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Persistent effects of initial labor market conditions: The case of China's tariff liberalization after WTO accession ☆

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ABSTRACT

Using data from Urban Household Survey in China, we investigate the persistent effects of tariff reduction due to WTO accession on the wages of labor market new entrants. Our identification strategy exploits variations in the degrees of tariff reduction across industries, and variations in the pre-WTO industry composition of local employment across Chinese prefecture-level cities. We find that cohorts entering the labor market when regional tariffs are reduced tend to have relatively lower wages. Although these adverse effects of tariff reduction on job-entrants' wages become weaker over time, they are still persistent after more than six years of labor market experience. We also find that such effects are particularly strong among workers in the tradable sector and the lower education group. Our estimation results are robust to various alternative measures, specifications and estimation methods.

1. Introduction

China's entry into the WTO in 2001 was one of the most important events for the global economy in recent decades. Since that event, however, increasingly heated debates have taken place in academic and policy circles over which parties have gained or lost due to China's WTO accession. A focal point of these discussions concerns the research findings that the U.S. lost substantial numbers of manufacturing jobs to China (e.g., Autor et al., 2013; Pierce and Schott, 2016). These studies have contributed to the public perception that China only benefited from the WTO accession and never paid a cost.[1] Such perceptions, however, miss the point that trade liberalization is always associated with reallocations of resources and redistributions of income, generating both winners and losers within a country. Instead of focusing on the exports and portraying China as an overall winner in global trade, our paper investigates the negative impact of the import tariff reduction after the WTO accession on Chinese workers.

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[1] For example, in an editorial article on December 11, 2006, *South China Moring Post* argues that "the negative impact that WTO membership could bring to the national economy is very limited with many previous fears unfounded."

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In this paper we address three main questions. First, how has tariff liberalization affected the wages of urban workers, especially the wages of the new entrants to the job market? Second, is the effect of tariff liberalization transitory, or does it have a long-lasting impact? Third, how do the effects of tariff liberalization vary by sector and education group? Our estimations suggest that workers who enter the labor market in times of low tariffs earn substantially lower initial wages. The negative effects of lower tariffs on those entering the job market decline over time, but these effects are still significant even six years after these workers began their careers. We also find that such effects are particularly strong among workers in the tradable sector and the lower education group.

We examine the effects of tariffs according to the years in which workers enter the labor market, as we seek to study the differential effects of tariffs on workers in the short term and medium-to-long term. Recent research in labor economics has emphasized the importance of labor market conditions at the time people enter the workforce (e.g., Oreopoulos et al., 2012; Schwandt and Von Wachter, 2019). These studies find that facing high unemployment rate when starting their first job, young workers suffer not only significant losses in wages in their first few years, but they also fail to fully recover those losses over the long term. Various theories on career development have been proposed to explain the prolonged wage stagnation of the so-called "unlucky cohorts" (e.g., McLaughlin and Bils, 2001).

We use the data of 1998–2009 from Urban Household Survey, a comprehensive individual-level survey conducted by the National Bureau of Statistics. As our data do not provide detailed information about the worker's industries, we study tariffs at the prefecture city level, and estimate the average effects of tariffs among all workers in the city. Our identification strategy relies on the heterogeneity of tariff reduction across industries, and on city-level variations in the composition of local industries at the time China joined the WTO. To meet its WTO obligations, China aggressively cut its tariff rates. Consequently, the average tariff rate went down from 18% in 2001 to 10% in 2006. There is indeed a large variation of industry level tariff reduction. For example, the tariff rate for automobiles dropped dramatically, from 70% to 25% between 2001 and 2006, but there was virtually no change for the steel industry. As the composition of regional industries was predetermined, it is possible to interpret the correlation between wage effects and trade exposure as a causal relationship. To deal with the possible endogeneity of the effects from tariffs, we use the maximum allowable tariff rate as an instrument for the actual tariffs in each region. We also show that our results are robust to alternative measures of regional tariffs.

After China entered the WTO, exports increased rapidly. Our estimation needs to deal with the potential confounding factor of the regional export shock. First, according to recent studies (Pierce and Schott, 2016; Handley and Limao, 2017), the reduction of tariff uncertainty after the U.S. granted permanent normal trade relations (NTR) to China correlates with the growth of Chinese exports. We construct a measure of city-level NTR gap and control it in the main regressions. Second, as an alternative way to control for the regional export effect, we include the world tariffs against Chinese exports in the regression. The world tariffs are the weighted average tariff rates faced by the Chinese exporters across destination countries. We find that our conclusions are not affected by the inclusion of either export control variable.

One further concern with our empirical approach is the potential rise in migration between cities that resulted from tariff liberalization. If there were large-scale migrations across cities in response to tariff reduction, then our analysis comparing cities over time would give an incomplete estimate on the impact of tariff reduction. However, even after many years of reform to the household registration (*hukou*) system, internal migration in China is still constrained by the government policy. Tombe and Zhu (2019) show that high costs of migration significantly limit the internal migration in China. As we demonstrate in Section 5, our analysis can still properly address questions regarding the effects of tariff liberalization on urban wages after considering the limited impact of the inter-regional migration.

Our sample period coincides with a major expansion of college education in China. Starting from the end of the 1990s, China dramatically increased its college enrollment. We try to control for the college expansion effect by using a province × post college expansion dummy. Our main results remain robust with this additional control.

Our findings should be interpreted with two caveats in mind. First, trade liberalization has many dimensions, including imports, exports, FDI, etc. Among these dimensions, our paper focuses on only one particular aspect of trade liberalization, namely import tariff reduction. We do not address questions regarding the gains to general welfare from trade liberalization. Second, our paper captures only the relative effects of tariff liberalization on those cities with more or less exposure to tariffs. We do not answer the question of whether tariff reduction has decreased the urban wage growth in absolute terms. Rather, we focus on the question of whether certain cities with greater tariff reduction are affected more than other cities with smaller tariff reduction.

This paper is related to a growing literature on the regional effects of trade liberalization. In a very influential paper, Autor et al. (2013) study how the competition from Chinese exports has reduced U.S. manufacturing jobs. Other major empirical studies on tariff reduction or import competition have examined topics such as wages, return to education, income inequality, poverty, and migration. These studies include those by Goldberg and Pavcnik (2007) on Colombia, Topalova (2007, 2010) and Edmonds et al. (2010) on India, Balsvik et al. (2015) on Norway, Malgouyres (2017) on France, and Kovak (2013), and Dix-Carneiro and Kovak (2015, 2017) on Brazil. Generally, the evidence regarding the effects of tariff liberalization is mixed across countries. For example, Kovak (2013) shows a strong negative impact of trade liberalization on wage income in Brazil. In contrast, Goldberg and Pavcnik (2007) find no significant effect of tariff liberalization on poverty rates in Colombia. Topalova (2010) argues that tariff liberalization of India has increased poverty only in rural areas. Our paper makes two contributions to this literature. First, we study the case of China, the largest trading nation in the world. Second, we examine the evolution of the tariff effect over the course of a worker's career.

Our findings also extend the recent literature that investigates the impact of WTO accession on China's economy. For example, economists have investigated the impact of China's import tariff cuts on firm outcomes such as productivity, markups and product quality (Yu, 2015; Fan et al., 2015; Brandt et al., 2017). A number of researchers have studied the effects of China's export growth on labor market outcomes in terms of employment, wages, skill distribution and migration (Cheng and Potlogea, 2017; Rodriguez-Lopez and Yu, 2017; Li, 2018; Facchini et al., 2019; Xu, 2020). Unlike these export-oriented studies, our paper examines the effects of import tariff liberalization. Moreover, this paper is also different from Dai et al. (2019), which examines household responses to tariff liberalization in China. Instead of focusing on the household behavior, here we study the medium-to-long term effect of tariff reduction on job market entrants and its heterogeneity by sector and education group.

Finally, our results provide a practical contribution to the literature on the long-run effects of initial labor market conditions. Kahn (2010) finds that college students in the U.S. who graduate during a recession suffer a loss in wages for 15 years. Other studies confirm this pattern using data from Canada (Oreopoulos et al., 2012) and from European countries (Cutler et al., 2015). Schwandt and Von Wachter (2019) examine the heterogeneous effects of initial labor market conditions by education, gender, and race. In addition to having reduced earnings, workers who start their careers in bad economic times are found to be associated with lower-quality occupations (Oyer, 2006, 2008; Altonji et al., 2016) and worse health outcomes (Maclean, 2013; Cutler et al., 2015). The above-mentioned studies, however, focus almost exclusively on the developed countries. Little is known about developing countries such as China, where the social security systems and labor market structures are very different from those of developed countries. Rather than using unemployment rates as a measure for labor market condition, we study the shock of a particular economic policy-tariff reduction after WTO accession.

The remainder of this paper is organized as follows. Section 2 outlines our empirical strategy. Section 3 describes the data and the graphical evidence. The main estimation results are reported in Section 4. We conduct several robustness checks in Section 5, and Section 6 presents our conclusions.

2. Empirical methodology

2.1. Econometric model

To study the impacts of tariffs on labor market entrants, we conduct the following individual-level regression analysis:

$$\ln(w)_{ict} = \alpha + \beta\, Tariff_{c,s} + D(city_c, entry\_year_s, year_t, gender_{ic},\ educ_{ic}) + \epsilon_{ict}, \tag{1}$$

where subscripts *i, c, s*, and *t* denote the individual, city, labor market entry year, and observation year, respectively. The dependent variable is log(wage rate). Our key variable of interest, $Tariff_{c,\,s}$, is the tariff rate of city *c* in year *s*, when the individual *i* enters the labor market. *D* is a vector of covariate variables, including city fixed effects, education level fixed effects, entry year fixed effects, observation year fixed effects, and the interactions between entry year and observation year fixed effects. Gender is also controlled, and it is interacted with other variables.

More important for our study, we allow tariffs to have heterogeneous effects on workers with different job market experience, through interacting the tariffs with experience group dummies. In our setting, job market experience over time is measured as the difference between the observation year and entry year. Limited by the sample size, instead of creating an experience group for each year, we define three broad experience groups as follows: (1) new entrants with 0-1 year of experience, (2) workers with 2–5 years of experience, and (3) workers with 6+ years of experience. As our focus is on the tariff levels at the labor market entry, we only include those workers who entered the labor force after 1998.

2.2. Measuring regional tariffs

We take advantage of China's geographic diversity to measure how urban households are affected by tariff reduction. Excluding Hong Kong, Macau, and Taiwan, China has 31 provincial-level regions, which are further divided into about 340 prefecture-level cities. These cities differed in their industrial compositions before China entered the WTO. Our identification strategy uses this heterogeneity in the various cities' exposures to tariff protection. We define a city's level of tariffs as the weighted average of the tariff rates for all tradable industries of that city. We use the averages of each industry's share of employment in 1998–2001 as the weights when constructing this measure.

Consequently, we define the regional tariff rate of city *c* in year *s* as follows:

$$Tariff_{c,s} = \sum_j \lambda_{jc,1998-2001} Tariff_{j,s}, \tag{2}$$

where $\lambda_{jc,1998-2001}$ is the pre-WTO employment share of industry *j* in city *c*:

$$\lambda_{jc,1998-2001} = \frac{L_{jc,1998-2001}}{\sum_{j'} L_{j'c,1998-2001}}. \tag{3}$$

Here, the employment weight, λ, sums to one, and it includes only those industries in the tradable sector. Topalova (2007) includes the weights from both the tradable and non-tradable sectors, and sets the tariff change for the non-tradable sector to zero. However, Kovak (2013) argues that this practice may not be appropriate, as in general equilibrium the price in the non-tradable sector should also adjust to changes in the tariffs that affect the tradable sector. Therefore, dropping the non-tradable sector provides a better proximation of the theoretical measure.

2.3. Threats to identification

One first concern with estimating Eq. (1) is the endogeneity of the tariff reduction. Tariff liberalization can occur as an outcome of the political economy processes. Thus, we take the following steps to deal with this problem.

First, our measure of tariff change alleviates reverse causality, because our city-specific employment weights are based on initial year industrial employment composition. It should not be affected by the changes in employment in later years that may have resulted from the tariff changes.

Second, over our sample period there was very little policy discretion regarding the extent of trade liberalization in each industry. During the trade negotiations before the WTO accession, China promised not only to reduce the overall tariff level, but also to reduce the variations in tariff rates across products. The relationship between tariff reduction from 2001 to 2007 and the initial tariff in 2001 was almost one-to-one (Brandt et al., 2017). Those industries with initially high tariff levels received greater reduction in tariffs. Regardless of their initial levels, after the WTO entry, the post-WTO tariffs converged to a relatively uniform level in 2007.

Third, as a robustness check, we follow Brandt et al. (2017), and use the maximum allowable tariff rate as an IV for the actual tariff rate. China's WTO accession agreement lists the entry tariff rates, target rates, and target years. These rates were basically determined by the negotiations in 1999. The entry rates are the tariff rates at the time of accession, and the target rates are the reduced rates that must be achieved by the target years. Our maximum allowable tariff assumes that after entry to the WTO, China can keep the entry rates until they change to the specified target rates in the target year. We calculate the regional maximum allowable tariff rate by using the same pre-WTO shares of employment.

Another concern of endogeneity is that workers may choose when to enter the job market according to macroeconomic factors. When facing unfavorable labor market condition, people may prolong their education and delay their job market entry. We argue that this is unlikely to be a serious problem in our case. In Appendix Table A1, we regress the tariff rates in entry year on two variables: age in labor market entry year and years of schooling. We find no evidence that tariffs affect the timing of labor market entry and education. This is consistent with Schwandt and Von Wachter (2019), who finds that the initial labor market conditions have no substantial impacts on the timing of labor market entry in the US.

Finally, a recent literature investigates the validity of the shift-share (Bartik type) instruments as an identification strategy (e.g., Adão et al., 2019; Borusyak et al., 2019; Goldsmith-Pinkham et al., 2020). We argue that this is less of a concern in our setting. First, we have over 400 industries. According to Adão et al. (2019) and Goldsmith-Pinkham et al. (2020), the identifying assumptions are more likely to be satisfied the greater the number of shares. Second, our research design is similar to a difference-in-difference framework. Goldsmith-Pinkham et al. (2020) shows that the identification is more likely to be valid when there is a clear pre-period.

3. Data and graphical evidence

3.1. Urban household survey

Our empirical work exploits several comprehensive datasets. The main data set is the Chinese Urban Household Survey (UHS) conducted annually by the National Bureau of Statistics (NBS). Using sampling techniques and daily accounting methods, the NBS collects data from non-agricultural households in all prefecture-level cities of all 31 provinces. The data record household information on income, demographic characteristics, work or employment, and family related matters (Ge and Yang, 2014). Importantly, the UHS reports in which year an individual first enters the job market. In addition, the UHS provides the education information for all individuals. In our research, the definition of skilled labor includes all workers with an education level of college or above. A major disadvantage of the UHS is that we cannot track individuals over time. We rely on repeated cross-section regressions. We use the data for 1998–2009, which cover both the pre- and post-WTO periods.

We have access to 18 provinces of the UHS data. Among these, Beijing, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong, and Guangdong are coastal provinces, and Shanxi, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Chongqing, Sichuan, Yunnan, Gansu, and Xinjiang are located in the inland region. In total, our UHS sample covers 177 prefecture-level cities. These 18 provinces accounted for 75% of the urban employment in China in 2007.

We further clean the data by applying the following rules: (1) Keep only the working age individuals, i.e., 16–60 for men and 16–55 for women. (2) Drop those individuals who are not in the labor force. (3) Drop those individuals working for the government or public service units, since their wages are largely regulated by the government. (4) Drop those observations with missing information about sector, education, or employment status. (5) Restrict the sample to those observations with positive wages. (6) Drop rural employment. (7) Restrict the sample to workers who entered the labor force after 1998.

Table 1
Summary statistics.

Variables	(1) *N*	(2) mean	(3) sd	(4) min	(5) max
Age in years	52,111	27.66	4.282	20	46
Worker starting age	52,111	22.73	3.602	16	35
Worker starting year	52,111	2001	2.686	1998	2007
Experience	52,111	4.929	2.856	0	11
Log(wage)	52,111	9.383	0.926	0.916	12.85
Tradable sector	52,111	0.168	0.374	0	1
Male	52,111	0.466	0.499	0	1
College and above	52,111	0.518	0.500	0	1
Local Hukou	52,111	0.942	0.233	0	1

Source: Authors' calculation based on Urban Household Survey.

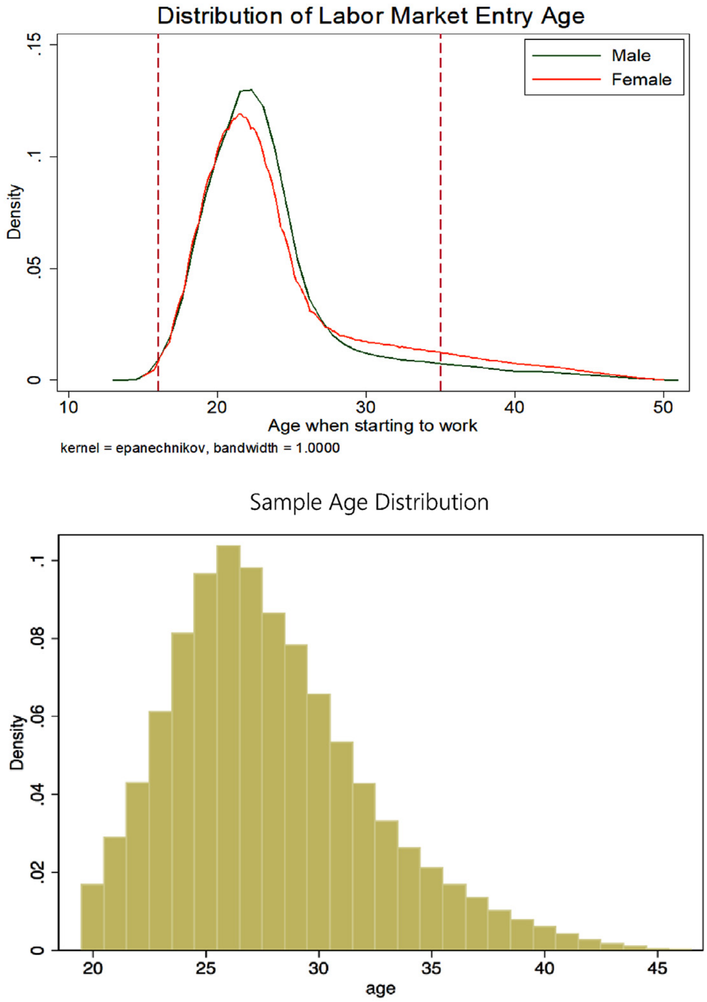

Fig. 1. Distribution of age. Source: Authors' calculation.

Table 1 reports the individual-level summary statistics of our UHS sample. Workers' average job-starting age is 22.7, and the overall average age is 27.6. Average experience is 4.9 years. About 16.8% of all the employees work in the tradable sector, which includes manufacturing and mining.

Fig. 1 shows the age distributions of labor market new entrants, and of our whole sample. As we can see from the first graph, at a younger age the distribution of women and men is about the same. However, for individuals over age 23, the women's average labor market entry age is significantly higher than that of men. Regarding the age distribution of our sample, we observe that it is skewed toward younger workers. This can be explained by the fact that we drop all workers who entered the labor market before 1998.

3.2. Industrial firm survey

The UHS data do not provide detailed industry information regarding the individuals' jobs. As a result, we do not have a measure of individual-level tariff exposure. Instead, we rely on a city-level measure. As we need detailed information on the composition of each city's industrial employment, we use the NBS Annual Survey of Industrial Firms over 1998–2001 for this purpose. This survey covers all state-owned firms and all non-state firms having sales revenues above 5 million Yuan (Brandt et al., 2014). We obtain total employment for each industry-city by aggregating the firm-level employment.

3.3. Mini population census

As the household samples for UHS are drawn from a large sampling frame of those households having an urban residential permit (*hukou*), migrant workers are under-represented in the sample. To deal with the migration issue, we use an individual level 20% random sample of the 2005 mini population census. The census data provide the location of an individual in 2000 and 2005. We define migrants as those people who arrived in current location between 2000 and 2005. These include both rural-urban migrants and urban-urban migrants. We calculate the share of migrants in urban population for each city. On average, 2.7% of the city urban population in 2005 are those migrants who arrived between 2000 and 2005. The median of this share is 1.8%.[2]

3.4. Tariff data

The tariff data at the 8-digit HS level for 1998–2008 come from the Chinese Customs. As the industrial firm survey from the NBS use the Bureau's own industry classifications, we create a concordance table to merge the 8-digit HS codes with the 4-digit Chinese industry classification (CIC) codes. We calculate the regional tariff measure following Eq. (3) by combining tariff data and employment shares calculated from the industrial firm survey.

Fig. 2 illustrates the evolution of the regional tariffs before and after China entered the WTO. The largest tariff cuts happened in 2002, the first year after the accession. Fig. 3 shows the geographical pattern of tariff cuts across Chinese prefectures. As we can see from the map, even within each province there are large variations of tariff reduction across cities. However, no clear visual pattern appears regarding which regions had larger tariff cuts.

Appendix Table A2 presents the tariff cuts between 1998 and 2007 for the two-digit industries (from largest to smallest). It seems that heavy industries such as steel, non-ferrous metal, and petroleum had relatively small tariff cuts. Appendix Table A3 lists the five cities with the largest tariff cuts, and the five cities with the smallest tariff cuts. There is indeed a large variation of tariff reduction at the city level.

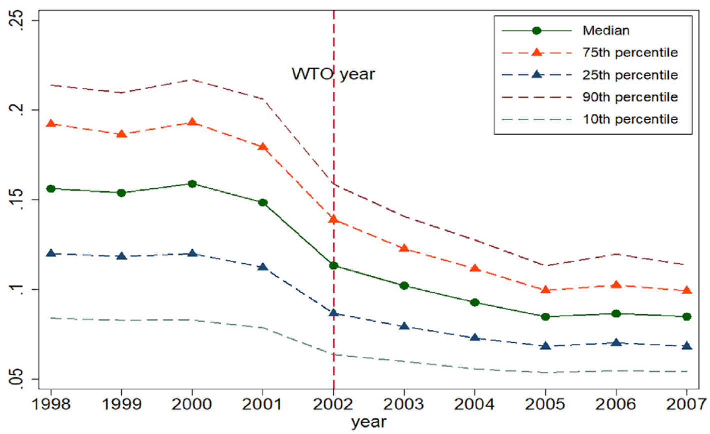

Fig. 2. Evolution of regional tariffs. Source: Authors' calculation.

[2] For detailed discussion on migration and 2005 mini population census, see Facchini et al. (2019) and Imbert et al. (2019).

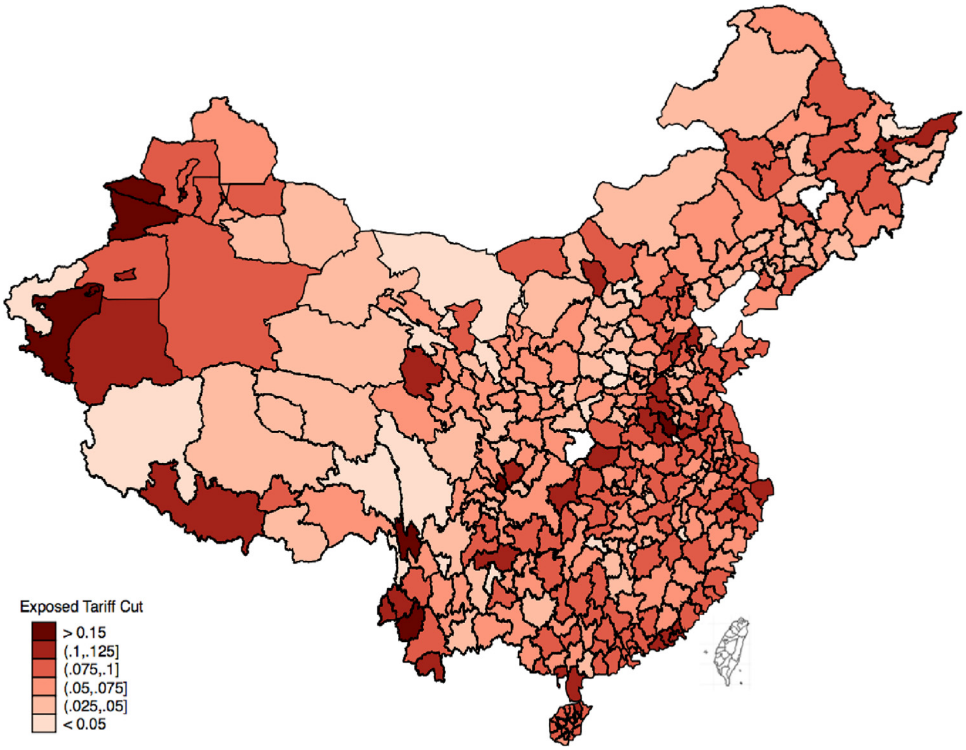

Fig. 3. Geographic distribution of regional tariff cut between 1998 and 2007. Source: Authors' calculation.

3.5. Graphical evidence

Fig. 4 shows simple graphical evidence of the impact of regional tariffs on the wages of labor market new entrants. In Fig. 4(a), we compare the wage evolution of two cohorts: the pre-WTO 1998–2000 cohorts, who entered the job market just before the WTO accession, and the post-WTO 2002–2004 cohorts. The *Y*-axis (the wage residual) is the residual from the wage regression on the city, gender, age, and year fixed effects. For the purpose of comparison, we further divide all regions into two groups: smaller tariff-cut regions, and larger tariff-cut regions, based on the median of the regional tariff reduction. For each cohort and region, we show the wage patterns for the new entrants (0–1 year), the experienced workers (2–5 years), and for the most experienced workers (6+ years). We can summarize the findings, shown in Fig. 4, as follows.

First, as expected, wage rises as work experience accumulates, and this pattern holds for both cohorts.

Second, the findings indicate a negative impact of tariff reduction on wages after the WTO entry. For the 2002–2004 cohorts, larger tariff cut regions are associated with lower wages. However, there is virtually no difference in wages between the smaller tariff cut and larger tariff cut regions for the 1998–2000 cohorts. As we expect China's tariff cuts to affect the career of the 2002–2004 cohort not that of the 1998–2000 cohort, this contrast can be interpreted as a difference-in-difference framework, where we compare the wage differences across regions of the treatment group (the 2002–2004 cohorts) and the control group (the 1998–2000 cohorts).

Third, for the 2002–2004 cohorts, the tariff effect persists even for the 6+ years group. This observation is consistent with the findings shown in Fig. 4(b), where we calculate the difference in wage residuals between the regions of larger and smaller tariff cuts. A negative difference indicates that wages are lower in the regions of larger tariff cuts. We can see that the tariff effect is relatively large for the 0–1 year group, but it is still present for the 6+ years group.

The graphic evidence we just presented illustrates the strong and persistent effects of tariff cuts on wages. We now turn to the more rigorous econometric evidence.

4. Estimation results

4.1. Baseline results

Table 2 reports the estimation results of Eq. (1), with the dependent variable being the log wage rate. Our sample includes workers in both tradable and non-tradable sectors. The first two columns show the estimation results with OLS, and the IV results are reported in the last two columns. Throughout the paper, we cluster the standard errors at the city level.

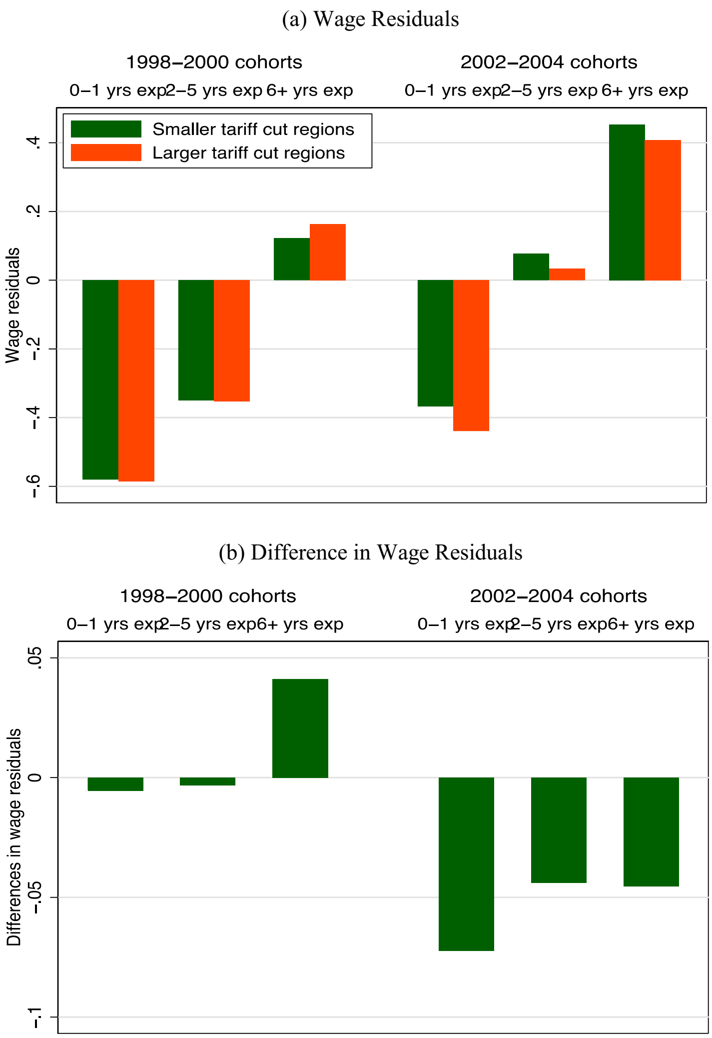

Fig. 4. Wages, regional tariffs and labor market cohorts.

Table 2
Regional tariff, years of experience and wages.

Variable	(1) Log(Wage)	(2)	(3)	(4)
	OLS		2SLS	
Regional tariff at labor market entry year	0.72*		0.59	
	(0.42)		(0.60)	
Regional tariff * Years of experience				
0–1 year of experience		1.67**		1.69**
		(0.69)		(0.82)
2–5 years of experience		1.11*		1.10
		(0.58)		(0.72)
6+ years of experience		0.78*		0.72
		(0.42)		(0.58)
Observations	52,108	52,108	52,108	52,108
R-squared	0.42	0.42	0.42	0.42
City FE	Yes	Yes	Yes	Yes
Entry age FE, year FE, and interaction	Yes	Yes	Yes	Yes
Education FE	Yes	Yes	Yes	Yes

Notes: Sample is from the UHS 1998–2009. Dependent variable is log(wage). See Section 2 for control variables. Columns (3) and (4) use regional maximum allowable tariffs as instruments for regional tariffs. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3
Subsamples of tradable and non-tradable sectors.

Variable	(1) Log(Wage)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				2SLS			
Sample	Tradable sector		Non-tradable sector		Tradable sector		Non-tradable sector	
Regional tariff in labor market entry year	2.58***		0.53		3.32***		0.17	
	(0.87)		(0.48)		(1.16)		(0.70)	
Regional tariff * Years of experience								
0–1 year of experience		4.95***		0.78		6.36***		0.38
		(1.36)		(0.77)		(1.56)		(0.89)
2–5 years of experience		2.26*		0.95		3.65**		0.58
		(1.16)		(0.62)		(1.50)		(0.79)
6+ years of experience		2.73***		0.51		3.72***		0.16
		(0.86)		(0.48)		(1.13)		(0.68)
Observations	8768	8768	42,188	42,188	8768	8768	42,188	42,188
R-squared	0.48	0.48	0.44	0.44	0.48	0.48	0.44	0.44

Notes: Sample is from the UHS 1998–2009. Dependent variable is log(wage). See Section 2 for control variables. Columns (5) to (8) use regional maximum allowable tariffs as instruments for regional tariffs. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Our estimation results confirm the graphical patterns shown in Fig. 4. We start with a simple regression in column (1). Wages are positively correlated with the regional tariff rate in the year of labor market entry, implying a negative effect of tariff cuts on wage growth. The coefficient is also marginally significant at the 10% level. In column (2), we interact the tariffs in the labor market entry year with the experience group dummies. We find that the tariff effect is strongest for the workers who have just entered the labor market. The coefficient of the interaction term decreases from 1.67 for the new entrants (0–1 year), to 1.11 for the experienced workers (2–5 years), and further to 0.78 for the most experienced workers (6+ years). Although our data cannot track the individuals, our econometric model allows us to trace the tariff effect on a labor-market entry cohort over time. Our conclusion from column (2) is that regional tariff cuts have a negative, persistent, but declining impact on the whole career of a worker, as his or her job market experience increases.

A similar pattern emerges in columns (3) and (4) with the IV estimation results. The coefficients of the interaction terms in column (4) are close to those in column (2). The reduced tariffs affect the new entrants more than the experienced workers, although the coefficients of the two experienced groups (2–5 years and 6+ years) are no longer statistically significant.

The estimated effect is also quantitatively significant. Consider two cities at the 25th and 75th percentiles of the tariff cut distribution. The tariff rate declines by 4.2 percentage points for the 25th percentile city, and 7.6 percentage points for the 75th percentile city. If we use the coefficients in column (2), the wages for the new entrants in the more exposed city (75th percentile) are 5.7 percentage points (1.67*3.4) lower than the wages for the new entrants in the less exposed city (25th percentile). The difference is smaller for the more experienced workers, at 3.8 percentage points (1.11*3.4), and for the most experienced workers, at 2.7 percentage points (0.78*3.4).

Our findings that tariff reduction tend to reduce workers' wage growth at the city level should not be surprising. Brandt et al. (2017) shows that Chinese manufacturing firms reduce their markups in response to the import tariff reduction after China's WTO entry. To the extent that a firm's demand for labor decreases in response to lower output prices, the competition of imports resulting from tariff reduction can adversely affect the wages paid by firms. Negative effects of tariff cuts on local wages are also found in other countries such as India and Brazil (Topalova, 2010; Kovak, 2013; Dix-Carneiro and Kovak, 2017).

4.2. Tradable sector vs. non-tradable sector

Our analysis in Table 2 focuses on the average effects, and thus it cannot address the vast heterogeneity across sectors of employment and education groups. First of all, tariff liberalization should affect the tradable sector directly.[3] The non-tradable sector, however, can also be affected in an indirect way if the labor market is integrated. In that case, the workers can switch sectors to seek new employment opportunities and higher wages. In Table 3, we re-estimate Eq. (1) with subsamples of workers in the tradable sector and the non-tradable sector. For both the OLS and IV estimations, the effects of tariffs are persistent and profound among workers in the tradable sector. Nevertheless, we do not find a statistically significant effect from tariffs in the non-tradable sector.

[3] Although the tradable sector includes agriculture, mining, and manufacturing, we exclude agriculture from our analysis, because liberalization in the trade of agricultural goods mainly affects rural residents.

Table 4
Subsamples of skilled and non-skilled labor.

Variable	(1) Log(Wage)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				2SLS			
Sample	Senior high or below		College or above		Senior high or below		College or above	
Regional tariff in labor market entry year	1.29**		0.40		1.07		0.53	
	(0.58)		(0.58)		(0.73)		(0.84)	
Regional tariff * Years of experience								
0–1 year of experience		3.04***		0.25		3.07***		0.35
		(0.86)		(1.08)		(1.15)		(1.24)
2–5 years of experience		2.06***		0.20		2.01**		0.37
		(0.73)		(0.87)		(0.99)		(1.18)
6+ years of experience		1.33**		0.38		1.22		0.50
		(0.58)		(0.59)		(0.74)		(0.86)
Observations	25,091	25,091	27,009	27,009	25,091	25,091	27,009	27,009
R-squared	0.33	0.33	0.38	0.38	0.33	0.33	0.38	0.38

Notes: Sample is from the UHS 1998–2009. See Section 2 for control variables. Columns (5) to (8) use regional maximum allowable tariffs as instruments for regional tariffs. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

4.3. Skilled vs. unskilled workers

Next, we study the impact of tariffs on the entry-level wages of the skilled and unskilled workers. This comparison is important because distinguishing between the two education groups has strong implication on income distribution. The first two columns of Table 4 give the results of regressions using the subsample of unskilled workers, defined as workers with senior high school education or below. We find large and statistically significant effects of tariffs on the unskilled workers. In contrast, when we use the wages of the skilled workers (defined as works with college education or above) as the dependent variable in columns (3) and (4), the coefficient of tariffs is positive, but not statistically significant. The IV estimation in columns (5)–(8) produce the results that are similar to those in columns (1)–(4). Furthermore, our results are consistent with the previous findings in the labor economics literature, which show that low education groups are affected more by the unemployment rates at the time they enter the labor market (e.g., Hoynes et al., 2012; Schwandt and Von Wachter, 2019).

Why did China's tariff reduction have greater impacts on the unskilled labor? There could be many possible reasons. One potential explanation is the complementarity of technology and skills. Chinese firms may invest in technology in order to compete with imported goods. Then these firms' demands for skilled labor tend to increase, which might partially offset the negative effects of tariff reduction on skilled wages.

Another explanation is that skilled workers are more mobile across industries (Pellandra, 2015; Fan, 2019; Facchini et al., 2019). If this is true, then the skilled workers are less likely to be trapped in industries that experience larger negative shocks. We run a city-level regression to test this hypothesis. Since we cannot observe detailed industry information of workers, we focus on the labor reallocation between the tradable sector and the non-tradable sector. In Panel B and Panel C of Table 5, the dependent variable is the city level change in employment share of the tradable sector for the skilled (or unskilled) workers between 2001 and 2006. The estimation results indicate that the change in the tradable sector's employment share correlates with change in tariffs for the skilled workers, but not for the unskilled workers. These results confirm that skilled workers are more likely to switch to the non-tradable sector when the tradable sector faces a negative shock from tariff liberalization. Note that we also find a statistically insignificant coefficient in Panel A, where we pool all workers together. This finding suggest that limited overall labor re-allocation between the tradable and non-tradable sectors may explain the lack of tariff effect on labor market entrants in the non-tradable sector in Table 3.

5. Robustness checks

5.1. Regional exports

After China entered the WTO, its tariff liberalization was accompanied by rapid growth in exports. If regional exports affect wages, and if those exports also correlate with changes in import tariffs, our estimation of the tariff effect could be biased. To alleviate this concern, we use two measures to control for the effects from exports.

First, we take advantage of the uncertainty over tariff reduction that resulted from the US granting permanent normal trade relations to China. Specifically, we calculate the normal trade relations gap (GAP) for each HS 8-digit product as the difference between the MFN tariff and the US. "column 2" tariff in 2000. The literature shows that this tariff gap is correlated with Chinese exports at the product level (Pierce and Schott, 2016; Handley and Limao, 2017). A table of concordance between the HS 8-digit goods categories and the 4-digit CIC industry categories allows us to calculate the CIC industry-level GAP as the simple average of the GAP for all HS products within that industry. Finally, we calculate the regional GAP for each city as the weighted average of GAP across all industries in the city, using the same employment weights as in the

Table 5
Regional tariff cut and labor reallocation between tradable and non-tradable sectors.

Dep. var.: Change of employment share of tradable sector at the city level	(1) OLS	(2) 2SLS
Panel A: All workers		
Tariff cut	−0.42	−0.42
	(0.34)	(0.32)
Province FE	Yes	Yes
Observations	177	177
R-squared	0.20	0.20
Panel B: Skilled workers		
Tariff cut	−0.68**	−0.80**
	(0.27)	(0.33)
Province FE	Yes	Yes
Observations	177	177
R-squared	0.11	0.11
Panel C: Unskilled workers		
Tariff cut	−0.42	−0.48
	(0.41)	(0.40)
Province FE	Yes	Yes
Observations	177	177
R-squared	0.20	0.20

Notes: This table reports city-level regressions. Dependent variable is the change in total (or skilled/unskilled) employment share of the tradable sector. Column (2) use regional maximum allowable tariffs as instruments for regional tariffs. Standard errors in parentheses are clustered at the provincial level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 6
Controlling for regional export effects.

Variables	(1) Full sample	(2) Tradable sector	(3) Non-tradable sector	(4) Senior high or below	(5) College or above
Panel A: Gap					
Overall effect	0.78*	2.58***	0.53	1.38**	0.40
Effects by experience group					
0–1 year of experience	1.81**	5.61***	0.73	3.03***	0.43
2–5 years of experience	1.13*	2.17*	1.01	2.11***	0.28
6+ years of experience	1.29**	3.99***	0.88	1.86**	1.02
Panel B: Export tariffs					
Overall effect	0.80*	2.76***	0.59	1.38**	0.48
Effects by experience group					
0–1 year of experience	1.71**	5.27***	0.81	3.12***	0.48
2–5 years of experience	1.21**	2.41*	1.05	2.14***	0.36
6+ years of experience	0.84**	2.90***	0.53	1.44**	0.35

Notes: Sample is from the UHS 1998–2009. Dependent variable is log(wage). In Panel A, regional export control is normal trade relation tariff gap and is interacted with all experience variables. In Panel B, regional export control is world tariff against Chinese exports and is interacted with all experience variables. See Section 5 for the definition of Gap and export tariffs and Section 2 for other control variables. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

construction of regional tariffs. Our regional GAP variable is designed to capture the degree of tariff uncertainty in each city, in the years prior to the WTO membership. We include the GAP interacted with a Post-WTO dummy as an additional control in the regression, and also interact GAP with all experience groups.

Second, we follow Bombardini and Li (2020) and collect data on the tariff rates of China's trading partners from UNCTAD – Trade Analysis Information System (TRAINS). The tariff data include over 6200 six-digit HS products from 193 countries during 1998–2009. For each product and each year, we calculate the weighted average tariff rates faced by Chinese exporters using export value as weights. Same as the GAP variable, we convert the HS products to CIC industry and construct a regional export tariff variable. Here we assume that China's export growth is correlated with the decrease in tariffs against Chinese goods. We include regional export tariffs as an additional control, and also interact export tariffs with experience group dummies.

Table 6 presents the OLS regression results of the full sample as well as the subsamples by sector and education group.[4] To save space, we report the regression results of the overall effects and the results of heterogeneous effects by experience group in the same column. If we compare the coefficients of column (1) in Panels A and B with those in columns (1) and

[4] We only report the OLS results in Tables 6–8. The IV results are qualitatively similar and are available upon request.

Table 7
Controlling for migration.

Variables	(1) Full sample	(2) Tradable sector	(3) Non-tradable sector	(4) Senior high or below	(5) College or above
Panel A: Local Hukou Sample					
Overall effect	0.86**	2.74***	0.65	1.43**	0.52
Effects by experience group					
0–1 years of experience	1.73**	5.15***	0.84	3.05***	0.38
2–5 years of experience	1.22**	2.50**	1.05	2.18***	0.30
6+ years of experience	0.92**	2.89***	0.63	1.47**	0.50
Panel B: Net Migration Ratio* Entry year					
Overall effect	0.68	2.58***	0.48	0.90	0.56
Effects by experience group					
0–1 years of experience	1.69*	5.00***	0.78	3.01***	0.27
2–5 years of experience	1.08*	2.27**	0.91	1.99***	0.16
6+ years of experience	0.75*	2.73***	0.48	1.26***	0.39

Notes: Sample is from the UHS 1998–2009. Dependent variable is log(wage). Panel A uses the subsample of local hukou people. Panel B includes the interactions of city level net migration ratio and entry year dummies as additional control variables. See Section 5 for the definition of local hukou sample and net migration ratio and Section 2 for other control variables. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

(2) in Table 2, we can see that the overall effects and heterogeneous effects of tariffs are all slightly larger in magnitude. As is consistent with our previous findings shown in Tables 3 and 4, we also observe in columns (2)–(5) of Table 6 that the effects of tariffs are statistically significant only for the workers in the tradable sector, and for the unskilled workers.

5.2. Migration

Since the subscript c in Eq. (1) denotes both the entry year city and observation year city, we implicitly assume there is no migration across cities for the urban residents. In a world with perfectly mobile labor, tariffs should not affect local wages as all cross-city wage differences would be arbitraged away by migration. However, if vulnerable people, especially rural-urban migrants, move to regions with smaller tariff cuts, then we will under-estimate the true effects of tariffs. Despite these potential difficulties, in this subsection we try to limit the impact of migration on our estimation results.

Firstly, we restrict our sample in UHS to those residents who own a local residential permit (*hukou*). Unlike rural-urban migrant workers, people with local *hukou* are less likely to migrate. Panel A of Table 7 shows the regression results, with the full sample and with the subsamples of workers in the tradable and non-tradable sectors, and of unskilled and skilled workers. In comparing these results to those given in the previous tables, we find no material change in our main results.

Another way to deal with the potential bias associated with the tariff-induced migration is to directly control for migration. We construct measures of internal migration following Facchini et al. (2019). The data come from the 2005 mini population census. We restrict the migrants to working-age (16–65 years old) population. For each city we calculate the net migration ratio as (migration inflow – migration outflow)/population. Panel B of Table 7 reports the regression results, in which we include the interactions between net migration ratio and entry year dummies. Our earlier conclusions still hold except that in the full sample, the coefficient of the overall effect is no longer statistically significant.

5.3. Alternative tariff measures

Our tariff reduction measure is slightly different from that of Kovak (2013), who proposes a theory-based measure with a factor-share adjustment. We do not make this adjustment, because we want to capture the reduced-form effects of the tariff reduction with as few structural assumptions as possible. As a robustness check, we recalculate the regional tariff measure by using Kovak's (2013) formula. Panel A of Table 8 reports the estimation results with this alternative measure. Our main findings remain robust to Kovak's measure of regional tariffs.

Tariffs on intermediate inputs may affect the local labor market through their own channels (Goldberg et al., 2010). Intuitively, there may be two offsetting effects from reduction of input tariffs. On the one hand, reduction of input tariffs can lower the prices of the intermediate inputs. In that case, firms may substitute intermediate inputs for labor, resulting in lower demand for workers. On the other hand, firms may increase their outputs when the costs of intermediate inputs are lower. In that case, firm expansion could lead to higher demand for labor. The net effect depends on whether the substitution effect or the scale effect is dominant.

By its construction, the input tariffs is a weighted average of the output tariffs, with the input-output table coefficients considered as weights. In this study, it is difficult to assess the output tariffs and input tariffs separately in the regressions, due to a collinearity problem. To deal with this issue, for a robustness check, we replace output tariff with the effective rate of protection (EPR), which considers both the output and input tariffs. To calculate the regional-level EPR, we first compute

Table 8
More robustness checks.

Variables	(1) Full sample	(2) Tradable sector	(3) Non-tradable sector	(4) Senior high or below	(5) College or above
Panel A: Kovak Tariff					
Overall effect	0.82**	2.67***	0.62	1.16***	0.46
Effects by experience group					
0–1 years of experience	1.50**	4.20***	0.94	2.27***	0.57
2–5 years of experience	1.12**	2.25**	0.97*	1.80***	0.33
6+ years of experience	0.90**	2.75***	0.67	1.28***	0.47
Panel B: ERP tariff					
Overall effect	0.14	0.67***	0.09	0.31*	0.03
Effects by experience group					
0–1 years of experience	0.33	1.33***	0.06	0.78***	-0.16
2–5 years of experience	0.19	0.52	0.16	0.48**	-0.10
6+ years of experience	0.15	0.71***	0.08	0.32*	0.02
Panel C: Controlling for Province*Post FE					
Overall effect	0.67	2.48***	0.48	1.24**	0.30
Effects by experience group					
0–1 years of experience	1.39**	4.38***	0.55	2.83***	−0.30
2–5 years of experience	1.00*	2.11*	0.85	1.98***	−0.05
6+ years of experience	0.72*	2.64***	0.46	1.30**	0.22
Panel D: Contemp. tariff					
Overall effect	0.61	2.42***	0.48	0.90	0.56
Effects by experience group					
0–1 years of experience	1.70**	5.10***	0.92	2.50***	0.86
2–5 years of experience	1.14*	2.35**	1.05	1.72**	0.62
6+ years of experience	0.80*	2.78***	0.56	1.15*	0.60
Panel E: Initial Manu. Share*Entry year					
Overall effect	0.60	2.73***	0.35	1.20*	0.30
Effects by experience group					
0–1 years of experience	1.42**	5.09***	0.52	2.87***	0.04
2–5 years of experience	0.98*	2.37**	0.78	2.00***	0.03
6+ years of experience	0.65	2.89***	0.33	1.23***	0.26

Notes: Sample is from the UHS 1998–2009. Dependent variable is log(wage). See Section 2 for control variables. Panel A uses tariff measure according to Kovak (2013). Panel B uses effective rate of protection. Panel C includes province*post FE as a control variable. Panel D controls for contemporaneous regional tariffs. Panel E includes the interactions between initial manufacturing share and entry year dummies as additional control variables. Robust standard errors in parentheses are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

the industry level EPR as follows:

$$EPR_i = \frac{Output\ Tariff_i - MS_i \times Input\ Tariff_i}{1 - MS_i}, \tag{4}$$

where MS_i is the ratio of intermediate input to output in industry i. The regional level EPR is an employment-weighted average of the industry EPR.

Panel B of Table 8 indicates that using EPR as an alternative tariff measure does not change the sign or the statistical significance for the tradable sector, or for the unskilled labor. However, in all of the regressions, compared to the previous results, Panel B shows a smaller coefficient, lending support to the argument that input tariff reduction tends to increase wages, thereby indicating a net gain from the scale effect. In summary, our results are basically robust to using EPR as the regional tariff.

5.4. Higher education expansion

Facing the Asian financial crisis in 1997, the Chinese government decided to expand higher education enrollment to stimulate the economy and postpone the arrival of high school graduates in the labor market. As a result, college enrolment doubled between 1998 and 2001, and it more than quadrupled by 2005.[5] College expansion would affect the wages of both skilled and unskilled laborers in the following years. To deal with this confounding factor, we include an additional control variable of "province × post expansion" fixed effects. The post expansion variable is a dummy variable that equals 1 if the year is 2002 or later. We choose 2002 because this is the graduation year of the first cohort after the expansion of higher education.

[5] Source: Authors' calculation based on *China Statistical Yearbook* (2006).

Panel C of Table 8 presents the estimation results with this additional control variable. Our new estimates are qualitatively similar to the previous estimates. These findings suggest that controlling for college expansion does not alter our main results.

5.5. Contemporaneous tariffs

In this study, our main variable of interest is $Tariff_{c,\,s}$, the tariff rate of city c in labor market entry year s. However, the tariff rate in the observation year, $Tariff_{c,\,t}$, may affect current wages and may be correlated with $Tariff_{c,\,s}$. In Panel D of Table 8, we control for the contemporaneous tariffs in the overall effect regressions and its interaction with experience groups in the heterogeneous effect regressions. The estimation results presented in Panel D are qualitatively similar to our baseline results.

5.6. Initial manufacturing share

Our tariff measure depends on the cross-sectional difference in initial industry employment composition. But the tariff reduction mainly affects the manufacturing sector. It is possible that regions with larger manufacturing sector have a different path of income growth in the post-WTO era. To deal with this concern, in Panel E of Table 8, we include the interactions between the initial manufacturing employment share and the entry year dummies. We find that with these additional controls, the basic patterns in Tables 2–4 remain unchanged.

6. Conclusions

In this paper, we find that cohorts of workers who enter the labor market at the times when regional tariffs are reduced tend to suffer persistent relative losses in wages. The negative effects of tariff reduction at the time of job entry decline in later years, but those effects still exist even after six years. The impact of tariff reduction is stronger in the tradable sector than in the non-tradable sector. Moreover, the unskilled laborers are more affected than the skilled laborers. We also show that our results are not driven by export expansion or migration. Our results regarding the wage effects are robust to different estimation methods (OLS and 2SLS), to different measures of regional tariffs, and to different specifications (including additional controls).

Our findings have important policy implications. Developing countries often pursue trade openness as an engine for faster economic growth and higher living standards. Although it is commonly believed that in the long run, open policies contribute to economic development, in the short-to-medium term the process of tariff liberalization may negatively affect certain parts of the economy. Our estimation results show that in China, tariff liberalization more severely hit the job entrants, especially the unskilled workers in the tradable sector. We want to emphasize that these results do not imply any conclusions regarding the overall impact of trade liberalization on aggregate income growth. Rather, they suggest that import tariff liberalization has a heterogeneous effect across groups of workers who differ in terms of experience, sector, and education. In China, the costs of adjusting to tariff liberalization have mainly fallen on young unskilled laborers in the tradable sector. According to this set of findings, it is the government's responsibility to better target and help those individuals who are more affected by trade reforms. In response to our finding that young people are particularly vulnerable to tariff shocks, policy makers should be concerned to help young workers, who often suffer permanent consequences from tariff liberalization.

Appendix

Table A1
Decision to enter job market.

Variables	(1) Age in labor market entry year	(2) Years of schooling
Tariff in labor market entry year	4.853	−0.185
	(3.054)	(0.523)
Observations	58,589	58,589
R-squared	0.081	0.114
City FE	Yes	Yes
Cohort and year joint FE	Yes	Yes
Gender and interactions	Yes	Yes

Notes: Sample is from the UHS 1998–2009. In Panel A, the dependent variable is the age when starting work. In Panel B, the dependent variable is years of schooling. Robust standard errors in parentheses are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Table A2
Tariff cut by 2-digit industry.

Industry name	Tariff 2001	Tariff 2006	Change of tariff
Beverages	0.427	0.233	−0.194
Furniture	0.205	0.015	−0.190
Tobacco	0.463	0.315	−0.148
Processing of food from agricultural products	0.283	0.165	−0.117
Foods	0.265	0.166	−0.100
Chemical fibers	0.141	0.043	−0.098
Textile	0.208	0.113	−0.094
Communication equipment, computers and other electronic equipment	0.147	0.059	−0.087
Transport equipment	0.194	0.110	−0.084
Support activities for mining	0.217	0.133	−0.084
Special purpose machinery	0.137	0.055	−0.082
Plastics	0.175	0.103	−0.072
Artwork and other manufacturing	0.204	0.135	−0.069
Paper and paper products	0.125	0.057	−0.069
Articles for culture, education and sports	0.194	0.127	−0.067
Timber, wood, bamboo, rattan, palm and straw products	0.114	0.047	−0.067
Textile wearing apparel, footwear and caps	0.240	0.176	−0.065
Measuring instruments and machinery for cultural activity and office work	0.133	0.071	−0.062
Electrical machinery and equipment	0.170	0.114	−0.057
Printing, Reproduction of recording media	0.099	0.044	−0.055
Leather, fur, feather and related products	0.200	0.149	−0.052
General purpose machinery	0.134	0.085	−0.049
Medicines	0.097	0.052	−0.045
Rubber	0.176	0.138	−0.039
Non-metallic mineral products	0.152	0.114	−0.038
Raw chemical materials and chemical products	0.117	0.085	−0.032
Extraction of petroleum and natural gas	0.050	0.020	−0.030
Metal products	0.134	0.109	−0.025
Smelting and pressing of ferrous metals	0.049	0.035	−0.014
Smelting and pressing of non-ferrous metals	0.045	0.032	−0.013
Processing of petroleum, coking, processing of nuclear fuel	0.053	0.044	−0.010
Mining and processing of non-ferrous metal ores	0.011	0.004	−0.007
Mining and processing of non-metal ores	0.038	0.036	−0.002
Mining and processing of ferrous metal ores	0.000	0.000	0.000
Mining and washing of coal	0.044	0.044	0.000

Source: Authors' calculation.

Table A3
Cities with largest and smallest tariff cut.

City name	Province	Tariff 2001	Tariff 2006	Change of tariff	Major industry	Employment share of major industry
5 cities with largest cut						
Shiyan	Hebei	0.341	0.155	−0.187	Transport equipment	0.729
Baoshan	Yunan	0.344	0.209	−0.135	Processing of food	0.405
Zhanjiang	Guangdong	0.276	0.156	−0.120	Processing of food	0.265
Bozhou	Anhui	0.216	0.101	−0.115	Beverages	0.260
Zhoukou	Henan	0.235	0.122	−0.113	Textile	0.315
5 cities with smallest cut						
Changzhi	Hebei	0.076	0.064	−0.012	Coal	0.353
Hegang	Heilongjiang	0.060	0.050	−0.010	Coal	0.831
Jinchang	Gansu	0.058	0.049	−0.009	Smelting of non-ferrous metals	0.779
Yingtan	Jiangxi	0.059	0.050	−0.009	Smelting of non-ferrous metals	0.697
Qitaihe	Heilongjiang	0.056	0.047	−0.009	Coal	0.885

Source: Authors' calculation.

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