The impact of globalization on youth education: Empirical evidence from China's WTO accession

Faqin Lin[a] Cheryl X. Long[b*]

a: School of International Trade and Economics, Central University of Finance and Economics (CUFE), 39 South College Road, Haidian District, Beijing, China, 100081.

b: Xiamen *University, Wang Yanan Institute for Studies in Economics (WISE) & School of Economics, China, 361005; and Colgate University, United States, 13346*

Abstract:

This paper presents empirical evidence that export growth in China after its WTO accession in 2001 has altered education attainment for Chinese youths. On one hand, China's export expansion after the WTO entry has increased the opportunity cost of schooling and thus has induced many youths to drop out of school at younger ages; but on the other hand, the subsequent trade upgrading has also led to increased demand for additional education at the college level. This paper exploits variation in trade exposure in the timing of youth education decision and trade exposure variation among regions to identify the existence and the relative importance of these two effects of China's WTO accession. We document statistically significant and robust evidence that while export expansion has caused 2 months' reduction in youth schooling on average, it has led to 2 months increase for individuals with at least a high school education. Moreover, we find that the reduction in education is mainly caused by processing exports and predominantly experienced by youths in rural areas and from families with siblings, while the improvement in education can be largely attributed to exports to high income nations and is largely observed for youths from urban areas. Consistent with individuals making rational choices when faced with additional employment opportunities arising from globalization, these findings have important consequences for income distribution in China.

Key words: Youth education, trade expansion, difference-in-difference

JEL classification: J24, F16, O19

* Corresponding to linfaqin@126.com (F. Lin) and cxlong@xmu.edu.cn (C. Long).

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1. Introduction

While globalization is believed to bring about numerous benefits from trade liberalization, the effect on education is not always clear. On one hand, education attainment could rise as export expansion often creates job opportunities with increased returns to skill (see Goldberg and Pavcnik, 2007, and Han, Liu and Zhang, 2012, for the case of China).[1] On the other hand, with growth in manufacturing export jobs that require less skill, the opportunity cost of schooling could dominate the potential returns to education, leading to a loss in education attainment, as evidenced in findings based on Mexican data (Atkin 2016).

As the largest beneficiary of trade liberalization by many accounts, China has experienced rapid economic growth driven by export expansion since the late 1970s, especially after its World Trade Organization (WTO) accession in late 2001 (Feenstra and Wei, 2010).[2] But it is less obvious how trade liberalization has impacted China's youth education attainment. While the country's exports since its WTO accession have been dominated by processing trade that is generally less skill-intensive (Dai, Maitra and Yu, 2016),[3] there has also been substantial upgrading in China's export sophistication over time (Rodrik, 2006; Schott, 2008; Wang and Wei, 2010), which should imply higher returns to education due to trade liberalization. Thus, China's

[1] For studies that show exporting firms pay higher wages, see Bernard and Jensen (1995), Park, Yang, Shi and Jiang (2010), and Lin (2015) for the case of China.

[2] The value of Chinese exports has approximately doubled every four years for over three decades since the late 1970s, and the average annual export growth rate reached nearly 30% from 2001 to 2006.

[3] For the period of 1996-2005, processing trade accounted for around 60 percent of the national total. For the importance of China's processing trade in explaining China's economic growth, see Yu (2015). Processing exports have also become popular in other developing countries, for example, Argentina, Kenya, Malaysia and Mexico. The low skill feature of China's exports is also the focus in Autor, Dorn and Hanson (2013) and Greenland and Lopresti (2016). The former finds that China's exports to the U.S. lead to increased unemployment and reduced wages and the later finds that Chinese exports to the U.S. result in increases in U.S. high school graduation rates due to competition effects on local labor markets, e.g., lowering wages and increasing unemployment for workforce without high school degrees.

export expansion after the WTO entry may have increased the opportunity cost of schooling and thus induced Chinese youths to drop out of school at younger ages, on one hand; but on the other hand, trade upgrading could have led to increased demand for additional education. This paper exploits trade exposure variation in the timing of youth education decision and trade exposure variation among regions to explore the existence and the relative importance of these two effects since China's WTO accession.

To preview the findings, students in Chinese regions with more exposure to trade liberalization who finished junior high school right after the WTO accession tend to experience less improvement in schooling relative to older cohorts in the same regions, as compared to their counterparts in regions with less exposure. But in the mean time, the education attainment of high school graduates after the WTO accession tends to improve more for individuals in regions more exposed to trade expansion than those in regions with less exposure. Alternatively, the improvement in education attainment between cohorts younger than 16 at the time of China's WTO accession and the older cohorts is smaller for those residing in the country's coastal regions than those in the country's inland regions, yet the pattern is reversed for the education attainment change for high school graduates. Trade liberalization thus has bifurcation effects on youth education attainment.

China provides a good setting to study the impact of globalization on youth education achievement, as its WTO accession in 2001 has led to a round of trade liberalization that dramatically increased the openness of its economy, with the timing

of the accession largely exogenous. To explore the impact of trade liberalization on education attainment, we focus on how additional job opportunities due to WTO accession affect individuals' schooling decisions at two key ages.

According to Chinese law, compulsory education (grade 9) is concluded and formal employment first becomes available when an individual reaches the age of 16. Hence, we compare the school attainment of individuals who reached the key age of 16 after China's WTO accession with those reaching 16 before 2001, as this is the earliest time individuals can make their own decisions regarding education, including the option to quit school. To explore potentially diverging effects of trade liberalization on individuals, we also compare the school attainment of individuals who reached the age of 19 after China's WTO accession with those reaching 19 before 2001. As individuals finish high school at the age of 19, our goal of studying this group is to examine how trade liberalization affects high school graduates' college education decisions.

For the analysis, we use China's population census data in 2005, the only national population census conducted after the country's WTO accession and before the global financial crisis of 2007-2008. The WTO shock is thus defined at the individual level, taking the value of one if the individual turned 16 (or 19) after the country's WTO accession. More importantly for our purposes, the WTO shock affected some parts of the country more than others because Chinese regions differ in their degree of exposure to international trade due to geographic locations. Thus, we can identify the impact of export expansion induced by the WTO accession on education using two

sources of sample variations: the difference between school attainment of residents who reached the key age of 16 (or 19) after China's WTO accession and that of slightly older cohorts, and the variation in exposure to globalization between different regions. Specifically, we apply a difference-in-difference strategy that compares the changes in education attainment between cohorts reaching the key age of 16 (or 19) before and after China's WTO accession in high-exposure regions versus low-exposure regions.

Our findings show that China's WTO entry has led to a bifurcation effect on youth education attainment, with a negative impact on individuals just completing the nation's mandatory education requirement of 9 years, but with a boosting effect on those that have finished high school, as more of them continue to pursue college degrees. The magnitudes obtained suggest that the WTO-induced export expansion has caused 2 months reduction in schooling on average, but has led to 2 months increase for individuals with at least a high school education. And our results do not change when alternative regional and cohort exposure measures are used and additional robustness checks are conducted.

Against these general patterns, we also find that the negative impact on schooling is dominated by processing trade, whereas exporting to developed countries seems to encourage education attainment by alleviating the negative effect and boosting college enrollments. Furthermore, export expansion has led to higher school drop-out rates mainly among rural regions and youths with siblings, while only urban youths experienced the beneficial effects on education attainment from the WTO accession.

To account for these heterogeneous effects of trade liberalization on youth education, we resort to the following mechanisms, which we will support by conducting additional empirical findings in the empirical part: First of all, while increased job opportunities in low-skilled sectors are immediately available for youths reaching the age of 16 after the WTO accession, the potential availability of high-skilled jobs involve more uncertainty, both in future economic outlook and in one's own ability in obtaining skills through additional education. Thus, for the 16-year-old cohorts that face a longer time horizon of planning, the pull of short-term gains from low-skilled jobs is more likely to outweigh the attraction of future benefit from potential high-skilled jobs after additional education is achieved.

Secondly, even for the 16-year-olds with more accurate information about their own abilities, credit constraints may still hamper their ability to borrow against future income, leading to higher opportunity cost of additional education. This is particularly true for rural youths and households with multiple children, as compared to youths from urban areas and single child families. Urban youths may also enjoy larger increase in additional education due to the greater ease in accessing college education in cities.

Finally, the differential impacts of export destination and processing trade illustrate the importance of skill content of exports in influencing a country's labor market. In contrast to the traditional Heckscher-Ohlin model that takes a country's endowments as exogenous, higher exports in skill-intensive sectors are expected to induce more education attainment when individuals can endogenously determine their

own education level.

The remainder of the paper is structured as follows: Section 2 provides a review of relevant literature to position the current study. Section 3 introduces the data set and the empirical methodology. Section 4 empirically investigates the impact of export expansion on educational attainment and the heterogeneity of the impact. Section 5 checks the robustness of the findings and validates the methodology through a variety of additional exercises. Finally, Section 6 discusses policy implications and concludes the paper.

2. Literature review

The current study relates to several strands of economic literature, including that on the relationship between trade and education, as well as those on how trade affects growth, distribution and labor market.

Through its direct impact on human capital and additional positive externalities (Bhuller, Mogstad and Salvanes, 2017), education is vital for driving long-run growth (Lucas, 1988). Thus, the first area of literature that the current study directly relates to is the issue of how trade impacts education. Two lines of literature link the relationship between trade and education, the first uses regional level data to explore the role played by trade, while the second rely on individual level data to study decisions made by individuals.

Using country-level panel data, Wood and Ridao-Cano (1999) as well as Blanchard and Olney (2015) both provide evidence that current changes in trade are a driving factor in the labor-schooling trade-off and that skill abundance as well as

export composition both play crucial roles in determining the impact on school attainment.[4] Similarly, examining Indian districts following the nation's 1991 trade reform, Edmonds, Pavcnik and Topalova (2010) find smaller increases in school attendance among students living in districts most affected by reductions in tariffs, while Shastry (2012) finds positive enrollment impact from the arrival of relatively high-skilled service job opportunities in India. Greenland and Lopresti (2016) exploits regional variation in exposure to Chinese import competition to identify the effect of trade on human capital accumulation in the U.S. from 1990 to 2007. They find large increases in U.S. high school graduation rates in labor markets most affected by import competition from China.

Studies on China include Li (2015) that investigates the impact of increased employment opportunities due to export expansion on education using regional level data. Specifically, weighted sector-specific tariff cuts are used to generate a weighted export shock based on initial labor structure and then to estimate the impact of export shock on education at the prefecture level.[5] The study finds that high-skilled export shocks raise both high school and college enrollments, while low-skill export shocks depress both. The amplified differences in skill abundance across regions reinforce the initial industry specialization pattern, suggesting a mutually reinforcing

[4] Wood and Ridao-Cano (1999) find that trade reduces educational acquisition in unskilled labor abundant countries from country level panel data regressions. Blanchard and Olney (2015) employ a panel of more than 100 countries over nearly 50 years to examine the effect of export composition on human capital accumulation, by using a gravity model to isolate exogenous variation in the skill-intensity of exports. They find that increases in a country's skill intensive exports increase educational attainment, while increases in agricultural or low-skill manufacturing exports decrease educational attainment. Examining Indian districts following the nation's 1991 trade reform, Edmonds, Pavcnik and Topalova (2010) find smaller increases in school attendance among students living in districts most affected by reductions in tariffs.

[5] The sector level export tariff rates, however, may not be exogenous at the prefecture level, as they are related to the local labor structure and sector structure. For example, Lu and Yu (2015) and Liu and Qiu (2016) show that tariff reduction level after the WTO accession was highly related to the initial tariff rate before the accession. In other words, sectors with higher tariff rates experienced greater cuts after the WTO accession.

relationship between regional comparative advantage and skill formation.

By focusing on regional variations, the above line of research can explore the importance of regional economic structure in affecting trade's impact on education. The advantage of the individual data based studies, on the other hand, is the availability of individual characteristics that help inform individual decision-making process in influencing trade's effect on education attainment, in particular, those factors that have been documented to play important roles in determining education outcomes. For example, using individual data and school level data, respectively, Munshi and Rosenzweig (2006) as well as Oster and Steinberg (2013) both find that the arrival of relatively high-skilled service job opportunities has led to increased school enrollment in India. Yet, Munshi and Rosenzweig (2006) are further able to explore the importance of individual characteristics such as caste and gender in influencing schooling choices in a globalizing economy.

Our paper most closely relates to this line of literature that use individual education outcome data, most notably the seminal paper by Atkin (2016), which explores variation in the timing of factory openings across commuting zones to present empirical evidence that the growth of export manufacturing in Mexico has induced youths to drop out of schools, due to increased opportunity cost of schooling for students at the margin. Using individual level data from China's 2005 population census, our paper provides similar evidence from the world's largest developing country and the largest exporter. Thus, our paper contributes to the literature by demonstrating that the loss of education following trade liberalization could be a

general pattern in the developing world that pursues low-skill intensive export-led growth strategies.

Compared to Atkin (2016), however, we find multi-faceted impact of trade liberalization on youth education. First of all, export liberalization is found to correlate with less education for individuals that completed mandatory education of 9 years after China's WTO entry but higher education attainment for individuals that have completed high school, implying diverging effects of globalization on education of different youths. We further find that the positive impact on education attainment is mostly enjoyed by urban youth whereas rural youth bears the brunt of the negative impact, and individuals from households with more siblings tend to fare worse.

The differential impact on the 16-year-old cohort versus that on the 19-year-olds is consistent with Duncan (1965), who first recognized the effect of shifting labor market conditions on the opportunity cost of continued education, as uncertain future income potentials from additional schooling are weighed against earnings from current labor market opportunities. On one hand, the diverging impact of the different cohorts can be accounted for by that people will not take the optimal decision facing uncertainty (see Thaler, Tversky, Kahneman and Schwartz, 1997; Andreoni and Sprenger, 2012). On the other hand, the variations in education outcomes due to urban-rural divide and family background may be accounted for by credit constraint (see Lochner and Monge-Naranjo 2011, Bjorklund and Salvanes 2010, Carneiro, Lopez-Garcia, Salvane and Tominey, 2017).

In addition, we show that exports to different destinations tend to have different

effects on education. Exporting to high income countries seems to help promote education, probably because such export can increase firm productivity (De Loecker, 2007) and high productivity firms prefer more skilled labor (Helpman, Itskhoki, Redding, 2010), thus increasing job opportunities for more educated workers. Youths from different regions and different family background also respond differently to the shock from globalization, with individuals from rural areas, especially multi-sibling families bearing more negative impact, whereas urban residents experiencing more benefit.

Furthermore, given the divergent effects of trade liberalization on youth education, our study also has relevance for the literature relating trade and income distribution. While numerous studies demonstrate the potential effect of globalization on income inequality (see Goldberg and Pavcnik, 2007; Harrison, McLaren and McMillan, 2010; Helpman, Itskhoki and Redding, 2010; Han, Liu and Zhang, 2012; and Helpman, Itskhoki, Muendler and Redding, 2014), the results found in the current paper suggest that we may see increased disparity in income and wealth in the years to come, both between urban dwellers and rural residents and among regions, as skills and education become more important in the new economy, with education choices diverging along the urban-rural partition and the regional divide. As the effect of trade liberalization on education attainment diverges between "high achievers" versus other individuals, potentially exacerbating and even perpetuating the already high disparity in income and wealth distribution among the general population, these findings will have equally important implications for the country's economic and social policies

related to distribution.

More generally, our study contributes to two other streams of literature related to trade. The first is the rapidly growing literature on the effects of trade on local labor markets, such as Topalova (2010) for India, Gonzaga, Menezes-Filho and Terra (2006) and Dix-Carneiro and Kovak (2015) for Brazil, Autor, Dorn and Hanson (2013), Autor, Dorn and Hanson (2015), Acemoglu, Dorn, Hanson and Price (2016) and Hakobyan and McLaren (2010) for the U.S.. In the context of China, Han, Liu and Zhang (2012) investigate the impact of China's WTO accession on the returns to education and wage inequality. Zhao, Wang and Zhao (2016) document that trade liberalization increases the use of child labor (6-17 years old) in China. In addition, our paper also provides empirical evidence in support of trade models with endogenous skill acquisition, such as Findlay and Kierzkowski (1983) and Stokey (1991).[6]

Finally, the current paper is linked to studies on the relation between economic growth and education in developing countries, such as Federman and Levine (2005) for Indonesia and Le Brun, Helper, and Levine (2011) for Mexico.[7] And as export also plays an important role in other large developing economies, including Malaysia, Mexico, Pakistan, the Philippines, Thailand, and Turkey, where manufacturing represents over 75% of each country's merchandise exports, respectively (Hanson and

[6] Findlay and Kierzkowski (1983) endogenize human capital in a Heckscher-Ohlin model and show that trade exacerbates initial skill differences across countries by raising the returns to skills, which is the more abundant factor—the Stolper–Samuelson effect. Stokey (1991) show that trade can induce divergent growth paths if positive externalities to education are incorporated into the model.

[7] Federman and Levine (2005) find industrialization increased school enrollments in Indonesia. Le Brun, Helper, and Levine (2011) find industrialization had mixed effects in Mexico.

Robertson 2010),[8] the finding that low-skill intensive export expansion may reduce school attainment has important policy implications for other developing countries as well.

3. Data set and empirical strategy

The data used in this study are from the One-Percent Random Sample of the 2005 Population Survey of China. The data set contains year of birth, region of residence, type of residence (urban/rural), gender, ethnicity and education level of individuals included in the sample, as well as the number of children in their households. Although China census data is also available for 1982, 1990 and 2000, the 2005 census is the only one that allows us to use the country's WTO accession in 2001 for identification purposes. As we are interested in how youth education decisions respond to export expansion induced by the WTO accession, we compare individuals who reached the key ages of 16 and 19 before and after 2001.

The first key age is chosen to be 16 years old for the following reasons: First of all, the Compulsory Education Law (CSL) of China was passed on April 12, 1986 and went into effect on July 1, 1986, requiring individuals to complete nine years of schooling.[9] Although the central government allowed localities to decide their own dates for the CSL to take effect, the adoption of the law was relatively quick, with the law taking effect in the last province (Tibet) by 1994 (See Huang 2016). According to

[8] China and the Manufacturing Exports of Other Developing Countries, Gordon H. Hanson, Raymond Robertson. in China's Growing Role in World Trade, Feenstra and Wei, 2010.

[9] This was the first time China adopted a formal law to specify educational policies for the entire country. The law had several important features: 1) nine years of schooling became compulsory; 2) children were required to start their compulsory education at six years of age in principle, 3) compulsory education was free of charge in principle; 4) it became unlawful to employ children during their compulsory schooling years; and, 5) local governments were allowed to collect education taxes to finance compulsory education (See Huang 2016).

the law, when children reach the age of six, their parents or legal guardians shall send them to start compulsory education, but the age to start school can be delayed to seven if mandated by regional conditions. Consequently, individuals will be 15 or 16 years old when completing nine years of compulsory education.

Furthermore, the minimum legal working age in China is 16 years old.[10] In fact, the CSL has defined the school-age children as those between the age of 6 and the age of 15 and has made it illegal to employ children during their compulsory schooling years. It is worth noting that many countries share with China the requirement of 9-year compulsory education and the legal working age of 16, for example, Mexico (Atkin 2016). And finally, the Compulsory Education Law of China has been implemented with great success and by year 2005, the majority of school age individuals were able to complete the compulsory nine year education and the enrollment rate for junior high school (or grades 7-9) among the appropriate age group (14-16 years old) was as high as 98.42%, while in 1986 the figure was only 69.5% (See Huang 2016). These patterns are confirmed in table A1 in the appendix, which presents the extremely low school drop-out rates for youths under the age of 15 in 2005, using the 2005 population census data.

Consequently, the age of 16 is the earliest time when an individual can make their own decisions regarding schooling. If the key age of 16 is reached after 2001, then the individual is more likely to gain more job opportunities due to export expansion

[10] However, when the CSL was first put into effect, it was unrealistic to require those over the age of 10 but with no formal education to complete the full nine-year compulsory schooling. A compromise was reached to require those younger than 16 to receive school education until they reach age 16 years old. Thus, the law initially required the minimum school-leaving age to be 16 rather than the full "9-year" formal education.

induced by the WTO accession than those who reached 16 before 2001. As a result, the cohort that reaches 16 years of age after 2001 will be more likely to forego additional education in high school, compared to older cohorts, if trade expansion represents higher opportunity cost for schooling.

The second key age we focus on is 19, when individuals finish high school and choose between pursuing college education and working. Although the CSL only governs students till they complete junior high school education, for the following reasons, the year of high school completion is the next meaningful decision time regarding schooling: First of all, while drop-out rates for high school students after admission are relatively low in China, college entrance exams can be demanding, making the pursuit of a college degree the next important individual decision after graduation from junior high school. As shown in table A1, while the drop-out rates for students in grades 10-11 (first two years in high school) were below 3%, college acceptance rate was only 22.3% for our sample period, as compared to high school acceptance rate of 67%.[11]

Furthermore, trade liberalization tends to lower the returns to high school education relative to other levels of education. While the WTO accession induced export expansion has increased the wage premium of college education, especially in the high-exposure regions (Han, Liu and Zhang, 2012), on one hand,[12] and has expanded export jobs requiring less skilled labor, on the other (Dai, Maitra and Yu,

[11] The figures are based on 2005 Census data, where the acceptance rate for high school (or college) is defined as enrollments in high school (or college) over graduates in junior middle school (or high school) for cohorts aged 16 (or 19) in 2005.

[12] Han, Liu and Zhang (2012) estimate that the WTO accession has increased college premium in high-exposure regions by about 8% relative to low-exposure regions.

2016), it has not enhanced the returns to high school education (Han, Liu and Zhang, 2012). These patterns are also confirmed in the 2005 population census data: College graduates on average have 23 percentage wage premium than youths with junior high school education, whereas high school graduates' wage premium is just 6 percent (see Table A2 in the appendix). Therefore, in contrast to the earlier decision to continue high school education, the pursuit of college education opens up opportunities of high skilled jobs to an individual, which should be another education decision potentially impacted by trade expansion.

Age is one dimension along which the impact of trade differs due to the WTO accession. The second dimension comes from the regional variation in the exposure to the WTO shock. While the WTO accession has dramatically increased China's export volume (with 30% annual growth over the period 2001-2007), it has affected some parts of the country much more than others because of the regions' different degrees of exposure to trade. Following the literature (Han, Liu and Zhang, 2012; Lan and Li, 2015; Cosar and Fajgelbaum, 2016; Han, Liu, Ural Marchand and Zhang, 2016), Chinese regions can be classified into two categories based on their geographical distance to the coast: regions with high-exposure to international trade versus regions with low-exposure to international trade.[13] Specifically, we classify ten coastal provinces as high-exposure regions, including Liaoning, Beijing, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan, from north to south,

[13] This methodology to compare high-exposure and low-exposure regions before and after trade liberalization shock is also similar to that in previous studies for other developing countries, such as Goldberg and Pavcnik (2005) on Colombia, Hanson (2007) and Verhoogen (2008) on Mexico, Topalova (2010) on India, and Atkin and Donaldson (2015) on Ethiopia and Nigeria.

and other provinces as low-exposure regions.[14]

Figure A1 and Table A3 in the appendix illustrate the differential impact of trade liberalization on high-exposure and low-exposure regions. While high-exposure regions already produced substantially more exports than low-exposure regions before the turn of the century, China's WTO accession in 2001 raised both the export volume and the percentage of local GDP accounted for by exports to a much higher level in high-exposure regions relative to low-exposure regions. The 10 coastal provinces accounted for 87% of total exports in the late 1990s, with exports accounting for 29% of regional GDP on average in 1999, while by the early 2000s they made up more than 92% of national exports, with the average export to local GDP ratio at 45% in 2005. And their higher average export growth rates project even higher proportions for later years.

We explore the variations in how the WTO shock impacts individuals' education decisions differently along the two dimensions discussed above. In other words, we use the difference-in-difference estimation technique to identify the association between globalization and education attainment. Our strategy thus shares the main advantage of a standard DID strategy, which allows us to control for both cohort and 4-digit region (or prefectural level) fixed effects, thereby permitting us to control for differences that are invariant across regions or cohorts.

To avoid the effect of population sorting due to migration, we exclude from our main sample of analysis individuals who lived away from regions of their original

[14] Provinces here refer to all provincial level units, including provincial level cities and autonomous regions.

residence registration (i.e., migrants).[15] And to sharpen the focus on how the WTO accession affects individuals' education decisions, we include in our baseline regressions only two cohorts of individuals, those who reached the key age of 16 (or 19) in 2002 and those reaching 16 (or 19) in 2000. Specifically, we define the WTO shock as a dummy variable that takes the value of one for individuals that reached 16 (or 19) years of age in 2002 and takes the value of zero for those that turned 16 (or 19) in 2000, and we compare how the shock affects these two cohorts of individuals differently in high-exposure regions versus low-exposure regions. Thus, our treatment group includes individuals reaching 16 (or 19) in 2002, whose educational choices could be affected by export expansion due to China's WTO accession and the resultant job opportunity increase, whereas the control group includes those who reached 16 (or 19) in 2000 and thus were not impacted by WTO-induced export expansion at their first chance to make educational decisions.

In other regressions, we also include additional cohorts of individuals as well as migrants to check the robustness of our main results and test alternative explanations. Table A4 in the appendix provides the summary statistics of the main variables used in the various samples. The sample size for our baseline regression with two cohorts of individuals those who reached the key age of 16 in 2002 and those reaching 16 in 2000 is 48,446, who reached the age 19 and 21 in the census year of 2005, respectively. As shown by the summary statistics, the average length of schooling is about 10 (9.97) years, just above the level of junior high school education. Out of this

[15] In one of the survey questions, the respondent is asked whether they now live away from the location of their registered residence and how long they have been away. We keep in our sample individuals who never left their registered residence to exclude migrants.

sample, 53% of the individuals are in the treatment cohorts who were 16 years old in 2002, and 33% of the individuals are in coastal regions, i.e., regions with high exposure to the WTO shock. The average age of the individuals is 19.94 years old and the sex ratio is exactly one to one. About 86% of the individuals are of Han ethnicity, about 75% youths live in rural areas, and only 19% individuals are the only child in their respective families.

4. Export expansion on educational attainment

3.1 Comparing education levels across cohorts

We first compare the education attainment differences across cohorts between high-exposure regions and those in low-exposure regions. Figure 1 presents the trend of how the average years of education change between 1990 and 2005 for various cohorts in high-exposure regions versus low-exposure regions. The left panel shows the average years of education for cohorts reaching the age of 16 in different years that reside in coastal versus inland regions, respectively, whereas the right panel gives the education attainment for individuals with at least a high school education that reached the age of 19 in different years, again separately for different regions.

As shown in the left panel, several stylized facts emerge when comparing the 16-year-old cohorts: First, among cohorts that reached 16 years of age before China's WTO accession in 2001 (alternatively, individuals older than 20 in the census year of 2005), average education level has shown an increasing trend over cohorts, with younger cohorts having more education than older cohorts. And this pattern holds for both high-exposure regions and low-exposure regions. Second, for cohorts who

reached 16 years of age after 2001, different regions have exhibited different trends. While in low-exposure regions, younger cohorts continued to achieve more education than older cohorts; high-exposure regions have seen a gradual reduction in education level over cohorts, with lower education attainment for younger cohorts. Third, throughout the period of 1990-2005, individuals in high-exposure regions tend to have higher average education level than those in low-exposure regions, but the gap between the two types of regions has changed over time. While the gap had remained largely constant before 2001, it has shrunk substantially since 2001.

The right panel presents patterns for individuals in the 19-year cohorts with at least a high school education, the "high achiever" group. Again, until the turn of the century the two regions had exhibited similar trends in the education attainment for these high achievers, with more schooling for younger cohorts. But after 2001, the divergence appeared again, this time with higher exposure regions showing larger improvement in education attainment over time than low exposure regions, although both regions have seen increase in college education for individuals that have completed high school.

These patterns suggest that while the average education level of youths has exhibited a common trend over time between high-exposure and low-exposure regions before 2001, the trends differed for the two regions after the WTO entry, however. This suggests that our data satisfies the common trend assumption and thus provides support for our adopting the difference-in-difference approach to explore whether export expansion after the WTO accession has contributed to changes in

education for Chinese youths.

4.2. WTO accession and education attainment: Baseline results

3.2.1 Estimation specification

Formally, we use the difference in difference method to examine whether export expansion due to the WTO shock has contributed to changes in youth education attainment, by conducting the following baseline regression equation:

$$\mathrm{Edu}_{arc} = \beta \mathrm{Treat}_c \times \text{High region}_r + \gamma' Z_a + \varphi' Z_{rc} + \delta_r + \delta_c + \varepsilon_{arc} \quad (1),$$

where Edu_{arc} is the years of education for youth a in region r and cohort c. Treat_c is the dummy indicating whether cohort c reached 16 (or 19) years of age in 2002, which is our measure for the WTO shock. High region_r is a regional dummy indicating whether prefecture r experiences high exposure to the WTO shock. The interaction term, $\mathrm{Treat}_c \times \text{High region}_r$, is thus the focus of our investigation, which captures the difference-in-difference effect of the WTO shock on education attainment. And if the observed patterns in figure 1 are robust, we expect the coefficient, β, to be negative and significant when we study the 16-year-old cohort sample, but positive and significant when the 19-year-old cohort sample is examined.

As described in Section 2, we define the 10 coastal provinces, including Liaoning, Beijing, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan as high-exposure regions and the other 22 inland provinces as low-exposure regions in our baseline estimation. To test the robustness of the baseline results, we will experiment with alternative exposure measures in other estimations. Our estimation also includes prefecture (or four-digit Chinese regional code) fixed effects

and cohort fixed effects (δ_r and δ_c). Regional fixed effects capture other time-invariant characteristics at the regional level, while cohort effects control for various common shocks at the national level, both including trade shocks and non-trade reforms such as the Grand Western Development Program and the College Expansion Program implemented around 1999 that could potentially impact education decisions. Later, we also experiment with region-cohort varying college expansion information for investigating the heterogeneity.

Note that the stand-alone effects of trade-exposure, High region_r, and the WTO shock, Treat_c, have already been fully absorbed in the regional and cohort fixed effects, respectively. In addition, Z_a controls a vector of observed individual attributes including type of residence (urban/rural), gender, ethnicity and the only child dummy. To test the robustness of the baseline results, we incorporate Z_{rc} into our regression that contains a vector of observed cohort-region specific controls such as import/ GDP ratio, technological adoption (patents) and investment in education in each prefecture that may have affected education. Finally, we cluster the standard errors ε_{arc} at the prefectural level to adjust for the correlation within each group.[16]

3.2.2 Testing the common-trend assumption

Before we present the baseline estimation results of equation (1), we first present additional evidence in support of the common trend assumption regarding the cohort effects of trade liberalization on education for youths aged 16 to 30 in 2002 (or 19 to 33 in 2005). We do this exercise mainly as a complement to the pre-trend patterns

[16] We also cluster the standard errors at the provincial level in one of the robustness checks.

exhibited in Figure 1, as readers may argue that, although Figure 1 suggests stable trends for both high-exposure and low exposure groups prior to the WTO accession, their slopes may not be identical.

To address this concern, we test more formally if the pre-trends for the two groups differ before 2001 by estimating more flexible regressions. Specifically, we augment equation (1) by replacing the treatment cohort dummy Treat_c (i.e., whether 16 or 19 years old in 2002) with a vector of cohort dummies to indicate each cohort that reached 16 or 19 years of age in each of the years during 1991-2005. In doing so, we impose little structure and simply base on the data to examine how the difference in education attainment between high-exposure and low-exposure regions has varied over time. If education in high-exposure regions changes significantly after the WTO accession, we expect to see the coefficient of the interaction term, β, shifts significantly after 2001 (compared with β before 2001).

The estimated coefficients of the interaction term, $\text{Treat}_c \times \text{High region}_r$, for each of the cohorts reaching 16 years of age in different years, as well as their 95% confidence intervals are plotted in Fig. 2, which show no significant differences in the education growth trend between high-exposure and low-exposure regions prior to 2001. However, since the 2001 WTO accession, there has been a significantly negative and monotonically decreasing gap in education attainment between high-exposure regions and low-exposure regions for the 16-year-old cohorts, but a significantly positive and increasing trend in the education attainment difference between the two regions for the 19-year-old and above high school cohorts. This

formally tests the common trend assumption and also provides preliminary evidence for the complex impact of the WTO accession on education.

3.2.3 Baseline results

Table 1 presents the results from estimating equation (1) with the 16-year-old cohorts in the sample. Column (1) shows the results from our baseline regression with years of education as the dependent variable, where the treatment group includes individuals who reached 16 in 2002 (alternatively 19 years old in 2005) and the control group includes 16 year olds in 2000. As expected, β, the coefficient of the interaction term, $\text{Treat}_c \times \text{High region}_r$, is negative and significant. The magnitude of the coefficient implies a substantial impact on education attainment of the WTO shock, suggesting that the trade expansion after the WTO accession has caused Chinese youths to reduce their education by 0.16 years or 1.9 months on average between 2000 and 2002. Estimates for other control variables are also in line with expectations in these regressions. Males, youths in urban area, individuals with Han ethnicity and those from one-child families tend to have more education.

Instead of using the years of schooling, an alternative measure for education is whether the individual achieves certain stages of education. Columns (2)-(4) present estimation results when these measures are used to study the impact of the WTO shock on the education decisions of the 16-year-old cohorts, regarding whether the individual chooses to the following levels of education: less than high school, high school completion, and college attendance. In column (5), we focus on those that have completed high school education to study the conditional likelihood of their attending

college. The results are consistent with the finding in column (1): A 16 year old is more likely to have less than high school education, less likely to finish high school, and less likely to go to college, due to the WTO shock.

We now switch gears to study how the WTO shock affects the education decisions of individuals at the age of high school graduation. Table 2 uses the cohorts reaching the age of 19 in 2002 and in 2000 as the treatment group and the control group, respectively. Table 2 has the same structure as Table 1, with the only addition of column (2), which includes only individuals who have completed high school among the cohorts reaching the age of 19 in 2002 or 2000. Column (1) shows no significant impact of the WTO shock on the whole sample, either positive or negative. But when zeroing in on high school graduates, the impact becomes positive and significant, implying that trade liberalization has resulted in a larger increase in college attendance among high school graduates in high-exposure regions than low-exposure regions. When the categorical measures are used to evaluate education level, similar patterns are observed. More students in regions with high exposure to the WTO shock continued onto college, instead of finishing education at the completion of high school, as compared to their counterparts in the less exposed regions.

To summarize, we have found bifurcation effects of the WTO shock on youth education in China. On the one hand, the WTO accession has led more individuals just completing the nation's mandatory education requirement of 9 years to quit school in search of jobs. On the other hand, more individuals that have finished high school have continued on to pursue college degrees, in response to the WTO shock.

Quantitatively speaking, export expansion has caused 2 months' reduction in schooling on average, but has led to 2 months increase for individuals with at least a high school education. What are the economic magnitudes of these effects? We conduct the following simple analysis. Based on our data, the elasticity of monthly income with respect to education is around 1 when we estimate the Mincer equation.[17] Given the mean value of years of education is 7.9 years for the whole youth sample (or 6.6 years for those with less than high school education), 2 months' decrease implies a 2% decrease in education and income (or 2.5% drop for the less educated group). For those who have at least a high school degree, the elasticity of monthly income with respect to education is around 4.4. Given the mean value of years of education is 13.1 years, 2 months' increase implies 1.3% increase in education and 5.6% hike in income. These effects on education attainment and income level are thus economically large, and more importantly, implying an increase of 8.1% in the income gap between groups with high education and low education.

In the remainder of this section, we will explore the hetergeneity of our findings depending on trade structure and individual backgrounds. And in Section 4, we will further check the robustness of the main findings and also test alternative explanations for the results.

3.3 Trade structure and the impact of WTO accession on education

3.3.1 Processing trade intensity

Our finding of negative impact of WTO accession on youth education attainment

[17] The estimation equation is as follows: $\log(\text{income})_{ar} = 1.057 \log(\text{edu})_{ar} + \gamma' Z_a + \delta_r + \varepsilon_{ar}$, with a robust standard error of 0.333.

is based on the argument that low-skill intensive export expansion will increase the opportunity cost of schooling, leading to a reduction in education attainment. To test this argument more directly, we further multiply each province's processing export share in year 2000 (based on China's customs data) with the high-exposure province dummy and the exposed cohort dummy in equation (1) to run the following triple difference regression (or DDD for short):

$$\text{Edu}_{arc} = \beta \text{Treat cohort}_c \times \text{High region}_r \times \text{Prcs share}_r + \varphi_1 \text{Treat cohort}_c \times \text{High region}_r + \varphi_2 \text{Treat cohort}_c \times \text{Prcs share}_r + \gamma' Z_a + \delta_c + \delta_r + \varepsilon_{arc} \quad (2)$$

Column (1) in table 3 presents the estimation results, showing that the increase in the intensity of processing trade significantly reduces the average years of education for the impacted 16-year old cohorts ($\beta < 0$). Note that the difference-in-difference coefficient now becomes positive and insignificant ($\varphi_1 > 0$), indicating that processing export is the key contributor to the loss of education attainment, without which there would have been no significant reduction in schooling. Quantitatively, one standard deviation increase in processing export intensity will cause an additional loss of education by around 0.142 years.

Column (2) in table 3 gives the corresponding estimation results for the impacted 19-year old cohorts that have completed high school. While the DDD coefficient is negative and significant ($\beta < 0$), the difference-in-difference coefficient is positive ($\varphi_1 > 0$). This implies the baseline result from table 2 that the education attainment for the high-achievers tends to increase more between 2000 and 2002 in

high-exposure regions than their low-exposure region counterparts only applies when the share of processing trade in local exports is sufficiently low. Once the share of processing trade reaches a certain level (about 70%), the trend is reversed, with more trade exposure correlated with less college attendance. Again, processing export seems to be the culprit responsible for the reduction in youth education.

3.3.2 Export destination

Another way to evaluate trade structure is to explore how trade expansions with rich versus poor countries have different effects. Thus, we use share of exports to OCED countries in each region to replace processing trade intensity in equation (2) and estimate the following regression equation (3):

$$\begin{aligned}\mathrm{Edu}_{arc} = \beta\mathrm{Treat\ cohort}_c \times \mathrm{High\ region}_r \times \mathrm{OECD\ share}_r + \varphi_1\mathrm{Treat\ cohort}_c \times \\ \mathrm{High\ region}_r + \varphi_2\mathrm{Treat\ cohort}_c \times \mathrm{OECD\ share}_r + \gamma' Z_a + \delta_c + \delta_r + \varepsilon_{arc}\end{aligned} \quad (3)$$

Columns (3)-(4) in Table 3 show the regression results for the sample of 16-year old cohorts and the sample of 19-year-old cohorts, respectively. We can see that the education impact of trade expansion on the 16-year-old cohorts remains negative and significant, unaffected by export destinations; and for the 19 year olds already finishing high school, trade expansion reduces their education in regions without any exports to developed countries. But in regions that have high enough levels of exports to developed countries, trade exposure actually benefits education, as export share to the developed world alleviates the negative effect. Quantitatively, one standard deviation increase in export share to developed countries will increase trade

expansion's positive impact on education by around 0.111 years.

Thus, the baseline finding of WTO shock increasing college education (table 2) only applies for regions with sufficient high export share to developed countries. These results are consistent with findings in the literature that exporting to high income countries can help increase firm productivity since there is scope for learning from foreign markets through contact with buyers and competitors (De Loecker, 2007) and that high productive firms usually prefer skilled and high ability labor (Helpman, Itskhoki and Redding, 2010).

3.4 Individual backgrounds and the impact of WTO accession on education

In this section we conduct several tests about possible heterogeneous effects for youths with different personal characteristics, e.g., residency type (or Hukou), only child status and gender. Due to huge income differentials between urban and rural areas, we expect the opportunity cost of education to be higher in rural areas than in urban areas, thus, the WTO accession induced export expansion will have a larger impact on youth education in rural areas. The same logic applies to the only-child status, since youths with siblings tend to have higher opportunity cost of schooling.

Table 4 displays the estimation results for testing these hypotheses, where columns (1)-(4) study the cohorts that reached 16 years of age in 2002 and 2000, while columns (5)-(8) examine the cohorts reaching 19 in 2002 and 2000. We can see that for the 16-year-old cohorts, the WTO shock only has significant and negative effects on education attainment for rural youths with siblings. In contrast, the positive and significant impact of the WTO shock on college education for 19 year olds who

have completed high school is only present for urban youths, but does not exist for youths in rural areas, regardless whether they are the only child in the household.

These results are in line with the expectations above, thus providing further support for the argument that trade expansion impacts youth educational decisions through altering the opportunity cost of additional education.

5. Robustness checks and alternative explanations

We now turn to robustness checks of our main findings and also address alternative theories that may account for the empirical findings presented above. Section 4.1 will provide multiple robustness checks, while Section 4.2 tests other possible explanations for the empirical results we have found.

4.1 Robustness checks

4.1.1 Alternative exposure measures

In the baseline regressions above, we use the high-exposure region dummy and the WTO accession indicator as measures for regional and cohort exposure to the WTO shock in order to study the difference-in-difference effect on education. In this section, we adopt several other measures for how much different cohorts in different regions are impacted by the WTO shock to re-run the regression for robustness check. Instead of the high-exposure region dummy variable, table 5 uses two alternative measures for trade exposure, the average provincial export share in local GDP over the period of 1990-2000 (column 1 and 5), and the geographic distance between the capital city in each province and the coast (column 2 and 6).

And to replace the WTO accession dummy corresponding to each cohort (Treat_c),

we use the average tariff level of the year when the cohort reached 16 years of age to measure the degree of the WTO shock for each cohort in column (3) and (7). Alternatively, we also use regional input-out tables to construct local averages of tariffs conditional on pre-existing industry composition at the provincial level. This allows us to identify variation across locations and over time in columns (4) and (8).

As can be seen from the results, when using these different exposure measures, the statistically significant effects of exposure to the WTO shock on youth education are preserved, both for the 16-year old cohorts and the 19-year old cohorts. Quantitatively for the 16-year old cohorts, a one standard deviation increase in export share causes the level of education to decline by around 0.033 years for the exposed cohorts; a one standard deviation reduction in distance (0.309 thousand miles) to the coast causes about 0.072 years (0.86 months) decline in schooling for the exposed cohorts; a reduction of average tariff levels by one standard deviation (3.24%) will cause about 0.08 years (0.96 months) decrease in education attainment for the exposed cohorts in the coastal region; and a reduction of region-specific tariff levels by one standard deviation (2.35%) will cause about 0.04 years (0.48 months) decrease in education attainment for the exposed cohorts in the coastal region. For the 19-year old cohorts, the corresponding effects (in opposite direction) are 0.025, 0.086, 0.035 and 0.015 years, respectively. Thus, these effects remain statistically significant and economically important.

4.1.2 Alternative samples

As China entered the WTO toward the end of 2001 (on December 11, 2001),

we exclude those who reached 16 years of age in 2001 from the treatment group in our baseline estimation. But it is possible that some individuals have predicted the WTO accession in advance and thus may make decisions to preempt the event, justifying the treatment of year 2001 as a post-WTO year. To test this possibility and check the robustness of our results, we include those individuals reaching the age of 16 in 2001 into the treatment group to re-run our estimation, with results shown in table 6, column (1). The coefficient of interest, β, remains negative and significant, but with a small magnitude, which is in line with the expectation that the WTO shock is smaller for those completing compulsory schooling in the same year, because the shock happened toward the very end of the year and not all individuals have predicted the event timely enough to respond in the same year.

If it indeed takes time for the WTO shock to spread to the larger population before individuals respond to the more abundant job opportunities brought about by the export expansion, then we would predict the DID effect to increase over time. Columns (2)-(4) in table 6 test the possibility by including additional cohorts that are younger and thus have more time to absorb and respond to the shock into the treatment group. In line with the expectation, the impact of $\mathrm{Treat}_c \times \mathrm{High\ region}_r$ remains negative and significant in these estimations, and as the treatment group includes additional younger cohorts (or groups of individuals reaching the age of 16 in later years), the coefficient becomes larger. Three years after the WTO accession, the related export shock has led to an average reduction of 0.64 years or 7.6 months in youth education, as compared to 0.16 years or 1.9 months' reduction after one year.

In column (5) of table 6, we include additional cohorts that reached the age of 16 before the WTO accession into the control group to have more balanced comparison, where the treatment group and the control group each includes 4 cohorts. As the older cohorts (those reaching the age of 16 between 1997 and 2000) will have had more time to catch up with education later in life if needed, these regressions will capture the effect of adult education that may differ across regions. The obtained coefficient of $\text{Treat}_c \times \text{High region}_r$ remains negative and significant, with the magnitude between that from column (4) and that from table 1, column (1), suggesting that individuals may be able to take more adult education over time in regions with high exposure.

Table 7 presents results when using different samples to study the WTO shock's impact on 19-year old cohorts who have completed high school education. Again, the positive and significant impact has been preserved in all the specifications. And similar to those observed for the 16-year old cohorts, the other patterns observed are all consistent with expectations.

4.1.3 New clustered standard errors and adding cohort-region specific controls

In the baseline regressions above, we cluster the standard error at the prefecture level. Readers may challenge that our main difference-in-difference results classify regions to 32 provinces (of which 10 belong to high-exposure regions), so clustering at the more local prefectural level may lead to underestimated standard errors. To address this concern, we cluster standard errors at the provincial level to re-run our benchmark regressions and we report the results in column (1) and (3) of table 8. As

can be seen from the results, the effects of exposure to the WTO shock on youth education continue to be statistically significant, both for the 16-year old cohorts and the 19-year old cohorts.

Furthermore, to check the robustness of our baseline regressions, we include a series of cohort-region specific controls (Z_{rc}) to account for confounding factors. For example, any changes in education infrastructure after 2001 could alter educational behaviors for the latter cohort differently. In addition, import may also have some effect on education, and the effect could be different from exports, with previous results suggesting that important yet different effects (e.g. Handley and Limao, 2017; Amiti et al., 2017).

To take into consideration other confounding features that may affect various cohorts differently and that are more likely to occur in "High exposure regions", such as imports, technological adoption and investment in education, we include cohort-region specific import/GDP ratio, the log of patent application numbers and investment share in education over GDP in each prefecture as additional controls in our regressions. As c seen from results in column (2) and (4) of table 8, the effects of exposure to the WTO shock on youth education continue to be statistically significant, both for the 16-year old cohorts and the 19-year old cohorts, whereas region-cohort specific imports do not have a significant effect on education.

4.1.4 Accounting for dynamics in education decisions

The dynamic nature of the incentives caused by trade liberalization on education is important and may have implications for our analysis. Given the sequential feature

of education decisions, an increase in the demand for high-skilled labor and thus college-educated individuals will also raise the value of completing high school, so the overall effect on educational choice at the end of compulsory schooling after junior high may be ambiguous theoretically. On one hand, trade expansion may increase the opportunity cost of high school education due to the increased labor intensive job positions open to junior high graduates; but on the other hand, the potential returns to high school education also increase, because it is a prerequisite to college education, which now has higher returns due to the greater availability of high-skill jobs brought about by globalization and may have spillover effects on returns to high school education.

The observed impact on education decisions of youths at the age of 16 is thus a combined outcome of the two opposite effects, and the fact that we observe a negative and significant effect of trade liberalization on education level for 16 year olds suggests that the impact due to higher opportunity cost of high school education dominates the indirect effect of higher returns on college education. Our finding of a negative effect of trade liberalization on education is therefore a lower-bound estimate, highlighting the importance of potentially detrimental impact of globalization on education.

To further explore the implications of the dynamic nature of youth education decision-making process, we also investigate the heterogeneous effects for youths with different probabilities of attending colleges. If the dynamics described above are important in determining youth education choices, then we should observe stronger

spillover effects of the college premium on high school attendance for 16-year-olds with an exogenously higher likelihood of going to college than for those who are less likely to go to college for reasons beyond their own control.

Two measures at the regional level are used to evaluate the likelihood of youths attending college: the percentage of residents in each region with college education, and the ratio between the number of local students taking part in the college entrance examination and the number of local universities. As the former measure is a proxy for the expected probability of having a college degree for residents living in the region, whereas the latter indicates the difficulty in being admitted to local colleges (which provide the highest quota for students from the same region and thus can approximate the availability of college education for students in the region), we expected the two measures to be negatively correlated and obtain opposite estimates.

We multiply our main interaction term with the measures described above to construct some triple interaction terms to study the impact of college attendance probability, and Table 9 reports the results. As seen from column (1) of the table, the negative effect of trade liberalization on education of the 16-year-old cohort is muted when the college attendance rate goes up in the region (corresponding to a larger percentage of local residents with college education), since the triple interaction term is statistically positive whereas our baseline interaction term remains negative and significant. Hence, there is a substantial amount of spillover effect through the dynamics of educational decision process, where higher college premium can help reduce the negative impact of trade liberalization on high school attendance, as long

as the local students have a high enough probability of attending college. But as the mitigation effect is completely overwhelmed as soon as the college attendance rate is below 11%, the negative impact remains the dominant effect on the education decisions for the majority of 16-year-olds in our sample, for which the mean college attendance rate is 9.76%.[18] In fact, 27 out of a total of 31 provinces/cities in our sample have college attendance rates below the threshold of 11%, accounting for 90.3% of the individuals covered in the analysis.

The results using the ratio between the number of local students participating in the college entrance examination and the number of local universities as the measure of college attendance propensity lead to similar interpretations, i.e., greater ease in going to college will be correlated with smaller negative impact of globalization on high school attendance (see column 3 of table 9). Thus, despite the potentially importance impact of dynamics, our main finding of a negative effect of globalization on education decisions by junior high school graduates is preserved.

We also report the results for studying the sample of 19-year-old cohorts in columns (2) and (4). When the percentage of local residents with a college degree is used as the college spillover measure (column 2), the triple interaction term is positive and statistically significant, whereas the original interaction term becomes insignificant, implying that only regions with a high enough propensity of college attendance will experience the positive impact of globalization on youths' decision to

[18] The threshold level of 11% for college attendance rate (measured as the percentage of local residents with a college degree) is calculated to equate the total effect of globalization on high school attendance to zero.

pursue college education. Results in column 4 lead to a similar interpretation.[19] Although the spillover dynamics discussed above does not apply to college attendance decisions at the age of 19, the positive correlation between availability of colleges in the region and college attendance rate is in line with expectations.

4.2 Alternative hypotheses

As the population census data is cross-sectional, our estimation strategy may raise several concerns. Alternatively, the main findings may be subject to other potential explanations, which we will address in this section.

4.2.1 Migration effects

As the WTO shock may induce some people from inland provinces to move to coastal regions in search of jobs, one may suspect that the observed correlation between the WTO shock and education attainment is due to sorting of individuals based on job availability (and thus education level) rather than trade expansion's impact on educational choices. And in the framework of standard difference-in-difference regression, we should not let the members of the treatment and control groups move between coastal and inland regions. Thus, we address the above concern by excluding from our sample of analysis individuals who lived away from regions of their original residence registration (i.e., migrants).

As migrants account for about 30% of the total sample of 69063 individuals that

[19] Although the triple interaction term is insignificant, an F-test implies that the combined effect of globalization on college attendance smaller when the difficulty to enter college becomes greater. In fact, when the number of students attending college entrance exam/the number of local universities (in 10,000s) exceeds 0.968, the positive impact of globalization becomes insignificant.

were 16 years old in 2000 and 2002, and about 38% in the 19-year-old sample of 22754 individuals, the reader might be concerned that excluding this sizable group from the analysis may challenge the robustness of our findings. We now address this concern by studying the sample with migrants included. If our argument about trade expansion inducing youths to give up additional education and join the labor market is correct, export expansion should cause youths from internal regions to go to coastal provinces, especially attracting less educated youths to manufacturing export job hubs.

As a result, we can further examine the validity of our argument by putting migrants back to the sample to test the following prediction: When migrants are included in the sample, we expect to obtain larger estimates for the impact of the WTO accession on the 16-year-old cohorts than the benchmark result, and this pattern should hold whether the migrants are included in the province of their residence in 2005 or in their original province. In column (1) of table 10, we introduce migrants to re-run our regression by assigning them to their provinces of residence. And in line with the prediction, the estimated coefficient is substantially larger than the result in table 1. Alternatively, we assign the migrants to their original home provinces, and column (2) reports results that do not significantly differ from those in column (1), where the smaller sample size is due to be fact that only 38% of the migrants in our sample report where they originally came from.

For the 19-year-old cohorts that have finished high school, the impact of including migrants in the province of their residence may be different. Since youths

who have graduated from high school but do not continue college education are also more likely to migrate from internal regions to coastal provinces than those attending colleges, including them in the sample should reduce the positive impact of the WTO accession on 19-year-old cohorts' education. Consistent with this prediction, column (4) of table 10 shows no significant impact of the WTO entry on the education decisions of high school graduates when including migrants, while the original effect is estimated to be statistically significant at 0.152 years when excluding migrants.

On the other hand, if we assign migrants back to their original home provinces, then those migrant youths who graduated from high school but did not go on to college will be included in the low-exposure regions, which should result in a larger positive effect of trade expansion on college education among the high-achiever group. The estimated coefficient in column (5) of table 10 is consistent with the prediction. Therefore, inclusion of migrants in our analysis does not change the main findings.

4.2.2 Selection effect

Against the argument that WTO-induced export expansion causes reduction in education attainment for Chinese youths reaching the age of 16, there is the possibility that some youths may choose to quit from school, for reasons other than pursuit of job opportunities, thus their decisions are not impacted by the WTO accession. If the probability change in such quitting behaviors is different between coastal regions and inner regions, this may explain the patterns observed in our baseline findings.

In order to address this concern, we exclude youths who did not look for jobs

after finishing school from our sample to redo the analysis[20]. By assuming that only for individuals who look for jobs after quitting school, their education decisions are to be affected by the job market situation, we expect this approach to help alleviate the selection concern. In columns (3) and (6) of table 10, we report the results for such tests and show that all the coefficients are very similar to the baseline results in table 1. We thus conclude that the potential selection effect may not be a big issue here.

4.2.3 College expansion

Another potential problem is that the college expansion in 1999 may have had some effect on education attainment, as high school graduates can enter into colleges more easily after 1999. Since more Chinese colleges and universities are located in the developed coastal regions (986 out of total 2553 colleges and 65 out of 116 key universities)[21], this may help lift the education level for high achieving youths more on the coast than in the inland, leading to an over-estimation of the WTO shock's positive impact on post-high-school education.

By controlling for cohort fixed effects, we already address the potential average impact of rising college acceptance rate on youths' decision to pursue college degrees over time. To further address the possibility that college acceptance rates have increased more in coastal regions[22], we include in our estimation the college

[20] We rely on the following survey question to exclude youths not looking for jobs from the sample: Among the nine possible answers provided below, which one gives the reason for why you do not have a job: 1. still in school; 2. have lost the capacity to work; 3. retirement; 4. doing housework; 5.do not look for jobs after graduation; 6. have lost job due to employer reasons; 7. have lost job due to personal reasons; 8. land is occupied by government; 9. others.

[21] The figure is based on college information issued by Ministry of Education of China. See http://www.moe.gov.cn/ (accessed on April 8, 2017).

[22] Indeed the college acceptance rate increased more in the coastal regions than in the inland regions between 2000 and 2002, with the former's rate increasing from 0.32 to 0.46 whereas the latter increasing from 0.20 to 0.27. The figure is computed based on number of senior high school graduates and university enrollments in 2000 and 2002, both from China Statistical Yearbooks.

acceptance rate in year that the individual reached 19 years of age, with the purpose to take into account of the role played by the supply of college education in the individual's education decision process. As shown in table 10, column (7), while college expansion does have a positive and significant effect, the WTO accession effect remains positive and significant, although with slightly smaller magnitude.

6. Conclusion

This paper finds that the WTO accession induced export expansion has altered the distribution of education in China. In particular, while trade liberalization has reduced the schooling of cohorts at the age of 16, it has increased the education level for youths with at least a high school education. Furthermore, growth in low-skill processing export can explain the negative schooling impact, whereas trade upgrading reflected by exports to developed countries could account for the increase in education. These patterns are consistent with predictions from trade theory: On one hand, the expansion of processing export due to the WTO accession generated an abundance of new low-skill jobs that substantially raised the opportunity cost of schooling for youths at the completion of compulsory education; but on the other hand, trade upgrading could also have led to increased demand for additional education for youths with a high school education at the age of 19.

In addition to the differential effects on youth education of trade of different types, individuals with different backgrounds are also found to experience divergent impacts of trade expansion on education attainment. While only urban students enjoy the benefit from trade liberalization to pursue more college education, rural students from

households with multiple siblings bear the bulk of the negative effect of trade expansion to choose less schooling. Given the increasing importance of education and human capital in determining income, our study predicts higher income disparity in China for the years to come and thus has relevance for income distribution policy-making.

More generally, these findings suggest that international trade could amplify the differences in skill accumulation across developing countries due to the mutually reinforcing relationship between comparative advantage and skill formation. Our findings thus have important policy implications for China and many other developing countries, since they often prioritize improving education level of the workforce at the same time of pursuing an export-oriented industrialization strategy focused on manufacturing. Given the trade-off between these goals, it is vital for policymakers to determine which types of exporting to promote, while taking into account of their impact on individuals' education decisions.

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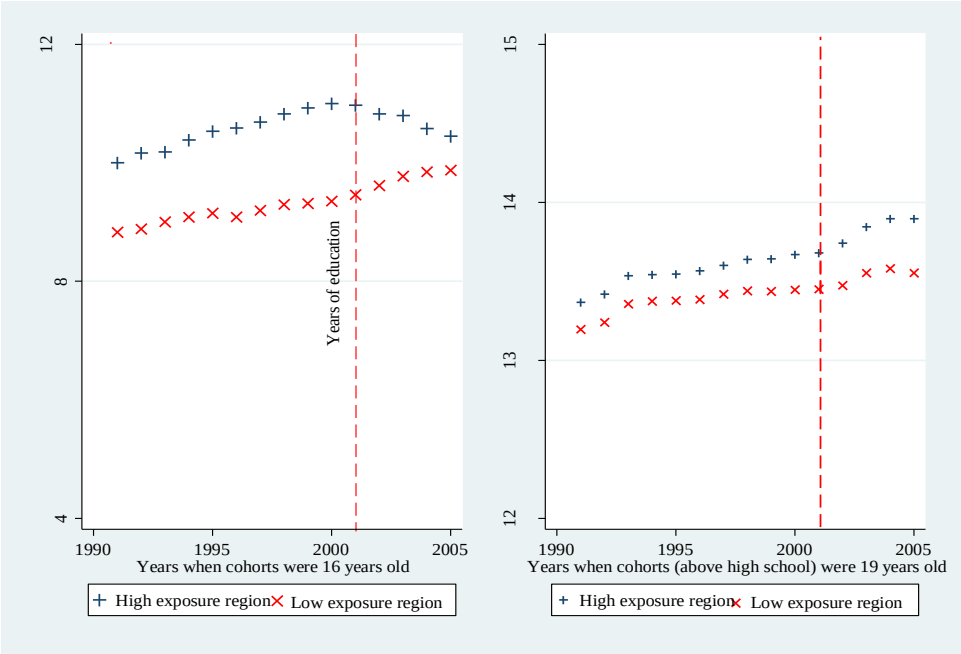

Figure 1: Years of education by cohort:
high-exposure-regions v. low-exposure-regions

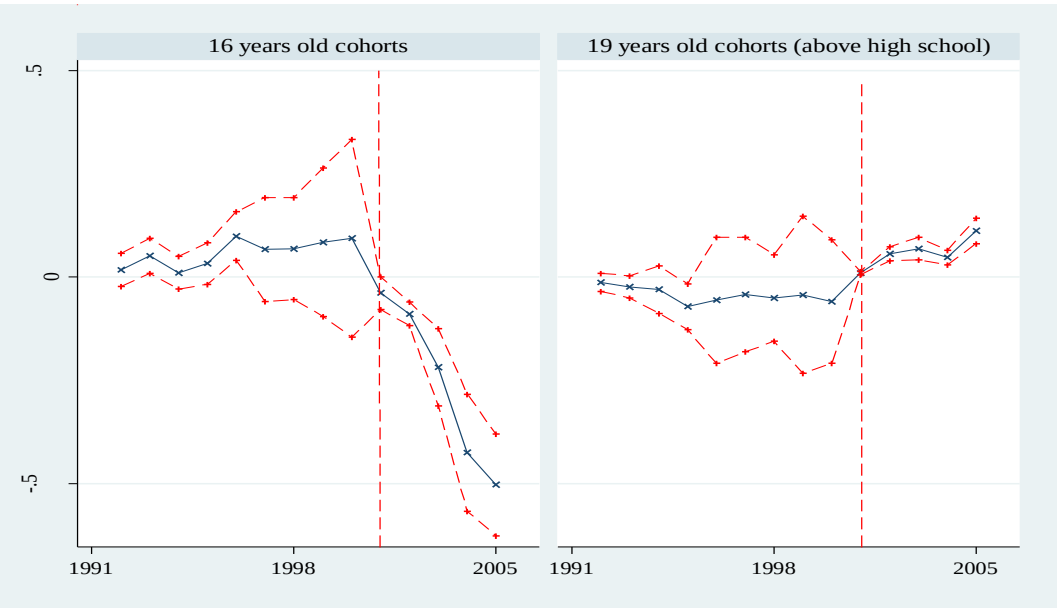

Figure 2: Flexible estimates of pre-trends for different cohorts

Note: The figure presents the estimated coefficients of the interaction terms between high-exposure dummy and the 16-year-old (or 19-year-old) cohort dummy for each year over the period 1991-2005, as well as their 95% confidence intervals.

Table 1: WTO Accession v. education attainment (16 years old cohorts)

	(1)	(2)	(3)	(4)	(5)
Treatment group:	2002	2002	2002	2002	2002
Control group:	2000	2000	2000	2000	2000
Sample	All	All	All	All	above high school
Dependent variable:	Years of education	Less than high school	High school	College	College
Treat × High-exposure-region	-0.158**	0.013***	-0.020*	-0.017**	0.026
	(0.0695)	(0.003)	(0.012)	(0.008)	(0.017)
Sex (Male)	0.145***	-0.0183***	0.0447***	0.0264***	0.0605***
	(0.0467)	(0.00587)	(0.00584)	(0.00607)	(0.0114)
Ethnicity (Han)	0.693***	-0.0403***	0.0557***	0.0154**	0.0415**
	(0.138)	(0.0104)	(0.00929)	(0.00612)	(0.0162)
Hukou-type (Rural)	-2.853***	0.471***	-0.171***	0.300***	0.279***
	(0.104)	(0.0131)	(0.0143)	(0.0194)	(0.0182)
Only child	0.390***	-0.0793***	0.0258**	-0.0535***	-0.0355*
	(0.0594)	(0.00739)	(0.0107)	(0.0107)	(0.0200)
Region effect	Yes	Yes	Yes	Yes	Yes
Cohort effect	Yes	Yes	Yes	Yes	Yes
Observations	48446	48446	48446	48446	17829
R-squared	0.460	0.357	0.103	0.395	0.344

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: WTO Accession v. education attainment (19 years old cohorts)

19 years old cohorts	(1)	(2)	(3)	(4)	(5)	(6)
Treatment group:	2002	2002	2002	2002	2002	2002
Control group:	2000	2000	2000	2000	2000	2000
Sample	All	Above high school	All	All	All	Above high school
Dependent variable:	Years of education	Years of education	Less than high school	High school	College	College
Treat × High-exposure-region	0.014	0.152**	0.004	0.031**	0.028***	0.051***
	(0.053)	(0.0671)	(0.008)	(0.011)	(0.010)	(0.017)
All controls as in Table 1	yes	Yes	Yes	yes	yes	yes
Region effect	yes	Yes	Yes	yes	yes	yes
Cohort effect	yes	Yes	Yes	yes	yes	yes
Observations	47635	14051	47635	47635	47635	14051
R-squared	0.488	0.223	0.446	0.095	0.360	0.207

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: WTO Accession v. education attainment: Processing trade and export destination heterogeneity

	Processing intensity		Exporting to OECD country intensity	
	16 years	19 years-above high school	16 years	19 years-above high school
	(1)	(2)	(3)	(4)
Treatment group	2002	2002	2002	2002
Control group	2000	2000	2000	2000
Dependent variable	Years of education		Years of education	
Treat × High–exposure-region × share	-0.364*	-0.522*	0.062	0.742*
	(0.247)	(0.310)	(0.571)	(0.437)
Treat × High-exposure-region	0.056	0.367*	-0.348*	-0.324*
	(0.185)	(0.203)	(0.193)	(0.217)
All pair-wise interactions	Yes	Yes	yes	yes
All controls as in Table 1	Yes	Yes	yes	yes
Cohort effect	Yes	Yes	yes	yes
Region effect	Yes	Yes	yes	yes
Observations	48446	14051	48446	14051
R-squared	0.460	0.223	0.460	0.223

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: WTO Accession v. education attainment: Individual background heterogeneity

	Urban	Urban--siblings	Rural	Rural-siblings	Urban	Urban--siblings	Rural	Rural-siblings
	16 years				19 years-above high school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment group	2002	2002	2002	2002	2002	2002	2002	2002
Control group	2000	2000	2000	2000	2000	2000	2000	2000
Dependent variable	Years of education				Years of education			
Treat × High-exposure-region	-0.084	-0.044	-0.208***	-0.009	0.208**	0.209*	0.044	0.045
	(0.108)	(0.139)	(0.057)	(0.058)	(0.094)	(0.143)	(0.091)	(0.102)
Treat × High-exposure-region×Siblings		-0.064		-0.354***		-0.002		-0.004
		(0.139)		(0.129)		(0.191)		(0.157)
All controls as in Table 1	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Cohort effect	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Region effect	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Observations	12275	12275	36171	36171	9942	9942	4109	4109
R-squared	0.284	0.284	0.264	0.264	0.113	0.113	0.104	0.104

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: WTO accession and educational attainment: alternative exposure measures

	Trade	Distance	Tariff	Region tariff	Trade	Distance	Tariff	Region tariff
	16 years				19 years-above high school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment group	2002	2002	2002	2002	2002	2002	2002	2002
Control group	2000	2000	2000	2000	2000	2000	2000	2000
Dependent variable	Years of education				Years of education			
Treat × High-exposure-region	-0.329*	0.233**	0.0243**	-0.169***	0.252**	-0.278**	-0.108**	0.054***
	(0.267)	(0.094)	(0.0107)	(0.058)	(0.112)	(0.125)	(0.0480)	(0.012)
All controls as in Table 1	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Cohort effect	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Region effect	Yes	Yes	Yes	Yes	Yes	yes	yes	yes
Observations	48446	48446	48446	36171	14051	14051	14051	4109
R-squared	0.460	0.460	0.460	0.264	0.223	0.223	0.223	0.104

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Trade share is provincial exports/GDP to replace the High Exposure-region dummy in the difference in difference estimation; distance is the geographical distance between provincial capital to the coast to replace the High Exposure-region dummy in the difference in difference estimation; tariff is yearly average effective tariff rate to replace the cohort treatment dummy in the difference in difference estimation.

Table 6: WTO accession and educational attainment (16-year old cohorts): alternative samples

16 years old cohorts	(1)	(2)	(3)	(4)	(5)
Treatment group:	2001,2002	2002,2003	2002-2004	2002-2005	2002-2005
Control group:	2000	2000	2000	2000	1997-2000
Dependent variable:	Years of education				
Treat × High Exposure-region	-0.120**	-0.334***	-0.504***	-0.637***	-0.490***
	(0.0552)	(0.107)	(0.146)	(0.165)	(0.130)
Sex (Male)	0.162***	0.117***	0.111***	0.0905***	0.143***
	(0.0451)	(0.0387)	(0.0336)	(0.0291)	(0.0313)
Ethnicity (Han)	0.696***	0.723***	0.709***	0.686***	0.738***
	(0.136)	(0.123)	(0.119)	(0.114)	(0.117)
Hukou-type (Rural)	-2.906***	-2.524***	-2.280***	-2.090***	-2.553***
	(0.108)	(0.0898)	(0.0763)	(0.0683)	(0.0690)
Only child	0.389***	0.351***	0.293***	0.290***	0.312***
	(0.0550)	(0.0467)	(0.0403)	(0.0332)	(0.0343)
Region effect	yes	yes	Yes	yes	yes
Cohort effect	yes	yes	Yes	yes	yes
Observations	71207	81235	115754	156763	231474
R-squared	0.463	0.418	0.381	0.358	0.399

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: WTO accession and educational attainment (19-year old cohorts): alternative samples

19 years old cohorts	(1)	(2)	(3)	(4)	(5)
Treatment group:	2001,2002	2002,2003	2002-2004	2002-2005	2002-2005
Control group:	2000	2000	2000	2000	1997-2000
Dependent variable:	Years of education				
Treat × High Exposure-region	0.0686*	0.184***	0.193***	0.226***	0.212***
	(0.0533)	(0.0662)	(0.0710)	(0.0767)	(0.0667)
All controls as in Table 1	yes	yes	Yes	yes	yes
Region effect	yes	yes	Yes	yes	yes
Cohort effect	yes	yes	Yes	yes	yes
Observations	21983	21312	29125	39693	60636
R-squared	0.210	0.246	0.273	0.297	0.238

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: WTO accession and educational attainment: alternative standard errors and adding region-cohort controls

	(1)	(2)	(3)	(4)
	16 years old cohorts		19 years old cohorts-above high school	
Treatment group:	2002	2002	2002	2002
Control group:	2000	2000	2000	2000
Dependent variable:	Years of education			
Treat × High Exposure-region	-0.158**	-0.106**	0.152**	0.158**
	(0.074)	(0.054)	(0.072)	(0.085)
Technological adoption (Log patents)		-0.347		-0.017
		(0.222)		(0.347)
Investment in education (Share of GDP)		-6.776		0.774
		(11.816)		(11.272)
Import/GDP		-0.018		0.008
		(0.217)		(0.196)
All controls as in Table 1	Yes	Yes	Yes	Yes
Region effect	Yes	Yes	Yes	Yes
Cohort effect	Yes	Yes	Yes	Yes
Observations	48446	48446	14051	14051
R-squared	0.460	0.460	0.223	0.223

Note: Robust standard errors clustered at provincial level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: WTO Accession v. education attainment: Accounting for dynamics

	% of residents with college education		Students attending college entrance exam / the number of local universities	
	16 years	19 years-above high school	16 years	19 years-above high school
	(3)	(4)	(1)	(2)
Treatment group	2002	2002	2002	2002
Control group	2000	2000	2000	2000
Dependent variable	Years of education		Years of education	
Treat × High–exposure-region ×	2.354*	1.417*	-0.792**	-0.252
college share	(1.666)	(1.058)	(0.416)	(0.526)
Treat × High-exposure-region	-0.256*	0.016	0.471**	0.244*
	(0.183)	(0.224)	(0.198)	(0.162)
All pair-wise interactions	Yes	Yes	Yes	Yes
All controls as in Table 1	Yes	Yes	Yes	Yes
Cohort effect	yes	Yes	Yes	Yes
Region effect	yes	Yes	Yes	Yes
Observations	48446	14051	48446	14051
R-squared	0.460	0.223	0.460	0.223

Note: Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Addressing alternative explanations: immigration, unemployment and college expansion

	16 years old cohorts			19 years old cohorts-above high school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Migrants included		No job hunting after quitting school	Migrants included		No job hunting after quitting school	College expansion
Dependent variable:	Years of education						
Treatment group:	2002	2002	2002	2002	2002	2002	2002
Control group:	2000	2000	2000	2000	2000	2000	2000
Treat × High	-0.328***	-0.252***	-0.126**	-0.050	0.249***	0.173**	0.124*
Exposure-region	(0.075)	(0.075)	(0.073)	(0.060)	(0.076)	(0.068)	(0.066)
College expansion							0.139***
							(0.006)
All controls as in Table 1	Yes	Yes	Yes	Yes	Yes	Yes	yes
Region effect	Yes	Yes	Yes	Yes	Yes	Yes	yes
Cohort effect	Yes	Yes	Yes	Yes	Yes	Yes	yes
Observations	69063	62829	44865	22754	20147	12556	14051
R-squared	0.420	0.431	0.480	0.216	0.225	0.247	0.223

Note: Columns (1) and (4) include migrants in the region where they lived in 2005, whereas columns (2) and (5) include migrants in their respective origin provinces. Robust standard errors clustered at prefectural level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

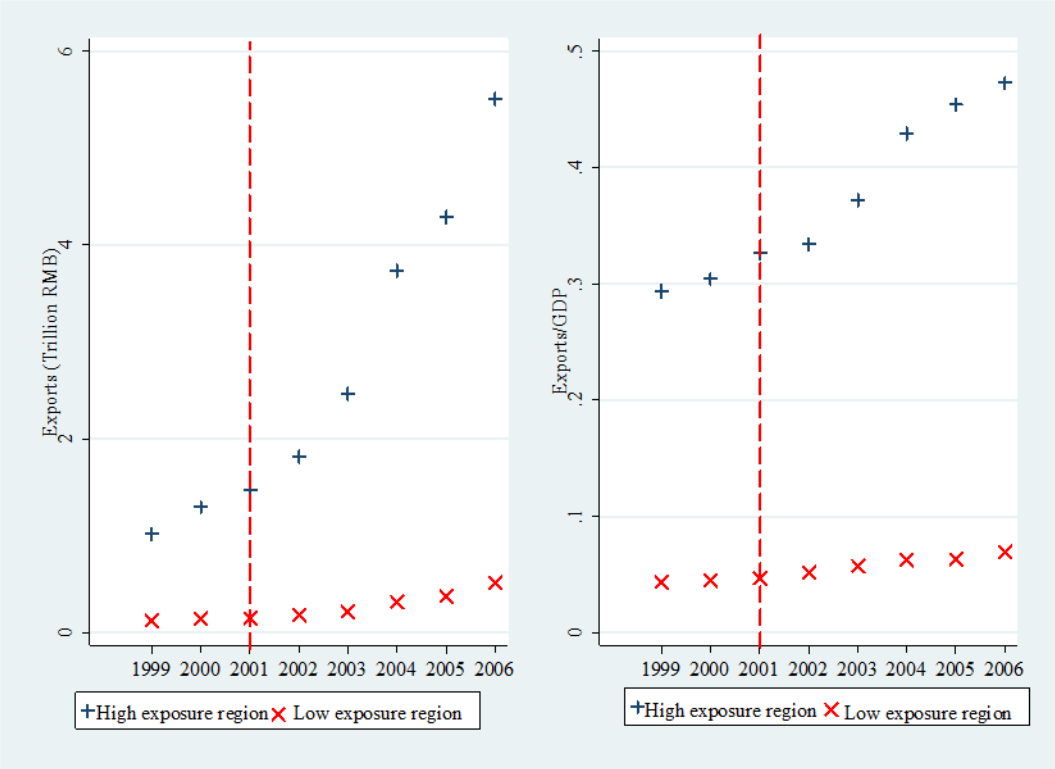

Figure A1: Differential impacts of WTO accession on high-exposure versus low-exposure regions

Note: This figure shows the exports (left one) and exports over GDP share (right one) for high-exposure and low exposure regions over period 1999-2006. Exports are in Trillions of RMB based on 2000 value. High-exposed regions include 9 coastal provinces that account for more than 90% of national exports during 2001-2006: Liaoning, Beijing, Tianjin, Shandong, Shanghai, Jiangsu, Zhejiang, Guangdong, Fujian, and Hainan. More details are in appendix table A. As can be seen, higher exposure regions have a much higher growing rate of export openness after the WTO accession.

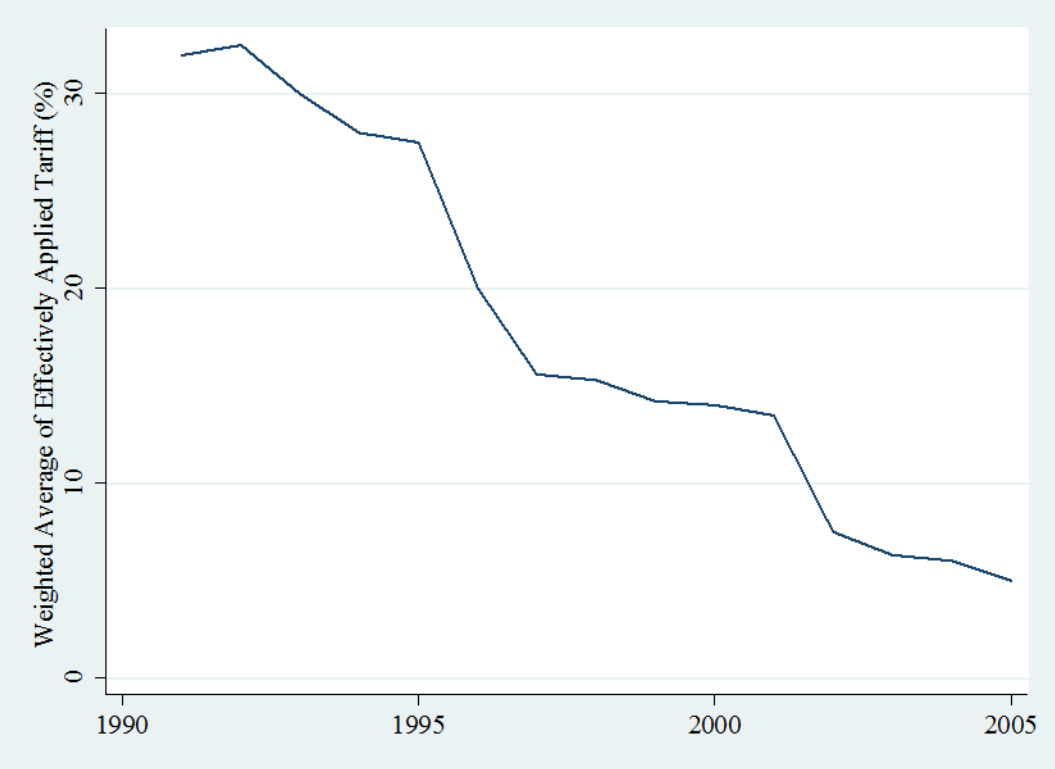

Figure A2: Tariff trend over 1990s and 2000s

Note: Tariff data are extracted from the TRAINS dataset provided by the World Integrated Trade Solutions (WITS).

Table A1: Drop-out rate in 2005 for 10-19 years old youths

	National	Coastal region	Inland region
10 years old	0.19%	0.05%	0.26%
11 years old	0.20%	0.06%	0.27%
12 years old	0.41%	0.17%	0.52%
13 years old	0.76%	0.30%	0.98%
14 years old	1.59%	0.90%	1.92%
15 years old	2.12%	1.38%	2.48%
16 years old	2.5%	1.75%	2.89%
17 years old	2.39%	1.59%	2.86%
18 years old	2.51%	1.76%	3.02%
19 years old	7.23%	5.19%	8.74%

Table A2: Labor structure in foreign invested enterprises in 2004 and wage premium in 2005

	Graduates	Undergraduates	College	High school	≤Middle school
FDI	0.29	3.47	6.67	33.78	55.79
HMT	0.23	2.88	6.13	31.58	59.18
Others	0.35	4.25	7.46	36.56	51.37
	Average monthly wage in 2005 for young workers				
Log value	7.56	6.64	5.95	5.14	4.84
Premium	0.56	0.37	0.23	0.06	0

Source: Lin (2011) and authors' own computation

Table A3: Provinces and their export shares before WTO accession

Province	Export share /National 2000	Export share /National 2005	Export/GDP 2000	Export/GDP 2005	Processing intensity	Export share to OECD
Beijing*	0.0405	0.0480	0.3588	0.3997	1.17	0.54
Tianjin*	0.0346	0.0389	0.4356	0.5679	0.77	0.72
Liaoning*	0.0308	0.0453	0.1925	0.2360	0.76	0.77
Shanghai*	0.1017	0.1191	0.4612	0.7947	0.93	0.72
Jiangsu*	0.1427	0.1614	0.2485	0.5356	0.55	0.71
Zhejiang*	0.1008	0.1055	0.2666	0.4637	0.22	0.67
Fujian*	0.0518	0.0620	0.2726	0.4306	0.58	0.69
Shandong*	0.0623	0.0779	0.1505	0.2034	0.59	0.75
Hainan*	0.013	0.032	0.0922	0.1282	0.80	0.46
Guangdong*	0.3185	0.3688	0.7875	0.8553	1.29	0.51
Hebei	0.0149	0.0143	0.0604	0.0884	0.28	0.60
Shanxi	0.0053	0.0040	0.0623	0.0676	0.08	0.73
Inner Mongolia	0.0039	0.0023	0.0573	0.0368	0.28	0.60
Jilin	0.0050	0.0032	0.0571	0.0552	0.37	0.64
Heilongjiang	0.0058	0.0080	0.0369	0.0892	0.14	0.29
Anhui	0.0087	0.0068	0.0592	0.0786	0.25	0.58
Jiangxi	0.0048	0.0032	0.0495	0.0487	0.34	0.48
Henan	0.0060	0.0067	0.0241	0.0389	0.23	0.57
Hubei	0.0078	0.0058	0.0375	0.0544	0.32	0.56
Hunan	0.0066	0.0049	0.0371	0.0460	0.19	0.54
Guangxi	0.0060	0.0038	0.0601	0.0585	0.23	0.47
Chongqing	0.0040	0.0033	0.0519	0.0589	0.32	0.42
Sichuan	0.0056	0.0062	0.0288	0.0516	0.32	0.48
Guizhou	0.0017	0.0011	0.0350	0.0347	0.28	0.49
Yunnan	0.0047	0.0035	0.0498	0.0618	0.19	0.32
Tibet	0.0005	0.0002	0.0799	0.0539	0.39	0.08
Shaanxi	0.0050	0.0046	0.0653	0.0634	0.31	0.63
Gansu	0.0017	0.0014	0.0349	0.0457	0.06	0.67
Qinghai	0.0004	0.0004	0.0352	0.0482	0.26	0.67
Ningxia	0.0013	0.0009	0.1020	0.0909	0.17	0.72
Xinjiang	0.0048	0.0066	0.0731	0.1568	0.24	0.16

Note: * denotes high export exposure regions. Export share is the average figure over the period 1996-2000, based on the China Industrial Enterprise Survey Data. Processing export share is the average figure over period 1996-2000 based on China's customs data.

Table A4: Summary statistics of main variables in our baseline regression

Variable	Observation	Mean	Std. Dev.	Min	Max
Years of education	48446	9.97	3.14	0	19
WTO× Ex-region	48446	0.17	0.38	0	1
WTO	48446	0.53	0.50	0	1
Ex-region	48446	0.33	0.47	0	1
Province export share	48446	0.06	0.10	0	0.32
Province import share	48446	0.08	0.15	0	0.38
Processing intensity	48446	0.47	0.39	0.06	1.29
Share to OECD countries	48446	0.56	0.15	0.08	0.77
Tariff level	48446	10.54	3.24	7.5	14
Regional specific tariff	48446	1.288	2.355	0	10.351
Distance	48446	290.18	308.70	0	1481.39
Age	48446	19.94	1.00	19	21
Sex	48446	0.50	0.50	0	1
Ethnic	48446	0.86	0.35	0	1
Hukou type	48446	0.75	0.43	0	1
One child	48446	0.19	0.39	0	1
Log(Patents applied)	48446	8.34	1.29	3.14	10.23
Investment to education/GDP	48446	0.04	0.01	0.02	0.09

Table A5: WTO accession and educational attainment (17 and 18-year old cohorts)

	(1)	(2)
	17 years old cohorts	18 years old cohorts
Treatment group:	2002	2002
Control group:	2000	2000
Dependent variable: Years of education		
Treat × High Exposure-region	-0.013	0.089
	(0.053)	(0.056)
All controls as in Table 1	Yes	yes
Region effect	Yes	yes
Cohort effect	Yes	yes
Observations	46062	49742
R-squared	0.481	0.484