International Trade Liberalization and Domestic Institutional Reform: Effects of WTO Accession on Chinese Internal Migration Policy

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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. Additionally, these regulation changes substantially amplified the effects of trade liberalization on local economic growth.

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Trade liberalization is an important economic force in 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; Dippel et al. 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. 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 both the world economy and the Chinese economy.[2] 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.[3] 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

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[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]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.

[3]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 assume as much in my model and I provide evidence from news reports that this was the case in Section I.A.

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. 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 increased demand for exports, led to relaxation of migration restrictions. I also find that both liberalizations contributed positively to economic growth.

My paper begins with a simple model of local-government regulation choices to investigate the connection between trade and migration policies. Following a standard approach in the fiscal federalism literature (Tiebout 1956; Gordon and Li 2012), I argue that Chinese regional governments seek to maximize net fiscal profits, which is tax revenue minus the cost of amenity provision for migrants.[4] When there is a positive demand shock for goods produced locally, regional governments have incentives to relax migration restrictions and allow a larger migrant inflow, but they also face the cost of providing public goods. The model predicts that positive trade shocks lead to relaxation of migration restrictions and that regions with larger output elasticity with respect to migrants relax the restrictions more following trade shocks.

I then estimate the effect of trade shocks on migration regulations across 250 Chinese prefectures from 2001 to 2007. Using the newly-collected dataset on prefecture-level regulations related to migrant workers, I construct a migration-friendliness index to summarize a local government's attitude toward migrant workers.[5] From 2001 to 2007, 168 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 identify regional trade shocks using a standard methodology; however, I use export shocks (similar to the that in Bustos (2011) and McCaig and Pavcnik (2018)), 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 trade shocks had larger increases in

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[4]I assume that a local worker's amenity level is set at an exogenous level.

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

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

their migration regulation index. The regulation score of prefectures whose trade shocks were in the upper third of the distribution rose 0.27-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, which fits the model's prediction. This result is robust to: (1) changing the trade measures to be as in Autor, Dorn and Hanson (2013); (2) including permanent-normal-trade-relations (PNTR) shocks as in Pierce and Schott (2016) and Handley and Limão (2017), and Multi-Fibre-Agreement (MFA) quota reduction as in Khandelwal, Schott and Wei (2013); (3) using an alternative measure of regulation scores.

I then proceed to evaluate the overall impact of liberalization on migrant flows, employment, wages and GDP growth. The trade shock impacts employment and wages through two channels: directly, through prices, and indirectly, through migration regulations. I use mediation analysis (Imai et al. (2011)) and use the natural population growth rate as an instrument to identify the effect of regulation changes on economic outcomes. Compared to prefectures whose trade shocks were in the lower third of the distribution, prefectures in the upper third had a 76,000 greater increase in the number of migrants due to the trade shock overall, 17% of which was due to changes in regulation. I also find significant and sizable effects of trade shocks and regulation changes on wages, employment, and GDP growth. About 9%-15% of the overall trade effect was mediated through migration regulation changes. The positive effect of changes in migration regulation on wages and GDP growth is likely to come from the complementarity between local and migrant workers, since migrant workers are usually less educated and unskilled.

My paper contributes to several literatures, in addition to the already-mentioned ones that study the determinants of institutions and the effects of the WTO. 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.[7] 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 labor market frictions exist. While this literature takes labor market frictions as given, I endogenize them in a theoretical model and use a novel dataset to construct an empirical measure for the stringency of regulations. Finally, I identify the effect of a plausibly exogenous trade shock on regulations that affect labor market frictions. To my knowledge, there is no study that has documented the (causal) effects of trade liberalization on migration regulations.[8]

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

[8]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

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 V. 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 I, I discuss the background on the Hukou system and describe my new data on Hukou regulation changes. Section II presents key motivating facts. Section III lays out a simple political economy framework. Section IV presents the empirical results. Section V concludes.

I.   Background and New Data

A.   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.

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.

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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.[9]

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.[10] In addition, local governments were allowed some discretion to design their own reforms following the central government guidelines.[11] The timing of the reform coincided with WTO accession; in research articles and interviews with government officials, WTO accession was described as a chance to reform the Hukou system.[12]

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.[13] 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.

B. New Data on Labor Regulations in China

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, reposi-

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

[10]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`.

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

[12]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."*

[13]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`.

tories of laws and regulations, as well as documents provided by relevant government units; all of these sources are recognized by Chinese legislative regulations.[14] 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.[15]

A keyword search of document titles was conducted for the following migration-related terms: *non-Hukou population*, *migrant worker*, *temporary residence*, and *Hukou*. There were 138 items from 1995 to 2001 and 673 items from 2001 to 2007, 44% related to labor issues (wage payments, labor unions, training, etc.), 18% related to welfare programs (unemployment insurance, injury insurance, medical insurance, pensions, etc.), 30% related to administrative issues (Hukou registration), and 9% related to birth control.

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. 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 index or score is generated by summing the item indices. 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. 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 2 and the maximum is 38. Besides Beijing, Chongqing, Shanghai and Tianjin, prefectures with very high scores include Ningbo and Guangzhou, which had very strong

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[14]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.

[15]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.

export-oriented growth.[16]

To ensure the objectivity of the score coding, I hired two research assistants with law degrees to code the scores independently. Out of the 295 regulations enacted from 1995 to 2005, the correlations between my coding and their codings for individual regulation scores are 0.62 and 0.69. The correlations of prefecture-level total scores are 0.87 and 0.88. In Appendix C.C4, 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.

II. Key Motivating Facts

A. Trend Break in Migration Regulations around the WTO Entry

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 nontariff 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.[17]
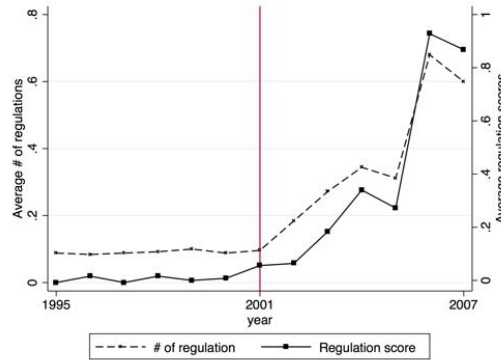
FIGURE 1. NUMBER OF MIGRANT/HUKOU REGULATIONS AND REGULATION SCORE, PREFECTURE-LEVEL AVERAGE, 1995–2007

Note: Each dot is a prefecture-year average. 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.

Figure 1 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

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[16]See Appendix A.A1 for details of the coding procedure and additional summary of statistics of the regulation scores.

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

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 0.8, indicating that there were more regulations and those regulations were more favorable to migrants than before 2001.
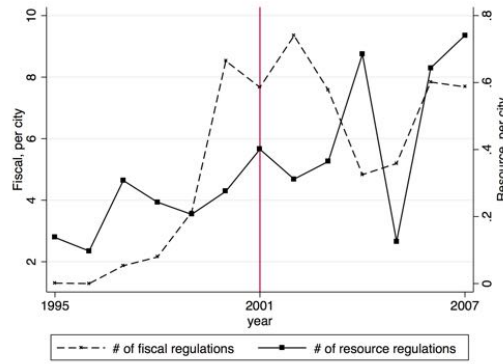
FIGURE 2. TREND OF NUMBER OF REGULATIONS, FISCAL-RELATED VS. RESOURCE-RELATED

Note: Each dot is a year total of all prefectures. The vertical line corresponds to China's accession to the WTO in 2001.

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.[18] Figure 2 plots the fiscal regulations with the dashed line and the resource regulation with the solid 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 1.

B. WTO Accession, Tariff Reductions, and Export Growth

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 decline was sizable, and industries that experienced bigger tariff declines also experienced bigger export volume growth. Figure 3 shows that the tariff on Chinese goods stood at about 5.8 percentage points in 1995, declined to 4.1 percentage

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

points in 2001, and declined even further to 3 percentage points in 2007. Figure 3 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.
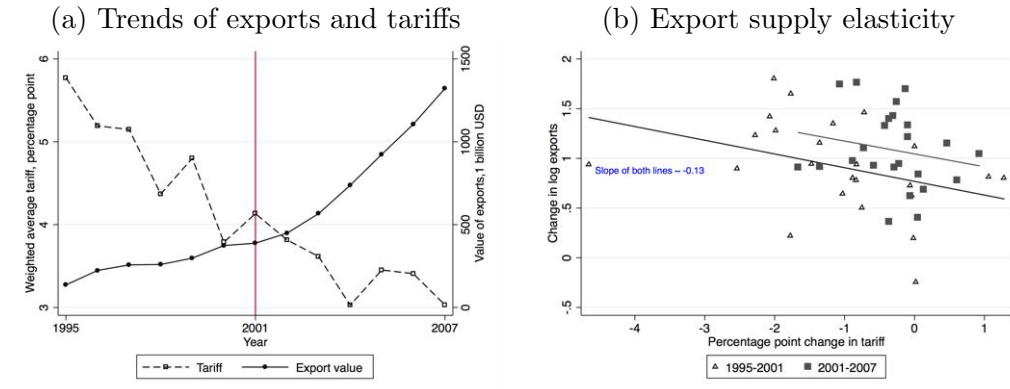
(a) Trends of exports and tariffs   (b) Export supply elasticity

FIGURE 3. DECLINING OUTPUT TARIFF AND INCREASING EXPORT VOLUME, 1995–2007

Note: In Panel (a), each dot on the red curve 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. In Panel (b), each dot is an industry-period. Triangles are for 1995–2001 and squares are for 2001–2007.

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. 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.

C. *More Exposed Prefectures Changed Migration Regulation More*

Once prefectures were given the freedom to modify the Hukou system, their incentives to do so depended on the gains from a flexible labor market. The main conjecture of this paper is that these gains increase with export opportunities. I now show some preliminary evidence that suggests this is the case. I thoroughly inspect this hypothesis in the context of the econometric analysis of Section IV.

Figure 4 plots the trends of regulation scores, dividing prefectures into three groups: the solid line for prefectures with trade shocks in the upper third of the distribution (big shock), the dashed line for prefectures with trade shocks in the middle third (medium shock), and the dotted line for prefectures with trade shocks in the lower third (small shock). Here, the trade shock is calculated as weighted average tariff reductions from 2001 to 2007 (post-WTO period), with prefectures with bigger shocks experiencing larger reductions in output tariffs. It is clear from the figure that although the trends for the three groups of prefectures were very similar before 2001, places with bigger trade shocks after 2001 chose to relax migration restrictions more.
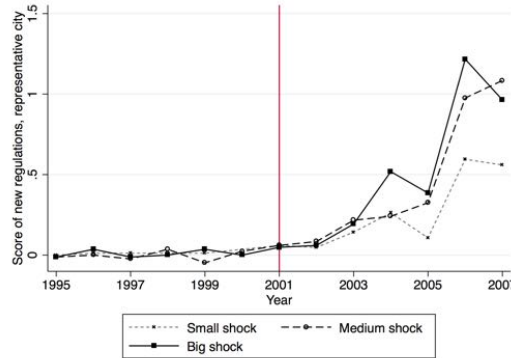
Figure 4. Regulation score, prefecture-level average, 1995–2007 (three groups by the size of trade shocks, 2001–2007)

Note: Each dot is a year-shock group. The score is the sum of all prefecture-level regulations related to migrants divided by the total number of prefectures. Trade shocks are constructed using the interaction of industry-level tariff declines with prefecture-level industry employment shares.

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 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 as well and also investigate other types of WTO-induced trade shocks.

III. A Political-Economy Model of Endogenous Migration Policies

I build a spatial equilibrium model with central and local governments' decision-making on levels of amenities for migrants from the rural areas. The setup at

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the local government level shares many features of the Tiebout (1956) framework, where the objective function of the government is to maximize the net fiscal profit. On top of it, I layer a central government problem to show how a national positive trade shock incentivizes the central government to initiate Hukou reforms (i.e., whether to switch from a strict Hukou system ($S = 0$) to a relaxed Hukou system ($S = 1$)). Conditional on the central government's choice, local trade shocks drive the change of migration regulations at the local government level. I also find a heterogeneous trade effect depending on the demand for migrants, which will be tested in Section IV.

A. Migrant Labor Supply

Consider an open economy with N+1 regions indexed by $n \in \{1, 2, ..., N, r\}$. All $n \leq N$ index cities, and $n = r$ is a rural area.[19] A mass of $\bar{M}$ rural residents can either live in the rural area or move to one of the cities and work as migrant workers. The indirect utility of rural worker l living in region n is $v_n^l = v_n \epsilon_n^l$, where ϵ_n^l represents worker l's idiosyncratic taste for living in region n, and v_n is common for all rural workers who live in region n. Index i represents a non-rural area. Each city i has an endowed natural amenity C_i.[20] Rural residents who live in city i enjoy a wage, a natural amenity C_i, and a local public good A_i which is provided by the city government. Importantly, A_i is *specific* to migrants, and it is subject to local public policies. For example, A_i encompasses policies that govern the acceptance of migrant children in local public school. If they choose to stay in the rural area, they will enjoy a fixed amenity level of C_r and a fixed wage of w_r.[21] I normalize $A_r = 0$. Thus, v_n is determined in the following way:

$$v_n = (C_n + A_n)^{\beta_1} w_n^{\beta_2},$$

where $\beta_1 > 0$ and $\beta_2 > 0$.

Worker l will choose to live in the region n that maximizes their utility, so $n = \text{argmax}_{n'} v_{n'} \epsilon_{n'}^l$. There is an idiosyncratic taste draw ϵ_n^l for each worker and area, and the draw is i.i.d. across workers and areas from a Fréchet distribution, $Pr(\epsilon_n^l \leq x) = e^{-x^{-\epsilon}}$, with $\epsilon > 1$. Thus, the number of migrant workers who live in area n is

$$(1) \qquad M_n = \left(\frac{(C_n + A_n)^{\beta_1} w_n^{\beta_2}}{v} \right)^{\epsilon} \bar{M},$$

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[19]This is a simplifying assumption, since I group the rural areas of all prefectures into one.

[20]The natural amenity can include the air quality, transportation infrastructure, landscape, and other nonexclusive features.

[21]C_r could include the value of the attachment to homeland, eligibility to be part of the rural social network, and the right to use farmland. For example, Munshi and Rosenzweig (2016) shows that local risk-sharing networks provide informal insurance and restrict migration in India.

where $v \equiv (\sum_n v_n^\epsilon)^{1/\epsilon}$. Under the Fréchet distribution, the average utility of migrant workers in all cities will be the same and proportional to v, thus v will be used as the measure of worker utility.

B. Labor Demand

Each city i is endowed with immobile local labor L_i and an immobile fixed factor R_i (for example, land). Firms use local labor, migrant labor, and a fixed factor to produce a unique product, but the product is different across cities.[22] Both local labor and the local fixed factor are supplied inelastically: $L_i = \bar{L}_i$, $R_i = \bar{R}_i$. The production function is Cobb-Douglas with constant return to scale, and output Y_i can be written as

$$Y_i = \mu_i' L_i^{\alpha_{1,i}} M_i^{\alpha_{2,i}} R_i^{1-\alpha_{1,i}-\alpha_{2,i}},$$

where $\alpha_{1,i}$ and $\alpha_{2,i}$ are both positive, and $\alpha_{1,i} + \alpha_{2,i} < 1$.[23] This is equivalent to writing the production function as

$$Y_i \equiv \mu_i M_i^{\alpha_i},$$

where $\mu_i \equiv \mu_i' L_i^{\alpha_{1,i}} R_i^{1-\alpha_{1,i}-\alpha_{2,i}}$, and $\alpha_i \equiv \alpha_{2,i}$.

p_i is the price of the product i faced by Chinese producers. A reduction in the output tariff induced by trade liberalization increases the price received by Chinese firms. The firm's revenue is subject to a sales tax t. The firm maximizes profits by choosing

$$\max_{M_i} \quad (1-t)p_i Y_i - w_i M_i$$

where w_i is the wage of migrant workers in city i. The market is perfectly competitive, and each firm earns zero profit. The first-order condition of the firm gives the inverse labor demand function

$$(2) \qquad\qquad w_i = \alpha_i(1-t)p_i\mu_i M_i^{\alpha_i-1}.$$

C. The Government's Problem

The local government's objective is to maximize net fiscal profit, which is equal to tax revenue minus expenditure on public services. The rationale of this objec-

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[22]The unique product can be viewed as a composite good. In 2000, the average years of education for urban residents age 15 and older was 10.3, while the number for migrant workers from rural areas was 8.2. The 2-year gap persisted until 2005. Thus, the migrant workers were relatively low-skilled compared to local urban residents. I calculate these numbers by using the 2005 mini-census.

[23]I use the Cobb-Douglas production function to keep the model predictions simple. With the CES production function, the intuition of the model remains, while results are more complicated. The local fixed factor can be fixed capital or land. Adding mobile capital will not change the main results of the model.

tive function is three-fold. First, it is in line with the fiscal federalism literature led by Tiebout (1956). Second, it fits the realistic feature of the local government incentives provided in the Chinese political structure. Gordon and Li (2012) argue that only few local government officials are promoted to higher levels of governments, while the rest of them stay in the system because they can get the rent or net fiscal profit. Third, this specification has an alternative interpretation where the city government prefers a bigger economy and smaller expenditure on migrants.[24]

I assume that each city government has a negligible impact on the overall migrant welfare v and takes v as given.[25] In the relaxed Hukou system ($S = 1$), the city government maximizes the net fiscal profit by choosing Hukou policies that set the amenity level A_i for migrant workers and the number of migrants M_i:

$$\max_{M_i, A_i} \quad t \cdot p_i Y_i - A_i M_i$$

subject to labor supply (Equation 1) and labor demand (Equation 2) constraints. The city government has full information about production and labor supply. Given the labor supply equation, A_i can be solved as a function of M_i. Thus the first-order condition of the local government is given by

$$(3) \qquad t \cdot \frac{\partial \, p_i Y_i}{\partial M_i} = A_i + \frac{\partial A_i}{\partial M_i} M_i.$$

In the strict Hukou System ($S = 0$), the city government faces the same maximization problem subject to the constraint that $A_i = 0$. So there is no maximization: M_i is determined by the labor supply equation and the labor demand equation, and the city government will take it as given.

The empirical analysis relies on changes in Hukou policies at the local level, but these local changes were only possible because the central government relaxed the national Hukou policy to allow for local flexibility. Trade liberalization affects the output prices in all regions, resulting in a change in the national GDP. I assume that the economy starts with the strict Hukou regime, and that the central government is willing to allow local governments to relax their Hukou policies if the expected national GDP gains exceed some threshold:[26]

[24]Instead of tax rate, t can be interpreted as the weight for utility from a bigger economy when the weight for disutility of migrant expenditure is normalized to 1. This tradeoff is present not only in China but also in cases of low-skilled immigration in the United States and Europe. For example, in the United States, there is a debate on whether to provide immigrant children with Medicaid. (`www.latimes.com/local/politics/la-me-immigrants-medi-cal-20160427-story.html`). In Europe, there is a discussion on how welfare program generosity affects migrant skill mix and in turn affects the strength of the welfare-state institution (`voxeu.org/article/immigration-and-welfare-state-new-evidence-eu`).

[25]This assumption is very reasonable in this context due to the overall size of the Chinese population and the number of prefectures. There are 340 prefectures in China. According to the 2000 Census, in 2000, the city of Shenzhen had the biggest number of migrants, 5,622,000; however, this was only 4% of the total national migrant population.

[26]The central government is interested in a large total output (or GDP), which is $Y = \sum_{i=1}^{N} p_i Y_i +$

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(4) $$S = \mathbf{1}(Y_{S=1} - Y_{S=0} \geq \underline{Y}),$$

where $\mathbf{1}(\cdot)$ is an indicator function. Assume that in the relaxed system, the cost of switching back to the strict system is prohibitively high.

D. Model Implications

In the relaxed Hukou system, a positive price shock in a city will lead to a higher amenity level for migrants, a larger migrant inflow, and a larger total output. The intuition is as follows. Suppose that the local government is deciding whether to let in one additional migrant. The left-hand side Equation 3 is the tax contribution of this migrant's wage. The right-hand side is equal to the cost of amenities for *this additional migrant*, plus the cost of changing the amenity level for *all existing migrants* due to the change in the number of migrants. With the specified migrant supply function, the right-hand side is a linear increasing function of amenities. Thus, when there is a positive price shock, as long as the change in migrants' wages is positive, the amenity will also increase. The migrant's wage increases directly due to the price shock, and decreases indirectly due to the increased number of migrants. However, the direct effect dominates, and the amenity level increases along with the migrant wage. The total output of a city is an increasing function of the number of migrants, and it will increase both because of the positive price shock, and because of the inflow of migrants.[27]

Particularly, in cities with a higher output elasticity of migrants (α_i), the amenity change will be bigger. When α_i is bigger, given the same increase in the number of migrants, the wage decline is smaller. Thus, the overall increase in the migrant wage is bigger, which translates to a larger increase in the amenity level through the first-order condition of the government.

In the strict Hukou system, a positive price shock in a city will lead to a larger migrant inflow and a larger total output. However, both the increase in number of migrants and the increase in output are smaller than in the relaxed Hukou system. This is because the amenity level is held constant, and the increase in the number of migrants is only affected directly by the trade shocks, but not indirectly through the changes in the amenity level, as in the relaxed Hukou system.

The shift of the Hukou regime depends on the overall output. In the symmetric

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$M_r w_r$. At the same time, a sudden, large inflow of population into a city might cause regime instability, and might cause the city to incur burdensome administrative and bureaucratic costs; these will impose a cost to the central government. For example, a report from the National Bureau of Statistics of China points out that the crime rate among temporary residents is 12.8%, which is four times the average crime rate. Source: `www.stats.gov.cn/ztjc/ztfx/fxbg/200306/t20030606_14197.html`.

[27]This result depends on the cost of amenity provision. Suppose that there is congestion in amenity provision, and the net fiscal profit of the government is $t \cdot p_i Y_i - A_i M^{\delta+1}$, with $\delta > 0$ featuring the congestion effect. Then a positive trade shock will result in a increase in amenity only when δ is smaller than a threshold.

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case, when all cities are the same and wages in the rural area are small enough, the overall output Y is an increasing function of the number of people who migrated. When there is an economy-wide positive price shock, both $Y_{S=1}$ and $Y_{S=0}$ will increase, and $Y_{S=1}$ will increase more. The central government will switch to the relaxed Hukou system if the gap between the two outputs passes the threshold $\underline{Y}$.[28]

IV. Empirical Results

A. Effects of Trade Shocks on Regulation Changes

1. Econometric Framework and Identification

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

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

where i represents a prefecture, and t represents a time period. X_{it} is the vector of potential confounding factors that could be correlated with the trade shocks. Δ represents the change during the time period, and I use change-in-log specifications to follow the model predictions closely. α_1 is the coefficient of export tariff shocks on changes in log migration regulation score.

The regional trade shock is calculated using applied tariffs from the World Bank TRAINS dataset on the 2-digit SIC level, and it corresponds to the price change $\hat{p}_i$ in the theoretical model. As in Kovak (2013), the regional shock in prefecture i and from time t to t' is

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

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

$\lambda_{ij} = \frac{L_{ij}}{L_i}$ 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):[29]

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

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[28]See proofs of propositions in Appendix B.

[29]Trade shocks due to tariff reductions on Chinese imports are measured in a similar way. See Appendix A.A2 for details.

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. In Figure 5 Panel (a), I plot 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. In Figure 5 Panel (b), I plot 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.

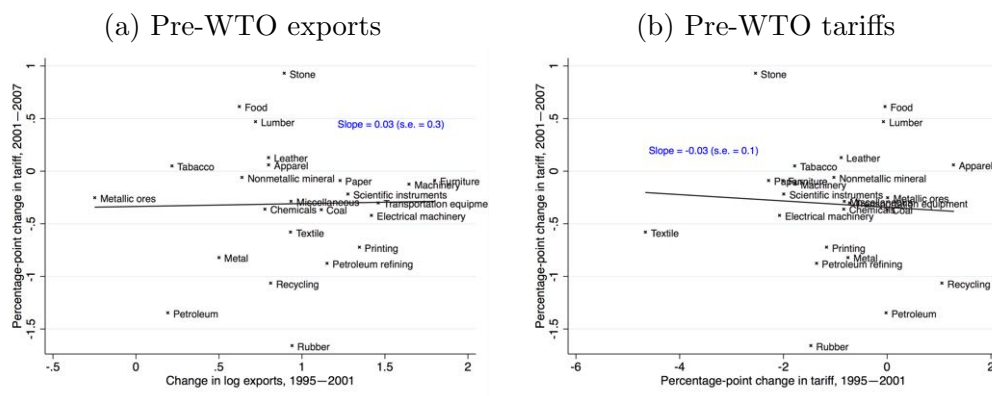| (a) Pre-WTO exports	(b) Pre-WTO tariffs

FIGURE 5. 2001–2007 TARIFF DECLINES AGAINST 1995–2001 EXPORT GROWTH AND TARIFF DECLINES

Note: Each dot is a two-digit SIC industry.

Figure 5 also help to address the concern that some unobserved domestic policies

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might target industries where tariffs happened to decline more or less than other industries in the post-WTO period.[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.

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.[31] Figure 6 Panel (a) plots the trends in wages of prefectures with small, medium, and large trade shocks, and the three trends from 1995 to 2001 are not statistically different from each other. Figure 6 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.[32]

(a) Wages   (b) Per capita GDP
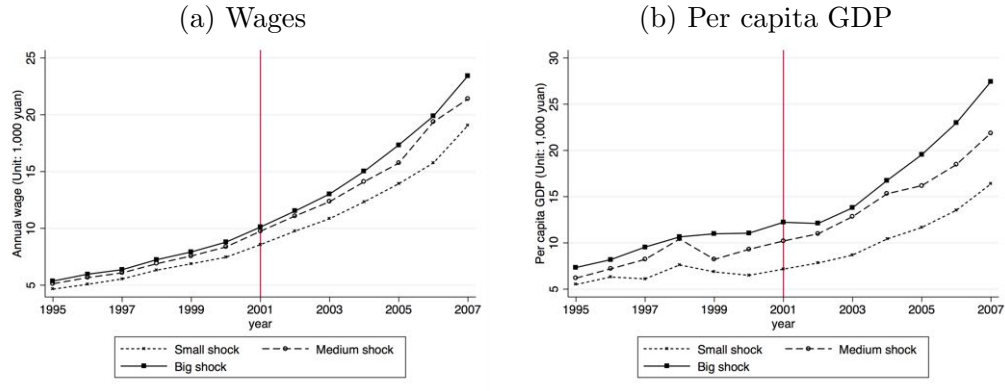
FIGURE 6. TRENDS OF WAGES AND PER CAPITA GDP, BY SIZE OF TRADE SHOCKS

Note: The wage and GDP data is from the City Statistics Yearbooks. I divide prefectures into small-, medium-, and large-trade-shock groups as in Figure 4.

2. MAIN RESULTS

Figure 7 shows the relationship between trade shocks and migration regulation changes from 2001 to 2007.[33] The horizontal axis depicts the export tariff shock in the 2001–2007 period; a bigger export tariff shock corresponds to lower export

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

[31]See the Herfindal Index Distribution in Appendix A.A2.

[32]See details of the City Statistics Yearbook data in Appendix A.A4.

[33]It is more appropriate to use the inverse-hyperbolic-sine-transformed total regulation score since there are six prefectures with negative total scores in 2001. However, the correlation between the changes

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.

Figure 7 resembles the previous trend graphs for the post-WTO period: prefectures that experienced more positive trade shocks saw their regulation score rise, meaning they became more friendly to migrants. The slope ranges from 0.7 to 1.4, and the values are statistically significant at the 5% level. By comparison, the same regressions in the pre-WTO period give slopes of 0.02 to 0.03 and they are statistically insignificant.[34]
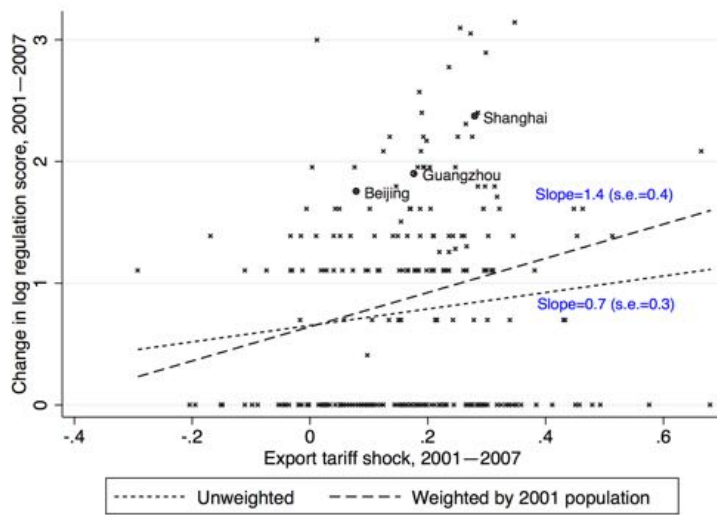
FIGURE 7. BIGGER TRADE SHOCKS, MORE PRO-MIGRANT REGULATION CHANGE, 2001–2007, 250 CHINESE PREFECTURES

Note: Each dot is a prefecture.

Table 1 shows the corresponding regression results. In Columns (1)–(8), 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 0.68 is sta-

in the inverse-hyperbolic-sine-transformed total regulation score and the changes in the log(regulation score+1) is 0.9925 for the 2001–2007 period, when I replace the negative regulation score of the six prefectures in 2001 to be 0. Thus, in the following text, I use the log transformation instead of the inverse-hyperbolic-sine transformation for ease of interpretation. I show the replication of Table 1, using the inverse hyperbolic sine transformation in Appendix C.C2 to show the equivalence of the two measures.

[34]See Appendix C.C1 for the corresponding pre-WTO plot.

tistically significant at the 5% level. It implies that a 1-percentage-point higher export tariff shock increased the change in log regulation score by 0.68, which is equivalent to 0.83-standard-deviation bigger regulation score increase. As in Figure 4, 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 21% larger increase in the regulation score; the difference is equal to 0.26 standard deviation of the score increase in the 2001–2007 period.[35]

TABLE 1—BIGGER TRADE SHOCKS, MORE REGULATION RELAXATION

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Δ log regulation score, 2001–2007								Placebo, 1995–2001	
Export tariff shock	0.68	1.19	1.09	1.09	0.97	0.94	0.85	0.76	-0.02	
2001-2007	(0.32)	(0.39)	(0.39)	(0.39)	(0.42)	(0.41)	(0.43)	(0.42)	(0.03)	
Import tariff shock		-0.09	-0.08	-0.08	-0.06	-0.07	-0.09	-0.06	-0.01	
2001-2007		(0.03)	(0.04)	(0.04)	(0.06)	(0.04)	(0.04)	(0.06)	(0.00)	
Intermediate tariff shock		0.18	0.20	0.20	0.10	0.23	0.13	0.11	0.00	
2001-2007		(0.11)	(0.11)	(0.11)	(0.17)	(0.12)	(0.13)	(0.17)	(0.03)	
Log regulation score			0.71		0.69	0.63	0.60	0.59		
2001			(0.14)		(0.14)	(0.14)	(0.16)	(0.15)		
Δ log regulation score				0.71						
1995-2001				(0.14)						
Export tariff shock					0.22			0.20		0.14
1995-2001					(0.17)			(0.18)		(0.10)
Import tariff shock					0.01			0.02		-0.02
1995-2001					(0.02)			(0.02)		(0.01)
Intermediate tariff shock					0.12			0.07		-0.03
1995-2001					(0.10)			(0.08)		(0.05)
Δ log wage						0.72		0.49		
1995-2001						(0.30)		(0.35)		
Δ log GDP p.c.							0.49	0.43		
1995-2001							(0.13)	(0.15)		
Observations	250	250	250	250	237	237	237	237	238	241
R-squared	0.01	0.07	0.12	0.12	0.13	0.13	0.15	0.16	0.01	0.01

Note: Standard errors are clustered at the province level. The mean (sd) of Δ log regulation score, 2001–2007 is 0.77 (0.82), 1995–2001 is 0.06 (0.26). The mean value of export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40).

Columns (2)–(8) control for various potential confounding factors in to check the robustness of the result. 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

[35]I focus on 250 prefectures with consistent data on GDP and wages from the City Statistics Yearbook. See Appendix A.A4 for details of data and Appendix C.C3 for replication of results in Table 1 with alternative sample sizes.

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 0.68 to 1.19 and are all statistically significant at the 10% level; all of them are within the 95% confidence interval of the estimate in Column (1).

Columns (9) and (10) show placebo tests. To make sure that tariff changes in the 2001–2007 period are good measures of the period-specific-WTO-induced trade shocks, Column (9) regresses the 1995–2001 regulation changes on the 2001–2007 trade shocks; the coefficients are insignificant. Column (10) regresses the 1995–2001 regulation changes on 1995–2001 trade shocks, and the coefficients are insignificant, indicating that the relationship between trade shocks and regulation changes did not exist in the pre-WTO years. This is consistent with the observation in previous sections about the timing of the regulation change: the absence of correlation is because the central government did not allow for the reform prior to 2000s.[36]

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.C4 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.C5, 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. Further, Appendix C.C6 controls for additional trade shock measures: the PNTR shocks as in Pierce and Schott (2016) and Handley and Limão (2017) and MFA quota reduction as in Khandelwal, Schott and Wei (2013). The coefficient on export tariff shocks remain largely unchanged from Table 1. 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, I add industry employment shares one at a time and find that the result is not sensitive to specific-industry effects in Appendix C.C7.

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.C8, 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

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[36]This is also consistent with the absence of correlation shown in Figure C1 in Appendix C.C1.

they are more likely to compete within tiers for capital, labor, and other resources.

3. HETEROGENEOUS EFFECTS

The theoretical model indicates that 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 (which is α_i in the model). 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.[37] 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 8 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 predicted by the model: prefectures that experienced 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.

Corresponding regression results are shown in Section C.C9, and the positive interaction effect of trade shocks and the migrant intensity is robust to controlling for lagged trade shocks and lagged wage and GDP growth rates as in Table 1 Column (8). 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.

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[37]I use the 2001 Industrial Enterprises Survey data to calculate the prefecture-level share of total sales in state-owned enterprises.
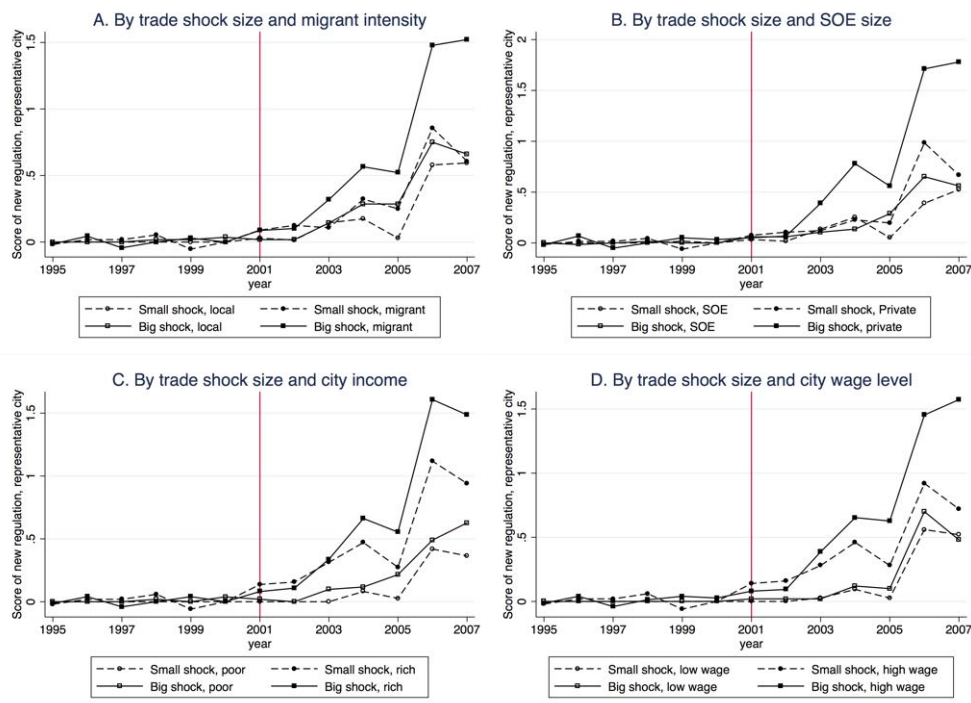
FIGURE 8. REGULATION SCORE, PREFECTURE-LEVEL AVERAGE, 1995–2007, BY THE SIZE OF TRADE SHOCK IN 2001–2007, AND BY MIGRANT INTENSITY IN 2001

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.

B. Effects of Trade Shocks and Regulation Changes on Migrant Flows, Wages, and Per Capita GDP

1. ECONOMETRIC FRAMEWORK AND IDENTIFICATION

Trade shocks affect economic outcomes (such as migrant flows, wages, employment, and per capita GDP) through two channels: directly, through prices, and indirectly, through migration policies. For migrant flows and employment, both effects are strictly positive: output price increases attract more workers and so do more relaxed migration policies. Output price increases also directly increase wages and per capita GDP, holding migrant flows and employment constant. However, relaxed migration regulations will increase migration, and competition will lower migrants' wages. At the same time, wages of local workers will increase

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since they are complementary to migrants. Thus, the overall effect of regulation on wages and per capita GDP depends on the composition of the workforce.

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 2001–2007 change of the migrant share of population in prefecture i, the change in the log migrant stock, the change in log wages, the change in total urban employment, or the change in per capita GDP. 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 A.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.[38]

I am also interested in identifying the effect of regulation changes on economic outcomes by using the following equation:

$$\Delta Y_{it} = \pi_0 + \pi_1 \Delta \ln(\text{regulation score}_{it}) + \pi_2 \text{Trade shocks}_{it} + X_{it}\Phi + \zeta_{it},$$

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. The regulation changes serve as a mediator in the relationship between trade shocks and economic outcomes. I need two sets of assumptions to identify π_1 in this equation: assumptions on alternative channels through which trade shocks affect economic outcome and assumptions on on endogeneity of the migration regulation channel.

First, I need to make assumptions on alternative channels. As discussed in Imai et al. (2011) and Dippel et al. (2017), the key identifying assumption for the effect of the mediator on outcome variables is sequential ignorability. Trade shocks can affect migrant flows directly and indirectly through the mediator, migration regulation change, as in In Figure 9 Panel (a). Alternatively, trade shocks can also affect the outcome variable through other regulations as in Panel (b). As long as there is no causal relationship between the migration regulation and other regulations as in Panel (c), sequential ignorability is satisfied, and the effect of migrant regulations on migrant flows is identified using the equation where both trade shocks and migration regulations are regressors.

Another potential concern is that in the model, both migration regulations and the economic outcomes change at the same time. Thus, it is not clear whether the causal relationship goes from migration regulations to migrant flows or the

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[38]To be conservative, I control for pre-WTO wage and GDP growth in the regression.

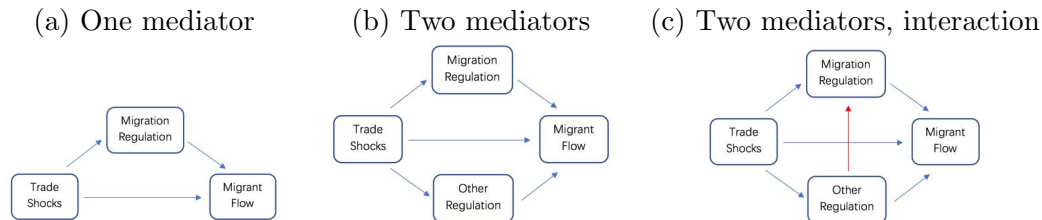(a) One mediator   (b) Two mediators   (c) Two mediators, interaction

FIGURE 9. MEDIATION ANALYSIS

Note: The figure is a modified version of Imai et al. (2011) Figure 1.

other way around. In Section C.1 below, I use the timing of the regulation change and the migration flow changes to show that it was the regulation change that drove the migrant flows, not the other way around, suggesting that the causal relationship goes from migration regulations to migrant flows.

Under these assumptions, combining π_1 with α_1 in Section A.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 $\frac{\pi_1 \cdot \alpha_1}{\gamma_1}$.

The second set of identification assumptions is on measurement of regulation scores and other omitted variables. On measurement of regulations, the first issue is that the regulations I collect may not be the complete set of regulations that affect 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. Some regulations can be at the borderline between 0 and 1, or 1 and 2, and my judgement may not be precise in this case. The third issue is that enacting a regulation may not be equal to enforcing a regulation. 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 the effect of regulation changes on economic outcomes is downward biased. On omitted variables, suppose that some prefectures have larger changes 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 regulation will also capture the community sentiment effect.

To address the potential bias resulting from violation of sequential ignorability, potential measurement errors and omitted variable bias, in Appendix C.C15, I instrument the regulation changes using the 2000 natural population growth rate. I proceed to present the OLS estimates first and then discuss the IV estimates at the end.

2. Trade Shocks, Regulation Changes, and Economic Outcomes: Mediation Analysis

Did migration regulation relaxation lead to bigger migrant flows? The information about the number of migrants is from the 2000 and 2010 censuses and a 1% population survey (2005). 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. In Figure 10, the horizontal axis depicts the change in the log regulation score 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 graph shows that the more relaxed the regulation on migrants, the bigger the increase in the migrant share. The megacities Beijing, Shanghai, and Guangzhou are not outliers. The graph suggests that the regulations affected migration flows.[39]
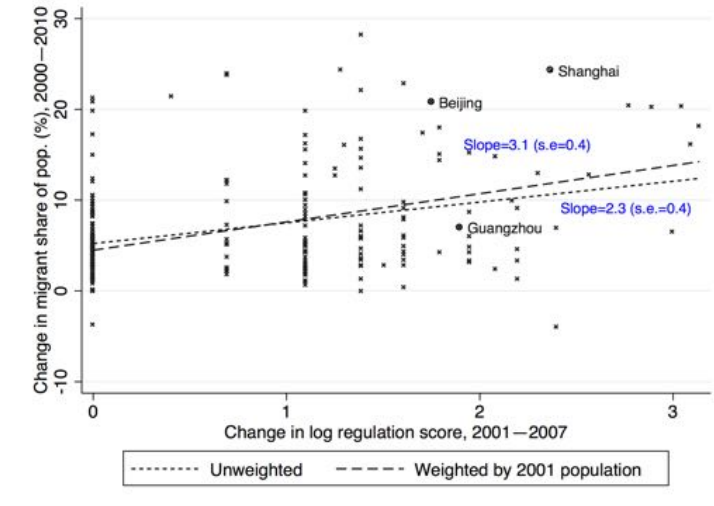
Figure 10. More regulation changes from 2001 to 2007, greater changes in migrant share of population from 2000 to 2010, 250 Chinese prefectures

Table 2 presents reduced-form effects of trade shocks and regulation changes on migrant flows. Panel A Column (1) uses changes in 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 6.67-percentage-point larger increase in the migrant

[39]For details of the migrant flow data, refer to Appendix A.A3.

share of the population. To alleviate the concern that trade shocks might be correlated with prefecture-level pre-WTO economic conditions, Column (2) adds lagged trade shocks, wages, and GDP growth, and the coefficient becomes smaller and insignificant. Column (3) and (4) focus on the effect of regulation changes. Column (3) shows that a 1% larger increase in the regulation score from 2001 to 2007 results in a 0.018-percentage-point larger increase in the migrant share of population. Columns (4) gives similar results when I control for lagged trade shocks and lagged economic growth. 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, but the significance level does not change. Evaluated at the coefficient estimate in Table 2 Column (2), big-shock prefectures had a 1.66-percentage-point higher increase in the migrant share of population than the small-shock ones. Using estimates from Table 2 Column (5) and Table 1 Column (1), big-shock ones had a 0.29-percentage-point larger increase in the migrant share of population through the regulation effect. The regulation effect is 17% of the overall trade effect. Given the median size of prefecture population in 2001 (3.6 million), the big-shock prefectures had a 76,000 greater increase in the number of migrants than the small-shock prefectures, 13,000 of which was related to the change in regulations.

Now I look at how migrants travel over various distances in response to trade shocks and regulation changes in Panel A Columns (6)–(10) 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. The regulation effect is 12.4% of the overall trade effect. Given the median size of the short-distance migrant population in 2001 (167,000), the big-shock prefectures had a 69,000 larger increase in the number of migrants than the small-shock prefectures, 8,000 of which was due to the change in regulation. The overall effect of trade shocks is significant for medium-distance migrants, and the regulation effect is 6.6% of it. Both effects are smaller than the ones for short-distance migrants, and the regulation effect is not always significant. For long-distance migrants, trade effects are not significant, but regulations effects are large and signficant. The results suggest that economic conditions affect short- and medium-distance migration, and when it comes to long-distance migration, regulatory forces on amenities matter more than economic forces.[40]

I proceed to discuss how trade shocks affected other economic outcomes such as wages, employment, and GDP growth in Table 3. A 1-percentage-point larger

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[40]See the appendix on additional results on migrant flows. Appendix C.C10 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.C11 investigates emigration instead of immigration and find no significant effect of trade shocks and regulation changes on emigration. Appendix C.C12 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.

TABLE 2—BIGGER REGULATION CHANGES (2001–2007), LARGER INCREASES IN THE NUMBER OF MIGRANTS (2000-2010)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Δ migrant share of population					Δ log # of migrants, short-distance				
Export tariff shock	6.67	5.37			4.58	1.31	1.48			1.36
2001–2007	(3.37)	(3.24)			(2.95)	(0.31)	(0.33)			(0.27)
Δ log regulation score			1.76	1.47	1.38			0.26	0.29	0.27
2001–2007			(0.46)	(0.40)	(0.34)			(0.06)	(0.06)	(0.05)
Controls (lagged)		X		X	X		X		X	X
Observations	250	237	250	237	237	240	227	240	227	227
R-squared	0.14	0.26	0.15	0.28	0.29	0.19	0.27	0.16	0.28	0.33
Mean (s.d.) of depent.	6.99 (5.78)					-.83 (0.80)				
Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Δ log # of migrants, medium-distance					Δ log # of migrants, long-distance				
Export tariff shock	0.42	0.41			0.38	-0.11	-0.24			-0.30
2001–2007	(0.20)	(0.19)			(0.18)	(0.39)	(0.42)			(0.39)
Δ log regulation score			0.07	0.06	0.04			0.14	0.13	0.13
2001–2007			(0.04)	(0.03)	(0.03)			(0.06)	(0.06)	(0.06)
Controls (lagged)		X		X	X		X		X	X
Observations	250	237	250	237	237	249	236	249	236	236
R-squared	0.59	0.63	0.57	0.62	0.63	0.12	0.22	0.09	0.21	0.24
Mean (s.d.) of depent.	1.60 (0.66)					0.85 (0.65)				

Note: Standard errors are clustered at the province level. Dependent variables are changes from 2000 to 2010. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), and the mean (sd) 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 (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).

increase in trade shocks leads to a 16% 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.

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 20% larger increase in per capita GDP, and a 12% 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 36% of the mean for changes in employment. The regulation effect is 9% to 10% of the total trade effect.

Table 3—More regulation changes, 2001–2007, and bigger increases in wages, employment, and per capita GDP, 2001–2007

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Δ log wage			Δ log GDP p.c.			Δ log total urban emp.		
Export tariff shock	0.14		0.13	0.53		0.51	0.28		0.27
2001–2007	(0.05)		(0.05)	(0.10)		(0.10)	(0.31)		(0.31)
Δ log regulation score		0.03	0.03		0.07	0.07		0.05	0.04
2001–2007		(0.01)	(0.01)		(0.03)	(0.02)		(0.03)	(0.02)
Controls (lagged)	X	X	X	X	X	X	X	X	X
Observations	237	237	237	237	237	237	236	236	236
R-squared	0.36	0.37	0.39	0.32	0.26	0.35	0.32	0.31	0.33
Mean (s.d.) of depent.	0.82 (0.14)			0.87 (0.27)			0.32 (0.39)		

Note: Standard errors are clustered at the province level. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), and the mean (sd) 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, lagged trade shocks, and lagged wage and GDP growth rates, 1995–2001, as in Table 1 Column (8).

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 15% of the total trade effect.[41]

In Section C.C15, I instrument the regulation changes using the 2000 natural population growth rate to address the remaining concern on the identification of the migration regulation effect. The natural growth rate of the population (birth rate minus death rate) predicts the future population size of a prefecture. A

[41]To address the concern on the quality of Chinese GDP data, I complement the GDP data with satellite night light intensity data; results are similar, shown in Appendix C.C13. I also control for province-level price index growth to check the effect on real income; Appendix C.C14 indicates that the price effect seems not to affect the relationship between trade shocks, regulation changes, and various economic outcomes.

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. In addition, the natural population growth rate is not likely to be correlated with government industrial policies. Overall, I find that OLS and IV estimates of the migration regulation effect are similar and not statistically different from each other.

C. Discussion on the Regulation Effects

1. Did Migrant Flow Drive Regulation Change, or Was It the Other Way Around?

On the one hand, migration regulation change 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, and lead to regulation changes. Since trade shocks affect both migrant flows and migrant regulation, it could be useful to distinguish which happens first. To do this, I look at the timing of the regulation change and the migration flow changes, as well as at the leads and lags.

In previous sections, I use the migration flow from 2000 to 2010, since I cannot observe the number of migrants in 2007. In Table 4, I check the effect of regulation changes in different time periods on migrant flows from 2005 to 2010. Column (1) shows that a 1% increase in regulation score from 1995 to 2000 (two lagged periods) is related to a 0.44% increase in the number of migrants 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 0.32. Column (3) uses the contemporaneous regulation change from 2005 to 2010, and the coefficient declines to 0.09. This could be the mechanical effect from the fact that the mean change in regulation increases from 0.04 in Column (1) to 0.95 in Column (3). However, when we go to Column (4), although there is still a sizable change in log regulation score of 0.53 from 2010 to 2015, there is no longer a positive effect of regulation changes on migrant flow from 2005 to 2010. Columns (5)–(8) use the change in the migrant share of population from 2005 to 2010 as the outcome variable, and the finding is similar to Columns (1)–(4).

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

2. Did Regulations Improve Migrant Outcomes?

As explained in Section I.A, 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

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ log # of migrants, t=2005-2010				Δ migrant share of pop. (%), t=2005-2010			
Δ log regulation score, 1995–2000	0.44 (0.14)				7.37 (1.76)			
Δ log regulation score, 2000–2005		0.32 (0.07)				2.43 (0.78)		
Δ log regulation score, 2005–2010			0.09 (0.04)				0.93 (0.39)	
Δ log regulation score, 2010–2015				-0.15 (0.09)				-1.41 (0.57)
Mean regulation change	0.04	0.30	0.95	0.53	0.04	0.30	0.95	0.53
Observations	254	254	254	254	254	254	254	254
R-squared	0.24	0.31	0.23	0.23	0.10	0.09	0.05	0.05

Note: Standard errors are clustered at the province level. The mean (sd) of Δ log # of migrants from 2005 to 2010 is 0.55 (0.56). 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.

schools. Thus, it would be helpful to see whether the regulations indeed improved these outcomes for migrants.

Unfortunately, the only available source that includes these measures is the 2005 minicensus 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 5 Panel A.

Table 5 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-unit increase in regulation score is related to a 0.3-percentage-point increase in the unemployment insurance rate for migrants. Given that the mean insurance rate for migrant is 21% and for locals is 37%, a 1 unit increase in regulation score will close 5.3% of the migrant-local gap. However, the coefficient is not statistically significant. Columns (2) and (3) show similar patterns, but the effects on pension and medical insurance rates are statistically significant at the 5% and 10% levels, respectively. Column (4) shows a significant effect of regulation scores on the length of contracts: a one-unit increase in regulation score is related to a 0.06 month increase in the length of contracts, which is 10% of the gap between locals and migrants. Column (5) indicates that a 1 unit increase in regulation score is

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related to an income increase of 13 yuan per month, which is 22% 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 5—REGULATION SCORE AND MIGRANT OUTCOMES IN 2005, 247 PREFECTURES

Panel A Dependent variable Y for migrants, 2005	(1) Unemployment Insurance (rate)	(2) Pension (rate)	(3) Medical insurance (rate)	(4) Terms of Contract (in months)	(5) Monthly Income (in yuan)	(6) School Enrolment (rate)	(7) Log # of children
Regulation score, 2005	0.003	0.005	0.005	0.06	12.7	0.001	-0.005
	(0.002)	(0.002)	(0.002)	(0.03)	(4.6)	(0.001)	(0.006)
Y for local, 2005	0.495	0.391	0.391	0.48	0.30	0.487	0.147
	(0.051)	(0.048)	(0.040)	(0.03)	(0.09)	(0.117)	(0.035)
Mean (s.d.) Y for migrants	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	0.382	0.213	0.265	0.343	0.599	0.123	0.940
Panel B							
Regulation score, 2005	0.008	0.000	0.001	0.14	7.54	0.001	-0.018
(Y for local as dependent var.)	(0.002)	(0.002)	(0.002)	(0.04)	(8.21)	(0.000)	(0.007)

Note: Standard errors are clustered at the province level. The mean (sd) regulation score in 2005 is 0.93 (2.67). Panel A regresses migrant outcomes on the 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 regulation score, controlling for the log number of adult locals and the log GDP p.c. in 2005.

Panel B regresses local worker outcomes on the regulation score, controlling for the local population size and GDP. Columns (1), (4), and (6) suggest that a higher regulation score is correlated with a higher unemployment insurance rate, longer terms of contracts, and a higher school enrollment rate for locals. These results might capture the fact that higher-income prefectures usually provide more amenities for both locals and migrants. 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), (3), and (5) 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.

Overall, the results in Table 5 show that prefectures with higher regulation scores also have higher migrant well-being, although the estimates are relatively small. The significant effects concentrate on pensions, medical insurance, terms

of contracts, and wages, and all these aspects are 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.

D. Migrant Network, Transportation Network, and Migrant Flow Responses

Another issue is that the effects of regulation changes and trade shocks might differ depending on how connected the prefecture is through the transportation network. Migrants can travel more easily to prefectures where transportation cost is low; they are able to travel back to their hometown when needed, and this can further incentivize temporary migration. Yang (2017) shows that the Chinese highway system expanded substantially from 1995 to 2015 as a result of a national infrastructure construction plan. I construct the change in overall connectedness of prefecture i using the reduction in transportation cost between prefectures from 2000 to 2005, given by:

$$\Delta \text{Connection}_{i,2000-2005} = \sum_j (T_{ij,2000} - T_{ij,2005}),$$

where $T_{ij,2000}$ is the number of hours needed to travel from prefecture j to prefecture i through the least-cost path in 2000, and $T_{ij,2005}$ is for 2005. $T_{ij,2000}$ and $T_{ij,2005}$ are 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 nonhighways, and 15 kilometers per hour on local roads.

I estimate the effect of changes in prefecture connectedness and regulation changes on migrant flows using the following equation:

$$\Delta \ln M_i = \pi_0 + \pi_1 TradeShock_i + \pi_2 \Delta \ln(\text{reg. score}_i) + \pi_3 \Delta C_i + \pi_4 INT_i + X_i \Phi + \zeta_i,$$

where $\Delta \ln M_i$ is the change in the log number of migrants in prefecture i from 2000 to 2010, $TradeShock_i$ is the export tariff shock from 2001 to 2007, $\Delta \ln(\text{reg score}_i)$ is the change in the log regulation score from 2001 to 2007, ΔC_i is the change in connectedness from 2000 to 2005, and then I add either the interaction between the trade shocks and changes in connectedness or the interaction between regu-

lation changes and changes in connectedness. I also control for the log number of migrants in 2000, import and intermediate shocks from 2001 to 2007, trade shocks from 1995 to 2001, and wage and GDP growth from 1995 to 2001, as in Table 2 Columns (5) and (10).

TABLE 6—INTERACTION EFFECTS OF REGULATION CHANGES (2001–2007) AND PREFECTURE CONNECTION (2000–2005)

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Δ log # of migrants, short-distance			Δ log # of migrants, medium-distance			Δ log # of migrants, long-distance		
Export tariff shock	1.51	1.45	0.70	0.44	0.42	0.37	-0.17	-0.20	0.03
2001–2007	(0.27)	(0.29)	(0.59)	(0.19)	(0.19)	(0.40)	(0.43)	(0.41)	(0.87)
Δ log regulation score	0.27	-0.12	0.26	0.04	-0.12	0.04	0.13	-0.07	0.13
2001–2007	(0.05)	(0.10)	(0.05)	(0.03)	(0.07)	(0.03)	(0.06)	(0.14)	(0.06)
Δ Connection	0.00	-0.04	-0.02	0.00	-0.01	0.00	0.02	-0.00	0.02
2000–2005	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Δ log regulation score		0.04			0.02			0.02	
× Δ Connection		(0.01)			(0.01)			(0.01)	
Export tariff shock			0.08			0.01			-0.02
× Δ Connection			(0.05)			(0.03)			(0.05)
Observations	225	225	225	235	235	235	234	234	234
R-squared	0.35	0.38	0.35	0.64	0.64	0.64	0.25	0.25	0.25
Mean (s.d.) of depent.	-0.81 (0.80)			1.60 (0.67)			0.84 (0.66)		

Note: Standard errors are clustered at the province level. Dependent variables are changes from 2000 to 2010. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), the mean (sd) export tariff shock is 0.18 (0.15), and the mean (sd) Δ Connection, 2000–2005 is 7.23 (4.01). All columns control for import and intermediate tariff shocks, the log total population, the level of the dependent variable in 2000, and lagged trade shocks and lagged wage and GDP growth rates, 1995–2001, as in Table 1 Column (8).

Results using the change in the transportation network (ΔConnection) are shown in Table 6. Column (1) controls for trade shocks and regulation changes and adds the change in connectedness, and there is no significant effect of the change in connectedness on short-run migration flows. Column (2) introduces the interaction of regulation changes and connectedness changes. The regulation effect becomes small (–0.12) and insignificant; the interaction effect is significant and positive. This indicates that the effect of regulation changes was amplified in prefectures that became more connected. Short-distance migrants migrate within a prefecture, and the positive interaction effect can be from the positive correlation between prefecture connectedness and economic growth expectation. The change in connectedness has negative effects on migrant flows (–0.04), and a possible explanation of the result is that when a prefecture is more connected with other prefectures, local rural workers can migrate out more easily. Combining the level effect with the interaction effect, the overall effect of connectedness is positive only when there are relatively big regulation changes (with a change in the log regulation score greater than 1). Column (3) adds the interaction between the export shock and connectedness changes, and there is again a positive, significant

interaction effect.

Columns (4)–(6) show effects on medium-distance migrants. Coefficients for the interaction with connectedness is a significant 0.02. This indicates that more connected prefectures attract more migrants from other prefectures when they relax migration regulations. Again, there is a negative effect of the change in connectedness on migrant flows (–0.01), potentially due to between-prefecture competition. The overall effect of connectedness is positive only when there are relatively big regulation changes. The interaction with the export shock is insignificant, and much smaller than short-run coefficients. Columns (7)–(9) show effects on long-distance migrants. The interaction effect with regulation changes is insignificant, but the size is comparable with medium-distance results. The interaction with the export shock is again not significant.

An alternative way to construct the change in connectedness is to take into account the initial migration network. Intuitively, the reduction in the travel time between two prefectures will have a bigger effect on the bilateral migrant flow if there are already a large flow of migrants between them. Appendix C.C16 shows that the result is similar.

Overall, this finding shows that when a prefecture becomes more connected, trade shocks and changes in migration regulations have bigger effects on attracting migrant inflows, especially for short- and medium-distance migrants. This finding reinforces the causal interpretation of the trade effect and the regulation effect, since we expect the effects should be bigger with better transportation infrastructure.

V.   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 use a simple political economy model to highlight the potential channel through which trade shocks can affect mobility restrictions and how these changes in regulation would affect labor market outcomes and economic growth in general. 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. However, trade liberalization can affect other types of economic institutions as well.[42] The external force of WTO rules and the pressure of competing

[42]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

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.[43] 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. Quantifying this potential productivity effect would also be a fruitful avenue for future work.

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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.

[43]Appendix C.C8 shows that prefectures respond strongly to regulation changes and trade shocks of other prefectures of similar income levels.

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For Online Publication

A1. Migration Regulation

Coding of the Regulation Score

I uncover and rate the regulations 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 extract this 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) Very short documents (fewer than 200 Chinese characters) are rated as 0, since they are usually purely administrative regulations.

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

4) 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.

5) 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.

6) 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.

Figure A1 shows the wordclouds of the strongly pro-migrant and strongly anti-migrant regulations. In a wordcloud, the size of a word is positively correlated with its frequency. Panel (a) shows the wordcloud of the regulations of a score of –2. The words with the highest frequencies are "administrative penalties," "fines," "remedy," "warn," "deport," and "illegal." Panel (b) shows the wordcloud of the regulations of a score of 2. The words with the highest frequencies are "training," "loans," "wages," "service," "injury insurance," and "wage arrears."

(a) Strongly anti-migrant (a score of –2)   (b) Strongly anti-migrant (a score of 2)

FIGURE A1. WORDCLOUDS FOR STRONGLY PRO-MIGRANT REGULATIONS AND STRONGLY ANTI-MIGRANT REGULATIONS

SUMMARY OF STATISTICS

Figure A2 plots the regulation score from 1995 to 2007. Each dot is a year-prefecture average score of new regulations on migrant issues. The solid line with solid squares includes all new regulations, the dashed line with hollow diamonds is for work-related regulations, the dashed line with hollow circles is for welfare-related regulations, and the two dotted lines are for administrative (solid circle) and birth-control-related (solid triangle) regulations. The figure shows that the increase in the total score of regulation is mainly driven by work- and welfare-related regulations. In 2007, for example, the average score for all regulations is about 1, where 0.62 is from work-related regulations, and 0.25 is from welfare-related ones.

Table A1 shows that in the 2001–2007 period, 673 new regulations were enacted on migrant issues, with a mean score of 1.08, and 175 prefectures enacted at least one new regulation. In the 1995–2001 period, the numbers are much smaller: 138 new regulations in total and a mean score of 0.05. Fifty prefectures have some regulation, but only 11 of them have positive regulations. Of the 11 positive-regulation prefectures, only one has regulations about work-related issues, but all 11 have administrative-related regulations. Among these 11 prefectures, nine are capital prefectures of provinces, with pro-migrant regulations about receiving local Hukou through purchase of commercial apartments and some specific issues
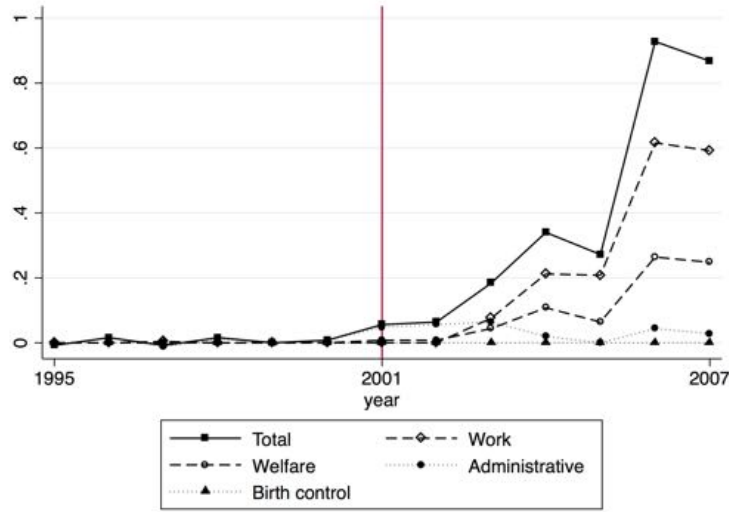
FIGURE A2. REGULATION SCORE, PREFECTURE-LEVEL AVERAGE AND BY TOPIC, 1995–2007

Note: Each dot is a year-prefecture average. The score is the sum of all prefecture-level regulations related to migrants divided by the number of prefectures.

on migrant workers.[44] There were only a few migrant-regulation changes before 2001, and they were concentrated in a few big prefectures on Hukou issues.

Figure A3 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.

A2.   *Trade Shocks*

INDUSTRY CROSSWALK, FROM 2-DIGIT GB CODE TO 2-DIGIT SIC CODE

The industrial composition 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.[45] 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

[44]The nine prefectures are Beijing, Changsha, Chongqing, Guangzhou, Huhehaote, Shanghai, Wuhan, Wulumuqi, and Xi'an. The other two prefectures are Huizhou and Xiamen.
[45]The 1995 Industrial Enterprise Survey data is not available.

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	# of regulations	Mean score	# of prefectures with			
			Any	(+)	(0)	(-)
2001—2007						
Total	673	1.08	175	162	62	9
Administrative	199	0.35	76	56	39	9
Birth control	59	0.35	36	0	36	0
Work	296	1.56	128	128	0	0
Welfare	118	1.67	64	64	0	0
1995—2001						
Total	138	0.05	50	11	48	9
Administrative	110	0.04	46	11	43	9
Birth control	26	0	20	0	20	0
Work	1	1	1	1	0	0
Welfare	0	0	0	0	0	0

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 A2. The Herfindahl index by industry is shown in Figure A4.

Trade Shock Measures, Main

Tariff data is the applied tariff (AHS) on the 2-digit SIC level from the World Bank.[46] 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:

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

where $X_{j,1995}^{cn}$ is the Chinese exports to country n in industry j in 1995 and tariff_{jt}^{cn} 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 A5 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.

$\hat{P}_{ijt}$ 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):

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[46]Source: `wits.worldbank.org`.
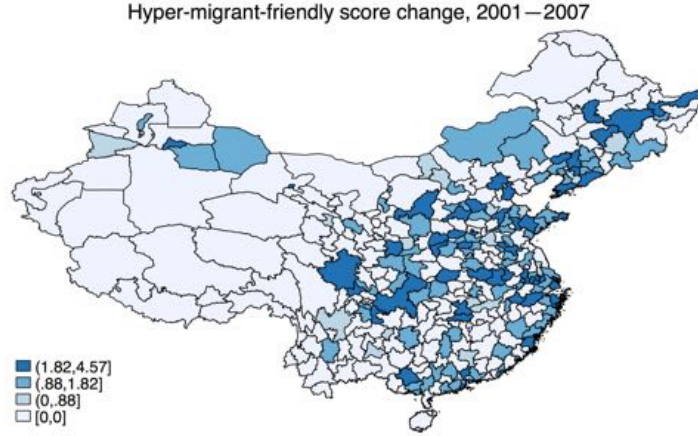
FIGURE A3. GEOGRAPHIC DISTRIBUTION OF REGULATION CHANGES, 2001–2007

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.

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

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

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 $\hat{P}_{ijt}^I$. 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.

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:

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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).

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

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

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
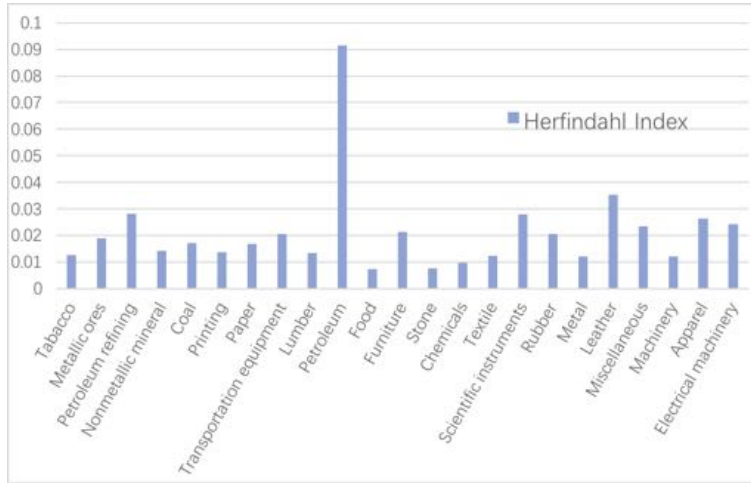
FIGURE A4. INDUSTRY CONCENTRATION ACROSS CITIES IN 2000, HERFINDAHL INDEX

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

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:
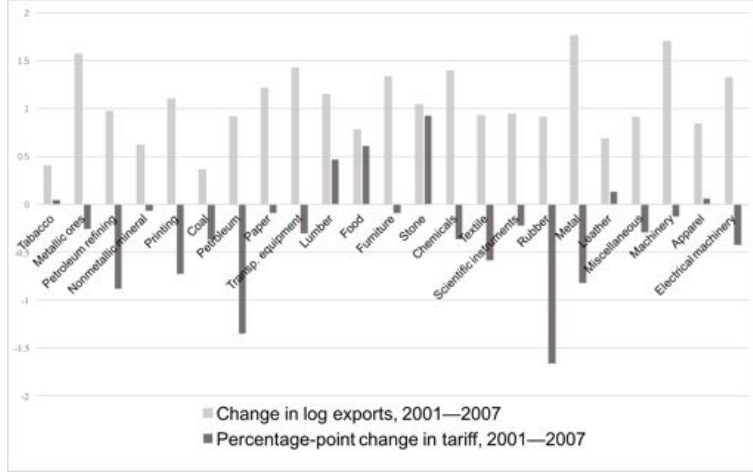
FIGURE A5. DISTRIBUTION OF TARIFF CHANGES AND EXPORT GROWTH ACROSS INDUSTRIES, 2001–2007

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

$$X_{jt} = \sum_n \frac{X_{jt*}^{cn}}{\sum_{n'} X_{jt*}^{n'n}} \frac{\sum_{n'} X_{jt*}^{n'n}}{\sum_{j'} \sum_{n'} X_{j't*}^{n'n}} GDP_t^n$$

$$= \sum_n \frac{X_{jt*}^{cn}}{X_{jt*}^n} \frac{X_{jt*}^n}{X_{t*}^n} GDP_t^n$$

$$= \sum_n \frac{X_{jt*}^{cn}}{X_{t*}^n} GDP_t^j,$$

where $\frac{X_{jt*}^{cn}}{X_{jt*}^n}$ is the fraction of imports in industry j and country n that comes from China in baseline year t^*, and $\frac{X_{jt*}^n}{X_{t*}^n}$ 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

$$\Delta X_{jt}^{GDP} = \sum_n \frac{X_{jt*}^{cn}}{X_{t*}^n} \left(log(GDP_{t'}^n) - log(GDP_t^n) \right).$$

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:

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

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

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

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

and

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

A3. 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.[47]

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.1, 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.

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[47]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.

Mean (sd) 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.[48] 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%.

A4. 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

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[48]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.

purely rural.[49] 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.[50] 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.[51] In 2001, the correlation between per capita GDP and night-light 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.

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

[50]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.

[51]NASA night-light data can be downloaded from `http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html`.

B1. Additional Discussion on the Model Features

In the model, I group the rural areas of all prefectures into one and focus on migration from a single rural area into multiple urban areas. Also, when talking about the prefecture-level government, I take the stand that it is only interested in the urban areas, and that its regulations are geared toward providing amenities that attract migrants to the urban areas.

This simplification is based on several features of the data and the institutional background. First, in migrant regulations, the treatment of migrants does not depend on their Hukou origin. This means that a migrant worker from another prefecture is usually treated the same as a migrant from the rural area of his or her own prefecture. Second, the average agriculture share of prefecture tax revenue in 2000 was just 13%, meaning that the urban area is the major contributor to prefecture tax revenue.[52] Third, local governments have few mechanisms and little incentive to restrict rural residents from emigrating. Migrants usually earn higher wages in the urban areas and remit part of their income to their family back in their hometown. This remittance helps to alleviate rural poverty. The empirical results in Appendix C.C11 confirm that the regulations did not affect emigration.

Admittedly, when a rural resident decides to migrate, the geographic distance between the origin and the destination is correlated with both the transportation cost and the cultural and language differences. Thus the supply of migrants could vary across prefectures. I discuss the heterogeneous effect of trade and regulation effects by connectedness of a prefecture and the size of potential migrant supply in Section IV.D and Appendix C.C12. However, to keep the representation simple, the model does not include this feature; the main implications of the model do not depend on this assumption.

B2. General Equilibrium Definition

A general equilibrium of this economy consists of the distribution of workers $\{M_n\}_{n \in \{1,...,N,r\}}$, city output values $\{Y_i\}_{i \in \{1,...,N\}}$, wages $\{w_i\}_{i \in \{1,...,N\}}$, amenities $\{A_i\}_{i \in \{1,...,N\}}$, the migrant welfare measure v, the type of Hukou system S, and economy-wide GDP, Y, such that (1) firms make optimal decisions about production; (2) rural workers make optimal location decisions; (3) city governments make the optimal decision about amenity provision; (4) the central government makes the optimal decision about the state of mobility; (5) city-level labor markets clear; and (6) the national labor market clears, i.e., $\sum_n M_n = \bar{M}$.

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[52]I calculated this by using prefecture-level fiscal revenue and expenditure data.

B3. Proof of Propositions

PROPOSITION 1: *In the relaxed Hukou system ($S = 1$), when there is a positive price shock in city i ($p_i \uparrow$), the local government will provide more amenities for migrants ($A_i \uparrow$), and migrants will flow into the city ($M_i \uparrow$). Overall output in city i will increase ($Y_i \uparrow$).*

PROOF:

Plug the wage expression from the labor demand equation (Equation 2) into the labor supply equation (1)

$$M_i = \left(\frac{(C_i + A_i)^{\beta_1} \left(\alpha_i (1-t) p_i \mu_i M_i^{\alpha_i - 1} \right)^{\beta_2}}{v} \right)^{\epsilon} \bar{M}.$$

Solving M_i as a function of A_i,

$$M_i = \left(\frac{\bar{M}}{v^\epsilon} (\alpha_i (1-t) p_i \mu_i)^{\beta_2 \epsilon} \right)^{\frac{1}{1+(1-\alpha_i)\beta_2\epsilon}} (C_i + A_i)^{\frac{\beta_1 \epsilon}{1+(1-\alpha_i)\beta_2\epsilon}}.$$

Since $S = 1$, I can solve A_i as a function of M_i:

$$A_i = \frac{M_i^{\frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1}}}{\left(\frac{\bar{M}}{v^\epsilon} \right)^{\frac{1}{\beta_1\epsilon}} (\alpha_i (1-t) p_i \mu_i)^{\frac{\beta_2}{\beta_1}}} - C_i.$$

And $\frac{\partial A_i}{\partial M_i}$ can also be solved as a function of M_i:

$$\frac{\partial A_i}{\partial M_i} = \left(\frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1} \right) \frac{M_i^{\frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1} - 1}}{\left(\frac{\bar{M}}{v^\epsilon} \right)^{\frac{1}{\beta_1\epsilon}} (\alpha_i (1-t) p_i \mu_i)^{\frac{\beta_2}{\beta_1}}}.$$

Plug A_i, $\frac{\partial A_i}{\partial M_i}$, and w_i into Equation 3:

$$t \cdot \alpha_i (1-t) p_i \mu_i M_i^{\alpha_i - 1} = (1 + \frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1}) \frac{M_i^{\frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1}}}{\left(\frac{\bar{M}}{v^\epsilon} \right)^{\frac{1}{\beta_1\epsilon}} (\alpha_i (1-t) p_i \mu_i)^{\frac{\beta_2}{\beta_1}}} - C_i.$$

Rearranging the terms,

$$t \cdot \alpha_i (1-t) p_i \mu_i M_i^{\alpha_i - 1} + C_i = (1 + \frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1}) \frac{M_i^{\frac{1}{\beta_1\epsilon} + (1-\alpha_i)\frac{\beta_2}{\beta_1}}}{\left(\frac{\bar{M}}{v^\epsilon} \right)^{\frac{1}{\beta_1\epsilon}} (\alpha_i (1-t) p_i \mu_i)^{\frac{\beta_2}{\beta_1}}}.$$

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Suppose that when p_i increases, M_i decreases. Thus, the left-hand side of the above equation increases. At the same time, the right-hand side decreases; the equation will not hold. Thus, M_i has to increase.

Log-linearizing the equation:

(B1) $\qquad \hat{M}_i = \dfrac{\beta_2 + \beta_1 S_{1,i}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i - \dfrac{1}{\frac{1}{\epsilon} + (1 - \alpha_i)(\beta_2 + S_{1,i}\beta_1)} \hat{v},$

where $S_{1,i} = \dfrac{\alpha_i t(1-t) p_i A_i M_i^{\alpha_i - 1}}{\alpha_i t(1-t) p_i A_i M_i^{\alpha_i - 1} + C_i} = \dfrac{B_i}{B_i + C_i}$, and B_i is the baseline per capita migrant contribution in taxes.

Similarly, I solve the percentage change in amenity as

$$\hat{A}_i = \dfrac{1}{S_{2,i}} \dfrac{S_{1,i} \cdot \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i + \dfrac{1}{S_{2,i}} \dfrac{S_{1,i} \cdot (1 - \alpha_i)}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{v},$$

where $S_{2,i} = \dfrac{A_i}{A_i + C_i}$. Thus, when p_i increases, A_i increases.

Total regional GDP is $Y_i = p_i \mu_i M_i^{\alpha_i}$. Then the percentage change in GDP is

$$\hat{Y}_i = \hat{p}_i + \alpha_i \hat{M}_i = \dfrac{\beta_2 + \beta_1 S_{1,i} + \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i - \dfrac{\alpha_i}{\frac{1}{\epsilon} + (1 - \alpha_i)(\beta_2 + S_{1,i}\beta_1)} \hat{v},$$

where $S_{3,i} = \dfrac{M_i}{L_i + M_i}$. Thus, when p_i increases, G_i increases.

For each city, the impact of p_i on v is negligible, and the term with $\hat{v}$ in the above equations can be dropped. ∎

PROPOSITION 2: *In the strict Hukou System ($S = 0$), when there is a positive price shock in city i ($p_i\uparrow$), migrants will flow into the city ($M_i\uparrow$) and overall output in city i will increase ($Y_i\uparrow$). However, both the increase in number of migrants and the increase in output are smaller than in the Relaxed Hukou system.*

PROOF:
Since $S = 0$ and $A_i = 0$, then

$$M_i = \left(\dfrac{\bar{M}}{v^\epsilon}(\alpha_i(1 - t)\mu_i)^{\beta_2 \epsilon}\right)^{\frac{1}{1 + (1 - \alpha_i)\beta_2 \epsilon}} C_i^{\frac{\beta_1 \epsilon}{1 + (1 - \alpha_i)\beta_2 \epsilon}} p_i^{\frac{\beta_2 \epsilon}{1 + (1 - \alpha_i)\beta_2 \epsilon}}.$$

M_i is an increasing function of p_i. Log-linearize the equation:

$$\hat{M}_i = \dfrac{\beta_2}{(1 - \alpha_i)\beta_2 + \frac{1}{\epsilon}} \hat{p}_i - \dfrac{1}{\frac{1}{\epsilon} + (1 - \alpha_i)\beta_2} \hat{v}.$$

Compared with Equation B1 in the proof for Proposition 1, the coefficient of $\hat{p}_i$ is smaller, meaning that the impact of price shocks on migrant flows is smaller

in the strict Hukou system than in the relaxed Hukou system:

$$\frac{\beta_2 + \beta_1 S_{1,i}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} - \frac{\beta_2}{(1 - \alpha_i)\beta_2 + \frac{1}{\epsilon}} = \frac{\beta_1 S_{1,i} \cdot \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} > 0.$$

Since Y_i is an increasing function of M_i, given p_i, the overall output increase will also be smaller. ∎

PROPOSITION 3: *In the symmetric case, when all cities are the same and the rural area has very small wages, the overall output Y is an increasing function of the number of people who migrated. When there is an economy-wide positive price shock, both $Y_{S=1}$ and $Y_{S=0}$ will increase, and $Y_{S=1}$ will increase more. Thus, the central government is more likely to switch to the relaxed Hukou system.*

PROOF:
Suppose that all cities are the same in terms of economic fundamentals and prices shocks, the total output in cities is
$$\sum_i Y_i = N \cdot Y_i = N \cdot p_i \mu_i M_i^{\alpha_i},$$

which is a strictly increasing function in M_i. Using the national-level labor-market clearing condition, $M_r = \bar{M} - N \cdot M_i$. The national total output is

$$Y = \sum_i Y_i + M_r w_r = N \cdot p_i \mu_i M_i^{\alpha_i} + (\bar{M} - N \cdot M_i) w_r.$$

The national total output will be a strictly increasing function in M_i when w_r is small enough. As shown in Proposition 2, when there is a positive price shock, the increase in number of migrants is bigger in the relaxed Hukou system than in the strict Hukou system; thus, overall output increase will also be bigger and the central government is more likely to switch to the relaxed Hukou system. ∎

B4. Estimation Equations

Let $\hat{x} \equiv d \ln x$ present percentage changes. I log-linearize the equilibrium equations and solve for the percentage changes of endogenous variables (amenity, migrant inflow, wage, total employment, and per capita GDP) as functions of the exogenous trade shock $\hat{p}_i$.[53]
The key variable of interest is the percentage increase in the amenity level ($\hat{A}_i$):

(B2)
$$\hat{A}_i = \frac{1}{S_{2,i}} \frac{S_{1,i} \cdot \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i \equiv f(\alpha_i)\hat{p}_i.$$

[53]Assume that price changes are small and higher-order terms are negligible.

Equation B2 shows that when there is a positive price shock, the amenity level also increases ($f(\alpha_i) > 0$).[54] In addition, when α_i is bigger, the amenity is more responsive ($f'(\alpha_i) > 0$), meaning that in places that are more migrant-intensive (or with higher migrant elasticity of output), a positive price shock leads to bigger changes in the amenity level.

I then solve for the percentage change in the migrant inflow ($\hat{M}_i$), total urban employment ($\hat{E}_i = \widehat{L_i + M_i}$), migrant wages ($\hat{w}_i$), local wages ($\hat{w}_i^L$), wages of the total employment ($\hat{w}_i^T$), and per capita GDP as functions of the exogenous trade shock $\hat{p}_i$. All of them are increasing functions of the trade shock.

The percentage increase in migrant inflow ($\hat{M}_i$) is

(B3)
$$\hat{M}_i = \frac{\beta_2 + \beta_1 S_{1,i}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i.$$

Total urban employment is the sum of local labor and migrant labor, and the percentage increase in total employment ($\hat{E}_i$) is

(B4)
$$\hat{E}_i = \widehat{L_i + M_i} = S_{3,i}\hat{M}_i = \frac{(\beta_2 + \beta_1 S_{1,i})S_{3,i}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i,$$

where $S_{3,i} = \frac{M_i}{L_i + M_i}$.

The percentage increase in migrant wages ($\hat{w}_i$) is

$$\hat{w}_i = \hat{p}_i + (\alpha_i - 1)\hat{M}_i = \frac{\frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i,$$

The percentage increase in local wages ($\hat{w}_i^L$) is

$$\hat{w}_i^L = \hat{p}_i + \alpha_i\hat{M}_i = \frac{\beta_2 + \beta_1 S_{1,i} + \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_i) + \frac{1}{\epsilon}} \hat{p}_i.$$

When pooling the migrants with the local labor, the percentage change in mean wages for the total employment ($\hat{w}_i^T$) is

(B5)
$$\hat{w}_i^T = (1 - S_{3,i})\hat{w}_i^L + S_{3,i}\hat{w}_i = \frac{(\beta_2 + \beta_1 S_{1,i})(1 - S_{3,i}) + \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}} \hat{p}_i,$$

where $S_{3,i} = \frac{M_i}{L_i + M_i}$.

[54] $S_{2,i} = \frac{A_i}{A_i + C_i}$, $S_{1,i} = \frac{\alpha_i t(1-t)p_i\mu_i M_i^{\alpha_i - 1}}{\alpha_i t(1-t)p_i\mu_i M_i^{\alpha_i - 1} + C_i} = \frac{B_i}{B_i + C_i}$. B_n is the baseline per capita migrant contribution in taxes, A_i is the baseline government-supplied amenity level, and C_i is the baseline natural amenity level.

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Define per capita GDP as $G_i = \frac{Y_i}{L_i + M_i}$. The percentage change in per capita GDP is

$$\hat{G}_i = \hat{Y}_i - S_{3,i}\hat{M}_i = \hat{p}_i + \alpha_2\hat{M}_i - S_{3,i}\hat{M}_i = \frac{(\beta_2 + \beta_1 S_{1,i})(1 - S_{3,i}) + \frac{1}{\epsilon}}{(1 - \alpha_i)(\beta_2 + \beta_1 S_{1,i}) + \frac{1}{\epsilon}}\hat{p}_i.$$

C1. Trade Shock–Regulation Relationship from 1995 to 2001

Figure C1 plots the relationship between changes in the log regulation score and export tariff shocks in the 1995–2001 period to compare with Figure 7. Pre WTO accession, there were clearly few changes in migrant-related regulations (with insignificant coefficients of –0.03 to 0.02, while the coefficients are 0.7 to 1.4 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.
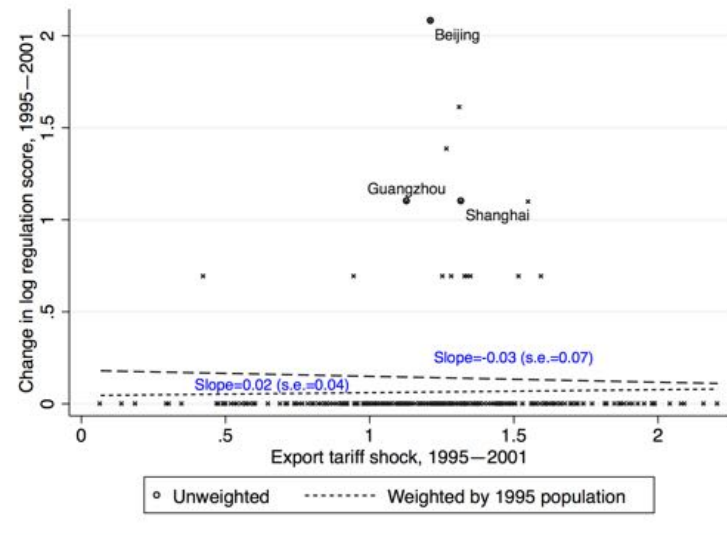
Figure C1. Effect of trade shocks on regulation change, 1995–2001, 250 prefectures

Note: Each dot is a prefecture.

C2. Inverse-Hyperbolic-Sine Transformation

Instead of log transformation, I use inverse-hyperbolic-sine transformation to allow for both positive and negative changes. The results are essentially the same as in Table 1.

C3. 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

TABLE C1—BIGGER TRADE SHOCKS, MORE MIGRANT-FRIENDLY

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Δ hyper regulation score, 2001–2007					Placebo, 1995–2001	
Export tariff shock	0.89	1.56	1.57	1.57	1.39	1.32	1.19	1.04	-0.02	
2001–2007	(0.41)	(0.51)	(0.51)	(0.51)	(0.56)	(0.54)	(0.57)	(0.56)	(0.03)	
Import tariff shock		-0.11	-0.11	-0.11	-0.10	-0.10	-0.13	-0.10	-0.01	
2001–2007		(0.04)	(0.04)	(0.04)	(0.07)	(0.05)	(0.04)	(0.08)	(0.00)	
Intermediate tariff shock		0.24	0.24	0.24	0.06	0.29	0.13	0.09	0.00	
2001–2007		(0.14)	(0.14)	(0.14)	(0.23)	(0.18)	(0.16)	(0.23)	(0.03)	
Hyper regulation score			-0.08		-0.09	-0.10	-0.13	-0.13		
2001			(0.26)		(0.25)	(0.23)	(0.24)	(0.23)		
Δ hyper regulation score				-0.08						
1995–2001				(0.26)						
Export tariff shock					0.23			0.20		0.14
1995–2001					(0.24)			(0.25)		(0.10)
Import tariff shock					0.01			0.02		-0.02
1995–2001					(0.03)			(0.02)		(0.01)
Intermediate tariff shock					0.21			0.12		-0.03
1995–2001					(0.13)			(0.13)		(0.05)
Δ log wage						1.19		0.84		
1995–2001						(0.44)		(0.52)		
Δ log GDP p.c.							0.75	0.64		
1995–2001							(0.17)	(0.20)		
Observations	250	250	250	250	237	237	237	237	238	237
R-squared	0.01	0.07	0.07	0.07	0.08	0.10	0.12	0.13	0.00	0.00

Note: Standard errors are clustered at the province level. The mean (sd) of Δ hyper regulation score, 2001–2007 is 1.01(1.08), 1995–2001 is 0.05 (0.40). The mean value of export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40).

result with respect to sample selection. Table C2 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.

In Figure 7, 114 prefectures experienced no regulation changes from 2001 to

[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 C2—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 2001–2007	All prefectures					Prefectures with nonzero changes		
Export tariff shock 2001–2007	0.72	0.81	0.75	1.02	1.03	0.57	0.67	0.64
	(0.19)	(0.21)	(0.22)	(0.35)	(0.36)	(0.24)	(0.28)	(0.28)
Import tariff shock 2001–2007		-0.03	-0.03	-0.04	-0.04		-0.03	-0.03
		(0.02)	(0.03)	(0.03)	(0.03)		(0.03)	(0.03)
Intermediate tariff shock 2001–2007		0.40	0.40	0.37	0.39		-0.04	-0.03
		(0.15)	(0.15)	(0.15)	(0.15)		(0.10)	(0.11)
Log regulation score 2001			0.81	0.79	0.78			0.17
			(0.30)	(0.30)	(0.31)			(0.11)
Employment share in petroleum ind, 2000				-1.05				
				(0.58)				
Observations	333	333	333	333	323	148	148	148
R-squared	0.03	0.10	0.15	0.16	0.16	0.02	0.03	0.04
Mean (s.d.) of depent.	0.64 (0.78)				0.64 (0.79)	1.37 (0.54)		
Mean (s.d.) of expor shock	0.16 (0.20)				0.14 (0.18)	0.20 (0.19)		

Note: Standard errors are clustered at the province level. 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%.

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 C2 Columns (6)–(9) include only prefectures with nonzero changes. The coefficient estimates are 15% to 40% 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.

C4.   *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 C3 uses the same specification as in Table 1 Column (3). Column (1)

Dependent variable 2001–2007	(1) Δ log regulation score 5 levels	(2) Δ log regulation score 3 levels	(3) Δ log num. regulations	(4) Δ log regulation score Work	(5) Δ log regulation score Welfare	(6) Δ log regulation score Admn.
Export tariff shock	1.09	0.83	0.46	1.03	0.61	0.32
2001–2007	(0.37)	(0.32)	(0.25)	(0.34)	(0.23)	(0.18)
Import tariff shock	-0.08	-0.05	-0.02	-0.07	-0.07	-0.02
2001–2007	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.01)
Intermediate tariff shock	0.20	0.23	0.20	0.06	-0.01	0.14
2001–2007	(0.19)	(0.14)	(0.12)	(0.16)	(0.11)	(0.08)
Y, 2001	0.71	0.75	0.33	3.16	1.25	0.14
	(0.32)	(0.24)	(0.18)	(0.39)	(0.12)	(0.16)
Observations	250	250	250	250	250	250
R-squared	0.12	0.16	0.16	0.07	0.06	0.08
Mean (s.d.) of depent.	0.77 (0.82)	0.57 (0.65)	0.57 (0.58)	0.61 (0.77)	0.29 (0.58)	0.13 (0.31)

Note: Standard errors are clustered at the province level. The mean value (sd) of export tariff shocks, 2001–2007 is 0.18 (0.15).

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 regulations were most significant, administrative ones were the least significant. Overall, all columns are consistent with the main result.

C5. Alternative Measure of Bartik-Style 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 C4 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

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TABLE C4—ALTERNATIVE MEASURE OF TRADE SHOCKS, BARTIK-STYLE

Depend. Var. (2001–2007)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δlog regulation score							
	Tariff based trade		Market access based trade shock				
Trade shock measures:	Main	Labor share	OLS	OLS	OLS	GDP IV	Gravity IV
Export shock	1.09	1.02	0.03	0.02	0.02	0.02	0.02
2001–2007	(0.37)	(0.36)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Import shock	-0.08	-0.07		0.01	0.00	-0.00	0.00
2001–2007	(0.04)	(0.04)		(0.01)	(0.01)	(0.01)	(0.01)
Intermediate shock	0.20	0.20		0.08	0.08	0.06	0.07
2001–2007	(0.19)	(0.18)		(0.08)	(0.09)	(0.10)	(0.09)
Log regulation score, 2001	0.71	0.71			0.46	0.44	0.45
	(0.32)	(0.32)			(0.31)	(0.31)	(0.31)
Urban share, 2001					0.01	0.01	0.01
					(0.00)	(0.00)	(0.00)
Observations	250	250	250	250	250	250	250
R-squared	0.12	0.11	0.06	0.07	0.16	0.16	0.16
Mean (s.d.) of export shock	0.18 (0.15)	0.17 (0.15)			16.40 (6.63)		
First-stage F-stat	-	-	-	-	-	493	488

Note: Standard errors are clustered at the province level. The mean value (sd) of Δ regulation scores, 2001–2007 is 0.77 (0.82).

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 C4 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 2% increase in regulation score changes. 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 26% higher increase in regulation scores, which is comparable to the 21% difference found in the main regression with tariff shocks.[56]

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[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.

In addition to the decline in tariffs, WTO acession also led to two other kinds
of reduction in trade barriers. First, Handley and Limão (2017) and Pierce and
Schott (2016) show that the United States applied MFN tariffs on Chinese ex-
ports 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. 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 Multifiber Arrangement (MFA) quota restrictions
until January 2005. The removal of these restrictions boosted Chinese exports in
corresponding industries.

Table C5 investigates these two factors. I use the 2000 customs data by firm,
eight-digit Harmonized System (HS) category, and destination country, then com-
bining it with the information on the 2000 Column 2 tariffs and MFN tariffs by
eight-digit HS category by the United States from Handley and Limão (2017).[57]
With these data, the reduction in trade uncertainty in region i is:

$$Column2_{i,2000} = \sum_p \frac{export^{US}_{p,i,2000}}{\sum_{p'} export^{US}_{p,i,2000}}(Column2^{US}_{p,2000} - MFN^{US}_{p,2000}),$$

where i is a prefecture, p is a six-digit HS category, $export^{US}_{p,i,2000}$ the exports from
Chinese prefecture i to the United States in category p in 2000, $Column2^{US}_{p,2000}$ is
the U.S. Column 2 tariff on category p in 2000, and $MFN^{US}_{p,2000}$ is the U.S. MFN
tariff. I construct the U.S. export share as

$$\text{US export share}_{i,2000} = \frac{export^{US}_{i,2000}}{export^{W}_{i,2000}},$$

where $export^{US}_{i,2000}$ is the total exports from Chinese prefecture i to the United
States in 2000, and $export^{W}_{i,2000}$ is the total exports from China to the rest of the
world in 2000. To account for the fact that different prefectures' output share
of output is different, and that it might affect the exposure to trade shocks, I
construct the export share as

$$\text{Export share}_{i,2000} = \frac{export_{i,2000}}{output_{i,2000}}$$

_____

[57]I convert the eight-digit HS codes to six-digit ones in both datasets to increase the matching prob-
ability.

where $export_{i,2000}$ is the value of exports from prefecture i in 2000, and $output_{i,2000}$ is prefecture i's total sales revenue in 2000 – both are taken from the 2000 Industrial Enterprises Survey.

The customs data is combined with the MFA quota restrictions to measure the quota removal effect. A prefecture's exposure to MFA restrictions is

$$\text{Value of textile w/quota}_{i,2000} = \sum_p \frac{export_{p,i,2000}}{\sum_{p'} export_{p',i,2000}} \cdot D(MFA_p^{2001-2005} = 1),$$

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.

TABLE C5—ALTERNATIVE MEASURES OF TRADE SHOCKS, UNCERTAINTY, AND TEXTILE QUOTAS

Dependent variable: Δ log regulation score, 2001–2007	(1)	(2)	(3)	(4)	(5)
Export tariff shock, 2001–2007	1.09	1.12	1.07	1.08	1.02
	(0.39)	(0.39)	(0.39)	(0.39)	(0.38)
Column2×US export share		2.06			
		(1.13)			
Column2×US export share×Export share			4.35		
			(3.62)		
Value of textile w/ quota				3.95	
				(1.50)	
Value of textile w/ quota×Export share					38.74
					(15.52)
Observations	250	250	250	250	250
R-squared	0.12	0.13	0.12	0.13	0.13
Mean (s.d.) of control		0.04 (0.04)	0.006 (0.01)	0.01 (0.03)	0.002 (0.003)

Note: Standard errors are clustered at the province level. All columns control for import tariff shocks, intermediate tariff shocks, and the log regulation score in 2001. "Column2" of a prefecture is the weighted average of differences between each product's U.S. Column 2 ad valorem tariff and its U.S. MFN tariff, with the the product's share of U.S. imports from the prefecture as the weight. Each product is on the HS6 level. "Export share" is a prefecture's output share of exports. "Value of textile w/ quota" is a prefecture's share of exports that is subject to textile quota restrictions during the 2001 to 2005 period.

I then add the uncertainty controls and the MFA controls into the baseline regression as in Table 1 Column 3. Table C5 Column (1) replicates Table 1 Column 3, and Column (2) adds the interaction between $Column2$ and US export share as the measure of uncertainty. Column (3) further interacts the uncertainty measure with the export share of output. Both columns show a small positive effect, indicating that the reduction in trade uncertainty indeed contributes to the change

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in regulations. However, the magnitude is relatively small, given the means of 0.04 and 0.006.

Columns (4) and (5) show the MFA effect. Column (4) controls for the value of textile subject to quota and Column (5) interacts it with the export share of output. Both columns show a positive and significant effect, indicating that the removal of the textile and clothing quota increased the migrant-friendliness of a prefecture. The effects are relatively small, evaluated at the mean. In addition, the distribution of value of textile w/quota is skewed to the right: the median value is 0.004 while the mean is 0.02. Thus, a few prefectures with big shares of exports in the textile and clothing industries are the major source of variation.

In all columns, the coefficients on the export tariff shock remain largely unchanged. Overall, I find a robust effect of the tariff shocks on regulation changes, and given the positive estimates on the uncertainty and MFA effects, the tariff effect can act as a lower bound for the overall WTO effect.

C7. 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 C2 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 1.09, which is the estimate in Table 1 Column (3). Thus, the results are not sensitive to specific-industry effects.[58]

C8. 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 C6 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.[59] Overall, I find no significant competition effect due to geographic proximity.

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[58]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 A.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.

[59]The five nearby prefectures are the five closest prefectures by euclidian distance, calculated from the longitude and the latitude.
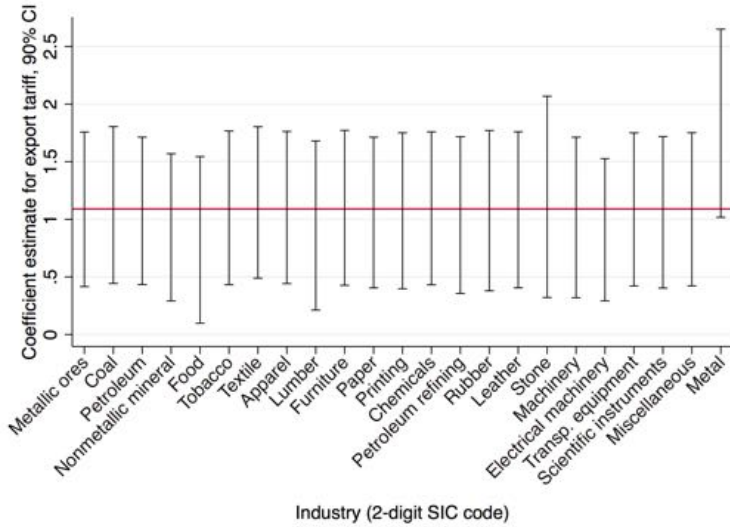
FIGURE C2. COEFFICIENTS FROM THE MAIN REGRESSION BY ADDING INDUSTRIAL-COMPOSITION CONTROLS ONE BY ONE

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 1.09 from Table 1 Column (3).

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. 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:

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

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Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ log regulation score, 2001–2007		All other prefectures in the same prov.			5 closest prefectures		
Export tariff shock, own	1.09	0.89	0.90	0.86	1.06	0.89	0.88
2001–2007	(0.39)	(0.38)	(0.39)	(0.39)	(0.41)	(0.44)	(0.45)
Export tariff shock, other pref.		0.59		0.39			
2001–2007		(0.77)		(0.57)			
Δ log regulation score, other pref.			0.29	0.28			
2001–2007			(0.19)	(0.18)			
Export tariff shock, nearby pref.					0.08		0.05
2001–2007					(0.14)		(0.13)
Δ log regulation score, nearby pref.						0.89	0.85
2001–2007						(0.65)	(0.63)
Observations	250	244	244	244	250	250	250
R-squared	0.12	0.09	0.10	0.10	0.12	0.13	0.13

Note: Standard errors are clustered at the province level. The mean (sd) of Δ reg regulation scores, 2001–2007 is 0.77 (0.82), 1995–2001 is 0.06 (0.26). The mean value of own export tariff shock, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40). 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.

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 2001.[60]

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

[60]The data on travel time is described in Section IV.D.

TABLE C7—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 industries	By the size of population			By the size of GDP p.c.		
Export tariff shock, own	1.04	1.09	1.11	1.12	1.05	0.84	0.82
2001–2007	(0.36)	(0.39)	(0.39)	(0.39)	(0.38)	(0.33)	(0.33)
Δ log regulation score, other, ind.	0.13						
2001–2007	(0.33)						
Export tariff shock, other, pop.		0.04		-0.05			
2001–2007		(0.35)		(0.37)			
Δ log regulation score, other, pop.			0.10	0.11			
2001–2007			(0.09)	(0.09)			
Export tariff shock, other, gdp					0.94		0.75
2001–2007					(0.31)		(0.33)
Δ log regulation score, other, gdp						0.30	0.28
2001–2007						(0.10)	(0.09)
Observations	250	250	250	250	250	250	250
R-squared	0.12	0.12	0.12	0.12	0.12	0.13	0.13

Note: Standard errors are clustered at the province level. The mean (sd) of Δ reg regulation score, 2001–2007 is 0.77 (0.82), 1995–2001 is 0.06 (0.26). The mean value of own export tariff shocks, 2001–2007 is 0.18 (0.15), 1995–2001 is 1.23 (0.40). 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 C7 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 (0.75–0.94 compared to 0.82–1.05); the elasticity between a prefecture's own regulation change and the competing prefectures' regulation change is 0.28–0.30.

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 regula-

tions 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.

C9. *Regression Results for Heterogeneous Effects*

Table C8 shows similar findings as in Figure 8 using regression analysis. The regression equation is as follows:

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

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 C8, 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 C8—MORE MIGRANT-INTENSIVE PREFECTURES RESPONDED MORE TO TRADE SHOCKS, 2001–2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable				Δ log regulation score, 2001–2007				
I for interaction, 2001	Migrant intensity		Private firm share		Log(wage)		Log(GDP p.c.)	
Export tariff shock, 2001–2007	-3.26	-4.40	-0.92	-1.37	-25.28	-30.19	-8.47	-10.22
	(2.37)	(2.72)	(0.56)	(0.64)	(13.14)	(13.66)	(4.49)	(5.17)
I, 2001	-1.45	-2.79	-0.39	-0.68	0.21	0.18	0.32	0.29
	(1.49)	(1.81)	(0.25)	(0.30)	(0.30)	(0.37)	(0.13)	(0.15)
Export tariff shock×I	12.33	14.92	3.93	4.18	2.84	3.35	1.00	1.18
	(7.20)	(8.17)	(0.87)	(0.91)	(1.45)	(1.50)	(0.51)	(0.58)
Controls		X		X		X		X
Observations	250	237	250	237	250	237	250	237
R-squared	0.13	0.17	0.16	0.20	0.17	0.21	0.23	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. The mean (sd) Δ log regulation score, 2001-2007 is 0.77 (0.82), and the mean (sd) 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).

Column (1) shows a positive interaction effect for migrant intensity and export tariff shock (12.33), and a negative coefficient for export tariff shock (–3.26).

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 (2.84), and a negative coefficient for export tariff shocks (–25.28). 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.

C10.   Decomposition of the Migrant Flow

Table 2 classifies migrant flows into short-, medium-, and long-distance categories. As a robustness check, Table C9 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 2 Panel A Column (5).

TABLE C9—REGULATION CHANGE (2001–2007) AND MIGRANT FLOW IN SUBCATEGORIES (2000–2010)

Dependent variable Δlog # of migrants Subcategory	(1)	(2) Purpose of migration	(3)	(4)	(5) Time since migrated	(6)	(7) Years of education	(8)
	Work	Family	Marriage	Other	<= 3 years	> 3 years	<=12 years	>12 years
Δlog regulation score	0.13	0.11	0.06	0.13	0.13	0.08	0.07	0.16
2001–2007	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.02)	(0.07)
Y, 2001	-0.32	-0.24	-0.42	-0.10	-0.29	0.11	-0.06	-0.23
	(0.05)	(0.04)	(0.04)	(0.07)	(0.04)	(0.05)	(0.04)	(0.06)
Log population, 2001	0.18	0.09	0.27	0.06	0.18	-0.07	0.04	0.12
	(0.06)	(0.05)	(0.04)	(0.07)	(0.04)	(0.03)	(0.03)	(0.06)
Observations	250	250	248	250	250	250	250	249
R-squared	0.35	0.13	0.30	0.04	0.29	0.07	0.02	0.15
Mean (s.d.) of depent.	1.47 (0.56)	1.15 (0.48)	0.92 (0.53)	-0.44 (0.48)	0.98 (0.45)	0.48 (0.44)	0.50 (0.35)	1.50 (0.53)

Note: Standard errors are clustered at the province level. The mean value (sd) of Δ regulation score from 2001 to 2007 is 0.77 (0.82).

I find that the relaxation of migration restrictions affected people who migrated

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for work 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 4: regulations take time to impact migrant flows. Finally, 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.

C11. 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 C10 replicates the results in Table 2 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), (2), (5), and (6) 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 only significant in Column (8).

TABLE C10—DID TRADE SHOCKS AND REGULATION CHANGES AFFECT EMIGRATION?

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ out-migrant share of population				Δ log # of out-migrants			
Export tariff shock	-4.57	-2.54			-0.01	-0.02		
2001-2007	(3.14)	(3.33)			(0.14)	(0.18)		
Δ log regulation score			-0.52	0.26			0.04	0.06
2001-2007			(0.52)	(0.50)			(0.03)	(0.04)
Controls (lagged)		X		X		X		X
Observations	250	237	250	237	250	237	250	237
R-squared	0.04	0.16	0.01	0.16	0.68	0.70	0.67	0.70
Mean (s.d.) of depent.	11.4 (6.4)				1.1 (0.55)			

Note: Standard errors are clustered at the province level. Dependent variables are changes from 2000 to 2010. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), and the mean (sd) 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 (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) .

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).

C12.   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.

TABLE C11—INTERACTION EFFECTS OF MIGRANT SUPPLY AND MIGRANT DEMAND

Dependent variable	(1) Δ migrant share of population	(2)	(3)	(4) Δ log # of migrants, short-distance	(5)	(6)	(7) Δ log # of migrants, medium distance	(8)	(9)
Export tariff shock	6.08	-15.33	6.45	1.01	4.36	1.03	0.37	-1.60	0.45
2001–2007	(3.19)	(19.15)	(3.15)	(0.26)	(4.30)	(0.25)	(0.18)	(2.09)	(0.16)
Δ log regulation score	1.65	1.68	-4.86	0.24	0.23	-0.32	0.06	0.06	-1.53
2001–2007	(0.41)	(0.41)	(4.40)	(0.05)	(0.05)	(0.76)	(0.04)	(0.04)	(0.66)
Log(agr. pop.)	-0.72	-1.04	-1.08	-0.42	-0.35	-0.48	-0.04	-0.06	-0.13
2001	(0.50)	(0.55)	(0.56)	(0.19)	(0.25)	(0.22)	(0.05)	(0.05)	(0.05)
Export tariff shock		1.93			-0.25			0.12	
× log(agr. pop.)		(1.67)			(0.32)			(0.13)	
Δ log regulation score			0.56			0.04			0.10
× log(agr. pop.)			(0.38)			(0.05)			(0.04)
Observations	249	249	249	240	240	240	250	250	250
R-squared	0.20	0.21	0.20	0.28	0.29	0.29	0.60	0.60	0.61
Mean (s.d.) of depent.	6.99 (5.78)			-0.81 (0.80)			1.60 (0.67)		

Note: Standard errors are clustered at the province level. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), the mean (sd) 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.

I investigate the impact of migrant supply on the equilibrium migrant flow in Table C11. 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.

C13. Night Light Intensities as the Measure of Economic Activity Intensities

To address concerns about Chinese GDP data quality, namely that the prefecture-level GDP information may be manipulated by the local government, I use night light intensity information from NASA satellite data to construct an alternative measure of economic activity intensities, following Henderson, Storeygard and Weil (2012).[61]

TABLE C12—ALTERNATIVE INCOME MEASURE: PRINCIPLE COMPONENT OF NIGHT LIGHT INTENSITY AND GDP PER CAPITA

Dependent variable	(1)	(2)	(3)	(4)	(5)
	Δ economic activity intensity., 2001–2007				
Export tariff shock	0.58	0.53			0.52
2001–2007	(0.20)	(0.21)			(0.20)
Δlog regulation score			0.10	0.09	0.09
2001–2007			(0.04)	(0.04)	(0.03)
Controls (lagged)		X		X	X
Observations	249	236	249	236	236
R-squared	0.09	0.14	0.07	0.10	0.17
Mean (s.d.) of depent.			0 (0.37)		

Note: Standard errors are clustered at the province level. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), and the mean (sd) 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 (2)(4)(5) also control for lagged trade shocks and lagged wage and GDP growth rate, 1995–2001, as in Table 1 Column (8) .

Table C12 replicates the results of Table 3 Columns (6)–(10). The outcome variable is the change in the log principle component of per capita GDP and the night light intensity, instead of changes in log per capita GDP. The results are largely unchanged.

[61]See Li and Zhou (2005) and Jia (2017) for evidence on the role of economic growth performance in local government officials' promotion. The NASA data source: https://www.ngdc.noaa.gov/eog/dmsp/downloadV4composites.html.

C14. Prices

I show that nominal wages and GDP increased where there is an inflow of migrant workers. However, if prices rise too much, then real income may not rise as much. There is no price index for the prefecture level, thus I measure price changes at the province level as the product of the annual consumer price indix (CPI) from 2002 to 2007. The CPI at the province level is from the website of the National Bureau of Statistics of China.

TABLE C13—TRADE SHOCKS, REGULATION CHANGES, AND WELFARE

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Δ log wage, 2001–2007					Δ log GDP p.c., 2001–2007					Δ log total urban emp., 2001–2007				
Export tariff shock	0.15	0.13			0.12	0.54	0.51			0.49	0.37	0.28			0.27
2001–2007	(0.07)	(0.06)			(0.06)	(0.13)	(0.14)			(0.13)	(0.20)	(0.18)			(0.17)
Δlog regulation score			0.03	0.03	0.03			0.09	0.08	0.07			0.09	0.05	0.04
2001–2007			(0.01)	(0.01)	(0.01)			(0.02)	(0.02)	(0.02)			(0.03)	(0.03)	(0.03)
Δprice	-0.03	-0.03	-0.02	-0.03	-0.04	-0.07	-0.10	-0.08	-0.12	-0.11	-0.00	0.05	-0.14	0.01	0.04
2001–2007	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Controls (lagged)		X		X	X		X		X	X		X		X	X
Observations	249	236	249	236	236	250	237	250	237	237	250	237	250	237	237
R-squared	0.22	0.33	0.14	0.31	0.33	0.32	0.38	0.27	0.38	0.41	0.29	0.36	0.26	0.32	0.39
Mean (s.d.) of depent.	0.82 (0.14)					0.87 (0.27)					0.32 (0.39)				

Note: Standard errors are clustered at the province level. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), the mean (sd) 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 (2)(4)(5)(7)(9)(10)(12)(14)(15) also control for lagged trade shocks and lagged wage and GDP growth rates, 1995–2001, as in Table 1 Column (8) .

Table C13 replicates the results of Table 3. The results are largely unchanged, and the price effect seems not to affect the relationship between trade shocks, regulation changes, and various economic outcomes.

C15. Trade Shocks, Regulation Changes, and Economic Outcomes: IV Approach

The natural growth rate of the population (birth rate minus death rate) predicts the future population size of a prefecture. A higher natural growth rate means that the prefecture will have a more abundant workforce. At the same time, a prefecture needs infrastructure to accommodate a larger population. Also, given China's one-child policy, a high natural population growth rate may indicate that the prefecture is not effective in enforcing the birth control policy. These factors are likely to make the prefecture government less willing to relax the migration policies.[62]

Table C14 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

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[62]As shown in the data section, birth control is an important aspect of migration policies.

TABLE C14—NATURAL GROWTH RATE AS AN IV FOR REGULATION CHANGES, FIRST-STAGE AND IV RESULTS

Dependent variable 2001-2007	(1) Δ log reg. score	(2) Δ migrant share of pop. OLS	(3) IV	(4) Δ log GDP p.c. OLS	(5) IV	(6) Δ log wage OLS	(7) IV	(8) Δ log total urban emp. OLS	(9) IV
Export tariff shock	0.70	4.58	3.43	0.51	0.49	0.13	0.08	0.27	0.23
2001–2007	(0.38)	(2.58)	(2.97)	(0.12)	(0.13)	(0.06)	(0.07)	(0.17)	(0.19)
Δ log regulation score		1.38	3.38	0.07	0.13	0.03	0.13	0.04	0.22
2001–2007		(0.45)	(2.23)	(0.02)	(0.13)	(0.01)	(0.05)	(0.03)	(0.22)
Natural growth rate of	-0.06								
pop., 2000	(0.02)								
Observations	237	237	237	237	237	237	237	236	236
R-squared	0.19	0.29	0.23	0.35	0.32	0.39	0.13	0.33	0.23
First-stage F stat.	-	5.51		6.95		5.64		6.26	
Hausman test p-value	-	1.00		1.00		0.97		1.00	
Mean (s.d.) of depent.	0.77 (0.82)	6.99 (5.78)		0.82 (0.14)		0.87 (0.27)		0.32 (0.39)	

Note: The mean (sd) export tariff shock is 0.18 (0.15). Column (1) has the same specification as in Table 1 Column (8), and adds the natural growth rate of population in 2000. Column (2) has the same specification as in Table 2, Panel A, Column (5). Column (3) instruments changes in the log regulation score with the natural growth rate of population, and the log regulation score in 2001. Columns (4)(6)(8) the same as in Table 3 Columns (5) (10)(15), and Column (5)(7)(9) are the corresponding IV regressions.

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. I then repeat the OLS regression in the previous two tables 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 score 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.

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

C16. *Alternative Connectedness Measure*

To take into account the migrant network, an alternative way to measure the change in connectedness is

$$\Delta \text{Connection}_{i,2000-2005}^{A} = \sum_{j} \frac{m_{ij}}{\sum_{j'} m_{ij'}} (T_{ij,2000} - T_{ij,2005}),$$

where m_{ij} is the number of migrants who are from prefecture j and reside in prefecture i in 2000. I calculate the bilateral migrant flows using the 2000 census

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data. I repeat the Table 6 exercise in Table C15, replacing the connectedness measure with the one with the migrant network measure (ΔConnection^A). The overall finding is similar to that in Table 6, but less significant.

TABLE C15—INTERACTION EFFECTS OF REGULATION CHANGES (2001–2007) AND PREFECTURE CONNECTION (2000–2005)

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Δ log # of migrants, short-distance			Δ log # of migrants, medium-distance			Δ log # of migrants, long-distance		
Export tariff shock	1.59	1.50	0.82	0.45	0.43	0.42	-0.15	-0.19	-0.05
2001–2007	(0.29)	(0.30)	(0.50)	(0.20)	(0.19)	(0.35)	(0.43)	(0.42)	(0.80)
Δ log regulation score	0.27	-0.08	0.25	0.04	-0.07	0.04	0.13	-0.03	0.13
2001–2007	(0.06)	(0.13)	(0.06)	(0.03)	(0.08)	(0.03)	(0.06)	(0.12)	(0.06)
Δ Connection	-0.02	-0.07	-0.05	-0.00	-0.02	-0.00	-0.00	-0.02	0.00
2000–2005	(0.02)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Δ log regulation score		0.05			0.02			0.02	
× Δ Connection		(0.02)			(0.01)			(0.01)	
Export tariff shock			0.11			0.00			-0.01
× Δ Connection			(0.05)			(0.03)			(0.06)
Observations	225	225	225	235	235	235	234	234	234
R-squared	0.35	0.38	0.34	0.64	0.64	0.64	0.24	0.25	0.24
Mean (s.d.) of depent.		-0.81 (0.80)			1.60 (0.67)			0.84 (0.66)	

Note: Standard errors are clustered at the province level. Dependent variables are changes from 2000 to 2010. The mean (sd) Δ log regulation score, 2001–2007 is 0.77 (0.82), the mean (sd) export tariff shock is 0.18 (0.15), and mean (sd) Δ Connection, 2000–2005 is 7.23 (4.01). All columns control for import and intermediate tariff shocks, the log total population, the level of the dependent variable in 2000, and lagged trade shocks and lagged wage and GDP growth rates, 1995–2001, as in Table 2\1 Column (8).