Local Labor and Welfare Effects of Import Competition: Evidence from PTPA

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Abstract

This paper examines the impact of increased import competition on local labor market adjustments and the welfare of Peruvian workers, leveraging substantial tariff reductions on U.S. imports to Peru after the implementation of the U.S-Peru Trade Promotion Agreement (PTPA) in 2009. We show that regions experiencing greater tariff reductions saw a sustained and pronounced increase in informal employment. Consistent with previous studies, our results confirm that the informal sector serves as an employment buffer, cushioning the adverse labor demand shocks driven by import competition. Using worker-level panel data, we find that individuals in regions facing larger tariff reductions are more likely to transition to informal employment and work significantly longer hours. This shift is more pronounced among women, skilled workers, older workers, incumbents, and those already in informal employment. We further explore the welfare implications, revealing that the informal sector also functions as a welfare buffer in the face of negative labor demand shocks. Our findings offer a fresh perspective on the impact of trade liberalization on the informal economy and highlight the important role of import competition in giving rise to informality, a prevalent phenomenon in middle- and low-income countries.

Keywords: Peru, informal employment, trade, import competition, PTPA
JEL Codes: F14, F16, F66, J21, J46, J61

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1 Introduction

International economists have long examined the distributional consequences of trade liberalization, often assuming full employment and friction-less worker transitions (Stolper and Samuelson, 1941). Yet, recent empirical work by Autor et al. (2013), Dix-Carneiro and Kovak (2017), Choi et al. (2024) and many others has documented persistently negative labor market outcomes in regions facing increased import competition. Despite these findings, a critical question remains unanswered: How does informality matter for the regional consequences of international trade? Can we discover new insights by considering the role of the informal sector in labor markets, or will we find consistent patterns?

Informality has been a persistent and widespread phenomenon in the labor market of developing countries. With more than 70% of the workforce engaged in informal employment, Peru ranks among the highest in Latin America and the Caribbean, well above some benchmark countries (OECD, 2015). Informality is increasingly recognized as an obstacle to economic development. Informal firms evade taxes, social contributions, and labor market regulations, including minimum wages and maximum working hours. Informal workers are either not covered by various benefits (health, UI, pension) or just get limited cover (Meghir et al., 2015; Dix-Carneiro et al., 2021). Considering the significant size and pivotal role of the informal sector, it is reasonable to assume that informality significantly shapes the aggregate and distributive impacts of international trade.

With many countries undergoing major episodes of trade liberalization in the last 40 years, the informal sector has received emerging attention in theoretical and empirical studies of international trade[1]. The long-standing debate on the relationship between trade and informality around two opposing views. On the one hand, trade leads to growth and structural transformation, so as the economy grows, the share of informal employment decreases (McCaig and Pavcnik, 2018). On the other hand, trade increases informality as domestic

[1]Please see Dix-Carneiro et al. (2021); Goldberg and Pavcnik (2003); Dix-Carneiro et al. (2021); Ponczek and Ulyssea (2021); Paz (2014); Bosch et al. (2012)

firms try to cut costs to cope with intensified import competition, which has been studied in Brazil (Dix-Carneiro and Kovak, 2017, 2019).

There are two empirical challenges related to trade and informality. First, there are no precise data to measure the reallocation of labor between the informal and formal sectors. In practice, McCaig and Pavcnik (2018) used an indicator for whether a worker works for a household business or self-employment as a proxy for informal employment. (Dix-Carneiro and Kovak, 2019) classified workers without a signed work card as informally employed in the Brazilian Decennial Demographic Census, which cannot follow the labor transition of individuals and cannot capture the dynamic of local labor adjustment over time. Second, the simultaneous occurrence of trade liberalization with economic growth and urbanization makes it difficult to disentangle the causal effect of international trade on the local labor market.

The paper addresses the empirical challenges above by focusing on Peru, which has nationally representative household surveys that include direct questions on formal or informal employment and contain a panel subsample allowing us to track labor transition at the worker level, and which was subjected to a large, plausibly exogenous shock with the 2009 United States–Peru Free Trade Agreement (PTPA). We examine the causal effect of import competition on the adjustments of the local labor market, particularly labor reallocation between the informal and formal sectors, and household welfare in Peru.

First, we begin with the dynamics of local labor market adjustments following the PTPA in 2009 by exploiting variations in industry tariff reductions and variations in pre-PTPA employment distribution across Peruvian regions. We find long-lasting effects on the local labor market, suggesting that regions most exposed to US import competition experience a decrease in employment but a rise in informal employment even after 10 years, compared to other regions. A region facing a 10 percentage points larger tariff reduction experienced a 0.72 percentage point larger increase in the share of informal employment from 2008 to 2018. These results are robust to include fixed effects, preexisting controls, other alternative

measures of trade exposure, and other potential confounds. We find no effects of the PTPA on local labor markets prior to its implementation. These local labor adjustments do not lead to migration or declines in the working-age population in the districts most exposed to PTPA, and we have the power to reject even small effects.

Next, we pair with panel data from 2007 to 2010 to examine workers' responses to PTPA-induced import competition and to explore the underlying mechanisms driving regional dynamics. Our analysis reveals a small but significant increase in the probability of informal sector employment in regions most exposed to import competition, while the overall effect on employment remains insignificant. Using self-employment as a proxy for informal employment, we find no significant impact on self-employment. Additionally, a decomposition of wages into hourly wages and working hours indicates that workers tend to work more hours, though the effect on hourly wages is insignificant. Last, we analyze the impact of increased import competition on household welfare. While we do not find strong evidence of effects on household income or poverty levels, we do observe a significant reduction in household expenditures. In the heterogeneity analysis, we show that the magnitudes of labor adjustment differ substantially across demographic groups. Women, unskilled workers, older cohorts, and workers in tradable sectors are more likely to be affected by PTPA-induced import competition.

This paper adds value to the current body of knowledge in three important ways. First, our paper contributes to the developing literature on the consequences of trade in the local labor market (Autor et al., 2013, 2014; Dix-Carneiro and Kovak, 2015, 2017; Edmonds et al., 2010; Kovak, 2013; Topalova, 2007, 2010; Erten et al., 2019; Arias et al., 2018). Although Peru has experienced significant trade liberalization since the 1990s, there have been limited empirical studies in Peru with a substantial share of informality. To our knowledge, we present the first evidence to assess the impact of the 2009 United States-Peru Free Trade Agreement. We investigate the dynamics of the local labor response to trade (Blanchard and Katz, 1992; Bound and Holzer, 2000; Dix-Carneiro and Kovak, 2017). Taking advantage

of worker-level panel data, we shed light on heterogeneity and investigate who wins and loses under globalization. Another key contribution of this paper to the literature on the regional effects of trade is that, moving from the influential work of Autor et al. (2014), we disentangle the combined impact on earnings by separately analyzing the effects on working hours and hourly wages.

Second, our study related to ongoing discussions about informal employment in developing countries. In contrast to their counterparts in formal employment, workers in the informal sector typically generally hold lower-quality jobs, receive lower pay, face greater risks, and have limited social security benefits (Gollin, 2008; La Porta and Shleifer, 2014; Meghir et al., 2015). Understanding the determinants of informal employment and mitigating the negative impacts of informality has been a key policy question. Consequently, evaluating the impact of trade liberalization on the local labor market while accounting for informality is crucial. We add new evidence on local labor adjustment at the aggregate market level and the worker level, which is consistent with the Brazilian study (Dix-Carneiro and Kovak, 2017) and acts as a flip side evidence mirroring Vietnam's trade policy on informality (McCaig and Pavcnik, 2018).

Third, we extend our empirical analysis to welfare in the presence of informality and show that the informal sector could act as a "welfare buffer" in the face of negative labor shocks induced by import competition. In contrast to the theoretical predictions in Dix-Carneiro et al. (2021), our empirical evidence provides an open question on welfare analysis in labor markets with a substantial share of informality.

Our work shares similarities with McCaig and Pavcnik (2018), but there are several key distinctions. First, McCaig and Pavcnik (2018) analyzed the increased export opportunities resulting from the Vietnam-US trade agreement. In contrast, our study on the PTPA focuses on the intensified import competition that affects Peru's local labor market, providing an opposite perspective to McCaig and Pavcnik (2018). Second, McCaig and Pavcnik (2018) modeled industry-level effects (proxied as changes in employment by industry) based on tariff

changes, while we exploit regional variation at a fine geographic level. Third, the absence of information from the survey about the informal or formal sectors in McCaig and Pavcnik (2018) leads to issues of generalization and measurement error, while our data include such information, improving credibility. Fourth, McCaig and Pavcnik (2018) utilized two rounds of surveys, whereas our cross-sectional surveys span two decades, allowing us to examine the dynamics of local labor adjustment and demonstrate changes in trends that correlate closely with the implementation of the PTPA.

The remainder of this paper proceeds as follows. In Section 2, we introduce the 2009 United States-Peru Free Trade Agreement. In Section 3, we describe the data sources and document some facts about informal employment in Peru. In Section 4, we construct our measure of PTPA exposure. In Section 5, we explain empirical strategies and report empirical results at the regional and worker level, respectively. In Section 6, we examine the robustness of the main results. In Section 7, we discuss alternative outcomes, falsification test, and heterogeneity, and Section 8 draws the conclusion.

2 Backgroud

2.1 The United States–Peru Free Trade Agreement

The United States–Peru Free Trade Agreement (PTPA) entered force on February 1, 2009 and has boosted U.S. exports by cutting agricultural tariffs and improving access for many U.S. commodities through rising tariff rate quotas (TRQs) over time. When PTPA entered into force, about two-thirds of Peru's agricultural tariffs for U.S. products were immediately eliminated, while the remaining tariffs are gradually being brought to zero. As a result, U.S. exports of agricultural products to Peru have nearly tripled from $424 million in 2008 to a record $1.2 billion in 2014 (U.S. Department of Agriculture, 2015).

In addition, Peru has existing duty-free access to the US market under the Andean Trade Preference Act (ATPA), which eliminates tariffs on a number of products from Peru, Bolivia,

Colombia, and Ecuador with the aim of strengthening legal industries in these countries as alternatives to drug production and trafficking. ATPA started on December 4, 1991 and expired up to February 29, 2008 under the renewed act. Given the existing tariff benefits on Peru's exports under ATPA, we focus on the intensified import competition induced by US imports on Peru's market after the implementation of PTPA (United States International Trade Commission, 2006).

Our identification strategy in Section 5 relies on several useful features of the PTPA-induced tariff changes. Figure 1a shows the evolution of import tariffs over the years and the implementation of the PTPA in 2009 led to significant tariff reductions. On average, PTPA reduced tariffs by 3 percentage points, from 3 to 0 percent. We match the Harmonized System (HS) code with the International Standard Industrial Classification (ISIC) code to capture the heterogeneity of tariff declines across industries.

2.2 Exogeneity of Tariff Changes

The main threat to interpreting our results as causal effects of the PTPA is that the tariff changes may have been correlated with unobserved factors affecting the labor outcomes. This correlation may arise if trade policymakers impose different tariff reductions on strong or weak industries, or if stronger industries are able to lobby for smaller tariff cuts (Grossman and Helpman, 1994).

However, there are a number of reasons to believe that these concerns were unlikely to be a serious problem in this specific case. First, following the approach of Goldberg and Pavcnik (2005); Kovak (2013); Brandt et al. (2017), we examine the relationship between the pre-PTPA tariff level and the tariff change at the product level and report the results in Figure 1b, suggesting that products with high tariffs before PTPA experienced the greatest tariff cuts, with the correlation between the pre-PTPA tariff level and the tariff change equaling -0.98. Second, since the PTPA's text is largely modeled on other recent U.S. trade agreements, particularly the U.S.-Central American-Dominican Republic Free Trade

Agreement (CAFTA-DR) (United States International Trade Commission, 2006), it is reasonable to rule out an endogenous relationship between the PTPA-induced tariff changes and Peru's pre-existing conditions. Third, to further address the concern about endogeneity in the change in tariff, we perform a robustness check in Section 6.1 using an alternative measure of regional PTPA exposure excluding the PTPA-induced tariff.

3 Data and Descriptive Facts

3.1 Data Sources

This section provides summary information on our data construction and measurement. We combine labor force data with a large and plausibly exogenous variation in tariff reductions induced by the 2009 United States-Peru Free Trade Agreement (PTPA).

Our main data source for the local labor market and welfare comes from the Encuesta Nacional de Hogares (ENAHO). ENAHO is Peru's National Household Survey, which is conducted annually by the National Statistics Office (INEI) and is representative of the Peruvian population. We used the annual household survey from 2004 to 2018 to exclude the Covid-19 period. ENAHO has recently been used by Ñopo (2008); Dell (2010); Aragón and Rud (2013). A notable advantage of the ENAHO surveys is that approximately 30% of households were revisited in the subsequent year.

We construct the main variables of interest to measure the local labor market. The first variable is an indicator of whether a worker works for an informal sector from a survey question on the worker's employment type. The question distinguishes whether the employment is informal or formal. The indicator takes the value 1 if an individual works in the informal sector and 0 otherwise. The second variable we use is an indicator of whether she works as an unpaid family worker or as a domestic worker. To measure household economic well-being, I construct a measure of household consumption by subtracting the transfers received by the household from total household consumption and normalizing the Lima metropolitan prices

using the deflation factor provided by ENAHO, following the calculation by Dell (2010). I also construct an indicator of poverty based on the income of the household.

We select variables representing individual characteristics such as gender, age, educational attainment, ethnicity, geographic location, urban-rural residence, and industry affiliation. The survey distinguishes between two-digit ISIC (Rev.4) industries. We use industry affiliation to link worker-level data with industry-level tariffs on imports from the United States to Peru, as described in Section 2. We also create a variable as an indicator of whether the worker is skilled or unskilled according to the International Classification of Occupations (ISCO). The International Labour Organization (ILO) defines the following occupational categories as skilled work: legislative, professional, services, skilled manufacturing, and technical; and the following occupational categories as unskilled work: elementary and domestic. The indicator takes the value 1 if an individual's job is classified as a skilled occupation and 0 otherwise, following the categorization in Hjort and Poulsen (2019).

Throughout the analysis, we restrict our sample to working-age individuals, defined as those aged 15 to 64. Table 1 presents summary statistics for the full sample in the baseline year, which includes 53,471 individuals, as shown in columns (1)-(2). We further narrow the sample to 4,834 individuals who were interviewed in four rounds from 2007 to 2010 and report the summary statistics for this panel subsample in columns (3)–(4) of Table 1. The comparison between the summary statistics of the full sample and the panel subsample suggests that individuals were randomly surveyed multiple times.

Our data offer several advantages over previous studies on the effects of trade on local economies and labor markets. First, unlike Dix-Carneiro and Kovak (2015, 2017), our surveys provide detailed information on employment in both the informal and formal sectors. Second, in contrast to McCaig and Pavcnik (2018), we are able to identify whether a worker is employed in the informal or formal sector, whether the worker is employed as an unpaid family worker or a domestic worker, and the district of residence. Third, repeated cross-sectional ENAHO surveys enable us to examine both the short- and long-term effects of trade

liberalization in Peru, whereas McCaig and Pavcnik (2018) investigates labor reallocation in Vietnam using only two survey rounds. Fourth, ENAHO provides a comprehensive set of information on the economy and local labor markets at a fine geographic level, allowing us to explore possible mechanisms. Fifth, the ENAHO surveys include worker-level panel data, which allows us to track the labor transition in the local labor market. Finally, the ENAHO surveys make it possible to disentangle the overall net effect of import competition on earnings, as discussed in Autor et al. (2014), by separating the impacts on working hours and earnings per hour.

3.2 Descriptive Facts on Informal Employment in Peru

In this section, we highlight some important facts about the formal and informal sectors in Peru.

Figure 2 plots the summary statistics by formality status in 2007. The blue bar shows that, on average, 80% of the labor force is hired informally, which is much higher than in other developing countries such as Vietnam (McCaig and Pavcnik, 2015) and Brazil (Dix-Carneiro et al., 2021). The orange bar shows that earnings in the informal sector are, on average, 60% lower than earnings in the formal sector. And informal workers are at least five times more likely to live in poverty than formal workers, as shown in the maroon bar.

We also document the characteristics of workers in the informal sector. Figure 3 shows that informality shows a U-shaped pattern with respect to age. In Figure 4, the orange bar highlights that informal workers are less educated: there is a 25 percentage points gap in the share of workers with at least secondary school education in the formal versus informal sectors. The blue bar shows that, relative to the formal sector, the informal sector has a larger share of female workers. The top two bars illustrate that the informal sector involves more unskilled and rural workers.

Moreover, the transition of labor from the informal to the formal sector is scarce in Peru. By pooling all workers with continuous labor records of at least two years in the ENAHO

surveys, we run the linear regression to show that men, skilled, middle-aged (25-44 years), urban, and educated workers are more likely to transit from the informal to the formal sector than other workers in Figure 5.

4 Construction of Our Measure of PTPA Exposure

Our measure of PTPA exposure is heavily derived from the specific–factor model of regional economies (Topalova, 2007; Kovak, 2013; Dix-Carneiro and Kovak, 2015), which takes a vector of industry-level measures of exposure to import competition and multiplies it by a vector of employment shares across industries. We calculate regional exposure to trade liberalization using a weighted average of changes in trade policy, with weights based on the pre-PTPA industrial distribution of employment shares and the industry-level tariff reductions as follows.

$$RTR_r = -\sum_j \beta_{rj} \Delta \ln(1+\tau_j), \qquad \text{where } \beta_{rj} = \frac{\lambda_{rj}\frac{1}{\phi_k}}{\sum_k \lambda_{rk}\frac{1}{\phi_k}}, \tag{1}$$

Here, r indexes regions, and j indexes industries. τ_j is the tariff rate in industry j, λ_{rj} is the share of regional labor initially allocated to the tradable industry j before PTPA, and ϕ_j is the cost share of non-labor factors. The tariff change, $\Delta \ln(1+\tau_j)$, is obtained from the UNCTAD Trade Analysis Information System (TRAINS). The value of λ_{rj} is calculated using data from the Peru 2007 census (at the provincial level). The value of ϕ_j is obtained from the Peru 2008 national accounts (Instituto Nacional de Estadística e Informática, 2023). Together, they allow us to calculate the weights β_{rj}.

Equation 1 is a weighted average of these tariff changes across tradable industries, with more weight on industries that capture larger shares of the initial regional employment. We map the spatial variation in regional tariff reductions, RTR_r, at the provincial level in Figure 6, suggesting that regions exposed to higher tariff declines are shown as lighter, whereas regions exposed to smaller tariff declines are shown as darker.

5 Empirical Strategy and Main Findings

5.1 Regional Dynamics

To shed light on the dynamic responses of the local labor market in regions facing large tariff reductions compared to those in regions facing smaller tariff declines, we adopt the specification of Dix-Carneiro and Kovak (2017) as follows.

$$y_{rt} - y_{r,2008} = \theta_t RTR_r + \alpha_d + \gamma_t(y_{r,2008} - y_{r,2004}) + \epsilon_{rt} \tag{2}$$

Here, y_{rt} represents the district-level outcomes of our interest, i.e., the share of informal employment in total employment, the share of self-employment in total employment and share of employment in total labor force in the region r at time t. We estimate the equation 2 separately for each year $t \in [2009, 2018]$. The term α_d controls for department fixed effects. We include the term $(y_{r,2008} - y_{r,2004})$ to control the pre-liberalization trends to address the possibility of confounding pre-existing trends. The coefficients of our interest are θ_t, indicating the cumulative effects of trade liberalization in each year after liberalization.

Table 2 shows the results of estimating equation 2 for the changes in the share of employment, informal employment, and self-employment in panels A, B, and C, separately. Columns (1)-(3) examine changes in local labor market outcomes after 1, 5, and 9 years after the implementation of PTPA. In Panel A, negative coefficient estimates indicate that regions regions facing larger tariff reductions experience relative declines in the share of employment. The coefficient of –0.030 in panel A, column (3) indicates that a region facing a 10 percentage points larger tariff reduction experienced a 0.30 percentage point larger proportional decline in share of employment from 2008 to 2018. Figure 7 confirms this pattern by plotting the coefficients on RTR_t for each year. The points for 2010, 2014 and 2018 correspond to the RTR_t coefficients in columns (1)-(3) of panel A in Table 2. However, the effect of PTPA-induced import competition on local employment is statistically insignificant

until 2012.

Panel B of Table 2 and the corresponding Figure 8 examine the effect of trade liberalization on regional informal employment. In panel B, all estimates for the coefficient on RTR_t are positive and significant, indicating that regions facing larger tariff reductions experience relative increases in the share of informal employment. The coefficient 0.028 in panel B, column (1) suggests that a region facing a 10 percentage point larger tariff reduction experienced a 0.28 percentage point larger increase in the share of informal employment from 2008 to 2010. The coefficients 0.035 and 0.072 in columns (2)–(3) show the persistent and enlarged effect on local informal employment over time. Figure 8 confirms this pattern by plotting the coefficients on RTR_t for each year.

Following the definition in the earlier literature (LaPorta and Shleifer, 2008; McCaig and Pavcnik, 2018), we estimate the equation 2 using self-employment as a proxy of informality. As a mirror of McCaig and Pavcnik (2018), which showed that there is a decrease in the probability of self-employment after a positive export shock, we find that the increase in self-employment in the local labor market in response to PTPA-induced import competition. In panel C of Table 2, the positive coefficients on RTR_t suggest that regions facing larger tariff reductions experience relative increases in self-employment. In detail, the coefficients 0.017 in column (1) are insignificant, while the coefficients 0.036 and 0.054 in columns (2)–(3) become significant, indicating that a region facing a 10 percentage point larger tariff reduction experienced a 0.54 percentage point larger increase in self-employment from 2008 to 2018. Figure 9 confirms this pattern in self-employment. By comparing the dynamic response for informal employment and self-employment in Figure 8 and Figure 9, we infer that using self-employment as a proxy for informality would lead to measurement error in empirical studies.

5.2 Worker-level Evidence

In this section, we present worker-level evidence using panel subsample and therefore mitigate concerns about the ecological fallacy inherent in region-level regression in Section 5.1. This panel subsample allows us to track individuals and examine the robustness of the results in the selection of unobserved heterogeneity in the labor market after PTPA.

Our empirical methodology relies on a comparison of the probability that an individual is employed in the informal sector before and after the implementation of the PTPA across Peru's districts unevenly exposed to the tariff reductions. We define the yearly regional tariff exposure as follows.

$$Tariff_{rt} = \sum_{j} \beta_{rj} Tariff_{jt} \tag{3}$$

In the initial empirical specifications, we estimate the linear probability model following the methodology used by Edmonds et al. (2010); Dai et al. (2021).

$$y_{irt} = \beta Tariff_{rt} + \lambda_i + \alpha_t + \delta_r + \epsilon_{irt} \tag{4}$$

Here, the subscripts i, r, and t represent an individual or household, a region, and the survey year, respectively. y_{irt} is the outcome of our interest, an indicator of whether a worker i employed in district r at time t works in the informal sector. $Tariff_{rt}$ stands for the regional tariff exposure in the region r in year t. We control for fixed effects for individual (λ_i), region (γ_r), and year (λ_t) separately. β is the coefficient of our interest, which captures the effects of the regional tariff exposure on the outcome variables. Standard errors are clustered at the department level.

We estimate the coefficient of regional tariff exposure as specified in equation 4 and report the results in Table 3. Column (1) presents the result for the probability of employment in an informal sector at the individual level. We find that on average, a 10 percentage point decrease in tariff exposure increases the probability of informal employment by 0.035 percent

point. However, we did not find evidence on employment and self-employment in response to the PTPA-induced tariff change at the worker level. Compared to Autor et al. (2013), which used the log weekly wage to measure the net effect of changes in hourly wages and hours worked, our ENAHO surveys allow us to decompose the net effect on wages into hourly wages and hours worked. As shown in columns (5) of Table 3, the effects of the regional tariff exposure on monthly and hourly income are statistically insignificant. However, we find a significant positive effect on weekly hours on the primary occupation of magnitude -1.1, suggesting that a 10 percentage point reduction in tariff exposure increases weekly working hours by 11 percentage points.

Next, we extend our empirical analysis to investigate the effects of PTPA-induced import competition on welfare and report the results in Table 5. In column (1), the coefficient is positive but insignificant, which means that PTPA-induced import competition does not have a measurable effect on the net household income per capita. We also do not find any suggestive evidence on poverty or extreme poverty, as shown in columns (3)–(4). However, we indeed find that on average, a 1 percentage point decrease in the regional tariff exposure decreases the monthly household expenditures per capita by 4.1 percentage points in column (2).

Our empirical finding is in contrast to the theoretical predictions in Dix-Carneiro et al. (2021), in which the informal sector may exacerbate the adverse welfare effects of the economic downturn in Brazil, suggesting that the informal sector acts as a "welfare buffer" in the face of negative labor shocks induced by import competition. As a response to intensified import competition, workers shift to the informal sector and work more hours to compensate for economic loss.

6 Robustness

6.1 Alternative Measure of Regional-level Trade Exposure

As a supplement to the regional tariff reductions in Section 4, we measure local vulnerability using only pre-PTPA measures of the US revealed comparative advantage (RCA) and district-level industrial labor distribution and therefore do not capture any endogenous reaction to PTPA itself. Following Hakobyan and McLaren (2016); Choi et al. (2024), we begin by creating RCA in a given industry j, using pre-PTPA data from UN Comtrade as follows.

$$RCA_j = \frac{exp_j^{US} / exp_j^{Other}}{\sum_i exp_i^{US} / \sum_i exp_i^{Other}} \tag{5}$$

Here, exp_j^{US} is the value of US's exports to all countries expect for Peru in industry j, and exp_j^{Other} is the value of exports from all countries other than United States to all countries excluding the United States and Peru in industry j. The numerator, the ratio of the two expressions, is roughly equal to the United States' share of exports in industry j. The denominator adjusts for the overall share of all exports of the United States, not just those of industry j. Thus, equation (1) captures US's relative advantage in producing exports in industry j relative to other industries $i \in I$ in 2005.

How much is a region in Peru likely to be affected by PTPA? We combine RCA and the pre-PTPA labor distribution to construct the measure below.

$$UnscaledVulnerability_r = \frac{\sum_{j=1}^{J} \lambda_{rj} \cdot RCA_j \cdot \tau_j^{2008}}{\sum_{j=1}^{J} \lambda_{rj} \cdot RCA_j} \tag{6}$$

where λ_{rj} is employment of industry j in district r and τ_j is the tariff rate of industry j in 2008. Since the units of this variable are not particularly intuitive, in most of the empirical work we normalize it by the difference between the average unscaled vulnerability in the most

vulnerable quartile and the average unscaled vulnerability in the least vulnerable quartile:

$$Vulnerability_r = \frac{UnscaledVulnerability_r}{E[UnscVul_r \mid c \in top\ quartile] - E[UnscVul_r \mid c \in bottom\ quartile]}. \quad (7)$$

Thus, increasing *Vulnerabilityr* by one unit is equivalent to moving from the average county in the least vulnerable quartile to the average county in the most vulnerable quartile. It is important to note that our *Vulnerabilityr* measure is based solely on pre-PTPA values of the US RCA and industrial composition, ensuring that it does not capture endogenous responses to the PTPA itself. We re-estimate equation 2 by replacing regional tariff reductions, RTR_r, with the measure of local vulnerability, *Vulnerabilityr*.

In Figure 12, the maroon dot (and line) and the blue diamond (and line) present the point estimates (and 95% confidence intervals) for the coefficients on local RTR and vulnerability, respectively. The blue series of Figure 12 shows that before PTPA, changes in employment have little relationship to local vulnerability. However, a clear negative trend takes hold in the years following the implementation of PTPA. While there is some modest recovery after the 2010s, by 2017, there is still a statistically significant and negative relationship between local vulnerability and changes in employment relative to the baseline. The pattern of coefficients remains largely unchanged relative to that in Figure 7. We can confirm the robustness of the main specification using alternative measurements of the local exposure to PTPA-induced import competition.

6.2 Addressing Inference Concerns

In all of our analysis, we use standard errors clustered at the department level to account for the possible spatial correlation in residuals within geography following Colin Cameron and Miller (2015). However, Adão et al. (2019) suggested that these popular shift-share designs may overreject the null hypothesis of no effect because regression residuals are correlated across regions with similar sectoral shares, independent of their geographic location. We

use the inference procedures proposed by Adão et al. (2019) to address the cross-region correlation in residuals in shift-share designs. In Table 4, we show that all the main results of the paper are robust to using their proposed correction.

7 Discussions

7.1 Migration

Economists have long studied how migration responds to local economic shocks Blanchard and Katz (1992). Researchers studying more recent local employment shocks have found much smaller migration responses. The large employment effects of the China shock produced no Autor et al. (2013) or small and delayed Greenland et al. (2019) migration effects. Similarly, Yagan (2019) and Choi et al. (2024) find no statistically significant effect in response to the Great Recession and trade-induced shock.

In this section, we examine whether individuals migrate from most PTPA-exposed regions to less exposed regions, in response to negative labor demand shocks. Figure 11 is an analog to Figure 7 except that log working-age population is the variable of our interest. In contrast to the employment results, which showed a decline in employment, we find a series of null results for the working-age population. As shown in Figure 11, there is no response in the working-age population to PTPA and that we have the power to reject even small effects.

These results suggest that rather than migrate away, many workers who lose formal employment in most PTPA-exposed regions appear to transition to the informal sector in the same region. Our results help explain the puzzle through the transition to the informal sector and the long-lasting economic effects of changes in local labor demand.

7.2 Falsification Test

We further examine the correlation between PTPA-induced tariff changes and pre-existing industry trends and levels. As discussed in Section 2.2, industry changes in tariffs are not

related to initial industry conditions nor pre-PTPA growth in imports from the United States. We perform the falsification test using the 2007-2008 ENAHO surveys and assign the pre-PTPA tariffs to the 2007 data and the post-PTPA tariffs to the 2008 data.

If preexisting trends in informal employment were correlated with industry-specific tariff reductions, this specification would produce tariff coefficient estimates with the same sign and a similar magnitude as those obtained from the analysis using data around the actual policy change. The results are presented in Table 6. The estimated coefficients on regional tariff exposure are close to zero in magnitude, statistically insignificant, and differ from the corresponding coefficients in Table 2. We find no evidence that changes in industry tariffs are correlated with preexisting trends in informal employment.

7.3 Heterogeneity in Worker Responses to Tariff Declines

The findings indicate that PTPA-induced tariff reductions increase the probability of a worker engaging the informal sector, leading to the reallocation of workers from the formal to the informal sector. The overall effects analyzed so far could mask the heterogeneity in the responses of workers. In this section, we use our equation 4 to estimate the effect of PTPA-induced import competition for mutually exhaustive and distinct subgroups of the sample.

7.3.1 By Demographic Groups

We explore the potential heterogeneity by gender, skill level, and age. This heterogeneity arises from differences in adjustment costs or differential changes in labor demand across workers with different demographic characteristics (Dix-Carneiro and Kovak, 2015; McCaig and Pavcnik, 2018). The results are reported in Table 7.

Panel A of Table 7 suggests the results using the indicator of working in an informal sector as the dependent variable. We divide the workers by demographic groups and estimate the equation 4, respectively. As shown in columns (2)–(3), the probability of working in an

informal sector increases more for female in response to PTPA-induced tariff reductions. In columns (3)–(4), we find that skilled workers observed higher increases in the probability of working in an informal sector in response to PTPA-induced tariff reductions than unskilled workers. Columns (5)–(6) report estimates for the younger cohort being 22–35 years old in 2007 and the older cohort being 36–49 years old in that year. The estimated coefficients are statistically significant and larger for the older cohort, while the coefficient is statistically insignificant and smaller for the younger cohort. Consistent with the main results in Table **??**, all estimates in panel F of Table 7 are significant and negative, suggesting that the decrease in regional tariff exposure, accompanied by increased import competition, significantly increases working hours for workers in all demographic groups.

7.3.2 By Pre-PTPA Employment Status

We consider the heterogeneous effect of import competition on workers who were employed before PTPA (incumbents) and on new entrants into the labor market. We split the sample into incumbents and new entrants and report the results for the estimation of Equation 4 in Table 8. In columns (2)–(3), we find that the probability of working in an informal sector increases significantly for incumbents, while the evidence is insignificant for new entrants. We further split the incumbents into informal and formal workers, and the estimates in columns (4)–(5) suggest that informal workers are more likely to continue working in the informal sector.

8 Conclusion

As globalization advances, trade policy sparks discussions among legislators and the public. Although recent studies have highlighted negative labor market impacts (Autor et al., 2013, 2014; Choi et al., 2024), there remains a lack of consideration of the presence of substantial informal sectors in developing countries.

Peru's trade agreement with the United States provides an excellent quasi-experiment to examine how trade-induced import competition affects the evolution of the labor structure, particularly the reallocation of labor between the informal and formal sectors in Peru, where approximately 70% of the labor is involved in the informal sector. We provide the first empirical evidence to assess the Peru Trade Promotion Agreement (PTPA), suggesting that in the regions most exposed to PTPA, trade-induced import competition leads to a persistent and expanding increase in informal employment over time, compared to other regions. Combining with the worker-level panel data, we find that PTPA-induced import competition shifts labor toward the informal sector and increases working hours in the short run. These changes in the local labor structure are not driven by labor migration. Our results show robustness to alternative specifications, measurement of PTPA exposure, and concerns about the cross-region correlation in residuals. We extend the analysis to the welfare of workers and find no significant evidence on income and poverty, suggesting that the informal sector acts as a "welfare buffer" to negative labor demand shocks.

Understanding the implications of domestic distortions for the effects of international trade is an important area of research, particularly in developing countries where these distortions are significant (Atkin and Khandelwal, 2020; Dix-Carneiro et al., 2021). Our findings highlight the importance of taking into account informality, a prevalent phenomenon in developing countries, in evaluating the benefits and costs of trade policy. One limitation of this study is the absence of data on Peruvian firms, which prevents us from developing a quantitative model to explain how these firms react to PTPA-driven import competition. Existing evidence suggests that smaller, less productive firms in the informal sector encounter fewer distortions compared to their larger, more productive counterparts in the formal sector (Dix-Carneiro et al., 2021). We leave this extension for future research.

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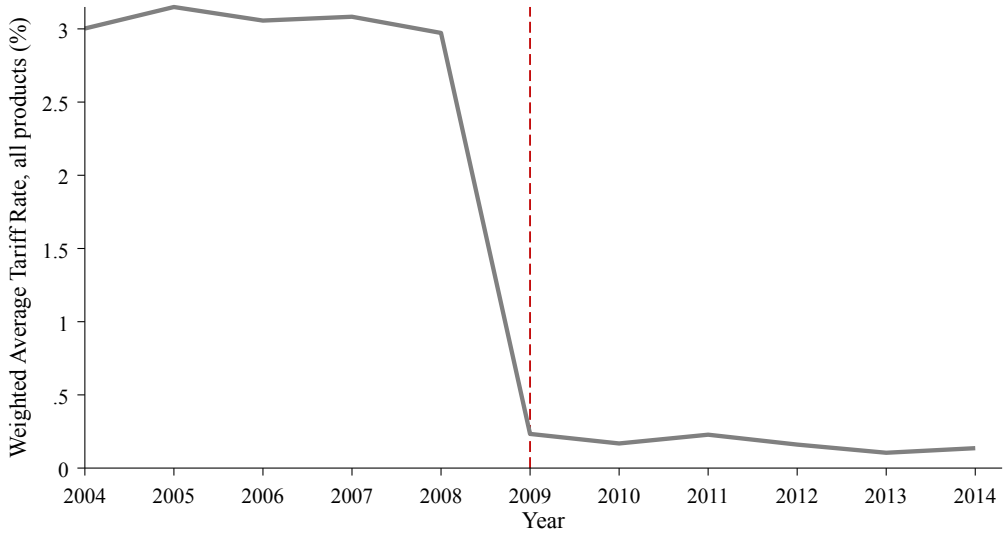
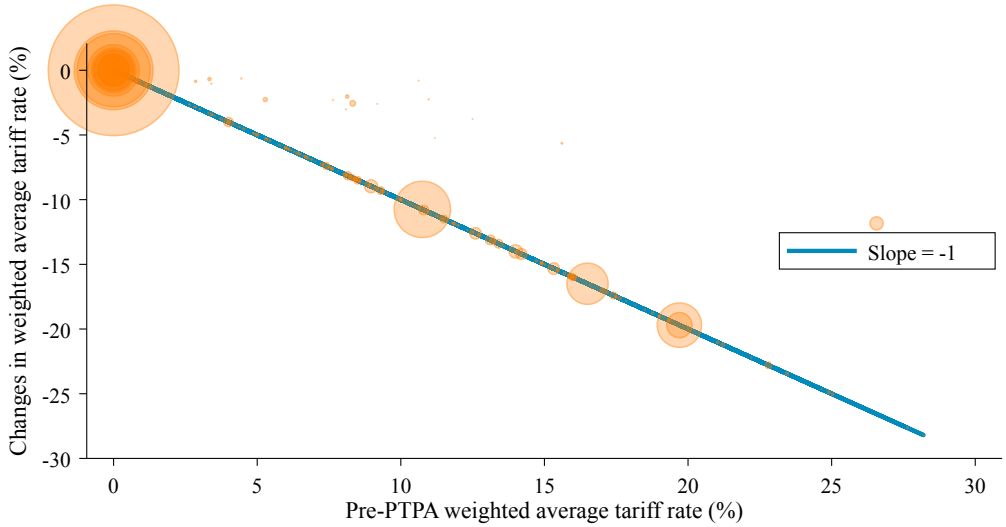
Figures



(a) Evolution of Import Tariffs



(b) Relationship between Tariff Changes and Pre-PTPA Tariffs at Product-Level

Figure 1: PTPA-induced Import Tariffs

Notes: Author's calculation based on tariff data retrieved from World integrated Trade Solutions (WITS). Figure 1a shows the evolution of import tariffs over years and Figure 1b shows the relationship between tariff changes and Pre-PTPA tariffs at the product-Level.

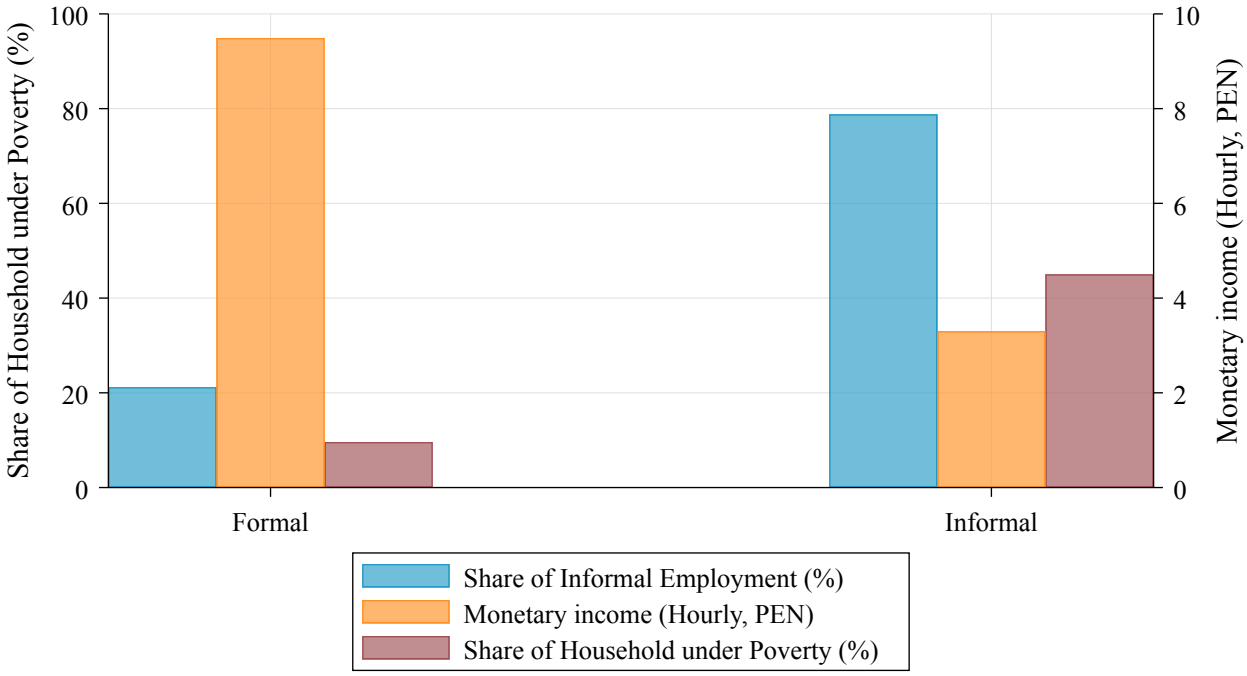


Figure 2: Share of Informal Employment and Hourly Monetary Income by Informality

Notes: Author's calculation based on 2007 ENAHO survey.

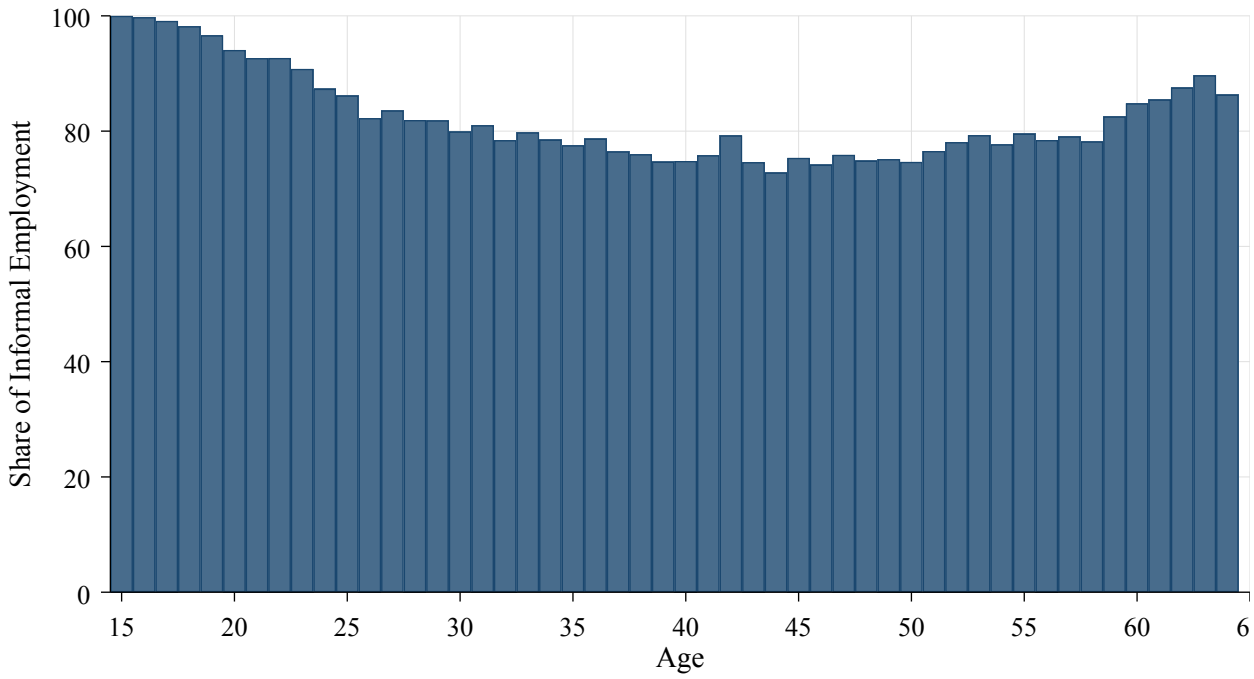


Figure 3: Distribution of Informal Employment by Workers' Age

Notes: Author's calculation based on 2007 ENAHO survey. This figure shows distribution of informal employment by workers' age.

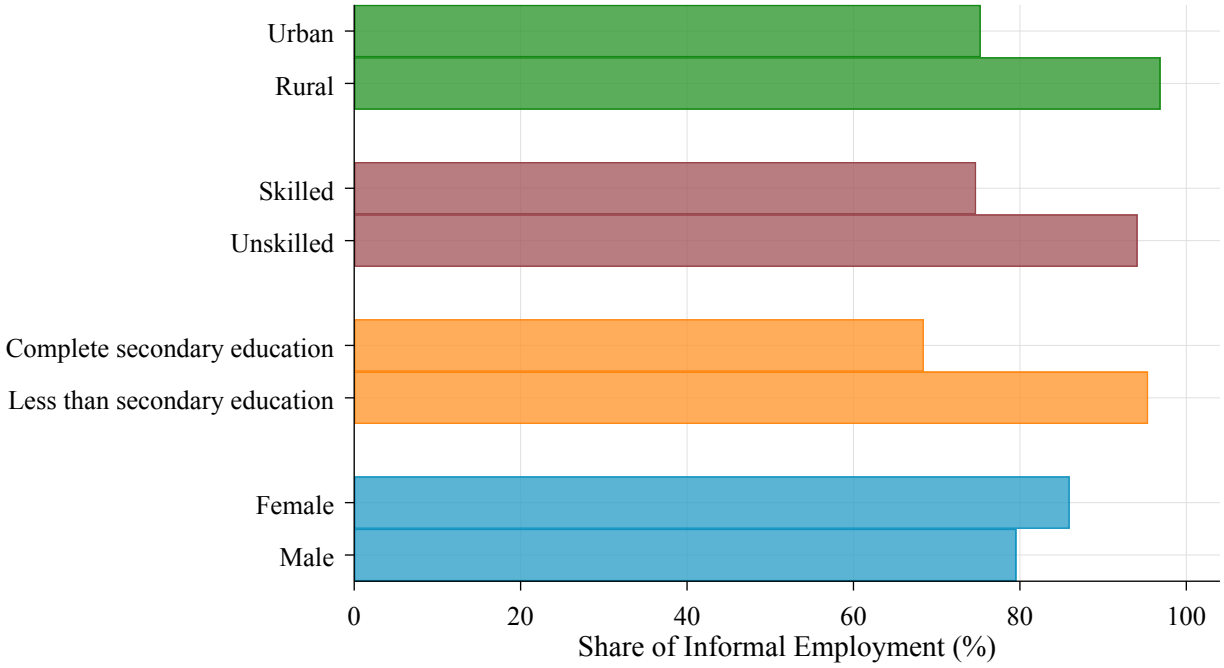


Figure 4: Distribution of Informal Employment by Workers' Characteristics

Notes: Author's calculation based on 2007 ENAHO survey. This figure shows distribution of informal employment by workers' characteristics.

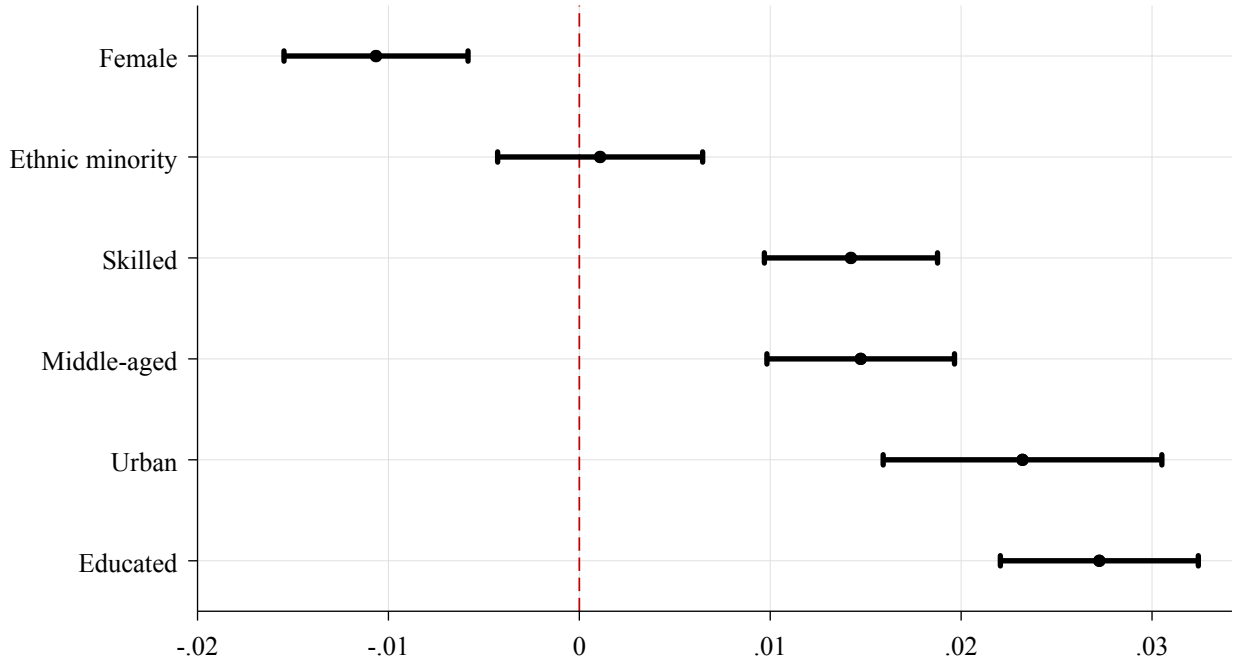


Figure 5: Transition from informal to formal sector in Peru

Notes: This figure shows the estimated coefficients for the probability of labor transition from informal to formal sector using two-consecutive year panel data during 2007-2018. We define the indicator of educated if the individuals have completed the secondary education and the indicator of skilled based on the classification in Section 3.

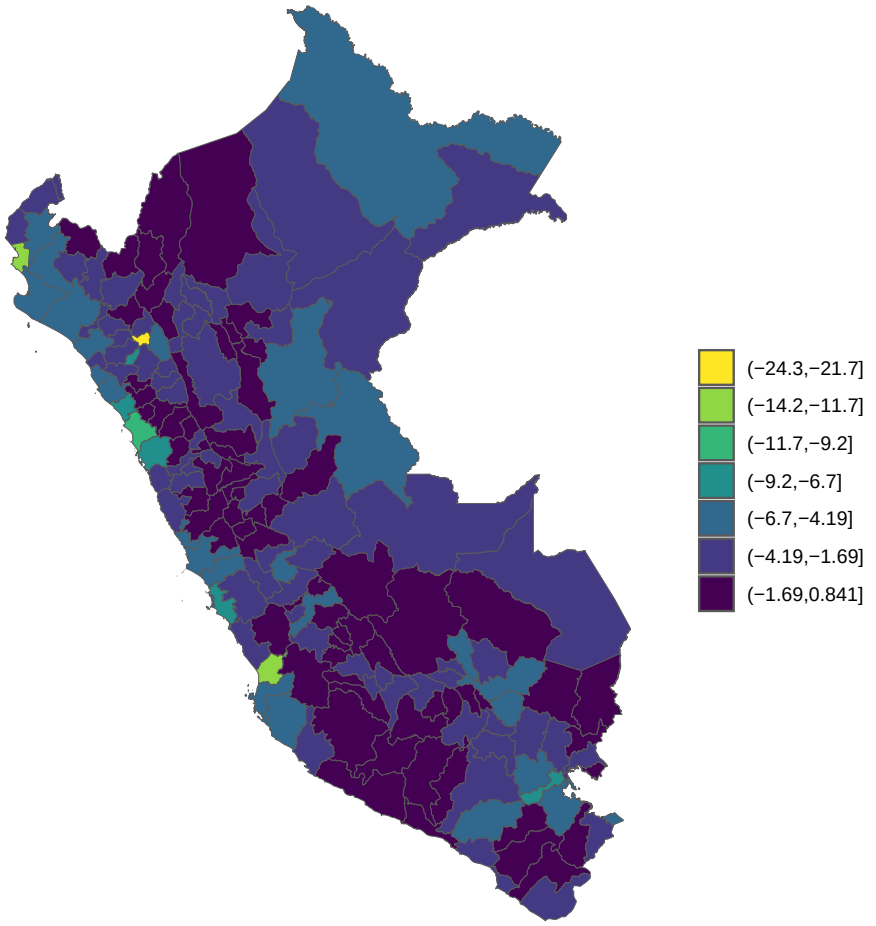


Figure 6: Regional Tariff Reductions in Peru

Notes: Provinces are colored based on the regional tariff reduction measure, RTR_r, as defined in Equation 1. Regions with greater tariff reductions are shown as lighter. Due to the cross-walking disparity between the district name and geospatial map, we only report the variation of RTR_r for the provincial level, but we use district-level RTR_r in the main analysis.

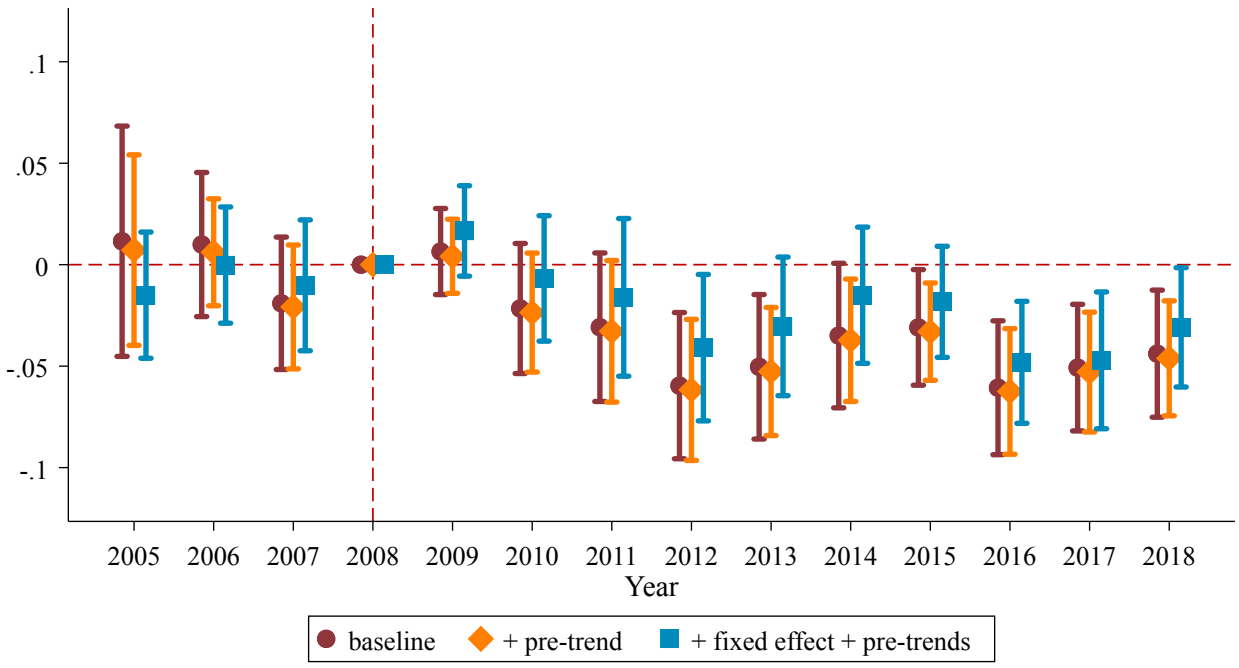


Figure 7: Changes in the share of employment after PTPA

Notes: Each point reflects an individual regression coefficient, θ_t, following equation 2, where the dependent variable is the change in the share of employment and the independent variable is the regional tariff reduction RTR_r , defined in equation 1. Note that RTR_r always reflects tariff reductions from 2011 to 2008. Specification 1 (blue dot and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and without pre-trends computed for 2004-2008. Specification 2 (orange diamond and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and with pre-trends. Specification 3 (maroon square and line) represents the point estimates and 95% confidence intervals for regressions with department fixed effects and with pre-trends, corresponding the results in Panel A of Table 2. Negative estimates imply larger declines in the share of employment in regions facing larger tariff reductions. Standard errors adjusted for 25 department clusters.

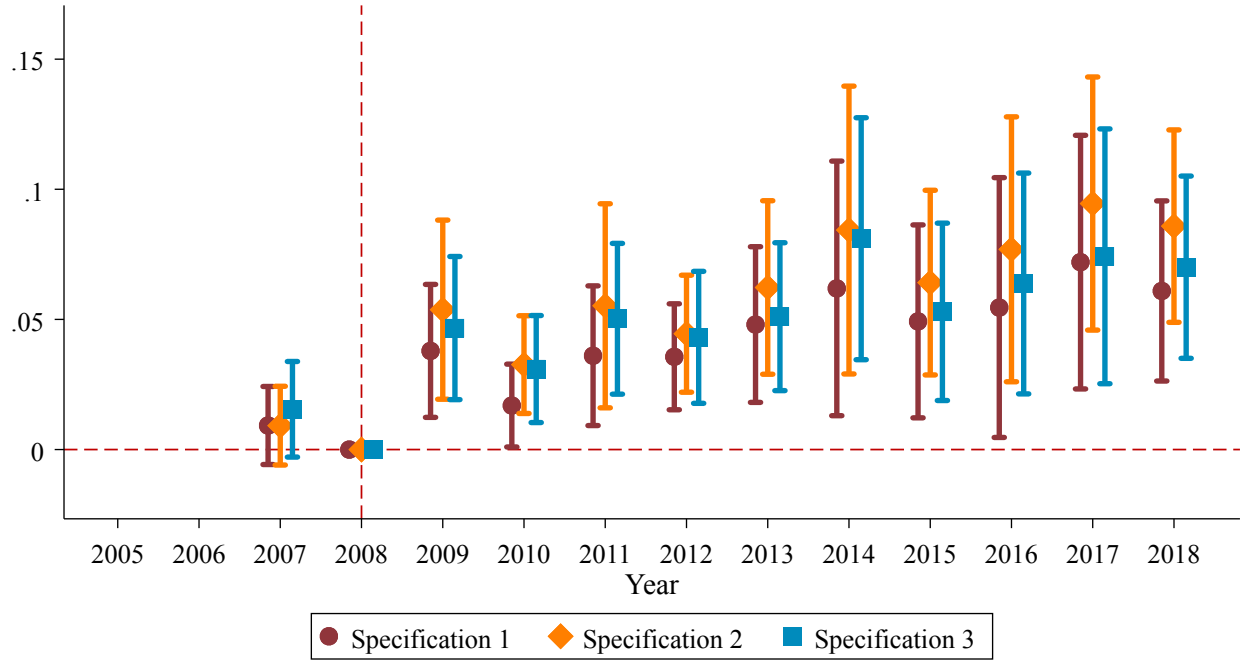


Figure 8: Changes in the share of informal employment after PTPA

Notes: Each point reflects an individual regression coefficient, θ_t, following equation 2, where the dependent variable is the change in the share of informal employment and the independent variable is the regional tariff reduction RTR_r , defined in equation 1. Note that RTR_r always reflects tariff reductions from 2011 to 2008. Specification 1 (blue dot and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and without pre-trends computed for 2004-2008. Specification 2 (orange diamond and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and with pre-trends. Specification 3 (maroon square and line) represents the point estimates and 95% confidence intervals for regressions with department fixed effects and with pre-trends, corresponding the results in Panel B of Table 2. Positive estimates imply larger increases in the share of informal employment in regions facing larger tariff reductions. Standard errors adjusted for 25 department clusters.

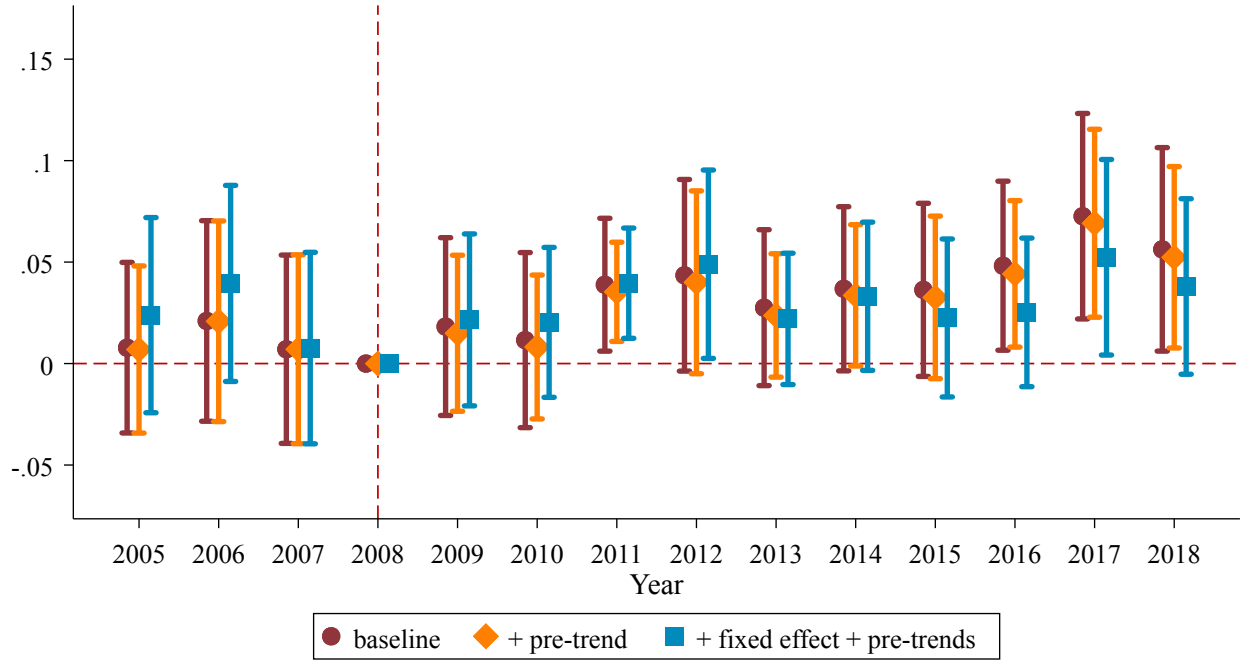


Figure 9: Changes in the share of self-employment after PTPA

Notes: Each point reflects an individual regression coefficient, θ_t, following equation 2, where the dependent variable is the change in the share of self-employment and the independent variable is the regional tariff reduction RTR_r , defined in equation 1. Note that RTR_r always reflects tariff reductions from 2011 to 2008. Specification 1 (blue dot and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and without pre-trends computed for 2004-2008. Specification 2 (orange diamond and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and with pre-trends. Specification 3 (maroon square and line) represents the point estimates and 95% confidence intervals for regressions with department fixed effects and with pre-trends, corresponding the results in Panel C of Table 2. Positive estimates imply larger increases in the share of self-employment in regions facing larger tariff reductions. Standard errors adjusted for 25 department clusters.

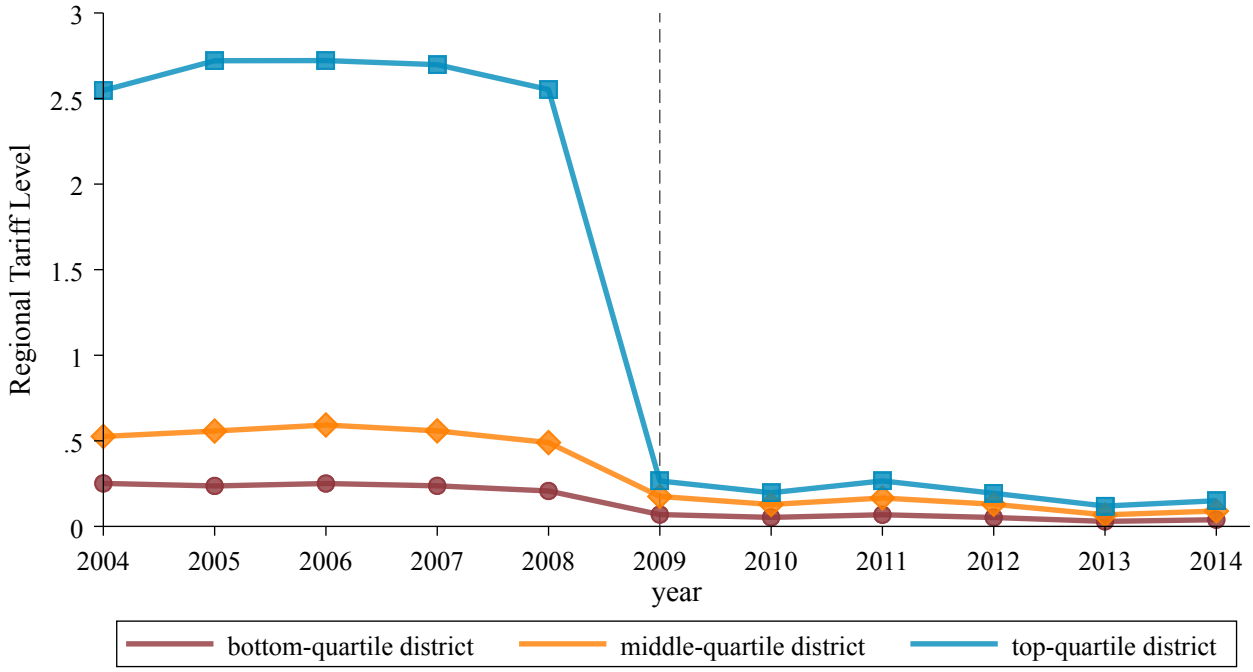


Figure 10: Evolution of tariff by quantile of local Vulnerability

Notes: This figure shows the weighted average regional tariff exposure across time by each quartile of 2008 district-level vulnerability. That is, for each district-year, we take baseline (2008) district employment by industry and multiply by US's revealed comparative advantage (RCA) for that industry (in 2008) scaled by τ_t , the Peru tariff on US goods in that industry in year t following the equation 6.

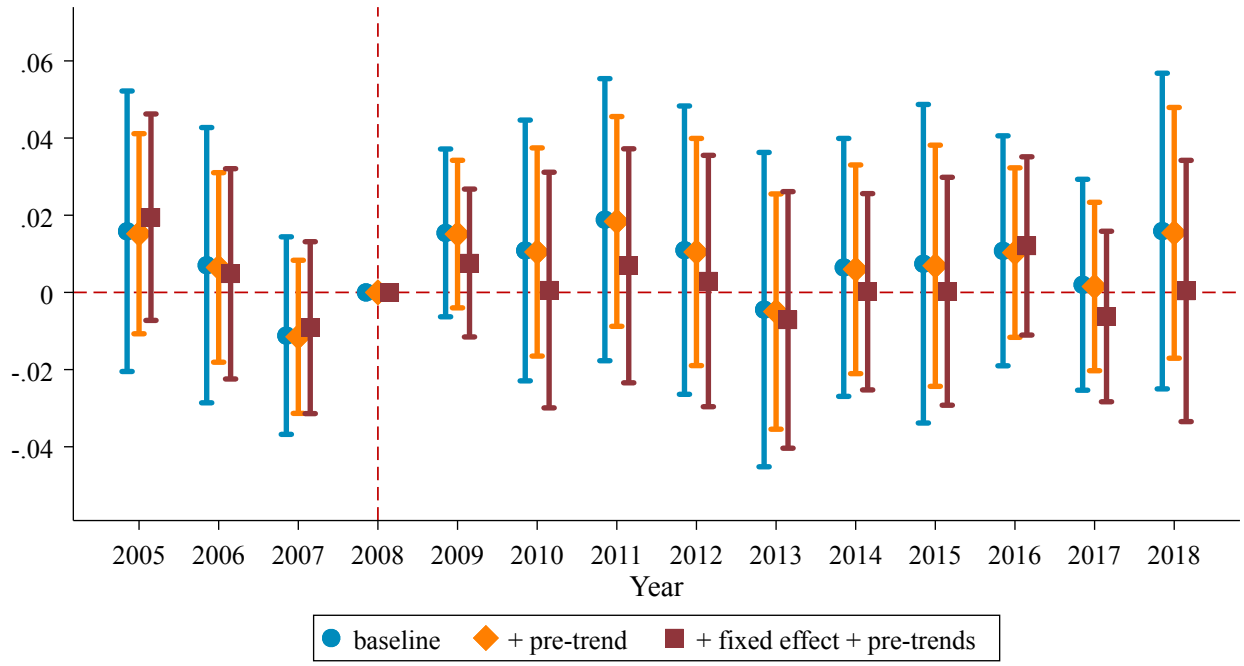


Figure 11: Changes in the share of working-age population after the implementation of PTPA

Notes: Each point reflects an individual regression coefficient, θ_t, following equation 2, where the dependent variable is the change in the share of working-age population and the independent variable is the regional tariff reduction RTR_r , defined in equation 1. Note that RTR_r always reflects tariff reductions from 2011 to 2008. Specification 1 (blue dot and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and without pre-trends computed for 2004-2008. Specification 2 (orange diamond and line) represents the point estimates and 95% confidence intervals for regressions without department fixed effects and with pre-trends. Specification 3 (maroon square and line) represents the point estimates and 95% confidence intervals for regressions with department fixed effects and with pre-trends, corresponding the results in Panel A of Table 2. Statistically insignificant estimates imply no response in regional working-age population or migration after PTPA. Standard errors adjusted for 25 department clusters.

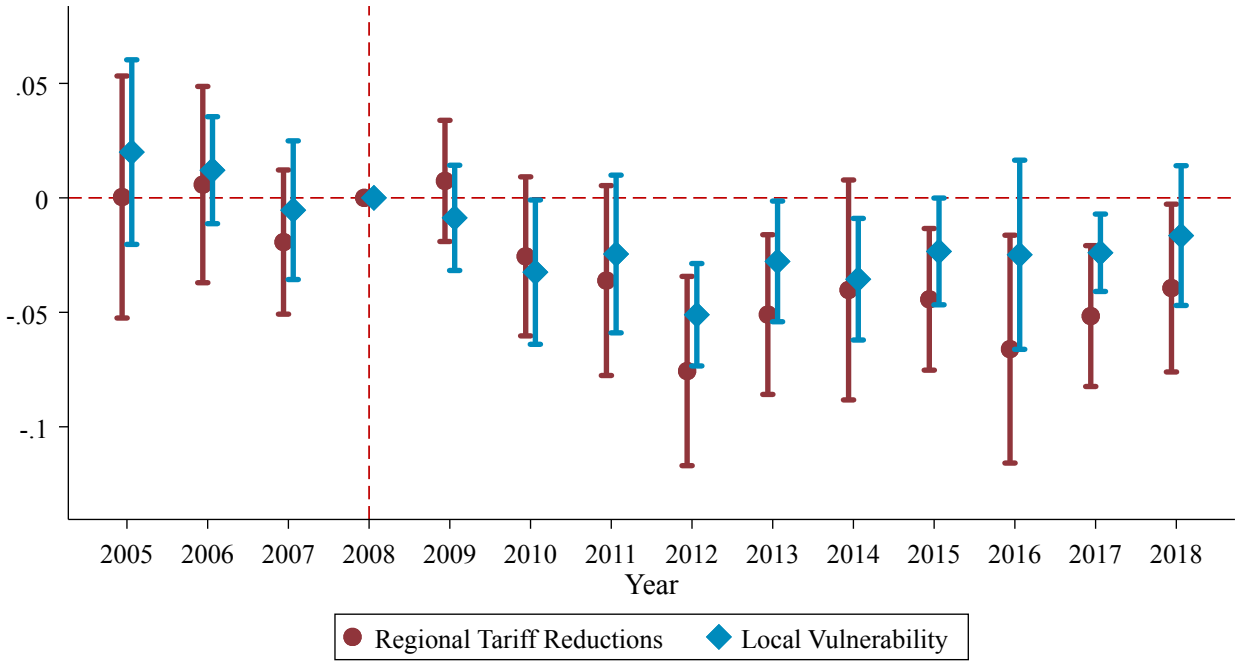


Figure 12: Changes in the share of employment after PTPA

Notes: The figure shows the point estimates (and 95% confidence intervals) for the coefficients on regional tariff reductions (RTR_r) defined in Section 5.1 and local vulnerability ($Vulnerability_r$) defined in Section 6.1 from different specifications of equation 2, corresponding to the maroon dot (and line) and blue diamond (and line) respectively. All regressions control for department fixed effects and pretrends computed by 2004-2008. Standard errors adjusted for 25 department clusters.

Tables

Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)
	Full sample (N=53,471)		Panel subsample (N=4,834)	
	Mean	St dev.	Mean	St dev.
A: Individual Characteristics				
Age	35	14	36	13
Female	.51	.5	.5	.5
Urban	.79	.41	.73	.44
Skilled	.61	.49	.61	.49
Head	.3	.46	.36	.48
Years of education	9.9	3.9	9.4	4
Employment (0/1)	.73	.44	.78	.42
Informal-employment (0/1)	.79	.41	.83	.48
Self-employment (0/1)	.38	.48	.43	.49
Monetary income on primary occupation (hourly)	4.7	11	4	5.6
Monetary income on primary occupation (monthly)	5.8	1.4	5.7	1.5
Monetary labor market income (monthly)	5.9	1.4	5.8	1.4
B: Household Characteristics				
Working hours on primary occupation (weekly)	40	22	40	22
Net household income per capita	5.6	.94	5.5	.88
Total expenditures per capita	5.5	.77	5.5	.74
Is poor	.41	.49	.43	.5
Is extremely poor	.11	.31	.12	.32

Notes: This table reports descriptive statistics for people aged 15 to 64 based on the 2007 ENAHO survey for full sample and panel subsample in columns (1)-(2) and (3)-(4), respectively.

Table 2: Dynamic Effect of PTPA-induced Import Competition on Local Labor Market: District-level Evidence

	(1)	(2)	(3)
	2008–2010	2008–2014	2008–2018
A: Change in the share of employment			
Regional Tariff Reductions	–0.0063	–0.013	–0.030*
	(0.016)	(0.017)	(0.015)
Sample size	510	510	510
R^2	0.23	0.26	0.26
B: Change in the share of informal employment			
Regional Tariff Reductions	0.028**	0.082***	0.072***
	(0.011)	(0.022)	(0.015)
Sample size	510	510	510
R^2	0.16	0.20	0.23
C: Change in the share of self-employment			
Regional Tariff Reductions	0.017	0.036*	0.054**
	(0.019)	(0.022)	(0.023)
Sample size	510	510	510
R^2	0.29	0.30	0.35

Notes: The table estimates the equation 2 and reports the effect of the regional tariff reduction induced by PTPA on the local labor market at the district level. Negative coefficient estimates for the regional tariff reduction imply larger declines in the outcomes of our interest in regions facing larger tariff reductions. We control for the department fixed effect and pretrends computed for 2004–2008. Standard errors (in parentheses) adjusted for 25 department clusters.

Table 3: Effect of PTPA-induced Import Competition on Local Labor Market: Worker-level Evidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Employment (0/1)			Wage (log)			
	Informal-employment (0/1)	Self-employment (0/1)	Employment (0/1)	Monetary labor market income (monthly, current PEN)	Monetary income on primary occupation (monthly, current PEN)	Monetary income on primary occupation (hourly, current PEN)	Weekly hours working on primary occupation
Regional Tariff Exposure	–0.0035***	0.0050	–0.0033	–0.019	–0.018	0.019	–1.1***
	(0.0013)	(0.0039)	(0.0043)	(0.019)	(0.019)	(0.017)	(0.18)
Sample size	14,894	15,757	19,326	11,573	11,333	10,980	15,747
R^2	0.76	0.73	0.57	0.73	0.74	0.69	0.60
Mean outcome	0.83	0.44	0.79	5.8	5.7	0.80	38

Notes: The table estimates the equation 4 and reports the effects of the regional tariff exposure induced by PTPA on local labor market using the individual–level panel data for 2007-2010. In columns (1)–(3), the dependent variable is an indicator for whether an individual is informal-employed, self-employed, and employed, respectively. In columns (4)–(6), the dependent variable is the log of monthly labor market income, monthly or hourly income on primary occupation, respectively. Column (7) represents the estimate for weekly working hours on primary occupation. All regressions control for district, year, and individual fixed effects. Standard errors are clustered at the district level.

Table 4: Adão et al. (2019) Inference Procedure

	(1)	(2)	(3)
	Change in the share of employment	Change in the share of informal employment	Change in the share of self employment
$\hat{\theta}$	–0.024	0.045	0.054
Robust	[-0.054, 0.006]	[0.020, 0.070]	[0.006, 0.103]
AKM	[–0.028, –0.020]	[0.039, 0.051]	[0.047, 0.062]
AKM0	[–0.028, -0.020]	[0.039, 0.051]	[0.047, 0.062]

Notes: This table report the results following Adão et al. (2019) inference procedure. All regressions include the full vector of baseline controls in Table 2. 95% confidence intervals are reported in square brackets. Robust is the Eicker-Huber-White standard error; AKM and AKM0 are the standard error proposed in Adão et al. (2019).

Table 5: Effect of PTPA-induced Import Competition on Household Welfare

	(1)	(2)	(3)	(4)
	Net HH income per capita (monthly)	Total expenditures per capita (monthly)	Is poor	Is extremely poor
Regional Tariff Exposure	5.0	4.1***	–0.0026	0.0030
	(3.2)	(1.5)	(0.0064)	(0.0098)
Sample size	8,424	8,424	8,424	8,424
R^2	0.75	0.89	0.70	0.59
Mean outcome	448	361	0.39	0.12

Notes: The table estimates the equation 4 and reports the effects of the regional tariff exposure induced by PTPA on economic well-being using the household–level panel data for 2007-2010. In columns (1) and (2), the dependent variable is net household income and expenditures per capita. In columns (3) and (4), the dependent variable is an indicator for whether the household is poor or extremely poor, respectively. All regressions control for the district, year, and household fixed effects. Standard errors are clustered at the district level.

Table 6: Falsification Test

	(1)	(2)	(3)
	Informal-employment	Self-employment	Employment
Regional Tariff Exposure	–0.0029	0.0089	–0.0053
	(0.0018)	(0.0058)	(0.0078)
Sample size	6,660	7,144	9,656
R^2	0.85	0.83	0.73
Mean outcome	0.84	0.44	0.78

Notes: The table estimates the equation 4 and reports the employment and wage effects of the regional tariff exposure induced by PTPA using the worker-level panel data for 2007-2008. In columns (1)–(3), the dependent variable is an indicator for whether an individual is informal-employed, self-employed, and employed, respectively. All regressions control for district, year, and individual fixed effects. Standard errors are clustered at the district level. We assign the pre-PTPA regional tariff exposure in 2008 to 2007 and the post-PTPA regional tariff exposure in 2009 to 2008. All regressions control for district, year, and individual fixed effects. Standard errors are clustered at the district level.

Table 7: Heterogeneous Effects of PTPA-induced Import Competition by Demographic Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Gender		Skill Level		Age	
	All	Female	Male	Skilled	Unskilled	Age 22-35	Age 36-49
A: Informal-employment (0/1)							
Regional Tariff Exposure	–0.0035***	–0.0048***	–0.0033*	–0.0050**	–0.0013	–0.0035	–0.0058***
	(0.0013)	(0.0017)	(0.0019)	(0.0023)	(0.0015)	(0.0034)	(0.0018)
Sample size	14,894	6,528	8,054	8,955	4,647	4,489	5,480
Mean outcome	0.83	0.86	0.80	0.77	0.93	0.84	0.79
B: Self-employment (0/1)							
Regional Tariff Exposure	0.0050	0.011	0.000087	–0.00024	0.0024	0.0041	0.016***
	(0.0040)	(0.0060)	(0.0052)	(0.0035)	(0.0029)	(0.0091)	(0.0058)
Sample size	15,757	7,167	8,281	9,109	5,298	4,722	5,615
Mean outcome	0.44	0.39	0.49	0.61	0.17	0.41	0.52
C: Employment (0/1)							
Regional Tariff Exposure	–0.0032	–0.0072	0.0011	–0.00046	–0.0094	–0.0037	–0.0023
	(0.0038)	(0.0065)	(0.0038)	(0.0012)	(0.0062)	(0.0076)	(0.0059)
Sample size	19,320	9,483	9,518	9,109	5,298	5,597	6,272
Mean outcome	0.79	0.72	0.86	0.98	0.90	0.82	0.88
D: Monetary income on primary occupation (hourly, current PEN)							
Regional Tariff Exposure	0.019	0.055*	–0.0074	0.049***	–0.015	-0.0087	-0.038
	(0.017)	(0.029)	(0.019)	(0.018)	(0.023)	(0.065)	(0.028)
Sample size	10,980	4,112	6,610	7,421	2,494	3,371	4,226
Mean outcome	0.80	0.57	0.95	0.80	0.80	0.80	0.93
E: Weekly hours working on primary occupation							
Regional Tariff Exposure	–1.1***	–0.72***	–1.2***	–1.3***	–0.88***	–0.97**	–1.1***
	(0.19)	(0.24)	(0.30)	(0.29)	(0.25)	(0.41)	(0.31)
Sample size	15,747	7,164	8,277	9,102	5,297	4,717	5,613
Mean outcome	38	34	40	40	33	38	40

Notes: The table estimates the equation 4 by demographic characteristics, respectively, and reports the heterogeneous effect of PTPA-induced tariffs on the local labor market. Standard errors are clustered at the district level. The sample is restricted to workers between the ages of 15 and 64 inclusive at the time of the survey. All regressions include individual, district, and year fixed effects. In panel A, we report the effect on the probability of working in an informal sector. In panel B, we report the effect on the probability of working as self-employment. In panel C, we report the effect on the probability of employment. Panel D-F report on the response of labor market income and work hours. Column (1) includes all workers, column (2)–(3) splits the sample into female and male workers, column (4)–(5) splits the sample into skilled and unskilled workers, column (6)–(7) splits the sample into younger and older cohorts.

Table 8: Heterogeneous Effects of Trade Liberalization by Pre-PTPA Employment Status

	(1)	(2)	(3)	(4)	(5)
	Pre-PTPA Tradable	Pre-PTPA Employment Status		Pre-PTPA Informal Status	
	All	Incumbents	New Entrants	Informal Workers	Formal Workers
A: Informal-employment (0/1)					
Regional Tariff Exposure	–0.0035***	–0.0039***	–0.00055	–0.012***	0.034
	(0.0013)	(0.0013)	(0.0053)	(0.0012)	(0.025)
Sample size	14,894	13,686	1,200	11,515	2,171
Mean outcome	0.83	0.82	0.90	0.94	0.17
B: Self-employment (0/1)					
Regional Tariff Exposure	0.0050	0.0052	0.0079	0.0043	0.014
	(0.0040)	(0.0046)	(0.0061)	(0.0047)	(0.025)
Sample size	15,757	14,060	1,689	11,879	2,181
Mean outcome	0.44	0.47	0.25	0.51	0.22
C: Employment (0/1)					
Regional Tariff Exposure	–0.0033	–0.0046	–0.022**	–0.0058*	0.013
	(0.0038)	(0.0034)	(0.0098)	(0.0035)	(0.018)
Sample size	19,326	15,167	4,148	12,875	2,292
Mean outcome	0.79	0.91	0.35	0.90	0.95
D: Monetary income on primary occupation (hourly, current PEN)					
Regional Tariff Exposure	0.019	0.019	0.017	0.029	0.024
	(0.023)	(0.024)	(0.097)	(0.025)	(0.076)
Sample size	10,980	10,163	812	8,263	1,900
Mean outcome	0.80	0.80	0.81	0.58	1.8
E: Weekly hours working on primary occupation					
Regional Tariff Exposure	–1.1***	–1.0***	–0.57	–1.0***	–3.5*
	(0.19)	(0.20)	(0.48)	(0.20)	(2)
Sample size	15,747	14,050	1,689	11,877	2,173
Mean outcome	38	39	29	38	44

Notes: The table estimates the equation 4 by the status of the pre-PTPA labor market, respectively, and reports the heterogeneous effect of PTPA-induced tariffs on the local labor market. Standard errors are clustered at the district level. The sample is restricted to workers between the ages of 15 and 64 inclusive at the time of the survey. All regressions include individual, district, and year fixed effects. In panel A, we report the effect on the probability of working in an informal sector. In panel B, we report the effect on the probability of working as self-employment. In panel C, we report the effect on the probability of employment. Panel D-F report on the response of labor market income and work hours. Column (1) includes all workers, column (2)–(3) splits the sample into incumbents and new entrants, column (4)–(5) splits the sample into informal and formal workers before PTPA.