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International trade liberalization and domestic institutional reform: Effects of WTO accession on Chinese internal migration policy

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GEP

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Effects of WTO Accession on Chinese Internal Migration Policy

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Abstract

Economic institutions that impede factor mobility become more costly when an economy experiences substantial transitions such as trade liberalization. I study how trade triggers changes in labor institutions that regulate internal migration in the context of China's Hukou system. Using a newly-collected dataset on prefecture-level migration policies, I document an increase in pro-migrant regulations following WTO entry and estimate the impact of prefecture-level trade shocks on migration regulations from 2001 to 2007. I find that regions facing more export market liberalization enacted more migrant-friendly regulations.

Key words: Trade Liberalization, Institution, Migration Policy

JEL: F16, O43, F63

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1 Introduction

Trade liberalization is an important economic force driving changes in institutions. For example, Atlantic trade improved the protection of property rights (Acemoglu, Johnson and Robinson 2005), Medieval trade in Venice pushed for constraints on the executive and innovations in contracting institutions (Trefler and Puga 2014), modern import competition in the United States and Germany impacted electoral outcomes (Autor et al. 2016; Che et al. 2016; Dippel et al. 2017; Jensen, Quinn and Weymouth 2017), and removal of quota restrictions on Chinese exports reduced misallocation resulting from the distorted quota-allocation (Khandelwal, Schott and Wei 2013). Trade liberalization usually has unequal impacts across firms, industries, and regions, incentivizing factor reallocation. Thus, it increases the effective cost of maintaining economic institutions that impede such reallocation, potentially leading to institutional reforms.

In this paper, I study how international trade liberalization affects institutions that regulate labor mobility in the context of China's Hukou system. The Hukou system is a vestige of a central-planning economy where the government creates artificial barriers between citizens in different geographic locations and different sectors. Before the economic reform in 1978, it was used to ration the allocation of all economic resources: land, jobs, goods, and social benefits. Even in the market-oriented economy today, people who live and work outside their Hukou prefecture need to obtain temporary registration to achieve a legal migrant status. But all migrants, even legal ones, have access to a diminished level of public goods, such as medical insurance and public schools. The Hukou system makes internal migration across regional borders similar to international migration across national borders.[1] Despite fast economic growth in the 1990s, China's Hukou system remained rigid.[2] However, around the time of WTO accession in 2001, the Chinese central government allowed prefecture-level governments to make their own Hukou regulation changes. A large body of literature has documented the profound impact of China's accession to the WTO on

[1] Similar systems also exist in other countries: *propiska* in Belarus, Kazakhstan, Russia, and Uzbekistan (abolished in Ukraine in 2001), *ho khau* in Vietnam, and *hoju* in North Korea (abolished in 2008). In 2016, 22.5% of the world population is subject to such internal migration regulations.

[2] This suggests that the Hukou system is a fundamental and sticky institution in China.

both the world economy and the Chinese economy.[3] I argue that the reduction in trade costs and the growth in Chinese export opportunities affected firms and consumers not only directly, through prices, but also indirectly, through changes in institutions. The economic costs of maintaining a rigid Hukou system could become very high when international trade opens up. Economic entities, in this case Chinese local governments, had the incentive to relax the Hukou restrictions and liberalize internal migration, particularly when a more flexible domestic labor market allowed government officials to reap larger gains from trade liberalization.

I identify the effect of trade liberalization on migration policy changes at the sub-national level. Identifying these effects at the country level is difficult for two reasons. At the country level, trade policies and migration policies are usually determined simultaneously, since countries with faster economic growth might choose both a more open trade policy and a more flexible migration policy.[4] In addition, although trade shocks are relatively easy to measure, it is difficult to uniformly quantify migration regulations across different countries. The Chinese context has several unique features that enable me to avoid the simultaneity problem and solve the measurement problem. First, by receiving most-favored-nation (MFN) status after the WTO accession, tariffs on Chinese exports fell, and export growth followed. This aggregate shock affected regions within China differently, depending on their initial local industrial composition. I use these differential shocks to identify the effect of trade. Second, given the decentralized nature of Hukou reform in the 2000s, I collect a new dataset on prefecture-level migration regulations from 1995 to 2015 to measure prefecture-level migrant friendliness.[5] I use a difference-in-difference identification strategy where I compare the change in migrant-friendliness of prefectures that experienced a big vs. a small trade shock in the post-WTO period of 2001 to 2007; these two types of prefectures had similar migrant-friendliness in the pre-WTO period of 1995 to 2001. I find that liberalized trade policies, which

[3] See Autor, Dorn and Hanson (2013), Pierce and Schott (2016), Amiti et al. (2017), and Handley and Limão (2017) on the impact of Chinese export growth on the U.S. economy, and Brandt et al. (2017), Zi (2017), Erten and Leight (2017), and Facchini et al. (2018) on the WTO accession on Chinese productivity, interregional migration, and intraregional structural transformation, among others.

[4] Indeed in the case of China, the central government's decision to allow localities to relax migration policy was motivated by entrance into the WTO. I provide evidence from news reports that this was the case in Section 2.

[5] The measure is similar to that in Besley and Burgess (2004).

increased demand for exports, led to relaxation of migration restrictions.

In addition to hand-coding the migrant-related regulations to evaluate whether they are pro-migrant or anti-migrant, I also apply natural language processing methods with machine learning algorithms to validate the manual coding. From 2001 to 2007, 162 cities out of 340 relaxed their migration restrictions to some degree and implemented new regulations related to workplace training, wage-arrears prevention, medical and social insurance, and school access.

I estimate the effect of trade shocks on migration regulations across 250 Chinese prefectures from 2001 to 2007 using a long-difference specification. I identify regional trade shocks using a standard methodology; however, I use export shocks (similar to the that in Bustos 2011, McCaig and Pavcnik 2018, and Bombardini and Li 2020), instead of import shocks, which are more common in the literature.[6] I calculate a prefecture's exposure to trade shocks using the interaction of industry-level tariff reductions and prefecture-level industry employment shares. To address the concern that industry-level post-WTO trade shocks might be correlated with pre-WTO industry characteristics, I show that industry-level post-WTO tariff declines were not correlated with pre-WTO export growth or tariff declines. The tariff reductions come from countries that import Chinese goods and should not be correlated with prefecture-level economic conditions. Accordingly, prefecture-level post-WTO tariff declines are not predicted by pre-WTO economic growth levels.

Overall, I find that regions that faced larger increases in access to export markets had larger increases in their migration regulation index, indicating more favorable treatment of migrants. The regulation score of prefectures whose trade shocks were in the upper third of the distribution rose 0.25-standard-deviation higher than the regulation score of prefectures in the lower third. Further, prefectures with a higher demand for migrants responded more positively to the trade shock. I also find that other WTO-induced export demand shocks generated similar regulatory changes, including (i) permanent-normal-trade-relations (PNTR) shocks as in Pierce and Schott (2016) and Handley and Limão (2017) and (ii) Multi-Fibre-Arrangement (MFA) quota reduction as

[6]The literature on the import competition effect of trade includes Autor, Dorn and Hanson (2013), Kovak (2013), and Topalova (2010).

in Khandelwal, Schott and Wei (2013). These results are robust to using trade measures following Autor, Dorn and Hanson (2013) and using alternative measures of regulation scores.

I complement the main analysis with two additional exercises to show that these regulatory changes were associated with improved migrant well-being and increased migrant flows. The documented regulation changes are *de jure.* To provide some evidence on *de facto* regulation changes or the enforcement of the regulations, I show that in the 2005 cross-section, migrants in places with higher migrant friendliness had higher levels of well-being, conditional on similar measures of well-being of locals.[7] This suggests that the migrant-friendliness score indeed captures the implementation of regulations that improve migrant well-being. I also show that trade shocks led to changes in migrant flows, and these migrant flow responses were associated with the regulatory changes.[8]

This paper contributes to several literatures. Among the already-mentioned papers that study the determinants of institutions and the effects of the WTO, this paper complements Khandelwal, Schott and Wei (2013) by providing the direct evidence on the impact of trade on observed regulation changes, instead of inferring institutional reforms from observed trade patterns. This method of direct measurement of institutional changes using regulation texts is in line with the recent political economy literature using text-based data (as in Gentzkow, Shapiro and Taddy 2019 and summarized in Gentzkow, Kelly and Taddy 2019).

A few theoretical papers study the interactions between trade liberalization and migration liberalization: specifically, how welfare gains from trade liberalization are affected by labor market frictions or how the effect of migration liberalization is compromised by the existence of trade frictions.[9] Tombe and Zhu (2015), Fan (2015), and Ma and Tang (2016) focus on China, studying the aggregate and distributional effects of international and domestic trade on productivity where

[7]The well-being measures include the share of migrant population with social insurance, wages, and contract lengths.

[8]It is difficult to separately identify the direct impact of trade shocks on migrant flows through prices, and the indirect impact through regulation changes. See discussions in Appendix C.11.1 on the threat to identification and various attempts to identify the causal impact of migration regulations on migrant flows.

[9]See Alessandria and Delacroix (2008), Kambourov (2009), Helpman and Itskhoki (2010), and Caliendo et al. (2017).

labor market frictions exist. While this literature takes labor market frictions as given, I argue that these labor market institutions are endogenous and respond to economic incentives, and provide empirical evidence on how a plausibly exogenous trade shock on regulations affect labor market frictions. To my knowledge, there is no study that has documented the causal effects of trade liberalization on migration regulations.[10]

This study relates to the literature on fiscal competition (for example, Fajgelbaum et al. 2015 and summarized in Oates 1999 and Wilson 1999). I show that regions compete to attract a common labor force by providing amenities or subsidies. However, I do not directly address efficiency issues related to such competition. Actually, when other distortions exist in the economy, this competition for labor could be welfare-improving for all. I discuss this possibility in Section 8. Lastly, this paper is related to the literature on the effects of migration on economic outcomes (for example, Card 1990, 2001, Borjas 2003, and Ottaviano and Peri 2012 among many others). While most of the papers in this literature use exogenous increases in migrant flows, I emphasize the importance of regulatory forces in driving changes in migration.

The rest of the paper is organized as follows. In Section 2, I discuss the background on the Hukou system. Section 3 describes my new data on Hukou regulation changes. Section 4 presents the trade shocks associated with China's WTO accession. Section 5 presents the main empirical results on the effects of trade on migration policies. Section 6 provides supplementary empirical evidence showing that these regulatory changes affected migrant well-being, and Section 7 shows the effect of trade and regulation changes on migrant flows. Section 8 concludes.

[10]Feler and Senses (2017) shows that trade shocks from China affect the local provision of public goods in the United States through the tax revenue channel. My paper adds to the discussion in two ways. First, local governments in Feler and Senses (2017) do not make adjustments in tax rates, and the public provision is a mechanical function of the tax revenue. In my case, the local government has the power to pass new regulations to adjust the amenity provision in response to trade shocks. In addition, the migration regulations control the number of migrants indirectly through the amenity level, and migrant flows can affect future economic growth. Second, the migration regulation changes are part of the Hukou reform, increasing labor mobility within China, and potentially decreasing spatial labor misallocation.

2 Background: The Hukou System in China

China's Hukou system is the internal registration system for Chinese citizens. Each individual has a Hukou status associated with a location and a sector (agricultural vs. nonagricultural) based on parents' status. To formally switch sector or prefecture, an individual needs to obtain a temporary Hukou registration enabling legal migrant status. Illegal migrants face the risk of retention and repatriation. Illegal migrants usually work on temporary jobs; formal manufacturing positions usually require temporary registration. Government jobs, jobs at state-owned enterprises, and many other permanent jobs are available only to locals. Even legal migrants with temporary Hukou suffer diminished access to public services such as medical insurance and public schools (CECC 2005; Yusuf and Saich 2008).

Before 2000, the central government held a rigid stand on the Hukou system, and lower-level governments were universally subject to the national policy. It was difficult for an urban resident to get a Hukou in other prefectures, unless he or she found an official job in an urban area that sponsored Hukou changes. The process was even harder for those wishing to switch from agricultural to nonagricultural Hukou. There were tight annual quotas, most of which were assigned to people whose spouse held a nonagricultural Hukou.

The Hukou stystem has been linked to spatial disparities in income (Wang and Zuo 1999; Tombe and Zhu 2015). In 2000, 11% of the population was employed in a prefecture-sector other than their assigned Hukou. Migrant workers worked and lived under inferior conditions; their legal rights at work were not protected and they had limited access to local schools and hospitals.[11]

Around 2000, the central government started to soften its stance on issues related to Hukou. The Tenth Five-Year Plan talked specifically about reducing political barriers to migration.[12] In addition, local governments were allowed some discretion to design their own reforms following the central government guidelines.[13] The timing of the reform coincided with WTO accession;

[11] Source: `http://www.gov.cn/zhuanti/2015-06/13/content_2878968.htm`.

[12] From the Tenth Five-Year Plan: *"We will adapt to the market-oriented employment mechanism ... to have an orderly and reasonable allocation of rural and urban labor."* Source: `www.people.com.cn/GB/shizheng/16/20010318/419582.html`, or `www.gov.cn/gongbao/content/2002/content_61966.htm`.

[13] According to a 2001 document by the State Council of China, *"Local governments should take into consideration*

in research articles and interviews with government officials, WTO accession was described as a chance to reform the Hukou system.[14]

The central government's evolving stance spurred substantial local responses. Cities started to improve the well-being of legal migrants and set up a pathway for some migrants to get permanent local Hukou. They set up guidelines to protect migrant workers' legal rights in the workplace and also granted partial access to the social safety net and other local amenities. Some prefectures allowed migrant children to enroll in local primary and secondary schools. A few prefectures established a point-based system for applying for a local Hukou.[15] Although migration was still regulated, the number of migrants increased. By 2010, the number of Chinese migrants was 260 million, almost double the 2000 figure, and a larger share of migrants were moving between prefectures.

3 New Data on Hukou Policies

3.1 The Regulation Dataset and Manual Coding of Migrant Friendliness

To document the change in Hukou regulations, I collected government regulation documents from the website `www.pkulaw.com`. This fee-for-service website contains databases including laws and regulations (22,148 items), legal news (16,696 items), legal cases (1,955 items), and other law and regulatory information in China.

I use the database of central and local government regulations. The website collected documents from official government websites, government gazettes, repositories of laws and reg-

local economic and social development levels and conduct reforms that balance population growth, infrastructure, employment and social security, and other welfare programs." Source: `www.gov.cn/zhengce/content/2016-09/22/content_5110816.htm`.

[14] An interview with the Minister of Public Security, Division of Hukou Management, in 2001, writes: *"The employment system, education system, and social security system are all evolving, and it is about the time to partially liberalize internal migration. Entering the WTO is an opportunity to change the Hukou system from management to service."*

[15] This is similar to the point-based system for immigration in Canada and Australia. Source: `https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate-canada/express-entry/eligibility/federal-skilled-workers/six-selection-factors-federal-skilled-workers.html` and `http://www.visabureau.com/australia/immigration-points-test.aspx`.

ulations, as well as documents provided by relevant government units; all of these sources are recognized by Chinese legislative regulations.[16] The database contains at least one regulation document from 332 of China's 340 prefectures. Through December 31, 2016, Shanghai, Beijing, and Chongqing have more than 25,000 items; the median number of items per prefecture is 861. To my knowledge, this is the most comprehensive dataset on Chinese government regulations.[17]

A keyword search of document titles was conducted for the following migration-related terms: *non-Hukou population*, *migrant worker*, *temporary residence*, and *Hukou*.[18] At the prefecture government level, there were 168 items from 1995 to 2001 and 749 items from 2001 to 2007. These regulations cover various aspects regarding migrant life. 31% of the regulations are about work-related issues, covering topics such as ensuring timely wage payments, labor unions, vocational training for migrant workers, providing legal assistance, and other support services. 12% are related to the access to the social safety net, for example, migrant workers' access to unemployment insurance, injury insurance, medical insurance, and pensions. 6% of the regulations are about other welfare-related programs: allowing migrant kids to local primary and secondary public schools, health benefits such as free vaccination, housing support, and financial services. 34% are on administrative issues regarding temporary Hukou registration, 9% are related to birth control policies for migrants, and 8% are about miscellaneous issues.

Figure 1 provides a glimpse of contents of the regulations. Panel (a) shows the top 200 words in the pool of regulations on work-related issues, with a larger font representing a higher frequency. We can see that the important words include "(wage) arrear," "training," "professional," "project payment," "labor contract," "pay," and "enterprise," pointing to the issues encountered by migrant workers at their workplace. Panel (b) presents the most frequent words for the regula-

[16]The local government database includes governmental regulations, regulatory documents, judicial documents, and government rules by all provinces, autonomous regions, municipalities, capital cities of provinces, 19 large prefectures designated by the State Council, and other prefectures.

[17]The dataset has also been used by Fan (2015) and Wenkai, Chongen and Peichu (2011) to evaluate Hukou reforms. However, they only evaluate the regulations that allow changes in the Hukou status, while I include all regulations related to migrant well-being.

[18]"Non-Hukou population" and "migrant worker" are common terms used to refer to internal migrants in China. Since the very definition of the internal migrants are tied with Hukou status, the terms "temporary residence" and "Hukou" are used to capture the regulations related to Hukou-related issues.

tion on welfare-related topics. The important words are quite different from Panel (a), including "children," "school," "compulsory education," "vaccination," and "immune."[19]

[Figure 1 about here.]

Some regulations are beneficial for migrant workers; others are not. Earlier, regulations mainly addressed how to manage the non-Hukou population, for example, repatriation of migrant workers in rental houses. I consider these regulations as anti-migrant. Starting in 2001, there were more regulations on reductions in fees for temporary residence and work permits, providing migrant children with compulsory schooling, urging firms to pay wages and sign contracts, and incorporating migrant workers into the social welfare system. Such regulations are deemed pro-migrant. Some regulation documents are purely about information on the logistics on obtaining certain certificates (e.g., birth certificate) for migrant workers, and they are deemed neutral.

To evaluate the migrant-friendliness of the regulations, I create a five-point index with scores ranging from –2 to 2, for each item, and a prefecture-level score in a certain year is generated by summing over the indices of all regulations enacted since 1995 until this year. The following rule is used to distinguish 1 vs. 2 among pro-migrant regulations: (1) if a regulation includes articles that increase the provision of services for migrant workers in multiple dimensions (e.g. wage payment, contract enforcement, and training), I tend to code it as 2 instead of 1; (2) if a regulation is about setting up a complete, executable guideline for a specific issue, I tend to code it as 2, while for temporary enforcement regulations, I tend to code them as 1. Similar rules apply to anti-migrant regulations. The sum of regulation scores is used to measure overall migrant-friendliness since each additional regulation either addresses a different issue or reinforces (or mitigates) the changes in the same issue. Overall, migrant amenities should be an increasing function of the regulation score.[20]

[19] Appendix A.1 shows the corresponding word clouds for other topics. Note that the original word cloud is produced using the Chinese texts, and synonyms in Chinese can translate into the same English words, resulting in the same words showing up more than once in the English-version word cloud.

[20] Figures A.11, A.12, and A.13 present the top 200 words among regulations that were coded pro-migrant, neutral, or anti-migrant. The pro-migrant frequent words include "wage," "training," "education," and "obtain local Hukou," the neutral ones include "family planning," "temporary residence permit," and "registration," and the negative ones

Among the 250 prefectures analyzed, the median score in the 1995–2001 period is 0, and the maximum is 7; for the 2001–2007 period, the median is 1 and the maximum is 44. Besides Beijing, Chongqing, Shanghai and Tianjin, prefectures with very high scores include Ningbo and Guangzhou, which had very strong export-oriented growth.[21]

3.2 Alternative Coding and Machine Learning Methods

To ensure the objectivity of the score coding, I hired two research assistants with law degrees to code the scores independently. This was done at the early stage of the study through the online platform `www.upwork.com`, and the 686 regulations enacted between 1995 and 2005 by provincial government and prefectural government have three codings, by myself and two research assistants. The correlations between my coding and their codings for individual regulation scores are 0.62 and 0.72 for the entire set of 686 regulations, and are 0.67 and 0.74 for the 390 regulations enacted by prefecture-level governments.

With this set of triple-coded regulations, I implement a supervised learning exercise with natural language processing (NLP) methods to supplement the manual coding. To improve the coding accuracy and reduce noise in the NLP coding process, both the prefecture-level regulations and the provincial level ones are included to obtain a larger sample size. I use the triple-coded sample as the training set, and the score is calculated as the average of the three codings, rounded to the closest integer. The assumption here is that by using the average of the three, the coding reflects the "true" extent of migrant-friendliness of the regulations. Then the model is applied to 4,273 regulations enacted from 1978 to 2016 to generate a classification to the five-point index with scores ranging from –2 to 2.

The main NLP classification method is random forest, where the algorithm is a decision tree combined with bootstrapped samples. The regulation text is decomposed into words, and each

include "rental housing," "public security department," and "punishment." See Appendix A for details of the coding procedure and additional summary of statistics of the regulation scores.

[21] In Appendix C.7, a three-point scale (–1, 0, 1) is used and regulation scores are separated by topic to confirm the robustness of my results on the score coding.

regulation is represented as a combination of words and corresponding frequencies of the words appearing in the text. First, I use the training set with document texts and their corresponding outcomes (the score of migrant friendliness). The decision tree starts with taking an attribute (a word) and the value of the attribute (the word count), and splitting the set of document by a criteria (word count larger or smaller than a number). Then the tree grows by moving on to the next attribute. Eventually the set of documents are classified into groups taking the value in the set of $\{-2, 1, 0, 1, 2\}$. The order of attributes and their values used in the hierarchy of decision making are chosen to minimize the error rate, which is the share of misclassified documents according to the rule.[22]

The final model is constructed using 686 documents and 10,243 words.[23] The top 200 words by importance are plotted in Figure 2. The top three are "floating population," "migrant worker," and "temporary residence permit." Among the rest, "family planning," "obtain local Hukou," and "(wage) arrear" are important words in the migrant-related regulations. "Timeliness," "effectiveness," and "normativity" are words usually used in the regulations to present a positive sentiment, and "rental housing" and "public security" are used in the ones coded more negatively.

[Figure 2 about here.]

Overall, the random forest coding is highly correlated with the manual coding, with a correlation of 0.73. I also implement two other NLP methods: multilayer perceptron classification (MLP) with neural networks, and convolutional neural network (CNN) with word-embedding. These two methods are based on neural networks and have more complicated decision rules, making it harder to visualize the important factors for the classification. However, the two methods generate very

[22]To avoid overfitting of a simple decision tree based on a training set, the random forest introduces randomness in the sampling method for the training set and the attributes used. First, the random forest uses a bootstrap sample of the same size of the training set using sampling with replacement. This means that the training set is different for each tree. Second, the random forest draws a sample of the attributes to choose from in each step of growing the tree. The result is the average across trees. Once the trees are grown, the importance of the each attribute can be calculated, so one can see what the key words are in the decision making process.

[23]Due to the randomness of the training set, the model accuracy can be evaluated as the share of mis-classified documents that are not included in the training process (out-of-bag prediction error). The number is 20.70% in the training set.

similar results.[24] In the empirical analysis, all three machine-learning codings will be used.

3.3 Summary of Statistics of the Regulation Data

Over time, the number of migrant-related regulations and their migrant friendliness increase. Figure 3 Panel (a) plots the prefecture-level average number of new regulations on migrant issues and the regulation score. Each dot on the dashed line represents the total number of regulations in each year divided by the total number of cities. Each dot on the solid line represents regulation scores. The trend shows that before 2001, about 0.1 regulation per city per year addressed migrant issues. However, the migrant-friendliness score was essentially zero, indicating no deviation from the national policy, on average. After 2001, both the number of new regulations and the regulation friendliness score increased substantially. In 2006, for example, there was about one regulation per prefecture, and the average score was about 1, indicating that there were more regulations and those regulations were more favorable to migrants than before 2001.

[Figure 3 about here.]

Figure 3 Panel (b) plots the trends in regulation score from 1995 to 2007, by topic. The figure shows that the increase in the total score of regulation is mainly driven by work- and insurance-related regulations (the solid line and dashed line with hollow circles, respectively). In 2007, for example, the average score for all regulations is about 0.9, where 0.5 is from work-related regulations, and 0.3 is from insurance-related ones.

One potential concern about the regulation data is that the number of migrant-related regulations might increase mechanically due to improved data coverage over time. To alleviate this concern, I also count the total number of regulations on fiscal topics and resource topics.[25] These regulations are more routine and logistic-related and should be less responsive to economic conditions. Figure 4 plots the fiscal regulations (the dashed line) and the resource regulation (the solid

[24] See the details of the NLP methods and results in Appendix A.1.

[25] The website www.pkulaw.com allows users to search by topic.

line). Both of them act as a kind of placebo regulation; neither line demonstrates a clear pattern, and there is no trend break around 2001, in contrast to the migration related regulations in Figure 3.

[Figure 4 about here.]

4 China's WTO Accession and Declines in Trade Barriers

4.1 Tariff Changes

China entered the WTO in November 2001 as the 143rd member country. In the accession agreement, China and the partner countries committed to reducing import tariffs, removing quotas, and reducing other non-tariff barriers. In short, China started to enjoy MFN status. This means, among other things, that Chinese goods would face the same tariffs as other WTO members.[26]

This paper focuses on the decline in output tariffs on Chinese goods imposed by countries that import from China, referred to as the "export tariff shock." The 2-digit-SIC-level tariff is constructed as the weighted average of destination-country applied tariffs on Chinese exports in the specific 2-digit industry, where the weights are shares of exports in this destination country in the specific industry in 1995, using the World Bank TRAINS dataset. The decline was sizable, and industries that experienced bigger tariff declines also experienced bigger export volume growth. Figure 5 shows that the tariff on Chinese goods stood at about 5.8 percentage points in 1995, declined to 4.1 percentage points in 2001, and declined even further to 3 percentage points in 2007. Figure 5 shows percentage point changes in tariffs on the horizontal axis and the change in log exports on the vertical axis. Each dot represents an industry. The hollow triangles are for 1995–2001 and the solid squares are for 2001–2007. In both periods, the fitted lines have a slope of –0.13, meaning that a one percentage-point reduction in the tariff faced by Chinese exporters induces a 13%–14% increase in export values.

[26] See China's accession protocol: `www.wto.org/english/thewto_e/acc_e/completeacc_e.htm`.

[Figure 5 about here.]

I study the post-WTO period of 2001–2007, comparing prefectures that had bigger versus smaller export tariff shocks. Although it seems that there are no discontinuous changes on the overall tariff level from the pre-WTO period to the post-WTO period, there are substantial changes on the industry level.[27] My identification strategy will rely on differences in export specialization across Chinese prefectures: there is a larger export tariff decline to prefectures with larger employment shares in industries facing larger output tariff declines. As in Kovak (2013), the regional shock in prefecture i and from time t to t' is

$$\text{Trade Shock}_{it} = \sum_j \beta_{ij} \hat{P}_{ijt},$$

$$\text{where} \qquad \beta_{ij} = \frac{\lambda_{ij} \frac{1}{\theta_{ij}}}{\sum_{j'} \lambda_{ij'} \frac{1}{\theta_{ij'}}},$$

$\lambda_{ij} = \frac{Lij}{Li}$ is the fraction of regional labor allocated to industry j, and $1-\theta_{ij}$ is the cost share of labor in industry j. λ_{ij} and θ_{ij} are calculated from the 2000 Industrial Enterprises Survey data. $\hat{P}_{ijt}$ is the price shock to industry j in region i from time t to t', and it is measured using export tariffs faced by Chinese exporters (with superscript X):[28]

$$\hat{P}^X_{ijt} = \hat{P}^X_{jt} = -\left[\ln(1+\text{tariff}^X_{jt'}) - \ln(1+\text{tariff}^X_{jt})\right].$$

I focus on the export tariff shock for several reasons. First, the export tariff decline was direct and salient from the government officials' perspective. The decline in input tariffs also played an

[27] Appendix Figure A.16 shows the distribution of tariff reductions across industries.

[28] Trade shocks due to tariff reductions on Chinese imports are measured in a similar way. See Appendix B.1 for details.

important role, but it was more indirect. Second, although policy discussions mentioned import competition, they mostly focused on the competition on high-end goods such as automobiles and agricultural products. China's comparative advantage was thought to be on labor-intensive or low-skill-intensive goods, and the export expansion in these industries was likely to trigger migration regulation changes. In the empirical analysis, I control for import tariff shocks and intermediate goods tariff shock.

4.2 Trade Uncertainty and Quotas

The WTO accession also induced other positive demand shocks for Chinese exports. First, Handley and Limão (2017) and Pierce and Schott (2016) show that the United States applied MFN tariffs on Chinese exports even before the WTO accession. However, before 2001, there was great uncertainty regarding the U.S. trade policy: the MFN status had to be approved each year by the Senate and the House; otherwise, the Column 2 tariff would be applied to Chinese exports. Handley and Limão (2017) argue that the greater policy certainty was the main impact of the WTO accession on the U.S.–China trade relationship. I measure the size of the PNTR shock experienced by prefecture i in the time period $t = 2001$–2007 as

$$PNTR_{it} = \sum_j \beta_{ij} (Column2^{US}_{j,2000} - MFN^{US}_{j,2000}) \times \frac{export^{US}_{i,2000}}{export^{W}_{i,2000}},$$

where $Column2^{US}_{j,2000}$ is the U.S. Column 2 tariff on industry j in 2000, $MFN^{US}_{j,2000}$ is the U.S. MFN tariff, $export^{US}_{i,2000}$ is the total exports from prefecture i to the United States in 2000, and $export^{W}_{i,2000}$ is the total exports from China in 2000.[29]

Second, Khandelwal, Schott and Wei (2013) show that the Chinese textile and clothing exports to the United States, the European Union, and Canada were subject to Multi Fibre Arrangement (MFA) quota restrictions until January 2005. The removal of these restrictions boosted Chinese

[29]The 2000 Column 2 tariffs and MFN tariffs at the eight-digit HS level imposed by the United States is from Handley and Limão (2017). I then use Pierce and Schott's (2012) concordance to map the eight-digit HS tariffs to 2-digit SIC tariffs. Each prefecture's exports to the U.S. and other countries are from the 2000 customs data with destination country and source region information.

exports in corresponding industries. A prefecture i's exposure to MFA shock in the time period $t = 2001$–2007 is

$$MFA_{i,t} = \sum_p \frac{export_{p,i,2000}}{\sum_{p'} export_{p',i,2000}} \cdot D(MFA_p^{2001-2005} = 1),$$

where p is an eight-digit HS category, $export_{p,i,2000}$ is the export of product p from Chinese prefecture i to the world, and $D(MFA_p^{2001-2005} = 1)$ is an indicator variable that takes the value of 1 if the export is to the United States, Canada, and the European Union, and product p is subject to the MFA quota at any time between 2001 and 2005.

Seeing the opportunities arising from these shocks to promote exports, Chinese local governments may respond similarly by relaxing internal migration restrictions. I will investigate the impact of these export demand shocks on migration regulations empirically in the next section.

5 Main Empirical Results: Effects of Trade Shocks on Regulation Changes

5.1 Econometric Framework and Identification

Did trade induce changes in labor regulations? I am interested in estimating the following equation:

$$\Delta \ln(\text{Regulation Score})_{it} = \alpha_0 + \alpha_1 \text{Trade Shock}_{it} + X_{it}\Gamma + \varepsilon_{it},$$

where i represents a prefecture and t represents a time period. X_{it} is a matrix of potential confounding factors that could be correlated with the trade shocks. Δ represents the change during the time period, and $\ln(\text{Regulation Score})_{it}$ is the inverse-hyperbolic-sine transformation of the regulation score in prefecture i and time period t. I use the transformed regulation score instead of the levels of the regulation score since the distribution of levels are very skewed to the right: the mean of the change in regulation score from 2001 to 2007 is 2.7, while the maximum is 37. The correspond-

ing numbers for the transformed ones are 1 and 4.6, respectively. The inverse hyperbolic sine transformation is used to include the prefecture-years with zero or negative cumulative migrant friendliness, and in the remaining text, I use "log regulation score" as a shorthand, given the close correspondence between the natural log and inverse hyperbolic sine.

α_1 is the coefficient of the effect of export tariff shocks on changes in log migration regulation score. Identification of α_1 requires that conditional on X_{it}, there are no unobservables that are correlated with the export tariff shocks and have a direct impact on migration regulation changes. I address two types of identification issues here. First, on the industry level, the WTO-induced decline in tariffs on Chinese exports should be uncorrelated with pre-WTO trends, such as pre-WTO export growth and pre-WTO tariff reduction. Otherwise, the regional trade shock will capture preexisting industry characteristics instead of WTO shocks. Second, on the prefecture level, the WTO-induced regional trade shocks should not be correlated with pre-WTO trends, such as pre-WTO GDP growth and wage growth.

Although China's WTO accession was a lengthy process involving lots of preparation and negotiation, the post-WTO tariff decline was still a shock to industries. China obtained MFN status after the WTO accession, and the resulting tariff reductions on Chinese exports were mainly determined by WTO rules. Empirically, across industries, the post-WTO tariff declines could not be predicted by either the pre-WTO export growth or the pre-WTO tariff decline. Thus, there were still relative industry "winners" and "losers" due to the WTO accession. Figure 6 Panel (a) plots the percentage-point change in tariff in the 2001–2007 period on the y-axis and the percentage change in exports in 1995–2001 on the x-axis. The linear fitted line has an insignificant coefficient of 0.03, meaning that the industries that had bigger pre-WTO export growth were not the ones that experienced bigger post-WTO tariff cuts. Figure 6 Panel (b) plots the percentage-point change in tariffs in 2001–2007 against the percentage-point change in tariffs in 1995–2001. The linear fitted line has a coefficient of –0.03 and is statistically insignificant. This indicates that the industries experiencing larger tariff declines during WTO accession had similar export growth and tariff changes in prior years.

[Figure 6 about here.]

Figure 6 also helps to address the concern that some unobserved domestic policies in the post-WTO period might target industries where tariffs happened to decline more or less than other industries.[30] If there were pre-WTO industry policies that intended to help or hurt certain industries, these policies were not correlated with post-WTO tariff changes; if there were post-WTO industrial policies that responded to pre-WTO export growth, they were also not correlated with the post-WTO tariff changes.[31]

Declining tariffs in various industries translated into prefecture-level shocks that should not be correlated with local economic conditions other than through the prefecture-level industrial composition.[32] Figure 7 Panel (a) plots the trends in wages of prefectures with small (bottom third of the trade shock distribution in the 2001–2007 period), medium (middle third), and large (top third) trade shocks, and the three trends from 1995 to 2001 are not statistically different from each other. Figure 7 Panel (b) plots the trends in per capita GDP; here, there seems to be a slight divergence among the three groups from 1995–2001. The three trends are not statistically different from each other, but to be conservative, I control for 1995–2001 wage and per capita GDP growth in the regressions.[33]

[Figure 7 about here.]

5.2 Main Results

Figure 8 shows the relationship between trade shocks and migration regulation changes from 2001 to 2007. The horizontal axis depicts the export tariff shock in the 2001–2007 period; a bigger

[30] For example, the Chinese government provided value-added tax rebates for exporting firms to encourage exports.

[31] Another piece of evidence against local governments' strategic manipulation of industrial composition is that the industry-prefecture level correlation of sales between 1998 and 2001 is 0.97.

[32] See the Herfindal Index Distribution in Appendix B.1.2.

[33] See details of the City Statistics Yearbook data in Appendix B.3.

export tariff shock corresponds to lower export tariffs and effectively higher export prices. The vertical axis depicts the post-WTO change in the log regulation score, and each dot is a prefecture. The dashed line is the linear fitted line with 2001 population size as weights, and the dotted line is the unweighted linear fitted line. The slope ranges from 0.9 to 1.9, and the values are statistically significant at the 5% level. This indicates that prefectures that experienced more positive trade shocks saw their regulation score rise, meaning they became more friendly to migrants. By comparison, the same regressions in the pre-WTO period give slopes of –0.02 to 0.01 and they are statistically insignificant.[34] In addition, following Borusyak, Hull and Jaravel (2018), I aggregate the regulation changes and trade shocks at the industry level to have a more transparent demonstration of the industry-level variation, and Appendix C.3 shows that it is not one or two industries that drive the results.[35]

[Figure 8 about here.]

Table 1 Panel (a) shows the corresponding regression results. The outcome variable is the change in log regulation score from 2001 to 2007. All columns have standard errors clustered at the province level to account for potential spatial correlation of laws and regulations at the province level. Column (1) controls for export tariff shocks from 2001 to 2007. The coefficient 0.90 is statistically significant at the 5% level. It implies that a 1-percentage-point larger export tariff shock increased the change in log regulation score by 0.90, which is equivalent to a 0.82-standard-deviation bigger regulation score increase. I divide prefectures into three groups: (1) prefectures with big trade shocks (0.33-percentage-point tariff changes on average); (2) medium shocks (0.18 percentage point); and (3) small shocks (0.02 percentage point). Thus, compared with small-shock prefectures, the big-shock prefectures experienced a 0.28-unit larger increase in the log regulation score; the difference is equal to 0.25 standard deviation of the score increase in

[34] See Appendix C.2 for the corresponding pre-WTO plot.

[35] Both Borusyak, Hull and Jaravel (2018) and Goldsmith-Pinkham, Sorkin and Swift (2018) propose diagnostic tests for exogeneity of the Bartik measure. However, both papers use Autor, Dorn and Hanson (2013) as an example of application, where there are over 200 industries. Borusyak, Hull and Jaravel (2018) points out that the application is less appropriate for settings with a small number of industries, as in Kovak (2013).

the 2001–2007 period.[36]

[Table 1 about here.]

Columns (2)–(8) control for various potential confounding factors to check the robustness of the result. First, I control for import and intermediate tariff shocks in case they are correlated with the export tariff shocks facing Chinese exporters. Second, I control for other variables that might have been important determinants of regulation changes, including the baseline value of regulation scores, the lagged change in regulation score, the lagged trade shock, or lagged economic growth rates.

The results are robust with respect to adding import and intermediate tariff shocks in Columns (2)–(8), and adding other potential determinants of regulation changes in Columns (3)–(8). The estimates for the effect of export tariff shocks from 2001 to 2007 range from 1.08 to 1.61 and are all statistically significant at the 10% level; all of them are within the 95% confidence interval of the estimate in Column (1).

Panel (b) repeats the exercise with regulation scores coded by the NLP methods. I take the mean of the scores from the three NLP methods to reduce noise. The results are very similar to the ones in Panel (a); as shown in Figure A.17, the correlation between scores coded manually and coded by the NLP methods is close 1.

[Table 2 about here.]

I then investigate the impact of alternative positive trade shocks on the regulation changes. Table 2 Column (1) replicates Table 1 Column (3), and Column (2) adds the measure of uncertainty reduction due to the PNTR shock. The coefficient estimate for the uncertainty shock is 4.15 and statistically significant, indicating that a one-standard-deviation larger uncertainty shock led to a 0.12 unit larger increase in the log regulation score. Column (3) shows a statistically significant

[36] I focus on 250 prefectures with consistent data on GDP and wages from the City Statistics Yearbook. See Appendix B.3 for details of data and Appendix C.6 for replication of results in Table 1 with alternative sample sizes.

effect of the MFA shock, with a one-standard-deviation larger MFA shock leading to a 0.14 unit larger increase in the log regulation score. When both shocks are added in Column (4), both coefficients become smaller. In all columns, the coefficients on the export tariff shock remain largely unchanged, and the effect of the tariff shock is larger than the other two shocks (a one-standard-deviation larger increase in the export tariff shock led to a 0.24 unit larger increase in the log regulation score). This result is reasonable since the tariff shocks affected all industries and all regions, the PNTR shock affected mostly the firms and regions that exported to the United States, and the MFA shock affected mostly the textile industry.

Overall, the findings are consistent with the hypothesis that in the post-WTO period, places with bigger trade shocks relaxed migration restrictions more. Appendix C.4 shows a stacked long-difference specification where each prefecture has two observations (1995–2001 and 2001–2007) and the results are similar. The effects are also robust to using the levels of regulation scores instead of the hyperbolic-sine-transformed ones (Appendix C.5). Appendix C.7 decomposes the migration regulations by topic and finds that the work-related and welfare-related regulations were impacted the most by trade shocks. The results are robust to using a three-point coding scale of regulations instead of a five-point coding scale. In Appendix C.8, I construct alternative Bartik-style trade shocks following Autor, Dorn and Hanson (2013) and instrument the Chinese export growth with importing countries' income growth; the results show similar patterns. Finally, to address the concern that certain industries drive the regional tariff variation and are correlated with other local factors that affect regulation changes directly, in Appendix C.9, I add industry employment shares one at a time and find that the result is not sensitive to specific-industry effects.

A prefecture may not only respond to its own trade shocks but also trade shocks happening in other prefectures, since all prefectures are competing for the migrant labor supply. In addition, a prefecture may change its own migrant regulations when other prefectures change theirs. In Appendix C.10, I show that prefectures responded strongly to trade shocks and regulation changes in other prefectures with similar income levels. This is consistent with the fact that Chinese prefectures in different income groups are considered to be in different tiers (for example, Beijing,

Shanghai, and Guangzhou are in the first tier), and they are more likely to compete within tiers for capital, labor, and other resources.[37]

5.3 Heterogeneous Effects

Places with bigger migrant-intensive industries should respond more to the trade shock. I investigate this heterogeneous effect using three sets of empirical proxies for a prefecture's migrant intensity. First, I calculate the migrant share of employment in each industry using the 2005 mini-census to measure industry-level migrant intensities. Then the regional migrant intensity is the employment-weighted average migrant intensity across industries. Second, state-owned enterprises (SOEs) are usually more restrictive in Hukou requirements and hire more locals than migrants. Thus, the employment share of private firms (or non-SOEs) will be positively correlated with migrant intensity.[38] Third, a prefecture's income level is empirically positively correlated with migrant intensity. This could be because richer prefectures tend to have more diversified industrial composition and rely less on SOEs. Thus, per capita GDP and wages can act as proxies for the migrant intensity.

Figure 9 divides prefectures into four groups, depending on the 2001–2007 trade shock size and one of the four proxies for migrant intensity in 2001, with the median value as the cutoff. In Panel A, the four groups are (1) big trade shock and migrant-intensive prefectures (solid line with solid squares), (2) big trade shock and not-migrant-intensive prefectures (solid line with hollow squares), (3) small trade shock and migrant-intensive prefectures (dashed line with solid dots), and (4) small trade shock and not-migrant-intensive prefectures (dashed line with hollow dots). In Panel B, C and D, the proxy for migrant intensity are the private firm employment share, per capita GDP and wages, respectively.

The four graphs confirm the heterogeneous response to trade shocks: prefectures that experi-

[37] This result is in line with Tiebout (1956) type of fiscal policy decisions. Feler and Henderson (2011) find negative strategic interactions among localities in making exclusionary policies against low-income households: Brazilian cities seem to view low-income households mainly as causes of fiscal expenditure instead of sources of fiscal revenue.

[38] I use the 2001 Industrial Enterprises Survey data to calculate the prefecture-level share of total sales in state-owned enterprises.

enced bigger trade shocks and were more migrant-intensive changed migrant regulations the most, and the ones that experienced smaller trade shocks and were less migrant-intensive changed regulations the least.

[Figure 9 about here.]

Table 3 shows similar findings as in Figure 9 using regression analysis. The regression equation is as follows:

$$\Delta \ln(\text{regulation score}_{it}) = \beta_0 + \beta_1 \text{TS}_{it} + \beta_2 \text{I}_{it} + \beta_3 \text{I}_{it} * \text{TS}_{it} + X_{it}\Gamma + \varepsilon_{it},$$

where TS_{it} is the export tariff shock in prefecture i and time period starting at $t = 2001$, I_{it} is one of the four measures for migrant intensity in prefecture i and year $t = 2001$. In Table 3, Columns (1), (3), (5), and (7) show export tariff shock from 2001 to 2007, the variable I, and the interaction of export shocks with I. Columns (2), (4), (6), and (8) add additional controls such as pre-WTO trade shocks and pre-WTO wages and GDP growth, as in Table 1 Column (8). All columns control for import and intermediate trade shocks, and the log regulation score in 2001.

[Table 3 about here.]

Column (1) shows a positive interaction effect for migrant intensity and export tariff shock (18.72), and a negative coefficient for export tariff shock (–5.14). At the mean value of migrant intensity (0.34), the overall effect of export tariff shocks becomes positive. This means that cities with bigger demand for migrants responded more positively to the export tariff shock. Column (2) shows similar results. Columns (3) and (4) use the private-firm share of output, which is positively correlated with migrant intensity, and there is a positive interaction effect as well. It means that cities where private firms dominated responded more positively to the trade shock.

Column (5) shows a positive interaction effect for initial wages and export tariff shocks (4.02), and a negative coefficient for export tariff shocks (–35.88). Approximately at the mean value of

log wages in 2001 (which is 9.11), the overall effect of export tariff shocks becomes positive. This means that richer cities responded more positively to the export tariff shock. Column (6) has similar interpretations. Columns (7) and (8) use per capita GDP instead of wages, and the result is similar: richer prefectures responded more positively, and the overall effect of export tariff shock became positive at the mean value of log per capita GDP. Since the income level and migrant intensity are positively correlated, the results in Columns (5)–(8) confirm the earlier finding.

Overall, migrant-intensive prefectures responded more positively to the trade shock, and this heterogeneity reinforces the conclusion that trade shocks caused the changes in migration regulations.

6 Regulation Changes and Migrant Wellbeing

I provide suggestive evidence on the enforcement of regulations. As explained in Section 3, migration regulations had specific targets: increasing migrant wages, forcing firms to sign contracts, providing social insurance to migrants, and giving migrant children access to local primary and secondary schools. Thus, it would be helpful to see whether the regulations indeed improved these outcomes for migrants and show that the *de jure* regulations were *de facto* effective.

Unfortunately, the only available source that includes these measures is the 2005 1% population survey data. Thus, I cannot see how regulation changes affected *changes* in migrant welfare. I can only investigate in the cross-section whether in prefectures with more pro-migrant regulations, migrants reported greater access to local amenities. To alleviate the concern that prefectures with more migrant-friendly regulations could be essentially different from other prefectures, I control for corresponding local-worker outcomes, log per capita GDP, and log number of migrant adults in 2005. Results are shown in Table 4 Panel A.

Table 4 Panel A indicates that the prefectures with higher regulation scores are also the ones with more favorable migrant outcomes, concerning social insurance, income levels, and contract issues. Column (1) shows that a one-standard-deviation increase in the log regulation score is

related to a 1-percentage-point increase in the unemployment insurance rate for migrants. Given that the mean insurance rate for migrant is 21% and for locals is 38%, a 1 unit increase in regulation score will close 5% of the migrant-local gap; Columns (2) and (3) show similar patterns for pension and medical insurance. The coefficients are statistically significant at the 5% level. Column (4) shows a significant effect of regulation scores on the length of contracts: a one-standard-deviation increase in the log regulation score is related to a 0.14 month increase in the length of contracts, which is 30% of the gap between locals and migrants. Column (5) indicates that a 1 unit increase in regulation score is related to an income increase of 31.4 yuan per month, which is 53% of the wage gap between locals and migrants. Column (6) shows that the regulation score has no significant impact on school enrollment rates among migrant children at the school age. Column (7) is about whether a regulation-score increase is correlated with more migrant children brought to prefectures where their parents are working; the result is insignificant.

[Table 4 about here.]

Panel B regresses local worker outcomes on the regulation score, controlling for the local population size and GDP. Columns (1) (4) (5) suggest that a higher regulation score is correlated with a higher unemployment insurance rate, longer terms of contracts for locals, and higher income among locals. These results might capture the fact that higher-income prefectures usually provide more amenities for both locals and migrants. Column (6) shows a small positive relationship between the regulation score and the local kids enrollment rate.[39] Column (7) shows that a larger number of local children is correlated with less generous migration regulations, suggesting potential congestion forces regarding education resources. It is reassuring that Columns (2) and (3) do not show significant effects of regulations on local welfare measures, indicating that regulation effects are not merely reflections of local socioeconomic levels that could affect migrant welfare directly but also the actual improvement through implementation and enforcement of the regulations.

[39] Given that the baseline enrollment rate is already very high (95%), the increase is very small.

Overall, the results in Table 4 show that prefectures with higher regulation scores also had higher migrant well-being, although the size of the estimates varies by the metric of well-being measure. The significant effects concentrated on unemployment insurance, pension, medical insurance, terms of contracts, and wages, and all these aspects were the focus of many migration regulations. These results suggest that more pro-migrant regulations were associated with improvements in the well-being of migrants in the workplace. The outcomes related to migrant children were not significantly affected by the regulations, and there are several potential explanations. First, school capacities were limited, and it was very costly for prefecture governments to expand the capacity in the short run. Second, prefecture governments may have only wanted the migrant workforce and were reluctant to make substantial changes to incentivize migrant workers to settle down with their family. Third, migrant workers might have viewed their migration as temporary and thus did not want to bring their family, especially considering the fact that migrant children are still not allowed to take the college entrance examination outside their Hukou location.

7 The Impact of Trade and Migration Policy Changes on Migrant Flows

The previous sections documented significant changes in migration regulations in response to trade liberalization, and that the regulation changes were associated with improvement of migrant well-being. In this section, I present supplementary analyses asking whether the trade shocks and the liberalization-induced relaxation in migration regulations led to large changes in migration flows.

In Figure 10 Panel (a), the horizontal axis depicts the export tariff shock from 2001 to 2007, the vertical axis depicts the change in the migrant share of population from 2000 to 2010, and each dot represents a prefecture. The information about the number of migrants is from the 2000 and 2010 censuses. A person is defined as a migrant if he or she has been living in a place other than the Hukou registration place for more than six months or has left the Hukou registration location

for more than six months.[40] The graph shows that larger trade shocks led to the larger increases in the migrant share. The megacities Beijing, Shanghai, and Guangzhou are not outliers.[41] Panel (b) depicts the change in the log regulation score from 2001 to 2007 on the horizontal axis instead, and it shows that the more relaxed the regulation on migrants, the larger the increase in the migrant share.

[Figure 10 about here.]

I estimate reduced-form overall effects of trade shocks on economic outcomes by using the following regression equation:

$$\Delta Y_{it} = \gamma_0 + \gamma_1 \text{Trade shock}_{it} + X_{it}\Pi + \xi_{it},$$

where ΔY_{it} can be the 2000–2010 change of the migrant share of population in prefecture i or the change in the log migrant stock. γ_1 will capture the reduced-form effect of trade shocks on outcome variables, including both the direct price channel and the indirect regulation channel. To identify γ_1, there should be no omitted variable that is correlated with the trade shock and affects the economic outcomes directly. The discussion in Section 5.1 shows that the prefecture-level post-WTO trade shocks are not correlated with pre-WTO wage and GDP growth. Thus, the identification assumption is likely to be satisfied.

To estimate the effect of regulation changes on migrant flows, I use the following equation,

$$\Delta Y_{it} = \pi_0 + \pi_1 \Delta \ln(\text{regulation score}_{it}) + X_{it}\Phi + \zeta_{it},$$

[40] The census and 1% population survey are conducted via personal visits. To address potential issues related to under-reporting, the Census Bureau randomly samples some neighborhoods after the census concludes and check the nonresponse rate. The nonresponse rate in the 2000 census is 1.81%. Source: `www.stats.gov.cn/tjsj/ndsj/renkoupucha/2000pucha/html/append21.htm`. The census information is collected solely for the purpose of counting the population, and the incentive to mis-report is minimal. As discussed in earlier sections, the distinction between legal and illegal migrants is only about whether one has temporary registration or not; the key difference is between *any type of migrants* and locals.

[41] For details of the migrant flow data, refer to Appendix B.2.

where π_1 represents how regulation changes affect the outcome variables, and π_2 represents the direct effect of trade shocks on the outcome variables. If π_1 is identified, combining π_1 with α_1 in Section 5.2, the effect of trade shocks on outcome variables through the regulation channel will be $\pi_1 \cdot \alpha_1$. The regulation effect as a share of the total trade effect is $\frac{\pi_1 \cdot \alpha_1}{\gamma_1}$. However, it is challenging to identify the causal impact of the regulation changes on the migrant flows, since the trade shocks affect the migrant flows directly, through prices, and indirectly, through the regulation changes, and potentially through other channels. In addition, there could be reverse causality issues since increased migrant flows could motivate regulation changes. Thus, the empirically estimated π_1 cannot be interpreted causally.[42]

Table 5 presents reduced-form effects of trade shocks on migrant flows and the association between regulation changes and migrant flows. Panel A Column (1) uses changes in the migrant share of the population from 2000 to 2010 as the outcome variable, and the main regressor is the export tariff shock. I also control for the import tariff shock, the intermediate tariff shock, the migrant share of population in 2000, and the log of population in 2000. Column (1) shows that a 1-percentage-point larger export tariff shock results in a 7.07-percentage-point larger increase in the migrant share of the population. Column (3) shows that a 1-unit larger increase in the log regulation score from 2001 to 2007 was associated with a 1.1-percentage-point larger increase in the migrant share of population. I then add both trade shocks and regulation changes together in Column (5). Both the coefficient of the export tariff shock and the regulation change become smaller, suggesting that part of the effect of trade on migrant flows was through the regulation changes. Given the median size of prefecture population in 2001 (3.6 million), the big-shock prefectures had a 64,000 greater increase in the number of migrants than the small-shock prefectures.

[Table 5 about here.]

Now I look at how migrants travel over various distances in response to trade shocks and

[42] See Appendix C.11 and C.13 for details of the identification challenges and several exercises attempting to address the reverse causality and omitted variable bias issues.

regulation changes in Panel A Columns (4)–(5) and Panel B. A migrant is defined as a short-distance migrant if he moves within a prefecture; between-prefecture-within-province migrants as medium-distance; and between-province migrants as long-distance. Both trade shocks and regulation changes contributed positively to the increase in the number of short-distance migrants. Given the median size of the short-distance migrant population in 2000 (167,000), the big-shock prefectures had a 79,000 larger increase in the number of migrants than the small-shock prefectures. The overall effect of trade shocks is significant for medium-distance migrants but insignificant for long-distance migrants. On the other hand, the correlation between regulation changes and migrant flows is larger among the long-distance migrants than among the medium-distance ones. The results suggest that economic conditions affect short- and medium-distance migration, and when it comes to long-distance migration, regulatory forces on amenities might matter more than economic forces.[43]

8 Conclusion

Trade is an important force in shaping economic institutions. This paper uses the trade shock that happened after China entered the WTO to study the effects of trade liberalization on labor institutions that regulate internal migration. I collect a novel data on the prefecture-level government regulations on migrant-related issues to document the change in migrant friendliness in response to trade shocks. Empirical estimates show that increased export potentials induced Chinese local governments to provide higher amenities for migrants, and that these indirect trade effects are statistically significant and economically sizable.

This paper focuses on the Hukou system, which regulates internal migration in China. How-

[43] See the appendix on additional results on migrant flows. Appendix C.11.4 uses alternative decomposition of migrant flows and shows that work-related migrants and migrants with more than 12 years of education responded more strongly to regulation changes. Appendix C.11.5 investigates emigration instead of immigration and find no significant effect of trade shocks and regulation changes on emigration. Appendix C.11.6 shows that a prefecture that is part of a province with a lot of agricultural population has a bigger inflow of medium-distance migrants once the regulation is relaxed.

ever, trade liberalization can affect other types of economic institutions as well.[44] The external force of WTO rules and the pressure of competing with a bigger international market forced Chinese governments to take measures to improve efficiency and increase transparency. Establishing the rule of law not only affects contemporaneous outcomes but also has long-run impacts on the economy. How to measure the effect of trade liberalization on these broader institutional features is left to future study.

In this paper, individual prefectures choose their own amenity levels to manage the size of their migrant labor force. The increase in overall migrant welfare puts pressure on each individual prefecture to increase their amenity level.[45] This competition between prefectures can decrease the fiscal profit of prefecture governments. If we think about the fiscal profit of local governments as economic rents, then the competition is welfare-improving for the economy since rents become smaller. In addition, the flow of people across geographic areas and sectors can reduce the variance of the national wage distribution and improve total productivity. The current paper does not attempt to answer these productivity-related questions; quantifying this potential productivity effect would also be a fruitful avenue for future work.

[44] According to the Deputy Director of Foreign Affairs Department, Legal Affairs Office, State Council of China: "After joining the WTO, a new set of rules must be applied through China's domestic law... According to the State Council Legislative Affairs Office's incomplete statistics, as of December 2002, the central government developed, modified, or abolished more than 1,000 laws, administrative regulations, departmental rules, and policy measures. All localities began to clean up in September 2001 in accordance with the unified arrangements. By the end of June 2002, 31 provinces, autonomous regions and municipalities had cleared more than 2 million pieces. Since then, the central and local conditions have continued to be modified and adjusted on a timely and planned basis." Source: Zhang, Zhoulai and Lei, Min, "The Largest-scale Regulation Change within the 5 Years after the WTO Accession." Xinhua News, 2006-12-10. The article is republished on the website of the Ministry of Commerce: `www.mofcom.gov.cn/article/zt_rswzn/subjectm/200612/20061204045235.shtml`.

[45] Appendix C.10 shows that prefectures respond strongly to regulation changes and trade shocks of other prefectures of similar income levels.

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Figure 1: Examples of frequent words for regulations on work-related issues and welfare-related issues

(a) Work-related

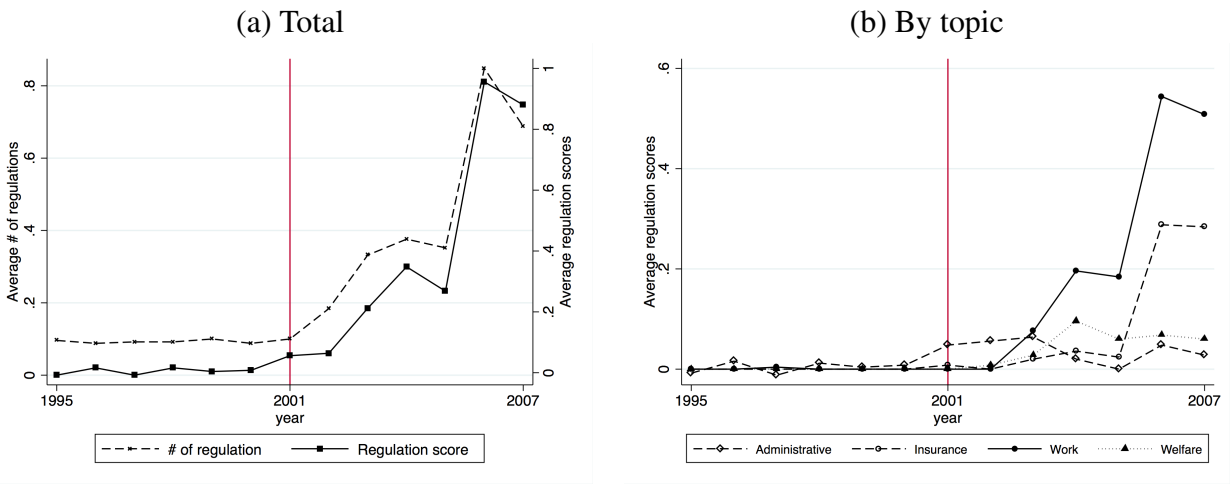
(b) Welfare-related

Note: This figure shows the most frequent words of the migrant-related regulations on work topics and welfare topics. A larger font indicates a higher frequency. Appendix A.1 shows the corresponding word clouds for other topics: birth control, Hukou, insurance, and other.

Figure 2: Wordcloud for the top 200 words by importance using the random forest

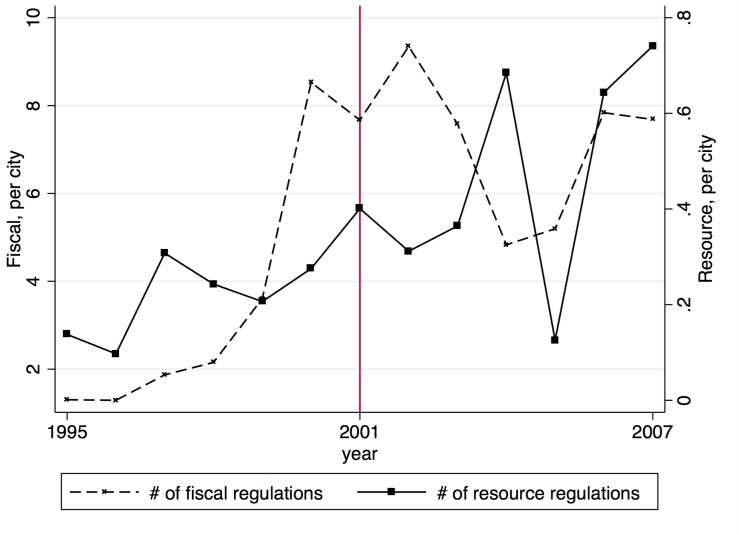
Note: This figure shows the most important 200 words used in the random forest classification. A larger font indicates a higher level of importance. For additional details of the method, see Appendix A.2.2.

Figure 3: More migrant-related regulations and higher regulation scores in the 2001–2007 period (prefecture-level average), compared to the 1995–2001 period



Note: Each dot is a prefecture-year average. Panel (a) presents the trend in the number of migrant-related regulations (solid line) and the score of these regulations (dashed line) for an average prefecture. The score is the sum of scores of all prefecture-level regulations related to migrants divided by the number of prefectures. The total number of prefectures is 250. The vertical line corresponds to China's accession to the WTO in 2001. Panel (b) presents the trends in the score of the regulations by topic.

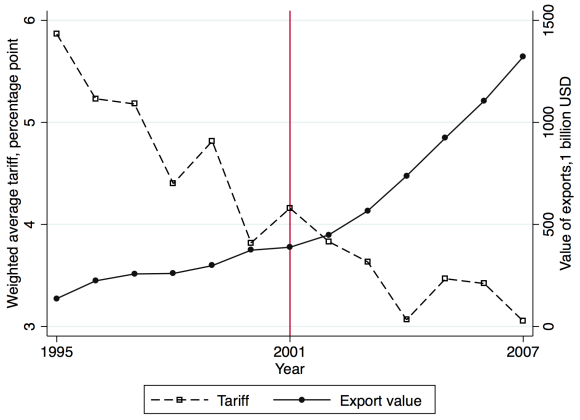
Figure 4: The number of regulations in the fiscal-related and resource-related categories did not experience trend breaks around 2001



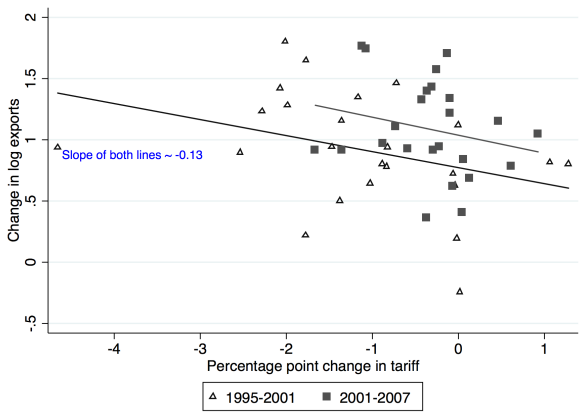
Note: Each dot is a prefecture-year average. The vertical line corresponds to China's accession to the WTO in 2001. The solid line is for the number of resource-related regulations, and the dashed line is for the number of fiscal regulations.

Figure 5: Declining output tariff and increasing export volume, 1995–2007

(a) Trends of exports and tariffs



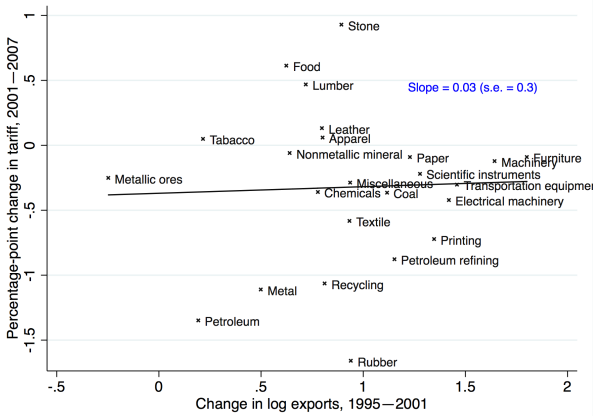
(b) Export supply elasticity



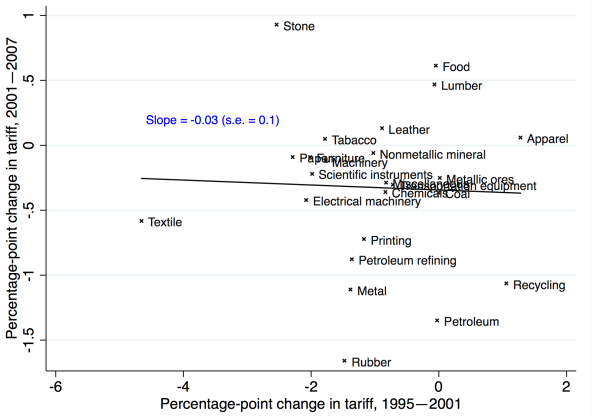
Note: In Panel (a), each dot on the dashed line is the weighted average of industrial-level tariffs, where the weights are shares of exports in this industry. The industry-level tariff is constructed as the weighted average of destination-country tariffs on Chinese exports in the specific industry, where the weights are shares of exports in this destination country in the specific industry in 1995. The solid line presents the trend in the value of exports. In Panel (b), each mark is an industry-period. Triangles are for 1995–2001 and squares are for 2001–2007.

Figure 6: At the industry level, 2001–2007 tariff declines were not predicted by the 1995–2001 export growth and tariff declines

(a) Pre-WTO exports

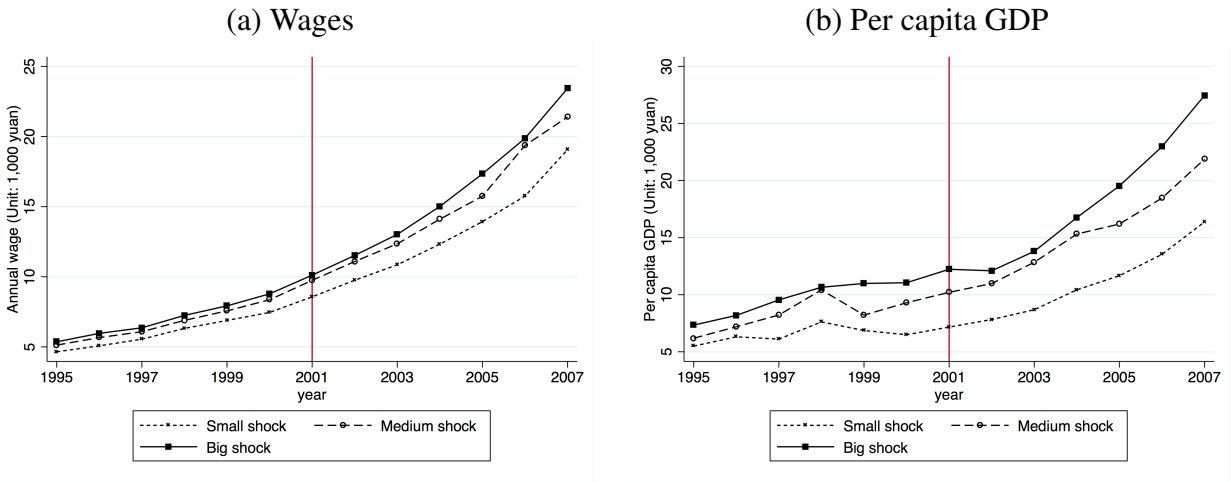


(b) Pre-WTO tariffs



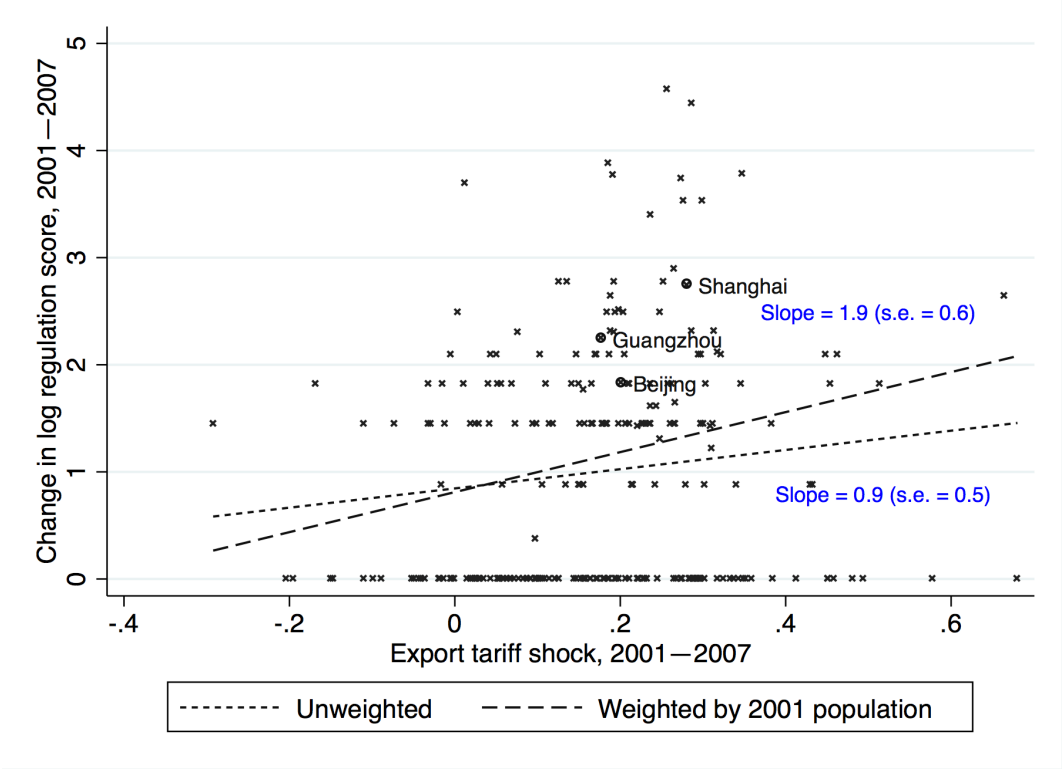
Note: Each dot is a two-digit SIC industry. Panel (a) shows the relationship between the change in log exports in the 1995–2001 period and the percentage-point change in tariff in the 2001–2007 period. Panel (b) shows the relationship between the percentage-point change in tariff in the 1995–2001 period and the percentage-point change in tariff in the 2001–2007 period.

Figure 7: No differential trends in wages and per capita GDP from 1995 to 2001, by size of trade shocks in the 2001–2007 period



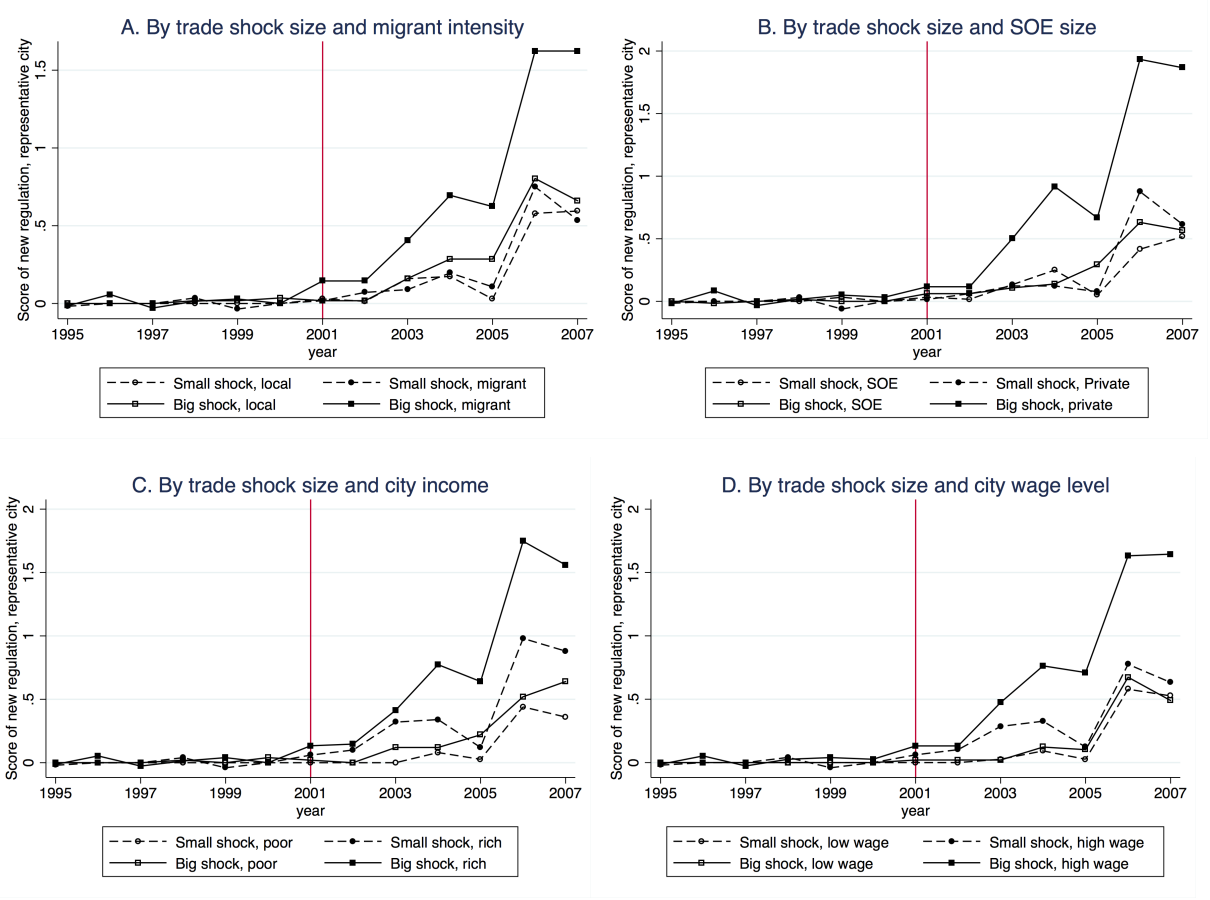
Note: The wage and GDP data is from the City Statistics Yearbooks. Prefectures are divided into small-, medium-, and large-trade-shock groups, where the small-shock regions are at the bottom third of the trade shock distribution (2001–2007 changes), the medium ones at the medium third, and the large ones at the top third.

Figure 8: Bigger trade shocks, more pro-migrant regulation change, 2001–2007, 250 Chinese prefectures



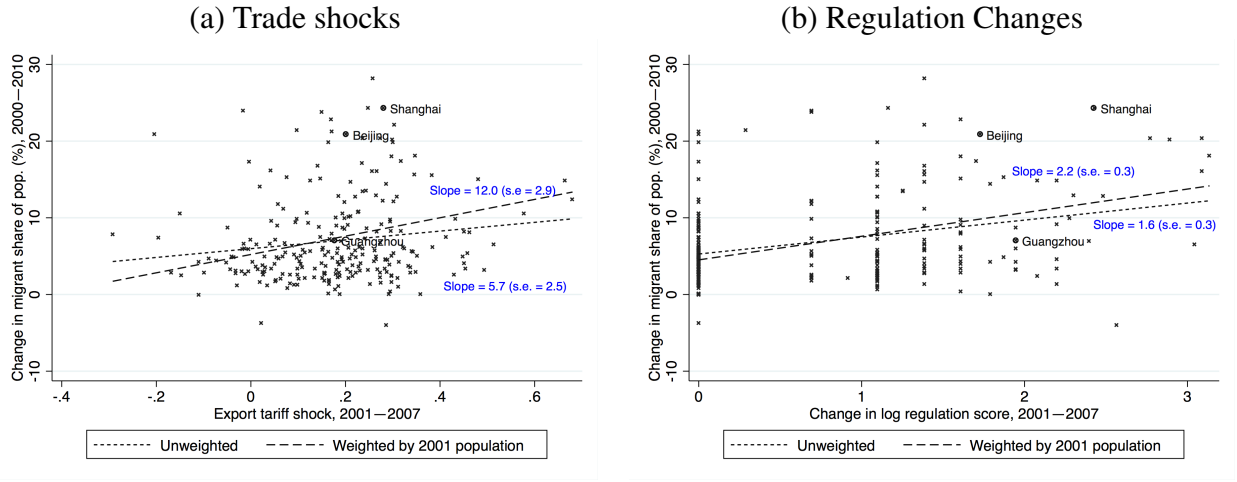
Note: Each dot is a prefecture. This figure presents the relationship between the export tariff shock and the change in log regulation score from 2001 to 2007. The dotted line is the linear fitted line, unweighted, and the dashed line is the linear fitted line weighted by the 2001 population size.

Figure 9: Regulation score, prefecture-level average, 1995–2007, by the size of trade shock in 2001–2007, and by migrant intensity in 2001



Note: Each dot is a year-shock-type group. Average of all prefecture-level regulations related to migrants. Panel A divides prefectures into four groups. The small-shock and local group represents prefectures whose post-WTO trade shock was below the median and migrant intensity was below the median. Migrant intensity is defined as the interaction of prefecture-level industry employment share in 2000 interacted with industry-level migrant share of employment in 2005. Panel B uses the 2001 prefecture-level employment share of private firms as the measure for migrant intensity; Panel C uses the 2001 prefecture-level log per capita GDP; and Panel D uses the 2001 prefecture-level wage.

Figure 10: Larger trade shocks and more regulation changes from 2001 to 2007, greater changes in the migrant share of population from 2000 to 2010, 250 Chinese prefectures



Note: Each dot is a prefecture. Panel (a) shows the relationship between the export tariff shock from 2001 to 2007 and the change in the migrant share of population from 2000 to 2010. Panel (b) shows the relationship between the change ing log regulation score from 2001 to 2007 and the change in the migrant share of population from 2000 to 2010. The dotted line is the linear fitted linear, unweighted, and the dashed line is the linear fitted line weighted by the 2001 population.

Table 1: Bigger trade shocks, more regulation relaxation, 2001–2007

Panel A.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: Δ log regulation score, 2001–2007, manual coding							
Export tariff shock	0.90**	1.60***	1.61***	1.54***	1.42**	1.36**	1.24**	1.08*
2001–2007	(0.41)	(0.51)	(0.52)	(0.55)	(0.57)	(0.55)	(0.58)	(0.56)
Import tariff shock		-0.12**	-0.12**	-0.13**	-0.11	-0.11**	-0.13***	-0.10
2001–2007		(0.04)	(0.05)	(0.05)	(0.08)	(0.05)	(0.05)	(0.08)
Intermediate tariff shock		0.27*	0.26*	0.27*	0.07	0.31*	0.16	0.10
2001–2007		(0.15)	(0.15)	(0.16)	(0.24)	(0.18)	(0.17)	(0.24)
Log regulation score			-0.08		-0.09	-0.11	-0.13	-0.13
2001			(0.23)		(0.23)	(0.21)	(0.22)	(0.21)
Δ log regulation score				-0.09				
1995–2001				(0.23)				
Export tariff shock					0.22			0.19
1995–2001					(0.24)			(0.25)
Import tariff shock					0.01			0.02
1995–2001					(0.03)			(0.03)
Intermediate tariff shock					0.23			0.15
1995–2001					(0.14)			(0.14)
Δ log wage						1.13**		0.79
1995–2001						(0.44)		(0.52)
Δ log GDP p.c.							0.72***	0.62***
1995–2001							(0.16)	(0.20)
Observations	250	250	250	237	237	237	237	237
R-squared	0.02	0.07	0.08	0.08	0.09	0.10	0.12	0.13
Panel B.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: Δ log regulation score, 2001–2007, NLP coding							
Export tariff shock	0.89**	1.61***	1.57***	1.50**	1.41**	1.36**	1.21**	1.08*
2001–2007	(0.40)	(0.51)	(0.52)	(0.55)	(0.57)	(0.55)	(0.58)	(0.57)
Observations	250	250	250	237	237	237	237	237
R-squared	0.01	0.08	0.09	0.09	0.10	0.11	0.13	0.14

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. In Panel (a), the dependent variable is the change in log regulation score using manual coding. In Panel (b), the dependent variable is the change in log regulation score using the NLP coding. The mean (s.d.) of Δ log regulation score, 2001–2007 is 1.0 (1.1) for both the manual coding and the NLP coding. The mean (s.d.) of Δ log regulation score, 1995–2001 is 0.06 (0.4) for the manual coding and 0.08 (0.4) for the NLP coding. The mean (s.d.) of export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40).

Table 2: Reduction in trade uncertainty and removal of textile quota also contributed to the regulation change

	(1)	(2)	(3)	(4)
Dependent variable:	Δ log regulation score, 2001–2007			
Export tariff shock, 2001–2007	1.61***	1.52***	1.59***	1.52***
	(0.52)	(0.49)	(0.52)	(0.49)
Uncertainty shock, 2001–2007		4.15***		3.67***
		(1.42)		(1.31)
MFA shock, 2001–2007			4.64**	3.86*
			(2.05)	(2.03)
Observations	250	250	250	250
R-squared	0.08	0.09	0.09	0.10

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. All columns control for the import and intermediate trade shocks, 2001–2007, and the log regulation score in 2001. The mean (s.d.) of Δ log regulation score, 2001–2007 is 1.0 (1.1). The mean (s.d.) of export tariff shocks, 2001–2007 is 0.18 (0.15). The mean (s.d.) of the uncertainty shock is 0.04 (0.03), and the mean (s.d.) of the value share of textile with quota is 0.01 (0.03).

Table 3: More migrant-intensive prefectures responded more strongly to trade shocks, 2001–2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Δ log regulation score, 2001–2007							
	Migrant intensity		Private firm share		Log(wage)		Log(GDP p.c.)	
Export tariff shock	-5.14	-6.87*	-1.17	-1.88**	-35.88*	-42.10**	-12.69*	-14.84**
2001–2007	(3.73)	(3.98)	(0.76)	(0.88)	(18.72)	(18.74)	(6.25)	(6.75)
Baseline characteristic	-0.98	-3.11	-0.43	-0.92**	0.47	0.44	0.48**	0.45**
2001	(2.16)	(2.47)	(0.33)	(0.38)	(0.45)	(0.51)	(0.18)	(0.21)
Interaction term	18.72	22.74*	5.39***	5.83***	4.02*	4.67**	1.48**	1.70**
	(11.10)	(11.75)	(1.11)	(1.17)	(2.07)	(2.06)	(0.71)	(0.76)
Controls		X		X		X		X
Observations	250	237	250	237	250	237	250	237
R-squared	0.09	0.14	0.13	0.18	0.16	0.20	0.24	0.26
Mean (s.d.) of I	0.34 (0.05)		0.55 (0.23)		9.11 (0.28)		8.94 (0.64)	

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. In Columns (1) and (2), the export shock is interacted with the migrant intensity in 2001. In Columns (3) and (4), the interaction term is with the share of private firms in 2001. Columns (5) and (6) use the log wage in 2001, and Columns (7) and (8) use the log per capita GDP in 2001. The mean (s.d.) Δ log regulation score, 2001-2007 is 1.0 (1.1), and the mean (s.d.) export tariff shock is 0.18 (0.15). All columns control for import and intermediate tariff shocks, 2001–2007 and the log regulation score in 2001. Columns (2)(4)(6)(8) also control for lagged trade shocks and lagged wage and GDP growth rates, 1995–2001, as in Table 1 Column (8).

Table 4: Regulation score and migrant outcomes in 2005, 247 prefectures

Panel A.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: Y for migrants, 2005						
	Unemploy. Insurance (rate)	Pension (rate)	Medical Insurance (rate)	Terms of Contract (months)	Monthly Income (yuan)	School Enrollment (rate)	Log # of Children
Log regulation score	0.01**	0.02**	0.02**	0.16*	36.12**	0.002	-0.03
2005	(0.01)	(0.01)	(0.01)	(0.09)	(14.33)	(0.004)	(0.02)
Y for local	0.58***	0.44***	0.41***	0.50***	0.37***	0.44***	0.12**
2005	(0.09)	(0.08)	(0.05)	(0.04)	(0.11)	(0.14)	(0.05)
Mean (s.d.) Y for migr.	0.21 (0.11)	0.35 (0.12)	0.36 (0.12)	4.50 (2.64)	924 (190)	0.94 (0.04)	4.47 (1.00)
Mean (s.d) Y for local	0.38 (0.16)	0.60 (0.14)	0.60 (0.15)	5.05 (2.88)	982 (336)	0.95 (0.02)	6.81 (0.75)
Observations	247	247	247	247	247	247	247
R-squared	0.44	0.26	0.29	0.34	0.63	0.12	0.96
Panel B.	Dependent variable: Y for local, 2005						
Log regulation score	0.02**	0.01	0.002	0.48***	31.0*	0.004*	–0.07**
2005	(0.01)	(0.01)	(0.009)	(0.13)	(15.4)	(0.002)	(0.03)
Observations	247	247	247	247	247	247	247
R-squared	0.45	0.45	0.42	0.23	0.57	0.08	0.88

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) regulation score in 2005 is 0.44 (0.87). Panel A regresses migrant outcomes on the log regulation score and local welfare measures, controlling for the log number of adult migrants and the log GDP p.c. in 2005. Panel B regresses local outcomes on the log regulation score, controlling for the log number of adult locals and the log GDP p.c. in 2005. Weighted by the 2005 prefecture population.

Table 5: Bigger regulation changes (2001–2007), larger increases in the number of migrants (2000-2010)

Panel A.	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Δ migrant share of population			Δ log # of migrants, short-dist.		
Export tariff shock	7.07**		6.15*	1.35***		1.20***
2001–2007	(3.37)		(3.19)	(0.31)		(0.26)
Δ log regulation score		1.10***	0.94***		0.18***	0.19***
2001–2007		(0.29)	(0.23)		(0.04)	(0.04)
Observations	250	250	250	240	240	240
R-squared	0.14	0.13	0.17	0.20	0.16	0.25
Mean (s.d.) of depent.	6.99 (5.78)			-0.83 (0.80)		
Panel B.	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Δ log # of migrants, medium-dist.			Δ log # of migrants, long-dist.		
Export tariff shock	0.41**		0.36**	-0.08		-0.16
2001–2007	(0.20)		(0.17)	(0.39)		(0.38)
Δ log regulation score		0.06*	0.05		0.10**	0.09**
2001–2007		(0.03)	(0.03)		(0.04)	(0.04)
Observations	250	250	250	249	249	249
R-squared	0.59	0.57	0.60	0.12	0.08	0.14
Mean (s.d.) of depent.	1.60 (0.66)			0.85 (0.65)		

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables are changes from 2000 to 2010. A migrant is defined as a short- distance migrant if he moves within a prefecture; between-prefecture-within-province migrants as medium-distance; and between-province migrants as long-distance. The mean (s.d.) Δ log regulation score, 2001–2007 is 1.0 (1.1), and the mean (s.d.) export tariff shock is 0.18 (0.15). All columns control for import and intermediate tariff shocks, the log total population and the level of the dependent variable in 2000.

For Online Publication

A Migration Regulation Data

A.1 Coding of the Regulation Score

The keyword search in the local government regulation dataset ends with 4,273 documents from 1978 to 2016. This includes 1,357 province-level regulations and 2,916 prefecture-level government regulations. The regressions in the paper only use the prefecture-level regulations, but for the purpose of manual coding and NLP coding, all 4,273 documents are used for a larger sample size.

I uncover and rate all the regulation documents that potentially affect the utility of migrant workers, by either changing the income, welfare, or amenity they get, or giving them access to local Hukou (which will indirectly provide income, welfare, and amenity benefits). I rate the regulations and extract information as follows:

1. Each regulation is assigned a migrant-friendliness index, referred to as the score in the paper. The score has a five-point scale: –2 as strongly against migrants, –1 as against migrants, 0 as neutral, 1 as favorable to migrants, and 2 as very favorable to migrants.

2. The pure administrative regulations (for example, informing the logistics of getting some documents, certificates, or proofs) are rated as 0.

3. The regulations related to birth control are rated as 0, since people are subject to birth control both in their home regions and in the regions where they live temporarily, and it is not clear which rules are more strict. Some of these regulations mention providing healthcare services to pregnant women and free vaccinations to children, and I code them as 1.

4. Most of the regulations related to temporary residence are rated as 0. In most prefectures, there are still temporary residence registration requirements, and although, some of the terms

have been revised, the revisions tend to be minor. Some regulations mention reducing the fee for registration and simplifying the procedures significantly; I code these as 1.

5. For all other regulations, the coding rules are as follows: (1) If the regulation is about setting up a complete, executable guideline for one specific issue (for example, how to guarantee payment of wages to migrant workers, or the rules for firms to purchase injury and medical insurance for migrant workers), a score of 2 is assigned (–2 if it is against migrants); (2) If the regulation addresses one issue, but is more about enforcement of the specified rules (for example, guaranteeing the payment of wages before the Chinese New Year), a score of 1 is assigned (–1 if it is against migrants); in some cases, the enforcement is very detailed, in which case I code it as 2 (–2 if it is against migrants); (3) If the regulation addresses two or more issues, either about guidelines or about enforcement, a score of 2 is assigned.

A.2 Three Supervised Learning NLP Methods and Results

A.2.1 Introduction of the Three Classification Methods

The logic of the supervised learning NLP method is to make use of the entire text of the regulations, and build a model based on the elements of the text, train the model with some regulations with scores coded, and then code the rest of the regulations using the model.

There are three NLP methods I consider. First is a decision tree. Here, only the words and word frequencies are used. The advantage is that it is easy to summarize the decision rule. i.e., what words are important in making the decisions. The disadvantage is that only words and word frequencies are used.

The second is multilayer perceptron classification with neural networks. The advantage is that the decision rule is more complicated than the decision tree. The disadvantage is that only words and word frequencies are used, and that it is less transparent in what words are important and how decisions are made.

The last one is classification based on word embedding. The advantage is that the entire text

can be used, including the neighbors of the words. Each word is turned into a vector based on its context, and similar words will be represented as similar vectors. Then the vectors are used to classify the documents. The disadvantage is that usually a large training dataset is needed, and the decision rules are less clear.

Table A.1: Comparison of the three NLP methods

Method type	Method name	Elements of the text used
Decision tree	Random forest	words and word frequencies
Neural network	Multilayer perceptrons	words and word frequencies
	CNN with Word embedding	words and word contexts

A.2.2 Method 1: Random Forest

The key parameters of the random forest include the number of trees, the number of attributes to draw from in each step, and the split rule. I use the 686 documents that are coded both by myself and by the two research assistants as the training set, and the score is calculated as the average of the three codings, rounded to the closest integer. The assumption here is that by using the average of the three, the coding reflects the "true" extent of migrant-friendliness of the regulations. The choice of parameters is as follows: 200 trees, 101 attributes to draw from, and gini split rule. Results are not very sensitive to the choice of the parameter values.

The estimated random forest model performs well when I use it to predict the migrant friendliness of the 4,273 regulations. Among all the documents, 3,092 documents generate the same score as my own coding, 538 documents have 1 unit larger coding, 569 with 1 unit smaller, and 74 documents differ from my coding by more than 1 unit. The cross-tabulation results are in Table A.2. One pattern is that hand coding seems to be more nuanced, with more –2, –1, and 2, while the random forest coding has more 1. This could reflect the possibility that since the majority of the documents have either 0 or 1 according to hand coding, the random forest model has more training samples in those categories to correctly specify their characteristics. For the ones with a smaller sample size, the performance of the random forest model can be compromised. Overall, the two sets of codings are highly correlated, with a correlation of 0.73.

Table A.2: Cross tabulation of random forest coding and manual coding

	Random forest coding					
Manual coding	–2	–1	0	1	2	Total
–2	2	1	4	4	0	11
–1	0	6	19	8	0	33
0	0	12	1,112	351	10	1,485
1	0	0	181	1,180	167	1,528
2	0	0	48	376	792	1,216
Total	2	19	1,364	1,919	969	4,273

Figure A.1: Hand coding and random forest coding results by topic

Another way to evaluate the coding by random forest and by hand is to see if these codings differ systematically by topic categories. There are overall 6 categories according to the contents of the regulations: (1) "birth" for issues related to birth control and family planning; (2) "Hukou" for issues related to the procedure and criterions of obtaining local Hukou or getting temporary residence; (3) "insurance" for social insurances: medical insurance, unemployment insurance, social security, birth insurance, and injury insurance; (4) "welfare" for schooling; (5) "work" for

issues related to contract, wage payment disputes, and vocational trainings; and (6) "other" for issues such as awards, etc. Figure A.1 shows the distribution of the gap between the hand coding and random forest coding results by topic. Overall, hand-coding seems to code the "insurance" and "work" type more positively. On the other hand, random forest coding favors the "other" category.

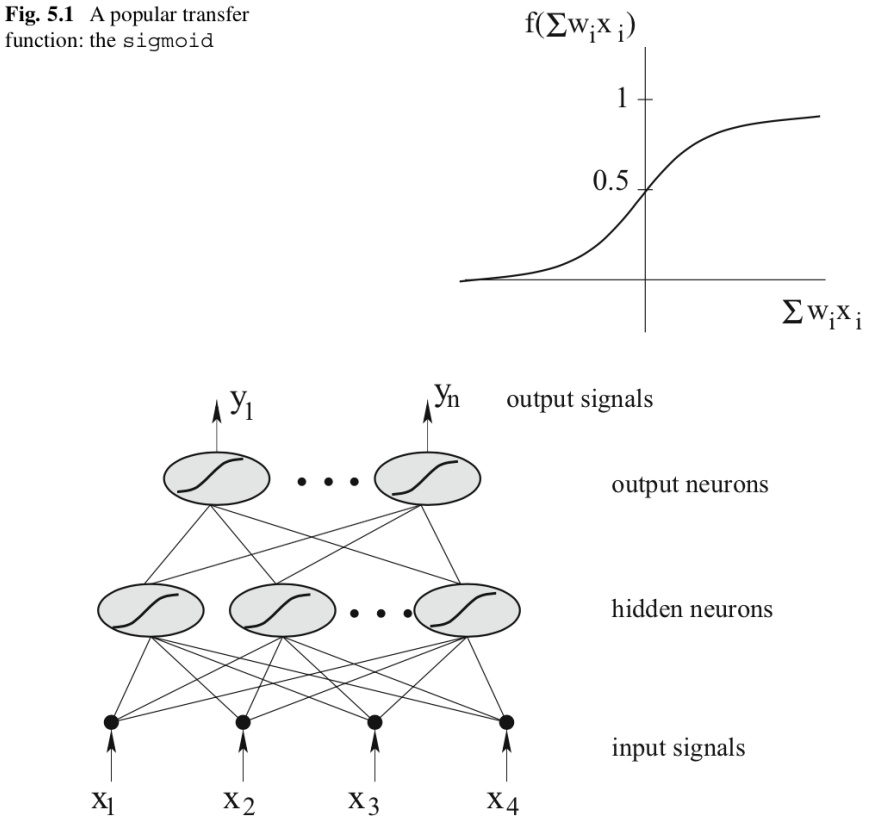
A.2.3 Method 2: Multi-Layer Perceptron Neural Network Classification

The algorithm is multi-layer perceptron (MLP) neural network. First, documents are split into words. The words with highest frequencies (e.g., the top 1000 words) will be chosen to form the vocabulary. Then each document will be represented as a matrix, with the word vector in the vocabulary combined with an indicator variable equal to one if the word shows up in the document. Second, I build a MLP neural network, with the document matrix as the input signals, the score of migrant friendliness as the output signals, and one hidden layers with neurons that are fully-connected with the input and the output layer, or more hidden layers. Transfer functions take weights on signals and neurons to calculate the value of neurons on the next layer. Figure A.2 also presents a neural network with two layers, the first layer takes the input signals and connects them to the hidden neurons, and the second layer takes the hidden neurons to output neurons. Eventually, output neurons projects out the output signals. For example, Figure A.2 shows a popular transfer function (sigmoid) that takes the weighted sum of x_i and projects it to a value between zero and one. Weights are randomly assigned at the beginning, and during the training process, updated based on the feedback of prediction results. The model is trained to have low loss and high prediction accuracy.

Again, I use the 686 documents that are coded by three independent people as the training set. The most frequent 2000 words in these text are chosen as the vocabulary. Out of the 686 documents, 30% are used for model validation and 70% are used for actual training. One epoch is one round of model training using the documents in the training set, and seven epochs are used. Other parameters include: 512 neurons are used in the hidden layer, 20% of the neurons are dropped before feeding into the transfer function to avoid overfitting, 32 documents are used to train the

model before the weights updates, and categorical crossentropy is used as the loss function. The results of the training process is shown in Figure A.3. The training accuracy increases over epochs, while the validation accuracy is around 82%.

Figure A.2: Depiction of a popular transfer function and an example neural network with two interconnected layers

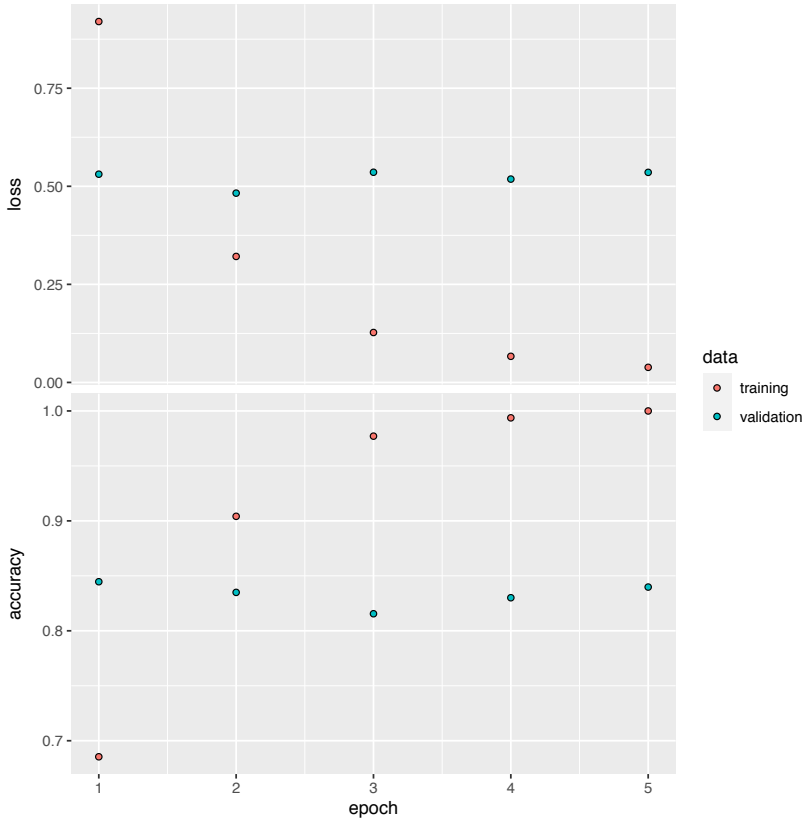


Source: Kubat (2017).

The estimated MLP model generate predicted scores very close to my own codings when I use it to predict the migrant friendliness of the 4,273 regulations. Among all the documents, 2,959 documents generate the same score as my own coding, 873 documents have 1 unit larger coding, 362 with 1 unit smaller, and 79 documents differ from my coding by more than 1 unit. The correlation between the two sets of codings is 0.73, similar to the correlation between the random forest model prediction and my own codings. I, again, show the distribution of the coding differences by topic (Figure A.4). Overall, hand-coding seems to have more negative codings for

"Hukou," "welfare," "work," and "other" category, and tend to have more positive codings for the "insurance" type.

Figure A.3: MLP model description



Unfortunately, unlike the random forest model, it is harder to analysis and visualize the important factors in determining the result of the MLP model.

Figure A.4: Hand coding and MLP coding results by topic

A.2.4 Method 3: Convolutional Neural Network with Word-Embedding

The third method is using convolutional neural network (CNN) with word embedding. First, as in the MLP model, top 2000 words are chosen to form the vocabulary. However, instead of an indicator variable for whether the word shows up in a document, words are represented as vectors using the word embedding method. Each dimension of the vector represent the feature of the word in a certain space. The entire document text can then be represented as an ordered collection of vectors, and this forms an embedding layer. Second, a convolutional layer is formed by applying an operator (filter) to the entirety of the text such that it transforms the information in the text. Third, the convolutional layer is flattened to a lower dimension to form a pooling layer, in order to avoid overfitting. Afterwards, similar to the MLP method, a fully connected hidden layer is used and an output layer will eventually generate the predictions. The word-embedding, filters, weights connecting different layers are computed to maximize the prediction accuracy using the training dataset.

Just to compare with the MLP network, the CNN with embedding has some advantages. First, instead of treating each individual word as a distinct signal, the word embedding use vectors to

represent words, and words that are similar (for the purpose of eventual document classification task) should have vectors that are similar. Thus, more information is contained. Second, in the convolutional layer, not only the individual words, but also the adjacent words are used, again retaining more information in the text.[46]

The parameter value of the model are as follows: 256 embedding dimensions (i.e., a word is represented using a 256 dimension vector), out of which 20% are dropped to avoid overfitting; 250 filters, each with a size of 3, and the filters move 1 word each time when scanning through the document; 250 neurons in the hidden layer, again 20% dropped before feeding into the transfer function to generate the output layer. The model is trained with the 686 documents with three codings. The results of the training process are shown in Figure A.5. Both the training accuracy and the validation accuracy increase over epochs, and the validation accuracy is around 81% in the last epoch.

Among all the documents, 2,887 documents generate the same score as my own coding, 960 documents have 1 unit larger coding, 340 with 1 unit smaller, and 86 documents differ from my coding by more than 1 unit. The correlation between the two sets of codings is 0.71, slightly smaller than the ones using random forest and MLP. I, again, show the distribution of the coding differences by topic (Figure A.6). Overall, hand-coding seems to have more negative codings for "Hukou," "welfare," "work," and "other" category, and tend to have more positive codings for the "insurance" type. This pattern is similar with the MLP ones.

[46] In the results shown below, the main text will only include the top 2000 words. However, increasing the size of the vocabulary (e.g., to include all words in the training text) does not significantly improve the prediction accuracy.

Figure A.5: CNN model description

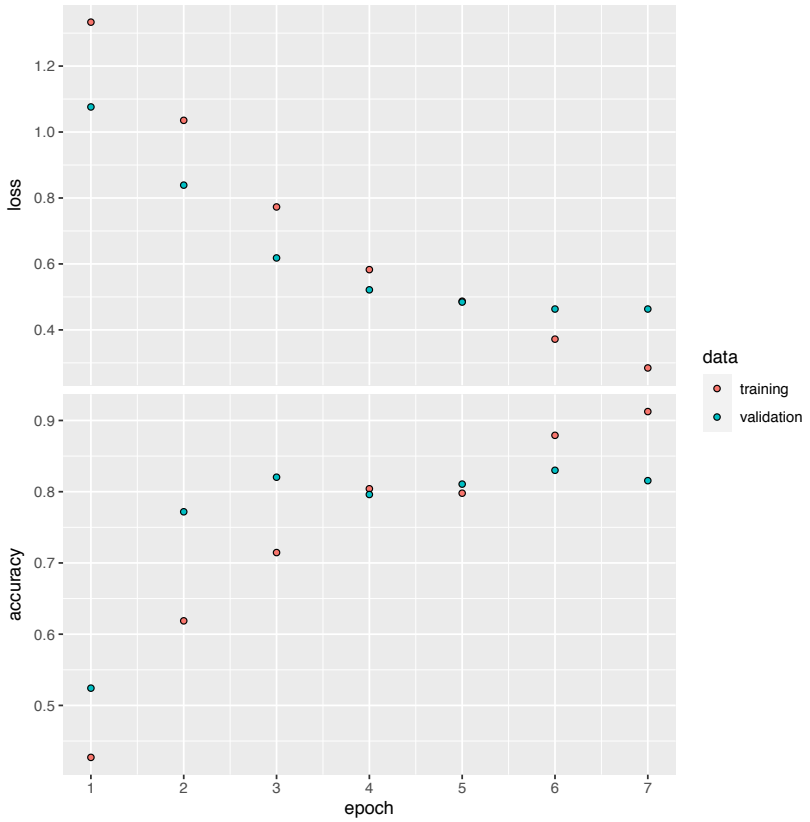


Figure A.6: Hand coding and CNN coding results by topic

A.3 Summary of Statistics

Section 3 shows the wordclouds for the work-related and welfare-related regulation. Figures A.7, A.8, A.9, and A.10 show the correpsonding wordclouds for regulations on birth control issues, Hukou-related administrative issues, social insurance issues, and other miscellaneous issues.

Figure A.7: Wordcloud for the top 200 words in the topic of birth control

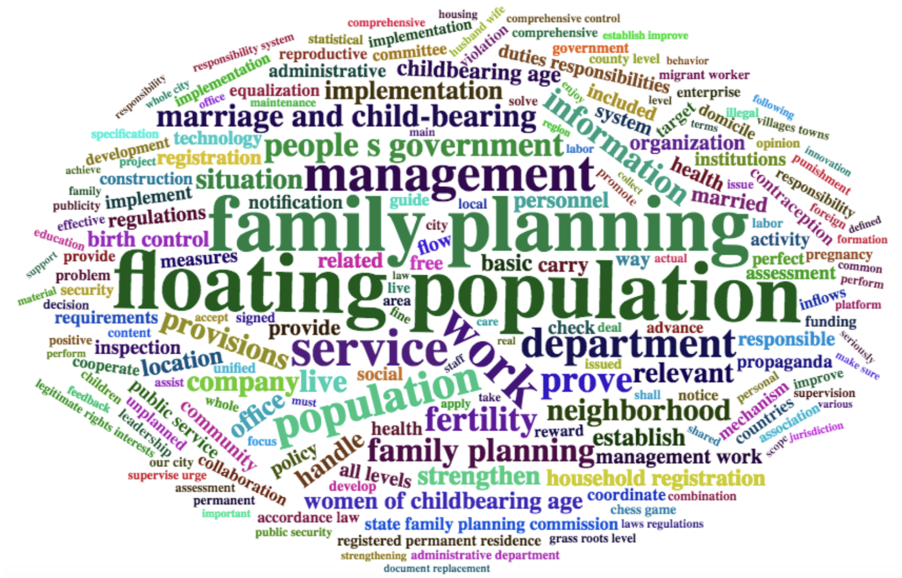


Figure A.8: Wordcloud for the top 200 words in the topic of Hukou

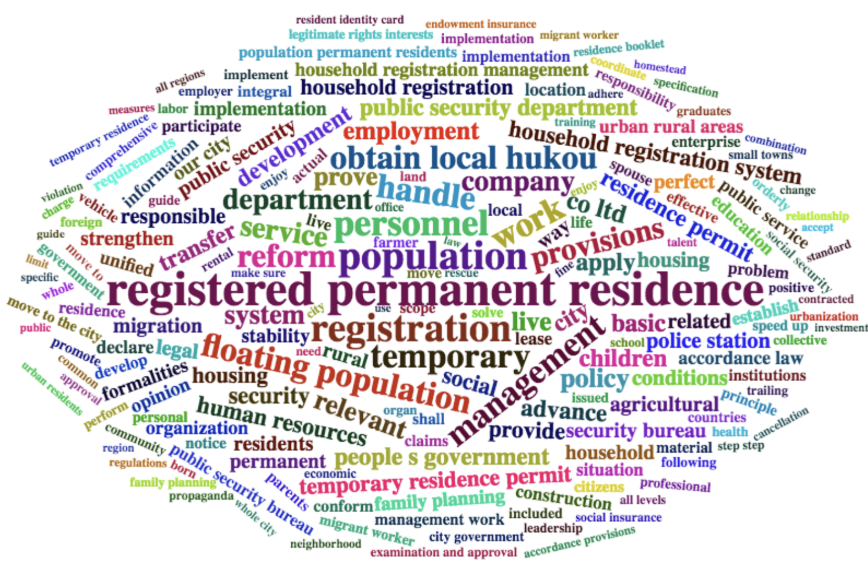


Figure A.9: Wordcloud for the top 200 words in the topic of insurance

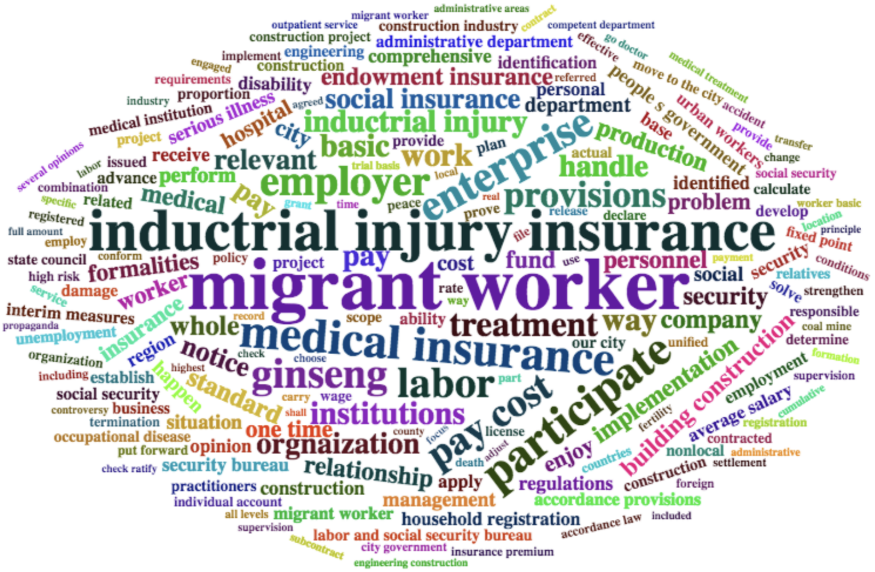


Figure A.10: Wordcloud for the top 200 words in the topic of other

Table A.3 shows that in the 2001–2007 period, 749 new regulations were enacted on migrant issues, with a mean score of 1, and 180 prefectures enacted at least one new regulation. In the 1995–2001 period, the numbers are much smaller: 168 new regulations in total and a mean score of 0.1. Fifty-five prefectures have some regulations, but only nineteen of them have positive regula-

tions. Of the nineteen positive-regulation prefectures, only one has regulations about work-related issues, but all nineteen have administrative-related regulations. Among these nineteen prefectures, twelve are capital prefectures of provinces, with pro-migrant regulations about receiving local Hukou through purchase of commercial apartments and some specific issues on migrant workers.[47] There were only a few migrant-regulation changes before 2001, and they were concentrated in a few big prefectures on Hukou issues.

Table A.3: Descriptive statistics on number of regulations and number of prefectures with positive regulations

	# of regulations	Mean score	# of prefectures with			
			Any	(+)	0	(-)
2001–2007						
Total	749	1	180	162	84	8
Work	286	1.4	121	120	12	0
Welfare	56	1.5	33	33	1	0
Insurance	104	1.7	56	55	5	0
Birth control	55	0	35	0	35	0
Hukou	179	0.3	73	53	36	8
Other	69	0.1	42	7	40	0
1995–2001						
Total	168	0.1	55	19	53	9
Work	1	1	1	1	0	0
Welfare	1	1	1	0	1	0
Insurance	2	1	1	1	1	0
Birth control	30	0	23	0	23	0
Hukou	130	0.1	51	19	47	9
Other	4	0.25	1	1	1	0

Figures A.11, A.12, and A.13 show the top 200 words for regulations coded as positive, neutral, and negative, respectively.

[47]The twelve prefectures are Beijing, Changsha, Chongqing, Guangzhou, Huhehaote, Jinan, Shanghai, Shijiazhuang, Wuhan, Wulumuqi, Xi'an, and Zhengzhou. The other seven prefectures are Dalian, Huainan, Huizhou, Qingdao, Wuxi, Xiamen, and Xuzhou.

Figure A.11: Wordcloud for the top 200 words for the regulations coded as positive

Figure A.12: Wordcloud for the top 200 words for the regulations coded as neutral

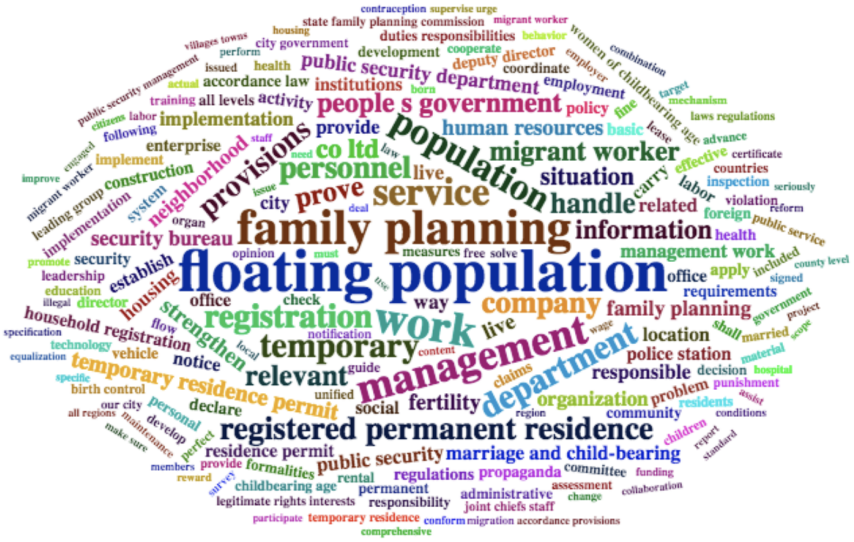
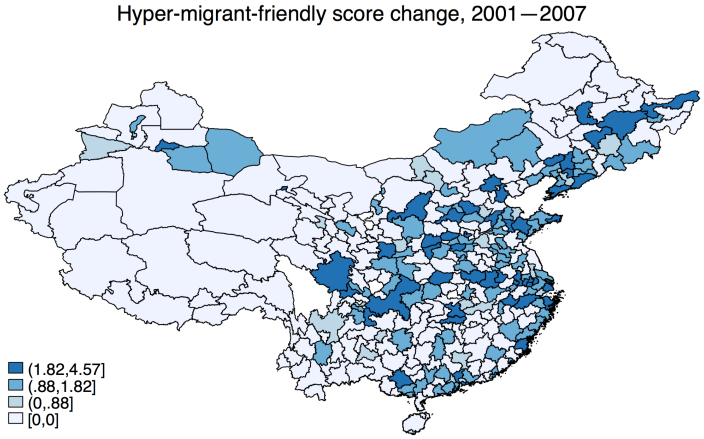


Figure A.13: Wordcloud for the top 200 words for the regulations coded as negative

Figure A.14 shows the geographical distribution of the new regulations. The total regulation score is the sum of all prefecture-level regulations related to migrants. Then I do an inverse-hyperbolic-sine transformation of the total regulation score. Changes are taken from 2001 to 2007. Overall, coastal prefectures had more changes, but many inland prefectures also made substantial changes.

Figure A.14: Geographic distribution of regulation changes, 2001–2007



Note: Each bordered area is a prefecture. The regulation score is the sum of all prefecture-level regulations related to migrants. Then I do an inverse-hyperbolic-sine transformation of the total regulation score. Darker blue means that the prefecture became very migrant friendly from 2001 to 2007, while the lighter the color, the smaller the change.

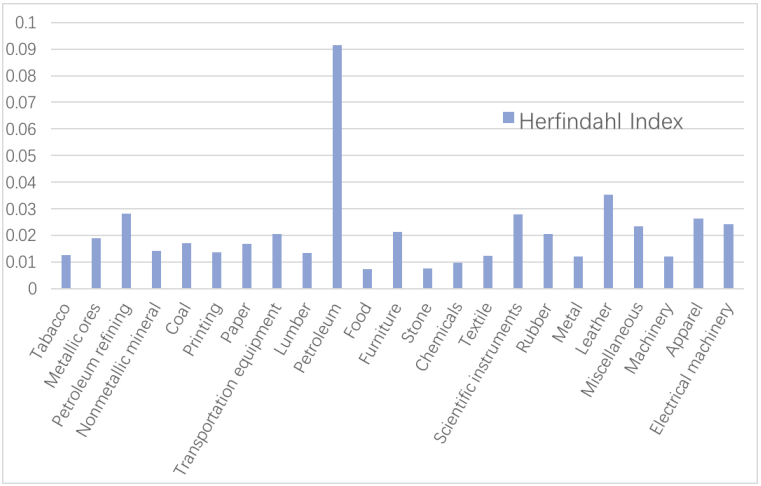
B Other datasets

B.1 Trade Shocks

B.1.1 Industry Crosswalk, from 2-digit GB Code to 2-digit SIC Code

The industrial composition is from the 2000 Industrial Enterprises Survey, which is conducted on Chinese manufacturing firms with annual sales of more than 500 million RMB and includes basic firm information such as name and address, financial information on sales, export values, fixed capital, wage payment and total sales costs, and total employment.[48] There are 145,546 firms in 2000 with positive sales revenue and wage information, more than 10 employees, and a valid industry code. The industry code is the 4-digit Chinese Industry Code, which I aggregate to the 2-digit level. The 2-digit Chinese Industry Code is slightly finer than the 2-digit SIC code, with the crosswalk between the codes shown in Table A.4. In addition, due to imperfect matching of the primary metal industry and the fabricated metal industry across the two sets of codes, I combine the two using export weights. The Herfindahl index by industry is shown in Figure A.15.

Figure A.15: Industry concentration across cities in 2000, Herfindahl Index



Note: Each bar is a industry, horizontally sorted by the value of exports in the industry in 2000.

[48] The 1995 Industrial Enterprise Survey data is not available.

Table A.4: Crosswalk, 2-digit Chinese industry code (GB) to 2-digit U.S. industry code (SIC), secondary sector

GB code	GB description	SIC	SIC description
6	Mining and washing of coal	12	Coal and lignite
7	Extraction of petroleum and natural gas	13	Crude petroleum and natural gas
8	Mining and processing of ferrous metal ores	10	Metallic ores and concentrates
9	Mining and processing of nonferrous metal ores	10	Metallic ores and concentrates
10	Mining and processing of nonmetal ores	14	Nonmetallic minerals, except fuels
11	Mining of other ores	14	Nonmetallic minerals, except fuels
13	Processing of food from agricultural products	20	Food and kindred products
14	Manu. of foods	20	Food and kindred products
15	Manu. of liquor beverages and refined tea	20	Food and kindred products
16	Manu. of tobacco	21	Tobacco products
17	Manu. of textile	22	Textile mill products
18	Manu. of textile fabrics wearing apparel and accessories	23	Apparel and related products
19	Manu. of leather, fur, feather and related products and footwear	31	Leather and leather products
20	Processing of timber, manufacture of wood, bamboo, rattan, palm and straw products	24	Lumber and wood products, except fuel
21	Manu. of furniture	25	Furniture and fixtures
22	Manu. of paper and paper products	26*	Paper and allied products
23	Printing, production of recording media	27	Printing, publishing, and allied products
24	Manu. of articles for culture, education, art, sport, and entertainment activities	26*	Paper and allied products
25	Processing of petroleum and coking	29	Petroleum refining and related products
26	Manu. of raw chemical material and chemical products	28	Chemicals and allied products
27	Manu. of medicines	28†	Chemicals and allied products
28	Manu. of chemical fibers	28	Chemicals and allied products
29	Manu. of rubber	30	Rubber and miscellaneous plastics products
30	Manu. of plastics products	28‡	Chemicals and allied products
31	Manu. of non-metallic mineral products	32	Stone, clay, glass, and concrete products
32	Smelting and pressing of ferrous metals	300⁎	Metal processing and products
33	Smelting and pressing of non-ferrous metals	300⁎	Metal processing and products
34	Manu. of metal products	300⁎	Metal processing and products
35	Manu. of general purpose machinery	35	Machinery, except electrical
36	Manu. of special purpose machinery	35	Machinery, except electrical
37	Manu. of transportation machinery	37	Transportation equipment
39	Manu. of electrical machinery and equipment	36	Electrical machinery, equipment, and products
40	Manu. of communication equipment, computers and other electric equipment	36	Electrical machinery, equipment, and products
41	Manu. of measuring instruments and machinery	38	Scientific and professional instruments
42	Manu. of artifacts and other manufacturing	39	Miscellaneous manufactured commodities
43	Recycling	91	Scrap and waste material

*https://www.osha.gov/pls/imis/sicsearch.html?p_sic=&p_search=stationery.
†https://www.osha.gov/pls/imis/sicsearch.html?p_sic=&p_search=drug.
‡https://www.osha.gov/pls/imis/sicsearch.html?p_sic=&p_search=plastic.
⁎https://www.osha.gov/pls/imis/sicsearch.html?p_sic=&p_search=metal. Here the SIC 300 will be the weighted average of SIC 33 (Primary metal products) and 34 (Fabricated metal products).

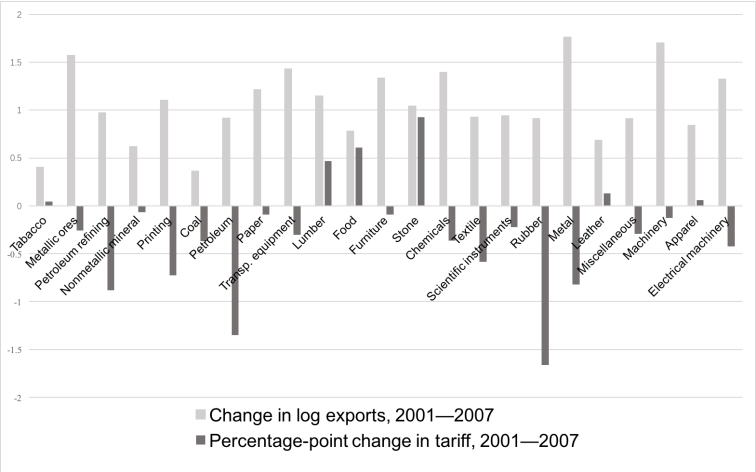
B.1.2 Trade Shock Measures, Main

Tariff data is the applied tariff (AHS) on the 2-digit SIC level from the World Bank.[49] The tariff on Chinese exports is calculated as the weighted average of import tariff imposed by each destination country, with the 1995 export share as weights:

$$\text{tariff}^{X}_{jt} = \sum_{n} \frac{X^{cn}_{j,1995}}{\sum_{n'} X^{cn'}_{j,1995}} \text{tariff}^{cn}_{jt},$$

where $X^{cn}_{j,1995}$ is the Chinese exports to country n in industry j in 1995 and tariff^{cn}_{jt} is the import tariff on Chinese exports to country n in industry j in year t. Chinese import tariffs are directly taken from the World Bank Database.

Figure A.16: Distribution of tariff changes and export growth across industries, 2001–2007



Note: Each bar is an industry. Horizontally sorted by value of exports in the industry in 2000.

Figure A.16 plots the change in log exports (in light gray) and percentage-point changes in tariffs (in dark gray) in the 2001–2007 period. 2-digit SIC industries are sorted by the value of exports in the industry in 2000. We can see that changes in tariff levels varied greatly across industries.

[49] Source: `wits.worldbank.org`.

$\hat{P}_{ijt}$ is the price shock to industry j in region i from time t to t', due to import tariffs (with superscript M), and due to import tariffs on intermediate goods (with superscript I):

$$\hat{P}^M_{ijt} = \hat{P}^M_{jt} = \ln(1+\text{tariff}^M_{jt'}) - \ln(1+\text{tariff}^M_{jt})$$

$$\hat{P}^I_{ijt} = \sum_{j'} \frac{\text{input}^{j'}_{ij}}{\sum_{j''} \text{input}^{j''}_{ij}} \left[-\ln(1+\text{tariff}^M_{j't'}) + \ln(1+\text{tariff}^M_{j't}) \right]$$

I use the input-output table from the 2002 Chinese Regional Input-Output Table to calculate each industry's contribution to a certain industry and to construct $\hat{P}^I_{ijt}$. The input-output table is available only on the province level; thus, my assumption here is that prefectures in the same province have the same input-output structure.

B.1.3 Alternative Trade Shock Measures, as in Autor, Dorn and Hanson (2013)

This section shows the construction of market-access-based trade shocks. The idea is this: suppose the overall export (import) increases in a certain industry over time at the national level, and per capita export growth can be calculated by dividing the increase in exports (imports) by the total number of people employed in the industry. Distributing the per capita export growth across regions according to the share of employment in the industry in a certain region, the overall regional trade shock is generated by summing over industries. Specifically, following Autor, Dorn and Hanson (2013), the formula to calculate regional export exposure is as follows:

$$\Delta IPW^M_{it} = \sum_j \frac{L_{ijt}}{L_{jt}} \frac{\Delta M_{jt}}{L_{it}} = \sum_j \frac{L_{ijt}}{L_{it}} \frac{\Delta M_{jt}}{L_{jt}},$$

$$\Delta IPW_{it}^{X} = \sum_{j} \frac{L_{ijt}}{L_{jt}} \frac{\Delta X_{jt}}{L_{it}} = \sum_{j} \frac{L_{ijt}}{L_{it}} \frac{\Delta X_{jt}}{L_{jt}},$$

where L_{it} is the start-period employment (year t) in region i, L_{jt} is the start-period employment in industry j, L_{ijt} is the start-period employment in region i and industry j. ΔM_{jt} is the observed change in China's imports from the rest of the world in industry j between the start and the end of the period. The labor market exposure to import competition is the change in import exposure per worker in a region (in Autor, Dorn and Hanson (2013), it is the change in Chinese import exposure), where imports are apportioned to the region according to its share of national industry employment. Meanwhile, the export exposure is calculated by replacing the observed change in China's imports from the world ΔM_{jt} with China's exports to the world ΔX_{jt}.

The primary measure of interest is ΔIPW_{it}^{X}. The Bartik instrument uses the overall national growth to generate regional growth, by interacting with regional initial conditions. The benefit here is that it will be free of other local shocks that are correlated with local export growth. However, using the observed trade volume increase might still be problematic, since the overall trade increase might be correlated with overall economic growth, in which case the result would capture the "economic growth effect" instead of the "trade growth effect." Thus, I instrument the trade volume change further in two ways: the importing country's income growth and gravity dummies.

The GDP-based instrument is constructed as follows: suppose a country's fraction of income allocated to different industries' consumption (imports) does not change over time, and the fraction of imports in an industry that comes from China also does not change over time, then the growth of demand for Chinese goods will be from the growth of the importing country's income level. Specifically, the import value of Chinese goods in industry j (used as the superscript rather than as the subscript) and year t is constructed as follows:

$$
\begin{aligned}
X_{jt} &= \sum_n \frac{X^{cn}_{jt^*}}{\sum_{n'} X^{n'n}_{jt^*}} \frac{\sum_{n'} X^{n'n}_{jt^*}}{\sum_{j'}\sum_{n'} X^{n'n}_{j't^*}} GDP^n_t \\
&= \sum_n \frac{X^{cn}_{jt^*}}{X^n_{jt^*}} \frac{X^n_{jt^*}}{X^n_{t^*}} GDP^n_t \\
&= \sum_n \frac{X^{cn}_{jt^*}}{X^n_{t^*}} GDP^j_t,
\end{aligned}
$$

where $\frac{X^{cn}_{jt^*}}{X^n_{jt^*}}$ is the fraction of imports in industry j and country n that comes from China in baseline year t^*, and $\frac{X^n_{jt^*}}{X^n_{t^*}}$ is the fraction of imports in industry j and country n out of the total import value. Then the export market access shock with the GDP measure in industry j between year t and t' is defined as

$$
\Delta X^{GDP}_{jt} = \sum_n \frac{X^{cn}_{jt^*}}{X^n_{t^*}} \left(log(GDP^n_{t'}) - log(GDP^n_t) \right).
$$

Alternatively, I use gravity dummies instead of GDP growth. First, I run a regression of log pairwise country imports on origin and destination country dummies, controlling for geographic distances. The export market access shock with the gravity measure is as follows:

$$
\Delta X^{Gravity}_{jt} = \sum_n \frac{X^{cn}_{jt^*}}{X^n_{t^*}} \left(D_{n,t'} - D_{n,t} \right).
$$

ΔX^{GDP}_{jt} and $\Delta X^{Gravity}_{jt}$ are used instead of ΔX_{jt} to calculate ΔIPW^X_{it}.

I also add a measure for the intermediate-goods market access shock:

$$
\Delta IPW^I_{it} = \sum_j \frac{L_{ijt}}{L_{it}} \hat{I}_{ijt}
$$

and

$$\hat{I}_{ijt} = \sum_{j'} \frac{input_{j'}^{ij}}{\sum_{j''} input_{j''}^{ij}} \left[\frac{M_{j't'}}{L_{j't}} - \frac{M_{j't}}{L_{j't}} \right].$$

B.2 Data on Migrants

The information about the number of migrants is from the 2000 and 2010 censuses and the 2005 1% population survey. The 2000 individual data is a 0.1% random sample of the population, and the 2005 data is a 0.2% random sample of the population. I use 2010 aggregate prefecture-level data for the analysis since the individual data is not available.[50]

A person is defined as a migrant if he or she has been living in a place other than the Hukou registration place for more than six months or has left the Hukou registration location for more than six months. There were 144 million migrants in 2000, 0.39 million per prefecture. In 2010, the number increased to 261 million, 0.77 million per prefecture.

There is also information about how far the person migrated. A migrant is defined as a within-prefecture migrant if the Hukou prefecture and the residence prefecture are the same. Between-prefecture within-province migration means the Hukou prefecture and the residence prefecture are different but in the same province. A between-province migrant is one whose Hukou province and residence province are different. The total number of migrants is decomposed into these three categories to see if trade shocks and regulation changes affected them differently.

When I study the effect of the 2001–2007 trade shocks on migrant flows, I use the 2000 and 2010 data, because it could have taken time for the regulations to affect actual migrant flows. In Section C.11.2, I exploit the timing of the regulation change and migrant flows to show whether the regulation drives the migrant flows or the other way around, and I use all three years of data.

[50] The census and 1% population survey are conducted via personal visits. To address potential issues related to under-reporting, the Census Bureau randomly samples some neighborhoods after the census concludes and check the nonresponse rate. The nonresponse rate in the 2000 census is 1.81%. Source: `www.stats.gov.cn/tjsj/ndsj/renkoupucha/2000pucha/html/append21.htm`.

Table A.5: Summary of statistics of census data, 2000, 2005, and 2010

Mean (s.d.) in million persons	2000	2005	2010
Total population	3.5 (2.7)	3.8 (4.0)	3.9 (3.2)
# of locals	3.1 (2.3)	3.2 (3.3)	3.1 (2.3)
# of migrants	.39 (.63)	.56 (1.20)	.77 (1.31)
By migration distance			
within cities (short distance)	.19 (.22)	.25 (.45)	.11 (.28)
across cities (medium distance)	.09 (.15)	.08 (.22)	.39 (.41)
across provinces (long distance)	.11 (.37)	.23 (.88)	.25 (.85)
By reason of migration			
Work	.12 (.36)	.26 (.83)	.41 (.80)
Family	.04 (.06)	.09 (.18)	.13 (.15)
Marriage	.01 (.02)	.04 (.08)	.04 (.04)
Other	.20 (.26)	.16 (.38)	.15 (.24)
By years of education			
<=12 years of education	.34 (.55)	.45 (1.11)	.59 (0.99)
> 12 years of education	.03 (.07)	.06 (.23)	.13 (.29)
By years since moved here			
<=3 years	.19 (.40)	.25 (.69)	.43 (.70)
> 3years	.16 (.22)	.26 (.68)	.32 (.62)

The 2005 Population Survey contains a wealth of information on respondents.[51] For example, the respondents were asked about their medical insurance, pension, unemployment insurance, terms of contract, and wages. I use the 2005 social insurance measures to check whether in places with more pro-migrant regulations, migrants enjoy more social insurance and are paid higher wages. Also, industries are identified by two-digit SIC codes. The industry classification helps to construct the industry-level migrant share of total employment, i.e., the industry-level migrant intensity. In the manufacturing sector, manufacturing of communication equipment, computers, and other electronic equipment has 68% of migrant employment; mining and processing of ferrous metal ores has only 15%.

[51] The 2000 Census also has the industry and occupation information, but the coding is not standard GB code. There is no information on social insurance or wages in the 2000 sample.

B.3 Other Prefecture-Level Measures

China is composed of 31 provinces, which are divided into 340 prefectures (including four municipalities: Beijing, Tianjin, Shanghai, and Chongqing). Each prefecture contains rural areas and urban areas. Thus, migrant flows could be within a single prefecture from rural area to urban area or between two prefectures.

I include 250 prefectures in the main analysis. Some of the 340 prefectures are purely rural.[52] Total population, total urban employment, wages, and GDP data at the prefecture level come from the Prefecture Statistics Yearbook. There are 258 prefectures in 1995, 264 in 2001, and 286 in 2007. The Yearbook contains primarily statistics for the urban part of the economy and intentionally excludes some rural prefectures. For example, Gansu province has 12 prefectures, but only six are included in the 2001 Yearbook. The number of prefectures in the Yearbook increases over time as more prefectures become urbanized. My final sample includes 250 prefectures from the 2001–2007 period; I drop Yulin Prefecture in Guangxi Province due to its border change, one prefecture with missing industrial composition data, and 12 other prefectures where 20% of employment is in the petroleum industry. I drop these 12 prefectures because their cities differ from other cities in many dimensions, but the results are unchanged if I keep these 12 prefectures and include the petroleum industry employment share as a control.

The average wage data, from administrative reports, includes the wages not only of people working in firms but also of people working in the government and other administrative working units.[53] Total urban employment includes urban residents working in the public sector and the private sector as well as individual laborers.

Since local government officials are promoted based on the GDP growth rate, they might be incentivized to manipulate their prefecture-level GDP data. I use night-light satellite data to check the validity of the GDP data.[54] In 2001, the correlation between per capita GDP and night-light

[52] For example, most prefectures in Yunnan, Gansu, Xinjiang, and Tibet provinces.

[53] Another way to calculate the average wage is to use the Industrial Enterprises Survey data. The correlation of the two wage measures is 0.8 across the 250 prefectures in 2001, and a linear regression with no constant term generates a coefficient of 1.08. I opt to use the wage data from the Yearbook because it covers all sectors of the economy.

[54] NASA night-light data can be downloaded from `http://ngdc.noaa.gov/eog/dmsp/`

intensity is 0.7. I use the GDP from the Yearbook as my main measure of economic activities and supplement it with the night-light intensity.

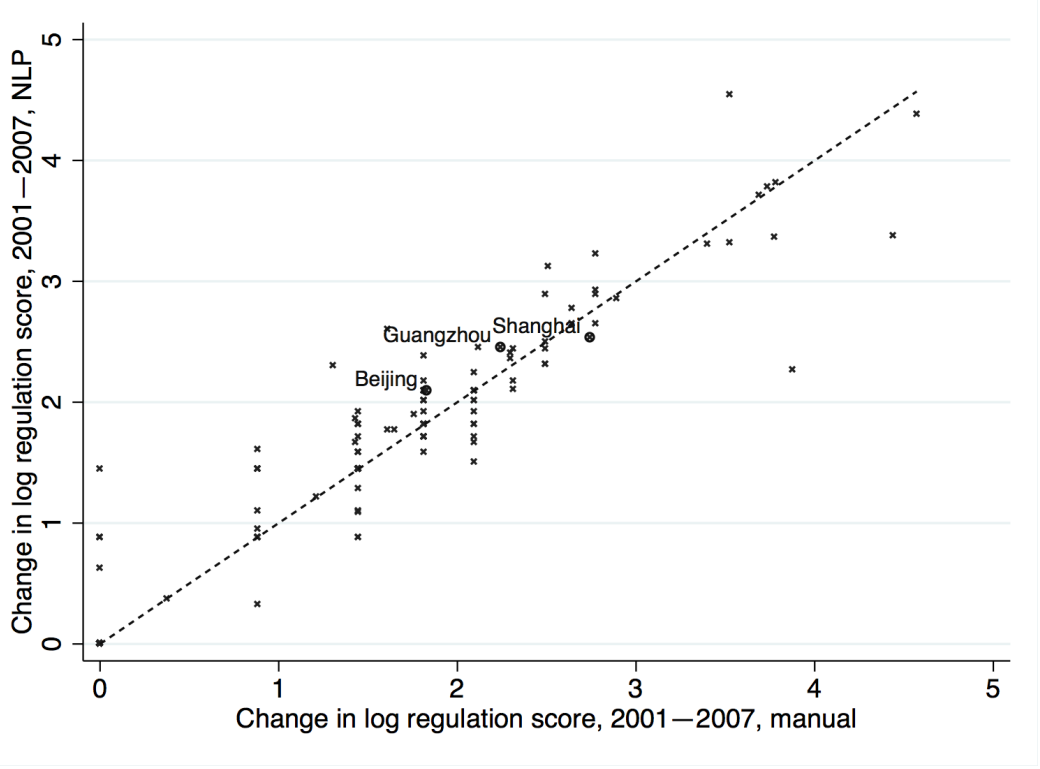
downloadV4composites.html.

C Additional Empirical Results

C.1 The Correlation Between the Manually Coded Regulation Scores and the NLP Scores

Figure A.17 shows the correlation between the change in log regulation scores from 2001 to 2007 that is coded manually and the one coded using NLP methods. The correlation is 0.97 and the dots are very close to the 45 degree line.

Figure A.17: The regulation scores coded manually and by NLP methods are highly correlated



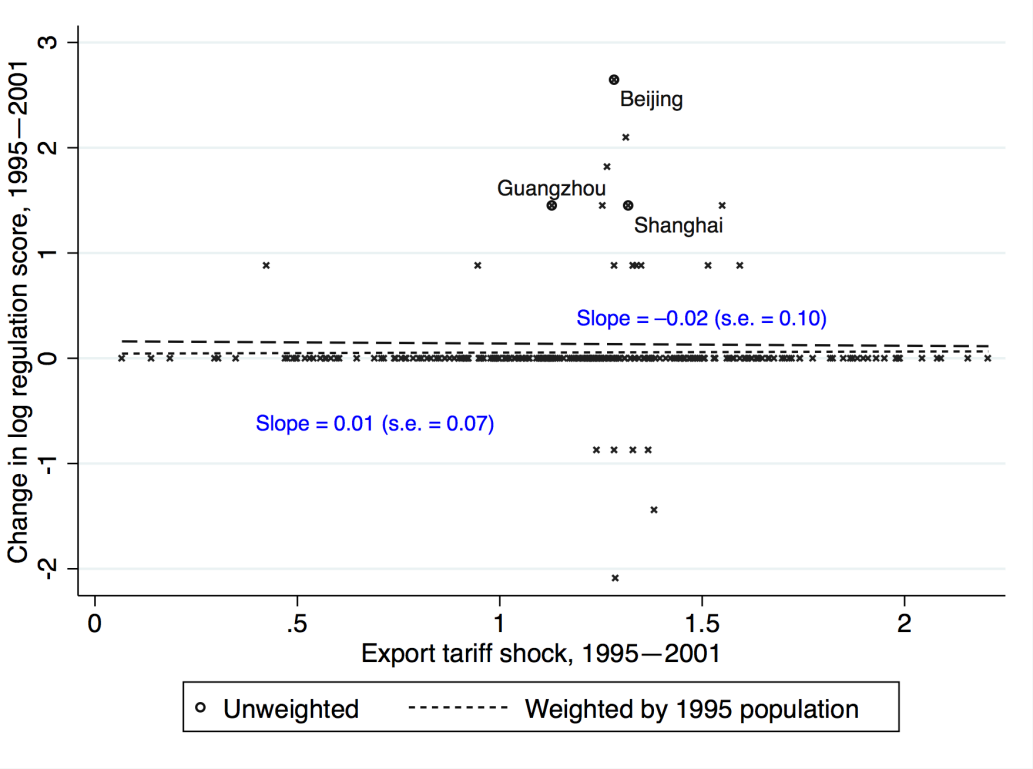
Note: Each dot is a prefecture.

C.2 Trade Shock–Regulation Relationship from 1995 to 2001

Figure A.18 plots the relationship between changes in the log regulation score and export tariff shocks in the 1995–2001 period to compare with Figure 8. Pre WTO accession, there were clearly few changes in migrant-related regulations (with insignificant coefficients of –0.02 to 0.01, while

the coefficients are 0.9 to 1.9 and statistically significant in the post-WTO period), and the few prefectures that changed migrant regulations were provincial capitals. This reinforces the argument about the significance of the WTO effect.

Figure A.18: Effect of trade shocks on regulation change, 1995–2001, 238 prefectures

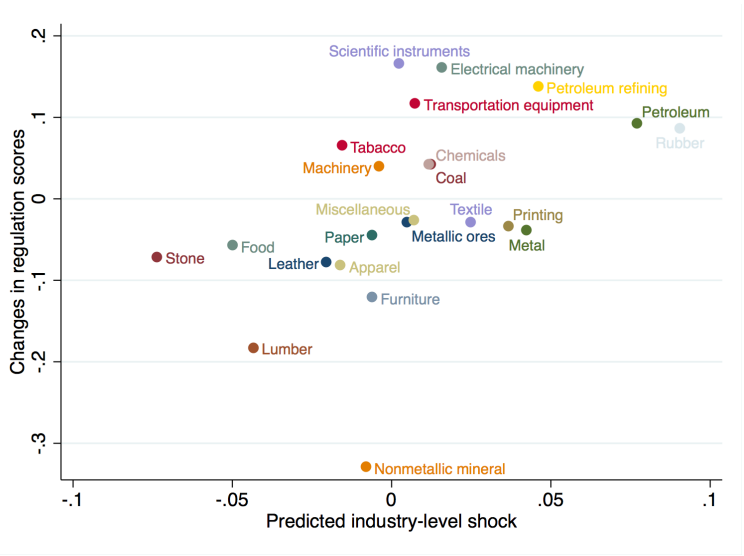


Note: Each dot is a prefecture.

C.3 Trade Shock–Regulation Relationship at the Industry Level

Figure A.19 plots the relationship between changes in the log regulation score and predicted export tariff shocks in the 2001–2007 period on the industry level to compare with Figure 8, following Borusyak, Hull and Jaravel (2018). The industry weighted IV regression generates the same point estimate of 1.08 as in Table 1 Column (8), and except for the non-metallic mineral industry, other industries show a rather linear relationship.

Figure A.19: Effect of trade shocks on regulation change, 1995–2001, 23 industries



Note: Each dot is an industry.

C.4 Main Results with Panel Specifications

The main specification in Section 5.2 uses the long differences between 2001 and 2007, and control for the 1995 to 2001 changes. Alternatively, the two long-differences can be stacked together:

$$\Delta \ln(\text{Regulation Score})_{it} = \alpha_0 + \alpha_1 \text{Trade Shock}_{it} + \alpha_2 \text{Trade Shock}_{it} \times I_t + X_{it}\Gamma + I_i + I_t + \varepsilon_{it},$$

where $t \in \{1995\text{–}2001, 2001\text{–}2007\}$, i represents a prefecture, I_i is prefecture fixed effects and I_t is a dummy which equal to 1 if it is the second period (2001–2007). Note that I allow for differential impact of trade shocks on regulation changes in the first and the second period, since as described in Section 2, prefecture-level governments were granted discretion on migrant-related issues mostly in the second period.

The results are shown in Table A.6. Column (1) regresses the change in log regulation score on the export shocks, import shocks, and intermediate shocks, with each shock interacted with the period dummy, controlling for prefecture fixed effects and the period dummy. The coefficient

estimates for the shocks are insignificant, indicating that in the 1995–2001 period, trade did not drive the changes in migrant regulations. The coefficient for the export shock interacted with the 2001–2007 period dummy is positive and statistically significant, indicating that the export tariff shock after the WTO accession significantly affected the migrant friendliness. Columns (2)–(4) add additional controls for the prefecture-characteristics at the beginning of each period, and the results are similar to Column (1). Columns (5)–(8) use the NLP coding stead of the manual coding, but the results are similar.

Table A.6: Bigger trade shocks, more migrant-friendly, panel specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Δ log regulation score, manual				Δ log regulation score, NLP			
Export tariff shock	-0.22	-0.21	-0.19	-0.19	-0.20	-0.19	-0.17	-0.17
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.23)	(0.24)	(0.24)
Export tariff shock × I(01–07)	1.64**	1.39**	1.27**	1.27**	1.61**	1.34**	1.25**	1.25**
	(0.60)	(0.61)	(0.59)	(0.59)	(0.63)	(0.63)	(0.61)	(0.61)
Import tariff shock	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01	-0.02	-0.02
	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Import tariff shock × I(post)	-0.10	-0.09	-0.08	-0.08	-0.10	-0.10	-0.09	-0.09
	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
Intermediate tariff shock	-0.23	-0.14	-0.15	-0.15	-0.18	-0.09	-0.10	-0.10
	(0.13)	(0.12)	(0.14)	(0.15)	(0.14)	(0.12)	(0.12)	(0.15)
Intermediate tariff shock × I(post)	0.30	0.20	0.24	0.24	0.28	0.18	0.21	0.21
	(0.18)	(0.18)	(0.20)	(0.20)	(0.18)	(0.18)	(0.20)	(0.20)
Observations	474	474	474	474	474	474	474	474
R-squared	0.71	0.72	0.72	0.72	0.71	0.72	0.72	0.72

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1)–(4) use the change in the log of regulation score by manual coding, and (5)–(8) use the one by NLP coding. All columns control for period fixed effects and prefecture fixed effects. Columns (2) and (6) adds the log GDP per capita at the beginning of the period, Columns (3) and (7) adds the initial log wage, and Columns (4) and (8) adds the initial log population. The mean (s.d.) of Δ log regulation score, 2001–2007 is 1.0 (1.1) for the manual coding and 1.1 (1.1) the NLP coding. The mean (s.d.) of Δ log regulation score, 1995–2001 is 0.06 (0.4) for the manual coding and 0.08 (0.4) for the NLP coding. The mean value of export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40).

Overall, the findings here are similar to the ones in Table 1.

C.5 Main Results with Score Levels

Table A.7: Bigger trade shocks, more regulation relaxation, score levels instead of logs

Panel A.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: Δ regulation score, 2001–2007, manual coding							
Export tariff shock	4.10**	7.19***	6.18***	6.18***	5.50**	5.12**	5.13**	4.00*
2001–2007	(1.55)	(2.14)	(1.95)	(2.05)	(2.12)	(2.05)	(1.99)	(2.02)
Import tariff shock		-0.69***	-0.56***	-0.60***	-0.69**	-0.47**	-0.60***	-0.64*
2001–2007		(0.21)	(0.19)	(0.20)	(0.32)	(0.19)	(0.19)	(0.32)
Intermediate tariff shock		-0.56	-0.18	-0.19	-1.86*	0.08	-0.58	-1.62
2001–2007		(0.79)	(0.66)	(0.67)	(1.06)	(0.82)	(0.72)	(1.12)
Log regulation score			3.50***		3.46***	3.40***	3.40***	3.35***
2001			(1.08)		(1.06)	(1.01)	(1.06)	(1.01)
Δ log regulation score				3.48***				
1995–2001				(1.07)				
Export tariff shock					-0.18			-0.38
1995–2001					(1.11)			(1.12)
Import tariff shock					-0.01			0.04
1995–2001					(0.10)			(0.09)
Intermediate tariff shock					1.69***			1.47**
1995–2001					(0.56)			(0.57)
Δ log wage						7.01***		6.13***
1995–2001						(1.69)		(2.20)
Δ log GDP p.c.							2.59***	1.60*
1995–2001							(0.81)	(0.89)
Observations	250	250	250	237	237	237	237	237
R-squared	0.01	0.06	0.28	0.28	0.29	0.31	0.30	0.33
Panel B.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: Δ regulation score, 2001–2007, NLP coding							
Export tariff shock	4.92**	8.81***	6.91***	6.96***	6.39**	6.29**	6.16**	5.35**
2001–2007	(1.87)	(2.67)	(2.21)	(2.34)	(2.42)	(2.28)	(2.28)	(2.29)
Observations	250	250	250	237	237	237	237	237
R-squared	0.01	0.05	0.52	0.52	0.53	0.53	0.53	0.54

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) of Δ regulation score, 2001–2007 is 2.7 (5.2) for the manual coding and 3.1 (6.6) for the NLP coding. The mean (s.d.) of Δ regulation score, 1995–2001 is 0.09 (0.7) for the manual coding and 0.12 (0.7) for the NLP coding. The mean value of export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40).

Instead of using inverse-hyperbolic-sine-transformed regulation scores, I use the level of scores in Table A.7. The results are similar to the ones in Table 1.

C.6 Changing the Sample of Prefectures

The main analysis focuses on 250 prefectures with complete data on economic conditions such as GDP and wages from the Prefecture Statistics Yearbook. In this section, I include all 340 prefectures in China to check the robustness of the result with respect to sample selection. Table A.8 Column (1) includes 333 prefectures.[55] The point estimates for export tariff shocks remain similar in Columns (2) and (3) when I add import tariff shocks, intermediate tariff shocks and the log regulation score in 2001. As mentioned in the main analysis, prefectures with a high employment share in the petroleum industry are outliers in the analysis. They experienced big and positive export tariff shocks, but the petroleum industry is mostly state-owned. Thus, the response of regulation changes was small in those industries despite the big trade shocks. Column (4) includes those prefectures in the analysis and control the employment share of the petroleum industry. Column (5) drops prefectures whose share of employment in the petroleum industry is higher than 20% as in the main analysis. The coefficients for export tariff shocks are comparable in these two columns, but bigger than in Columns (1) to (3), consistent with the outlier story.

[55] Seven Tibetan prefectures are not included because there is no input-output table for Tibet, and I cannot construct the intermediate tariff shock. The result in Column (1) holds if I include the seven prefectures, but I drop them in Column (1) to be comparable with Columns (2) to (4).

Table A.8: Effects of trade shocks on regulation changes, 2001–2007, different sample sizes

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ log regulation score	All prefectures					Prefectures with non-zero Δ		
Export tariff shock	0.94***	1.06***	0.99***	1.35***	1.36***	0.73**	0.89**	0.90**
2001–2007	(0.26)	(0.28)	(0.29)	(0.47)	(0.49)	(0.29)	(0.34)	(0.34)
Import tariff shock		-0.05	-0.04	-0.05	-0.05		-0.04	-0.04
2001–2007		(0.03)	(0.03)	(0.04)	(0.04)		(0.04)	(0.04)
Intermediate tariff shock		0.55**	0.55***	0.52**	0.53**		0.00	-0.00
2001–2007		(0.20)	(0.19)	(0.19)	(0.20)		(0.14)	(0.14)
Log regulation score			0.78*	0.73*	0.73*			-0.07
2001			(0.38)	(0.40)	(0.40)			(0.15)
Employment share in				-1.41*				
petroleum ind, 2000				(0.76)				
Observations	333	333	333	333	323	148	148	148
R-squared	0.03	0.10	0.13	0.14	0.14	0.02	0.03	0.03
Mean (s.d.) of depend.	0.83 (1.0)				0.83 (0.10)	1.81 (0.75)		
Mean (s.d.) of trade shock	0.16 (0.20)				0.14 (0.18)	0.18 (0.14)		

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1)–(4) include all prefectures in China expect for prefectures in Tibet, since there is no input-output table for Tibet and intermediate tariff shocks are missing. Column (4) controls for the employment share in petroleum industry in 2000, and Column (5) drops the prefectures with employment share in petroleum industry higher than 20%. Columns (6)–(8) include all prefectures with nonzero changes from 2001 to 2007, excluding prefectures with employment share in petroleum industry higher than 20%.

In Figure 8, 114 prefectures experienced no regulation changes from 2001 to 2007. Thus, it is useful to distinguish whether the result of trade shocks on regulations is driven by the comparison between prefectures with no changes and prefectures with changes, or between the prefectures with big positive changes and small positive changes. Table A.8 Columns (6)–(9) include only prefectures with nonzero changes. The coefficient estimates are 19% to 44% smaller than in Table 1 Columns (1) to (3) and remain statistically significant at the 5% level. This result suggests that both the extensive margin and the intensive margin of regulation changes are important in estimating the trade effects.

C.7 Alternative Measure of Regulation Changes

One important aspect of the data is the coding of regulations' migrant-friendliness. In the main specification, I use the regulation score on a -2 to 2 scale, with -2 as the least migrant-friendly and 2 as the most migrant-friendly. Alternative, I use a "negative (–1), neutral (0), and positive (+1)" scale and also a simple count of the number of regulations to check the robustness of the result.

Also, the regulations can be decomposed by topics into work-related, welfare-related, and administrative to investigate the effect of trade shocks on each category.

Table A.9: Alternative measure of regulation change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Δ log regulation score		Δ log num.	Δ log regulation score				
2001–2007	5 levels	3 levels	regulations	Work	Welfare	Hukou	Insurance	Other
Export tariff shock	1.61***	1.49***	0.51*	1.28***	0.71***	0.44**	0.35	0.09
2001–2007	(0.52)	(0.43)	(0.29)	(0.42)	(0.21)	(0.20)	(0.38)	(0.06)
Import tariff shock	-0.12**	-0.10**	-0.03	-0.07**	-0.04	-0.03	-0.09***	-0.01*
2001–2007	(0.05)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.00)
Intermediate tariff shock	0.26*	0.25**	0.23**	0.10	0.11*	0.20**	-0.21*	0.06
2001–2007	(0.15)	(0.12)	(0.08)	(0.14)	(0.06)	(0.07)	(0.11)	(0.04)
Y, 2001	-0.08	0.13	0.32***	2.42***	-	-0.07	1.03***	-0.02
2001	(0.23)	(0.19)	(0.06)	(0.14)	-	(0.14)	(0.05)	(0.02)
Observations	250	250	250	250	250	250	250	250
R-squared	0.08	0.10	0.15	0.06	0.05	0.08	0.05	0.03
Mean (s.d.) of Y	1.0 (1.1)	0.8 (0.9)	0.6 (0.6)	0.7 (0.9)	0.2 (0.5)	0.1 (0.4)	0.3 (0.7)	0.03 (0.2)

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean value (s.d.) of export tariff shocks, 2001–2007 is 0.18 (0.15).

Table A.9 uses the same specification as in Table 1 Column (3). Column (1) replicates Table 1 Column (3), with the outcome variable using the five-level coding. Column (2) uses the three-level coding, and Column (3) uses the log number of regulations. Columns (4)–(6) use the five-level coding by topic.

The results show that the effect of trade shocks on regulation changes is robust to variation in the regulation measure. The five-level coding is the most informative about the migrant-friendliness, and the effect of export tariff shocks is also the biggest and most significant among the first three columns. In the latter three columns, trade shocks that affected work-related and welfare-related regulations were most significant. Overall, all columns are consistent with the main result.

C.8 Alternative Measure of Bartik Trade Shocks

To check the robustness of the main results with respect to the measure of trade shocks, I use industry labor shares as weights directly: $\beta_{ij}^{'} = \lambda_{ij}$ in Table A.10 Column (2). Compared to Column (1), which replicates Table 1 Column (3), the coefficient on the export tariff shock is very similar to the main results.

Alternatively, I follow the Autor, Dorn and Hanson (2013) measure of local-labor-market trade shock and construct local-market-access shocks. The market-access shock is also a Bartik-style measure, with industry-level export growth distributed across regions, weighted by local-industry labor shares. The difference with the Autor, Dorn and Hanson (2013) measure is that I use export growth instead of import growth, since export growth is more relevant in the Chinese context. Also, since Autor, Dorn and Hanson (2013) analyze the effect of exposure to Chinese exports on the U.S. economy, the authors use Chinese exports to other developed countries as an instrument to capture the Chinese productivity growth effect. In my case, I want to capture the demand-side forces that led to the expansion of Chinese exports, so I use the GDP growth of the importing countries as an instrument. An alternative measure would be the change in country dummies from a bilateral trade gravity regression.

Table A.10 Columns (3)–(7) show the results with the market-access-based shocks. Column (3) contains only the export shocks, Column (4) adds the import and intermediate shocks, and Column (5) adds urban share of the prefecture as a control. Column (6) instruments the export shock with the GDP-based instrument. Column (7) uses the gravity-dummy-based instrument. The size of the

coefficient on the export shock is robust across these specifications, but the IV coefficients are less significant. The results show that a $1,000 per worker increase in exports led to a 0.03 increase in log regulation score. Again, I divide prefectures into big-, medium- and small-shock ones, and the difference in export shocks between the big- and small-shock ones is $14,000 per worker. This translates into a 0.42 higher increase in log regulation scores, which is comparable to the 0.33 difference found in the main regression with tariff shocks.[56]

Table A.10: Alternative measure of trade shocks, Bartik-style

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: Δ log regulation score, 2001–2007						
Trade shock measure:	Tariff-based		Market-access-based				
	Main	Labor share	OLS	OLS	OLS	GDP IV	Gravity IV
Export tariff shock	1.61***	1.50***	0.04***	0.03***	0.03***	0.04**	0.03**
2001–2007	(0.52)	(0.48)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Import tariff shock	-0.12**	-0.11**		0.02	0.00	-0.00	0.00
2001–2007	(0.05)	(0.05)		(0.02)	(0.02)	(0.02)	(0.02)
Intermediate tariff shock	0.26*	0.26*		0.15	0.12	0.09	0.10
2001–2007	(0.15)	(0.14)		(0.10)	(0.12)	(0.12)	(0.11)
Log regulation score, 2001	-0.08	-0.08			-0.18	-0.19	-0.19
	(0.23)	(0.23)			(0.19)	(0.18)	(0.18)
Urban share, 2001					0.02***	0.02***	0.02***
					(0.01)	(0.01)	(0.01)
Observations	250	250	250	250	250	250	250
R-squared	0.08	0.07	0.07	0.09	0.16	0.16	0.16
Mean (s.d) of Y	0.18 (0.15)	0.17 (0.15)			16.40 (6.63)		
First-stage F-stat	-	-	-	-	-	321	515

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean value (s.d.) of Δ regulation scores, 2001–2007 is 1.0 (1.1).

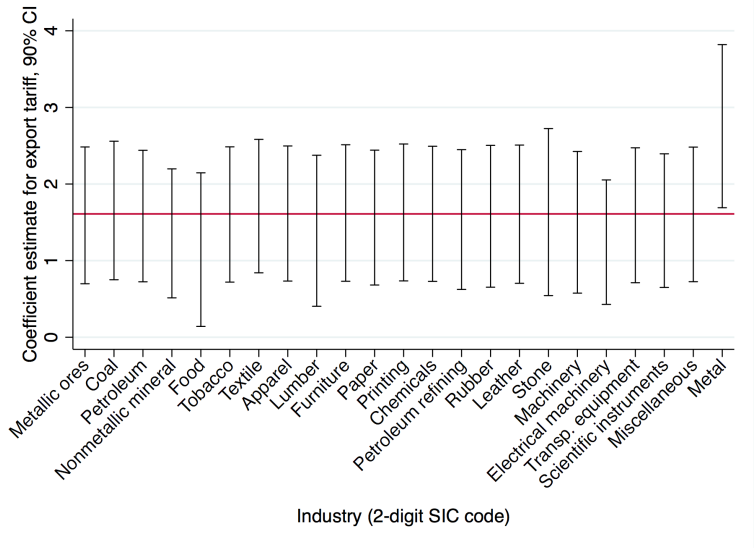
[56]The per capita export was about $300 in 2001 and $1,000 in 2007. The number of employed workers in the Industrial Enterprises Survey in 2000 is 50 million. Thus, the $14,000 per worker difference is equivalent to $580 per person and is comparable to the $700 mean increase from 2001 to 2007.

C.9 Adding Industrial Composition Controls

The regional tariff shocks are generated using the interaction of prefecture-level industrial composition and industry-level tariff reductions. If certain industries drive variation and are correlated with other local factors that affect regulation changes directly, then the estimates for regional tariff shock effects would be biased. To check whether such an industry exists, I add industry employment shares one at a time and run the regression in Table 1 Column (3).

Figure A.20 plots the coefficient estimates with 90% confidence intervals, and each bar is from a regression, including a specific-industry employment share. The coefficient estimates are relatively stable around 1.61, which is the estimate in Table 1 Column (3). Thus, the results are not sensitive to specific-industry effects.[57]

Figure A.20: Coefficients from the main regression by adding industrial-composition controls one by one



Note: Each bar is the 90% confidence interval of the coefficient estimate of export tariff shocks from a regression as in Table 1 Column (3), controlling for a specific-industry share of total employment. The horizontal bar is the point estimate of 1.61 from Table 1 Column (3).

[57] Including the metal industry employment share makes the coefficient on export shocks bigger, while the metal employment share itself has a significant negative effect. This is because the metal industry is very high in state-ownership, and as discussed in Section 5.3, state-owned enterprises tend to hire fewer migrants than private firms. The heterogeneous effect is also robust to controlling for individual industry employment shares.

C.10 Competition between Prefectures in Regulation Changes

Prefecture *i*'s regulation change and trade shock can affect not only its own regulation but also that of other prefectures. The most direct measure of the intensity of competition is to focus on nearby prefectures. Table A.11 Column (1) replicates the result in Table 1 Column (3). Columns (2)–(4) consider the competition with other prefectures in the same province. Column (2) adds trade shocks, Column (3) adds regulation changes, and Column (4) controls for both. Columns (5)–(7) repeat the exercise by considering the competition with five nearby prefectures.[58] Overall, I find no significant competition effect due to geographic proximity.

Table A.11: Competition between prefectures, geographic proximity

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ log regulation score, 2001–2007		All other prefectures, same prov.			5 closest prefectures		
Export tariff shock, own	1.61***	1.34**	1.33**	1.30**	1.57***	1.38**	1.37**
2001–2007	(0.52)	(0.50)	(0.51)	(0.52)	(0.54)	(0.58)	(0.59)
Export tariff shock, other pref.		0.59		0.29			
2001–2007		(1.00)		(0.70)			
Δ log regulation score, other pref.			0.30	0.29			
2001–2007			(0.20)	(0.19)			
Export tariff shock, nearby pref.					0.08		0.05
2001–2007					(0.14)		(0.14)
Δ log regulation score, nearby pref.						0.96	0.91
2001–2007						(0.82)	(0.79)
Observations	250	244	244	244	250	250	250
R-squared	0.08	0.09	0.10	0.10	0.08	0.08	0.08

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) of Δ reg regulation scores, 2001–2007 is 1.0 (1.1). The mean value of own export tariff shock, 2001–2007 is 0.18 (0.15). Column (2) controls for the trade shock in all other prefectures in the same province. Column (3) controls for the regulation change in all other prefectures in the same province. Column (4) controls for both. Columns (5)–(7) repeat the exercise by controlling for the variables in the 5 closest prefectures.

In addition to focusing on nearby prefectures, a prefecture's exposure to competition with all other prefectures in terms of trade shocks and regulation changes can be measured in three ways.

[58] The five nearby prefectures are the five closest prefectures by euclidian distance, calculated from the longitude and the latitude.

First, the distance between prefectures can arise from similarities in the industrial composition. The distance between prefecture o and prefecture d is the sum of squared differences in employment shares in each industry:

$$D_{o,d}^{ind} = \sum_j (EmpShare_{o,j}^{2001} - EmpShare_{d,j}^{2001})^2,$$

where $EmpShare_{i,j}^{2001}$ is the employment share in industry j in prefecture i in 2001, $i \in \{o, j\}$.

Second, the distance can be due to similarities in the population size. The distance between prefecture o and prefecture d is the squared differences in log population in 2001:

$$D_{o,d}^{pop} = (\log(population_o^{2001}) - \log(population_d^{2001}))^2.$$

Third, the distance can come from similarities in per capita GDP:

$$D_{o,d}^{GDP} = (\log(\text{GDP p.c.}_o^{2001}) - \log(\text{GDP p.c.}_d^{2001}))^2.$$

I then construct the weight assigned to each destination prefecture d with respect to an origin prefecture o by taking the inverse of the distance measure as above, combined with the inverse of geographic distance:

$$w_{o,d}^S = \frac{1}{D_{o,d}^S} \cdot \frac{1}{D_{o,d}^{geodist}},$$

where $S \in \{ind, pop, GDP\}$, and $D_{o,d}^{geodist}$ is the travel time between prefecture o and prefecture d in 2000. $T_{ij,2000}$ is from Yang (2017), using the highway and non-highway network in China, with the assumption that the speed of travel is 90 kilometers per hour on highways, 25 kilometers per hour on national and provincial non-highways, and 15 kilometers per hour on local roads.

The trade shock in prefectures that compete with prefecture o is measured as

$$TS_o^S = \sum_d \frac{w_{o,d}^S}{\sum_{d'} w_{o,d'}^S} TS_d,$$

and regulation change in the competing prefectures is measured as

$$R_o^S = \sum_d \frac{w_{o,d}^S}{\sum_{d'} w_{o,d'}^S} R_d,$$

where $S \in \{ind, pop, GDP\}$.

Table A.12: Competition between prefectures, by industrial composition, population size, and income similarity

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ log regulation score, 2001–2007	By ind.	By size of pop.			By size of GDP p.c.		
Export tariff shock, own	1.49***	1.59***	1.63***	1.63***	1.54***	1.25**	1.22**
2001–2007	(0.48)	(0.51)	(0.52)	(0.51)	(0.51)	(0.46)	(0.47)
Δ log regulation score, other, ind.	0.22						
2001–2007	(0.32)						
Export tariff shock, other, pop.		0.09		0.00			
2001–2007		(0.48)		(0.50)			
Δ log regulation score, other, pop.			0.08	0.08			
2001–2007			(0.09)	(0.09)			
Export tariff shock, other, GDP					1.34***		1.06**
2001–2007					(0.37)		(0.39)
Δ log regulation score, other, GDP						0.32***	0.30***
2001–2007						(0.09)	(0.09)
Observations	249	249	249	249	249	249	249
R-squared	0.08	0.08	0.08	0.08	0.09	0.12	0.13

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) of Δ reg regulation score, 2001–2007 is 1.0 (1.1). The mean value of own export tariff shocks, 2001–2007 is 0.18 (0.15). Column (1) controls for regulation changes in other prefectures, using the distance in hours of travel and closeness of the industrial composition as weights. Column (2) controls for trade shocks in other prefectures, using the distance in hours of travel and closeness of the population size as weights. Column (3) controls for regulation changes in other prefectures, using the same weights as in Column (2); Column (4) controls for both trade shocks and regulation changes in other prefectures. Columns (5)–(7) repeats the exercise in Columns (2)–(4) using the distance in hours of travel and closeness of GDP p.c. as weights.

I test whether the trade shocks and regulation changes in competing prefectures increase a

prefecture's incentive to change its own regulation. Table A.12 includes a prefecture's own trade shocks and initial regulation score and adds changes in regulation scores in competing prefectures in terms of industrial composition. The coefficient on other prefectures' regulation change is positive but insignificant. Columns (2)–(4) focus on competition by population size. Column (2) includes trade shocks of competing prefectures, Column (3) includes regulation changes, and Column (4) includes both. None of the coefficients are significant. I do the same exercise in Columns (5)–(7), focusing on competition by per capita GDP. I find positive and significant effects of both trade shocks and regulation changes: a one-unit change in the export tariff shock in competing prefectures has almost the same effect as a one-unit change in a prefecture's own export tariff shock (1.06–1.34 compared to 1.22–1.54); the elasticity between a prefecture's own regulation change and the competing prefectures' regulation change is 0.30–0.32.

Overall, I find that including competing prefectures' trade shocks and regulation changes does not greatly affect the coefficient on a prefecture's own trade shocks. However, evidence indicates that prefectures are competing in regulations with other prefectures that are similar in terms of income. This means that prefectures with similar income compete for the same pool of migrants, and there is a significant spillover effect in both trade shocks and regulation changes.

C.11 Effects of Regulation Changes on Migrant Flows

C.11.1 Econometric Framework and Identification

I estimate the effect of changes in migration regulation on migrant flows by using the following regression equation:

$$\Delta Y_{it} = \pi_0 + \pi_1 \Delta \ln(\text{regulation score}_{it}) + X_{it}\Phi + \zeta_{it},$$

where ΔY_{it} can be the 2000–2010 change of the migrant share of population in prefecture i or the change in the log migrant stock, and π_1 represents how regulation changes affect the outcome variables.

There are several challenges in identifying π_1. First, it is not clear whether the causal relationship goes from migration regulations to migrant flows or the other way around. On the one hand, migration regulation changes can affect migrant amenities, making the city more or less attractive to migrants and leading to bigger or smaller migrant inflows. On the other hand, larger migrant inflows could put pressure on city infrastructure and local employment, leading to regulation changes.

Second, there could be omitted variables that are correlated with both the regulation changes and migrant flows. Suppose that some prefectures have larger growth in pro-migrant sentiment, then it could be the case that both communities and the local government become more migrant-friendly. In this case, the effect of the change in migration regulations will also capture the community sentiment effect.

Third, there could be specific omitted variables related to the fact that trade shocks affect both migration regulations and migrant flows. Trade shocks affect migrant flows through two channels: directly, through prices (and thus, wages), and indirectly, through migration policies. One must control for trade shocks in the regression to identify the regulation effect, but this may not be sufficient. Suppose that regions with larger export shocks also enact more favorable land policies to attract firms, and these firms are able to convince the local government to relax migration restrictions. At the same time, favorable land policies make the region more attractive to workers as well. In this case, without explicitly measuring and controlling for such industrial policies, the estimate of π_1 will be biased.

The last concern relates to the measurement of regulations. The migration regulations I collect may not be the complete set of regulations affecting migrant workers. It is possible that a government enacts a regulation that is not specifically targeted at migrant workers, but at all low-skilled workers in a certain industry. My dataset does not capture such regulations if migrant-related keywords do not show up in the regulation title. The second issue is the coding of migrant-friendliness. I code the migrant-friendliness on a five-point scale, but the actual strength of the regulation could be continuous. In addition, enacting a regulation may not be equivalent to enforcing a regula-

tion. I do not have a prior regarding whether the prefectures with bigger changes in regulation scores enforced the regulations more strictly than prefectures with smaller changes. Overall, if the measurement error is random, the coefficient estimate for π_1 is biased towards zero.

Keeping all of these challenges in mind, I pursue several approaches to estimating the extent to which changes in migrant regulations facilitated increases in migration to regions facing more favorable trade shocks.

C.11.2 Did Migrant Flows Drive Regulation Changes, or Was It the Other Way Around?

The first exercise provides suggestive evidence against reverse causality. I show that changes in migration legislation preceded changes in migrant flows by looking at the timing of the regulation change and the migration flow changes, as well as at the leads and lags. In Table A.13, I check the effect of regulation changes in different time periods on migrant flows from 2005 to 2010.[59] Column (1) shows that a one-unit increase in the log regulation score from 1995 to 2000 (two lagged periods) is related to a 2.95-percentage-point increase in the migrant share of population from 2005 to 2010. In Column (2), I use regulation changes from 2000 to 2005 (one lagged period), and the coefficient on the change in log regulation score declines to 1.53. Column (3) uses the contemporaneous regulation change from 2005 to 2010, and the coefficient declines to 0.63. This could be the mechanical effect from the fact that the mean change in log regulation scores increases from 0.02 in Column (1) to 1.2 in Column (3). However, when we go to Column (4), although there is still a sizable change in the log regulation score of 0.6 from 2010 to 2015, there is no longer a positive effect of regulation changes on migrant flows from 2005 to 2010.

[59]The number of migrants by prefecture in 2005 is calculated using the 2005 1% population survey, with a similar definition of migrants as in the 2000 and 2010 censuses.

Table A.13: Regulation change and migrant flows, lagged, current, and lead, 250 prefectures

	(1)	(2)	(3)	(4)
Dependent variable:	Δ migrant share of population, 2005–2010			
Δ log regulation score, 1995–2000	2.95**			
	(1.30)			
Δ log regulation score, 2000–2005		1.53***		
		(0.54)		
Δ log regulation score, 2005–2010			0.63**	
			(0.30)	
Δ log regulation score, 2010–2015				-1.24***
				(0.44)
Observations	250	250	250	250
R-squared	0.07	0.08	0.04	0.05
Mean (s.d) of X	0.02 (0.4)	0.4 (0.8)	1.2 (0.9)	0.6 (0.6)

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean value of the Δ migrant share of population from 2005 to 2010 is 5.5 (5.4). All columns controls for the level of Y and the log total population in 2005.

Overall, I find a positive effect of lagged or current regulation changes on migrant flows, but no effect of lead regulation changes. This finding suggests that regulations were indeed binding, and changes in regulations determined migration, rather than being the result of migrant flows.

C.11.3 Trade Shocks, Regulation Changes, and Migrant Flows: IV Results

To address the concerns on the identification of the migration regulation effect using the OLS regressions, in Appendix C.13, I instrument the regulation changes using the 2000 natural population growth rate. The natural growth rate of the population (birth rate minus death rate) predicts the future population size of a prefecture. It can be a relevant instrument since a higher natural growth rate means that the prefecture will have a more abundant workforce, and the local government is less likely to relax migration restrictions. At the same time, the natural population growth rate is not likely to be correlated with government industrial policies, which is an important potential omitted variable. I test empirically that conditional other 2000 prefecture characteristics, the 2000 natural population growth rate is not correlated with migrant flow from 2000 to 2010.

One might be concerned that given the one-child policy in China, there is no cross-sectional variation in natural population growth rates. As summarized in Zhang (2017), although the policy was applicable throughout China, the actual implementation of the policy vary a lot over time and across regions.[60] In addition, fertility rates and death rates depend on factors such as the local population age structure, food consumption, habits (such as smoking), and environmental pollution, which are not directly managed by government policies.[61] Empirically, among the 250 Chinese prefectures used in the main analysis, the mean natural population growth rate is 5.2 per thousand, with a standard deviation of 2.8.

Overall, in Appendix C.13, I show that OLS and IV estimates of the migration regulation effect are similar and not statistically different from each other. Both trade shocks and regulation changes contributed positively to migrant inflows, and also affected wages, employment and local GDP growth, as shown in Appendix C.12.

C.11.4 Decomposition of the Migrant Flow

Table 5 classifies migrant flows into short-, medium-, and long-distance categories. As a robustness check, Table A.14 uses alternative classifications: (1) the purpose of migration in Columns (1)–(4); (2) the time since migrating in Columns (5)–(6); and (3) years of education in Columns (7)–(8). The specifications here are the same as in Table 5 Panel A Column (5).

[60] For example, Qian (2009), Liu (2014), and Li and Zhang (2017) use different proxies for regional stringency of the one-child policy to study the impact of the policy on various outcomes.

[61] Environmental regulations can affect pollution levels, but it is unlikely that these policies are correlated with migration regulations.

Table A.14: Trade shocks (2001–2007) and migrant flow in subcategories (2000–2010)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ log # of migrants	Purpose of migration				Time since migrated		Year of education	
Subcategory	Work	Family	Marriage	Other	<= 3	> 3	<= 12	> 12
Export trade shock	0.44*	0.55**	0.32	0.84***	0.42*	0.55**	0.33	0.65**
2001–2007	(0.23)	(0.21)	(0.28)	(0.25)	(0.20)	(0.24)	(0.20)	(0.29)
Y, 2001	-0.30***	-0.22***	-0.39***	-0.05	-0.25***	0.11*	-0.03	-0.20***
	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Log population, 2001	0.15*	0.09	0.29***	0.08*	0.16**	-0.08	0.00	0.09
	(0.07)	(0.07)	(0.08)	(0.04)	(0.06)	(0.06)	(0.05)	(0.08)
Observations	250	250	248	250	250	250	250	249
R-squared	0.35	0.13	0.32	0.14	0.29	0.09	0.07	0.14
Mean (s.d) of depend.	1.5 (0.6)	1.2 (0.5)	0.9 (0.5)	-0.4 (0.5)	1.0 (0.4)	0.5 (0.4)	0.5 (0.4)	1.5 (0.5)

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean value (s.d.) of export trade shock from 2001 to 2007 is 0.18 (0.15).

Table A.15: Regulation change (2001–2007) and migrant flow in subcategories (2000–2010)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ log # of migrants	Purpose of migration				Time since migrated		Year of education	
Subcategory	Work	Family	Marriage	Other	<= 3	> 3	<= 12	> 12
Δ log regulation score	0.10***	0.08**	0.04	0.09***	0.09***	0.05*	0.05*	0.12***
2001–2007	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Y, 2001	-0.32***	-0.24***	-0.42***	-0.10	-0.29***	0.11**	-0.05	-0.22***
	(0.04)	(0.04)	(0.05)	(0.07)	(0.03)	(0.05)	(0.04)	(0.05)
Log population, 2001	0.18**	0.10	0.27***	0.06	0.18***	-0.07	0.04	0.12
	(0.08)	(0.06)	(0.07)	(0.04)	(0.06)	(0.05)	(0.05)	(0.08)
Observations	250	250	248	250	250	250	250	249
R-squared	0.35	0.13	0.30	0.03	0.28	0.06	0.02	0.14
Mean (s.d) of depend.	1.5 (0.6)	1.2 (0.5)	0.9 (0.5)	-0.4 (0.5)	1.0 (0.4)	0.5 (0.4)	0.5 (0.4)	1.5 (0.5)

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean value (s.d.) of Δ regulation score from 2001 to 2007 is 1.0 (1.1).

I find that trade shocks and the relaxation of migration restrictions affected people who migrated for work and for family the most and people who migrated for marriage the least. This is a

reasonable result, since the regulations were mostly work-related. Regulation changes had bigger effects in the later period (migrated in the nearest three years from the time of the survey) than the current period (migrated in more than three years ago from the time of the survey). This finding is consistent with Table A.13: regulations take time to impact migrant flows. Finally, both trade shocks and the regulation changes affected the migrants with more than 12 years of education the most. In the 2000–2010 period, the medium- and long-distance migrant flows increased a lot, and it seems that more-educated migrants were the driving force.

C.11.5 Emigration Instead of Immigration

The 2000 and 2010 censuses also collected information on emigration, since each household was asked to report the number of family members who left their Hukou location for more than six months. Table A.16 replicates the results in Table 5 Panel A by replacing the immigration share of population with emigration share of population and replacing the change in log number of short-distance migrants by the change in log number of out-migrants. Overall, there is no consistent significant effect of either trade shocks or regulation changes on emigration. Columns (1) and (3) show that bigger local export shocks decreased the outflow of people, but the results are not precisely measured. The effect of regulation changes on emigration is mixed and insignificant.

The results for emigration are consistent with the immigration results. Positive local shocks will make people less likely to migrate to other regions to work. Regulation changes centered mostly on improving the well-being of people who migrated to the region. This could still increase the incentive of within-prefecture migration, which might be captured by the positive effect in Column (8).

Table A.16: Did trade shocks and regulation changes affect emigration?

	(1)	(2)	(3)	(4)
Dependent variable:	Δ out-migration share		Δ log # of out-migrants	
Export trade shock	-4.64		-0.00	
2001–2007	(3.27)		(0.15)	
Δ log regulation score		-0.43		0.03
2001–2007		(0.46)		(0.02)
Observations	250	250	250	250
R-squared	0.04	0.01	0.68	0.67
Mean (s.d.) of dependent var.	11.4 (6.4)		1.1 (0.6)	

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables are changes from 2000 to 2010. The mean (s.d.) Δ log regulation score, 2001–2007 is 1.0 (1.1), and the mean (s.d.) export tariff shock is 0.18 (0.15). All columns control for import and intermediate tariff shocks, the log total population and the level of the dependent variable in 2000.

C.11.6 Migrant Supply

The potential supply of migrants can affect the responsiveness of migrant flow to trade shocks and regulation changes. For prefecture o, the distance-weighted agricultural population is

$$\log(agrPOP)_o^{2001} = \sum_d \frac{w_{o,d}}{\sum_{d'} w_{o,d}} \log(agrPOP)_d^{2001},$$

where $w_{o,d} = \frac{1}{D_{geodist_{o,d}}}$, which is inverse of travel time between prefecture o and prefecture d in 2000, and $\log(agrPOP)_d^{2001}$ is the log agricultural population in prefecture d in 2001.

I investigate the impact of migrant supply on the equilibrium migrant flow in Table A.17. Columns (1)–(3) use the change in the migrant share of population as the outcome and control for agricultural population, measured as above. In addition, Column (2) adds the interaction between trade shocks and agricultural population, and Column (3) adds the interaction between the regulation change and agricultural population. I find no significant effect either on the agricultural population or on the interaction. Columns (4)–(6) investigate the effect on short-distance migrant flows, where migrants move within a prefecture. Thus, I use the agricultural population in the same prefecture. There is no significant interaction effect, but there is some evidence that places with a

larger agricultural population to begin with do not move much either. One possible interpretation is that these prefectures have some fixed characteristics that lead to low mobility. Column (7)–(9) show the effect on medium-distance migrant flows, where migrants move within a province across different prefectures. I use the agricultural population in the whole province as the measure for the potential pool of migrant supply. I find a positive interaction effect between the regulation change and migrant supply: a prefecture that is part of a province with a lot of agricultural population has a bigger inflow of migrant workers once the regulation is relaxed.

Table A.17: Interaction effects of migrant supply and migrant demand

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	Δ migrant share of pop			Δ log # of migr. short dist.			Δ log # of migr. medium dist.		
Export trade shock	6.80**	-15.25	7.12**	1.04***	4.46	1.07***	0.35*	-2.02	0.43**
2001–2007	(3.23)	(19.58)	(3.20)	(0.26)	(4.34)	(0.25)	(0.18)	(2.02)	(0.17)
Δ log regulation score	1.00***	1.02***	-3.44	0.17***	0.16***	-0.38	0.05	0.05*	-1.18**
2001–2007	(0.24)	(0.24)	(3.56)	(0.04)	(0.04)	(0.50)	(0.03)	(0.03)	(0.53)
Log (agr. pop.), 2001	-0.69	-1.02*	-1.01*	-0.42**	-0.35	-0.50**	-0.04	-0.07	-0.12**
	(0.51)	(0.55)	(0.58)	(0.19)	(0.26)	(0.22)	(0.05)	(0.05)	(0.04)
Export trade shock		1.98			-0.26			0.15	
×Log (agr. pop.)		(1.71)			(0.32)			(0.13)	
Δ log regulation score			0.39			0.04			0.07**
×Log (agr. pop.)			(0.31)			(0.04)			(0.03)
Observations	249	249	249	240	240	240	250	250	250
R-squared	0.18	0.19	0.19	0.28	0.28	0.28	0.60	0.60	0.61
Mean (s.d.) of depend.		7.0 (5.8)			-0.8 (0.8)			1.6 (0.7)	

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) Δ log regulation score, 2001–2007 is 1.0 (1.1), the mean (s.d.) export tariff shock is 0.18 (0.15). All columns control for import and intermediate tariff shocks, the log total population and the level of the dependent variable in 2000. Columns (1)–(3) use the weighted average agricultural population. Columns (4)–(6) use the agricultural population in the same prefecture. Columns (7)–(9) use the agricultural population in the same province.

C.12 Trade Shocks, Regulation Changes, and Economic Outcomes

C.12.1 OLS Results

In this section, I discuss how trade shocks affected other economic outcomes such as wages, employment, and GDP growth. In Table A.18, a 1-percentage-point larger increase in trade shocks leads to a 15% larger increase in wages. Big-shock prefectures had a 5% higher increase in wages than the small-shock prefectures. The overall trade effect is 6% of the mean (and 34% of one standard deviation) for changes in wages, and the regulation effect is 15% of the total trade effect.

Table A.18: More regulation changes, 2001–2007, and bigger increases in wages, employment, and per capita GDP, 2001–2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Δ log wage			Δ log GDP p.c.			Δ log total urban emp.		
Export trade shock	0.17**		0.15**	0.57***		0.55***	0.39*		0.37*
2001–2007	(0.07)		(0.06)	(0.13)		(0.12)	(0.21)		(0.20)
Δ log regulation score		0.02***	0.02***		0.05***	0.05***		0.07**	0.04*
2001–2007		(0.01)	(0.01)		(0.02)	(0.02)		(0.03)	(0.02)
Observations	250	250	250	250	250	250	249	249	249
R-squared	0.30	0.25	0.33	0.27	0.21	0.30	0.22	0.08	0.23
Mean (s.d.) of depend.	0.82 (0.14)			0.87 (0.27)			0.32 (0.39)		

Note: Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) Δ log regulation score, 2001–2007 is 1.0 (1.1), and the mean (s.d.) export tariff shock is 0.18 (0.15). All columns control for import and intermediate tariff shocks, the log total population, the level of the dependent variable in 2000.

The effect of regulation changes on wages can go either way, depending the relative size of the increase in local wages and the decrease in migrant wages. My finding of a positive effect of regulation changes on wages is similar to the finding in Lee, Peri and Yasenov (2017), where the authors study the effect of the U.S. repatriation of Mexicans in the 1930s on local employment, and they find that the decrease in the number of Mexican workers was associated with small decreases in native employment and increases in native unemployment. Although my results point to the wage margin rather than the employment margin, the finding suggests that an inflow of migrant

workers could be beneficial for local workers overall.

The overall effect of trade shocks and the regulation effects are bigger for per capita GDP and total urban employment than for wages. Big-shock prefectures had a 17% larger increase in per capita GDP, and a 9% larger increase in employment than the small-shock prefectures. The overall trade effect is 20% of the mean for changes in per capita GDP, and 28% of the mean for changes in employment. The regulation effect is 9% of the total trade effect.

Overall, the trade effect on wages and income is statistically significant and economically large. The effect on per capita GDP is bigger than the effects on wages and employment, potentially capturing other channels through which trade shocks affected the economy (through payment to other factors, for example). The regulation channel is significant for wages, per capita GDP, and total urban employment, and the regulation effect is about 9% to 14% of the total trade effect.

C.13 Trade Shocks, Regulation Changes, and Economic Outcomes: IV Results

To address the concerns on the identification of the migration regulation effect using the OLS regressions, I instrument the regulation changes using the 2000 natural population growth rate. The natural growth rate of the population (birth rate minus death rate) predicts the future population size of a prefecture. It can be a relevant instrument since a higher natural growth rate means that the prefecture will have a more abundant workforce, and the local government is less likely to relax migration restrictions. At the same time, the natural population growth rate is not likely to be correlated with government industrial policies, which is an important potential omitted variable. I test empirically that conditional other 2000 prefecture characteristics, the 2000 natural population growth rate is not correlated with migrant flow from 2000 to 2010.

Table A.19 Column (1) regresses the change in log regulation scores on trade shocks as in Table 1 Column (8), controlling for the 2000 natural growth rate of population. The coefficient for the natural growth rate is negative and statistically significant, meaning that in prefectures with higher natural growth rates, the increase in migrant regulation score is smaller. Column (2) adds

the natural population growth rate in the regression of migrant flows on trade shocks and regulation changes, and its coefficient is insignificant. I then repeat the OLS regression in Table 5 and Table A.18 regarding migrant flows, wages, per capita GDP, and employment, and I also use the 2000 natural growth rate and the 2000 regulation score as instruments for the change in regulation scores from 2001 to 2007. Compared with the OLS estimates, the effect of changes in regulation scores on economic outcomes is bigger in the IV regressions. However, the IV standard errors are much bigger, and the difference between the OLS estimates and the IV estimates are not statistically significant according to the Hausman test.

Table A.19: Natural growth rate as an IV for regulation changes, first-stage and IV results

Depend. variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δ 2001–2007	Log reg.	Migrant share of pop.			Wage		GDP p.c.		Employm.	
	score	OLS	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Export trade shock	1.36***	6.01**	6.15**	5.35*	0.15**	0.12*	0.55***	0.50***	0.37**	0.36*
2001–2007	(0.48)	(2.64)	(2.62)	(3.07)	(0.06)	(0.07)	(0.12)	(0.14)	(0.18)	(0.19)
Δ log regulation score		0.90**	0.94***	1.75	0.02***	0.05	0.05***	0.15	0.04*	0.06
2001–2007		(0.35)	(0.34)	(1.61)	(0.01)	(0.04)	(0.02)	(0.11)	(0.02)	(0.13)
Natural pop. growth rate	-0.09***	-0.07								
2000	(0.02)	(0.13)								
Observations	250	250	250	250	250	250	250	250	249	249
R-squared	0.13	0.17	0.17	0.15	0.33	0.28	0.30	0.19	0.23	0.23
First-state F stat	-	-	-	12		13		6		7
Hausman test p-value			1.0		1.0		1.0		1.0	
Mean (s.d.) of depend.	1.0 (1.1)		7.0 (5.8)		0.9 (0.3)		0.8 (0.1)		0.3 (0.4)	

Note: *** p<0.01, ** p<0.05, * p<0.1. The mean (s.d.) export tariff shock is 0.18 (0.15). Column (1) has the same specification as in Table 1 Column (3), and adds the natural growth rate of population in 2000. Column (3) has the same specification as in Table 5, Panel A, Column (3), and Column (2) adds the natural population growth rate. Column (4) instruments changes in the log regulation score with the natural growth rate of population, and the log regulation score in 2001. Columns (5)(7)(9) the same as in Table A.18 Columns (3)(4)(9), and Column (6)(8)(10) are the corresponding IV regressions.

Overall, the OLS results from the mediation analysis are robust, and if anything, the OLS might underestimate the effect of regulations on economic outcomes.