | | |
| $\Delta Tariff_m$ | −0.266** | −0.454*** | 0.255*** | 0.379*** | 0.056 | 0.088 | 0.316*** | 0.427*** |
| | (0.126) | (0.139) | (0.074) | (0.071) | (0.097) | (0.118) | (0.057) | (0.069) |
| R-squared | 0.81 | 0.87 | 0.61 | 0.71 | 0.91 | 0.92 | 0.70 | 0.68 |
| **Panel B. Adult-specific vs child-specific tariff shocks** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.345*** | −0.530*** | 0.286*** | 0.407*** | 0.077 | 0.116 | 0.350*** | 0.477*** |
| | (0.129) | (0.139) | (0.076) | (0.073) | (0.100) | (0.121) | (0.060) | (0.072) |
| $\Delta Tariff_m^{Child}$ | 7.333*** | 6.868*** | −4.450*** | −3.769*** | −2.822* | −3.666** | −3.732*** | −5.453*** |
| | (1.800) | (1.858) | (1.189) | (1.363) | (1.616) | (1.743) | (0.883) | (1.008) |
| R-squared | 0.82 | 0.88 | 0.63 | 0.72 | 0.91 | 0.92 | 0.72 | 0.72 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.157 | 0.196 | -0.023 | -0.040 | -0.133 | -0.156 | -0.034 | -0.042 |

*Notes:* This table reports robustness check on the effects of local exposure to trade liberalization on changes in child labor and schooling for the periods 1991-2000 ("medium run"), and 1991-2010 ("long run"), where the measures of adult- and child-specific tariff reductions are constructed using employment shares from the 1980 Census. For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: Additional Robustness Checks: BHJ Procedure

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Overall tariff reduction** | | | | | | | | |
| $\Delta Tariff_m$ | −0.048 | −0.338** | 0.116 | 0.302*** | −0.005 | 0.041 | 0.197** | 0.303*** |
| | (0.144) | (0.134) | (0.117) | (0.107) | (0.065) | (0.077) | (0.090) | (0.107) |
| R-squared | 0.01 | 0.11 | 0.08 | 0.26 | 0.00 | 0.00 | 0.15 | 0.21 |
| Observations | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| **Panel B. Adult-specific tariff reductions** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.191 | −0.527*** | 0.209** | 0.410*** | 0.052 | 0.126 | 0.312*** | 0.470*** |
| | (0.140) | (0.127) | (0.103) | (0.090) | (0.074) | (0.086) | (0.066) | (0.072) |
| R-squared | 0.13 | 0.41 | 0.29 | 0.55 | 0.03 | 0.08 | 0.51 | 0.63 |
| Observations | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| **Panel C. Child-specific tariff reductions** | | | | | | | | |
| $\Delta Tariff_m^{Child}$ | 8.254*** | 9.084*** | −4.855*** | −5.074*** | −3.826** | −5.089*** | −6.566*** | −9.524*** |
| | (3.197) | (2.869) | (1.554) | (1.337) | (1.494) | (1.798) | (1.736) | (1.854) |
| R-squared | 0.48 | 0.53 | 0.57 | 0.55 | 0.42 | 0.50 | 0.62 | 0.76 |
| Observations | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |

*Notes:* This table reports robustness check on the effects of local exposure to trade liberalization on changes in child labor and schooling for the periods 1991-2000 ("medium run") and 1991-2010 ("long run"), following the estimation procedure proposed by Borusyak et al. (2022). For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A9: Additional Robustness Checks: AKM Inference Procedure

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Overall tariff reduction** | | | | | | | | |
| $\Delta Tariff_m$ | −0.048 | −0.338** | 0.116 | 0.302*** | −0.005 | 0.041 | 0.197*** | 0.303*** |
| | (0.146) | (0.146) | (0.086) | (0.084) | (0.101) | (0.117) | (0.058) | (0.074) |
| R-squared | 0.81 | 0.87 | 0.59 | 0.69 | 0.91 | 0.92 | 0.67 | 0.64 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| **Panel B. Adult and child-specific tariff reductions** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.181 | −0.537*** | 0.217** | 0.425*** | 0.035 | 0.111 | 0.315*** | 0.472*** |
| | (0.157) | (0.157) | (0.094) | (0.091) | (0.110) | (0.131) | (0.059) | (0.072) |
| $\Delta Tariff_m^{Child}$ | 7.038** | 10.229*** | −5.817*** | −6.941*** | −1.975 | −3.404* | −6.867*** | −9.722*** |
| | (3.300) | (3.095) | (1.924) | (1.820) | (1.915) | (2.055) | (1.382) | (1.566) |
| R-squared | 0.81 | 0.88 | 0.61 | 0.72 | 0.91 | 0.92 | 0.71 | 0.71 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |

*Notes:* This table reports robustness check on the effects of local exposure to trade liberalization on changes in child labor and schooling for the periods 1991-2000 ("medium run") and 1991-2010 ("long run"), where standard errors are computed following the procedure proposed by Adão et al. (2019). For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A10: Additional Robustness Checks: Controlling for the China Shock

| | School only | | Work | | Idle | | Paid work | |
|---|---|---|---|---|---|---|---|---|
| | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 | 1991-2000 | 1991-2010 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A. Overall tariff shock** | | | | | | | | |
| $\Delta Tariff_m$ | −0.014 | −0.323 | 0.082 | 0.278*** | 0.005 | 0.060 | 0.154** | 0.265*** |
| | (0.179) | (0.199) | (0.108) | (0.103) | (0.133) | (0.161) | (0.077) | (0.101) |
| R-squared | 0.81 | 0.87 | 0.60 | 0.70 | 0.91 | 0.92 | 0.68 | 0.65 |
| **Panel B. Adult-specific vs child-specific tariff shocks** | | | | | | | | |
| $\Delta Tariff_m^{Adult}$ | −0.152 | −0.543** | 0.168 | 0.401*** | 0.069 | 0.159 | 0.274*** | 0.450*** |
| | (0.218) | (0.241) | (0.127) | (0.123) | (0.175) | (0.214) | (0.082) | (0.103) |
| $\Delta Tariff_m^{Child}$ | 5.726 | 9.007* | −3.381 | −5.246* | −3.013 | −4.289 | −5.571*** | −8.801*** |
| | (5.131) | (4.862) | (2.484) | (2.671) | (3.517) | (3.728) | (1.965) | (2.294) |
| R-squared | 0.81 | 0.88 | 0.62 | 0.72 | 0.91 | 0.92 | 0.72 | 0.71 |
| Observations | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Mean dep. var. | 0.157 | 0.196 | -0.023 | -0.040 | -0.133 | -0.156 | -0.034 | -0.042 |

*Notes:* This table reports robustness check on the effects of local exposure to trade liberalization on changes in child labor and schooling for the periods 1991-2000 ("medium run") and 1991-2010 ("long run"), where in addition to the controls from the specification in Equation (9), we also include measures of adult- and child-specific exposure to Chinese import competition, constructed based on Equations (11) and (12). For additional details, see footnote to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.