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International Trade and Internal Migr

International Trade and Internal Migration with Labor Market Distortions: Theory and Evidence from China

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Abstract

This paper discusses how globalization a ects welfare by reallocating labor across sectors and space when factor markets are distorted. It incorporates a traditional agriculture sector into the trade literature with heterogeneous rms, matching frictions and multiple asymmetric regions in terms of their geographical locations. The model predicts that a reduction in trade impediments reallocates market share towards more productive producers, encourages rms to post more vacancies, and induces workers to migrate towards the manufacturing sector and towards the coastal regions. Therefore, the economy gains from trade through increase in productivity, expansion of the manufacturing sector, and reallocation of labor across locations. In addition, by comparing the decentralized competitive equilibrium with the socially optimal solution, I show that falls in trade barriers exacerbate existing distortions caused by matching frictions but decrease misallocation of labor across sectors and space. This implies potential gains from trade through increase in labor market e ciency. The empirical evidence supports the main theoretical implications. I nd that rising export exposure explains more than 50% of the decline in agriculture employment share between 2000 and 2010 in China. Moreover, compared with prefectures at the 25th percentile of export exposure growth, the migrants share in prefectures at the 75th percentile increased by 11.66 percentage points more during this period.

JEL Codes: F12, F1 , F , O18, O19

Ke Words: gains from trade, labor market distortions, internal migration, structural change

1 Introduction

Factor markets inefficiencies are prevalent and have been idel studied in the economic development literature. umerous studies have sho n that labor allocation pla s a significant role in explaining cross-countr variation in total factor productivit (TFP) and total income (Gollin et al., 2002; Hsieh and Kleno , 2009; Vollrath, 2009; Duarte and Restuccia, 2010) . Yet, one feature shared b most models of trade-induced structural change is that the abstract from changes in distortions of factor markets and concentrate on the benefits through expansion of sectors ith comparative advantages. The goal of this paper is to go be ond this channel of gains from trade and discuss the elfare enforcement effects of international trade through increasing factor markets efficienc .

In this paper I incorporate three different t pes of labor market distortions in a unified frame ork. First, I consider the inefficienc ithin the manufacturing sector caused b t o central market failures in the matching model: congestion externalities and appropriabilit problems . When the appropriabilit and congestion problems do not balance each other, the competitive equilibrium involves either too man or too fe vacancies. Second, the model includes misallocation of labor bet een the agriculture sector and the manufacturing sector due to the sharing rule of ages ithin famil farms. I assume that the suppl price of migrants is the value of the average product in the agriculture sector, rather than the marginal product. This mechanism of determining ages is common in developing countries here factor markets are absent, resulting in too man orkers in the agriculture sector. Third, there is misallocation of factors across space due to frictions of internal trade costs. In contrast ith the existing literature treating each countr as a point in space, the distribution of economic activities across space is uneven in this paper. Decrease in trade costs exacerbates the first t pe of distortion as it has larger impact on the number of vacancies in the planner's problem than in the decentralized problem. Mean hile, the second t pe of distortion is mitigated hen trade induces some members in famil farms to leave and makes the rest receive their full marginal product. The model also predicts that the trade-induced migration across space generates elfare gains b reallocating population to ards regions hich participate in the global market more.

An important contribution of this paper is to investigate all three mechanisms above ithin the standard international trade frame ork of monopolistic competition heterogeneous firms, so that I can separate out the impact of changes in labor market distortions from the total gains from trade. A general-equilibrium model is developed to bring together

[1]See Restuccia and Rogerson (2013) for a literature review.

[2]The discussion of these two problems goes back to Hosios (1990). The appropriability problem arises when rms only internalize a part of the value of the match created by its vacancy, while the social planner considers the whole social value of a job. It leads to too few vacancies. The congestion externality exists because rms only cares about the average probability at which a vacancy is lled, while the social planner makes its decision according to the marginal e ects of an additional vacancy. This leads to too many vacancies. Since this paper takes a dynamic setting, the conditions that generate the optimality of the equilibrium is not exactly the same as in Hosios (1990).

the dual econom structure, trade bet een and ithin countries, structural change across sectors, and factor mobilit across space. In particular, this paper considers multiple regions partitioned into t o countries. Regions are distinguished from each other b differences in shipping costs. There are t o sectors ithin each region: the agriculture sector and the manufacturing sector. Goods are assumed to be mobile bet een sectors, regions, and countries, but factors move onl bet een sectors and regions ithin the same countr . Labor is full emplo ed in the agriculture sector and gets average product as their income, hile unemplo ment generated b the search frictions exists in the manufacturing sector and acts as the equilibrating mechanism bet een labor markets across sectors.

The model is first anal zed for a special case ith s mmetric regions. o labor migrating across space under this assumption. The assumption is then relaxed to account for the gains from trade through labor reallocation across space. I sho that the model ields implications consistent ith several st lized facts about China, a countr featured ith large reforms in openness polic , serious factor misallocation across sector and space (Brandt et al., 2013; Tombe and hu, 2015), and large domestic trade cost (Poncet, 2005). First, there are higher shares of emplo ment in the non-agriculture activities in the coastal cities. Second, there are large migration flo s from the interior to the China's coastline. Third, there is a dramatic shift of emplo ment from agriculture to ards other sectors, as ell as gro ing spatial inequalities in the last couple of decades. Specificall , the model predicts that ithin each region, a reduction in trade impediments raises the average productivit as in Melitz (2003). Firms post more vacancies, hich makes it more valuable for orkers to search jobs in the manufacturing sector. As a consequence, orkers migrate from the agriculture sector to the manufacturing sector, ith an increase in ages in both urban and rural sectors. In addition, reductions in international trade barriers have larger impacts on the labor market at locations ith geographical advantages, inducing spatial movements of labor from the interior regions to regions closer to the global market.

With the model calibrated to China's econom , I decompose the elfare gains from trade ith counterfactual anal sis into four channels: increase in market share of the more efficient firms in the manufacturing sector, increase in vacanc -unemplo ment ratio in the manufacturing sector, reallocation of labor from rural to urban, and migration flo s to ards the ports. The results sho that although the change ithin the manufacturing sector pla s an important role in explaining the elfare gain from trade, the reallocation of labor across sectors and space contributes around 40 of the total elfare increase. I then separate out the impact of changes in labor market efficienc from the total gains from trade. B comparing the decentralized competitive equilibrium ith the first-best labor market conditions, I sho that decreasing trade barriers exacerbates ithin sector inefficienc but raises across-sector allocative efficienc . The total revenue in the calibrated econom converges to its first-best value as trade cost falls. This suggests that opening to trade can impact elfare through changes in the labor market efficienc .

The main theoretical implications are examined ith China's census data in 1990, 2000, and 2010. M empirical anal sis follo s studies using micro level data to evaluate local effects of trade (Edmonds et al. 200 , Kovak 2013, Autor, 2013) and exploits the fact that cities in China var in their composition of emplo ment across industries and tariff changes var across industries. The empirical evidence supports the main predictions of the theoretical model that a reduction in variable trade costs reduces size of labor force in the agricultural sector and induces inter-regional labor migration. In particular, in the district that experience the average rising export exposure, the increase in export explains more than 50 percent of the decline in the emplo ment share in agriculture during 2000-2010. Additionall , compared ith prefectures at the 25th percentile of export exposure gro th, the migrants share in prefectures at the 75th percentile increased b 11. percentage points more during this period. Moreover, the effects of export exposure decrease over distance to the coastline. Using firm level data from the Annual Surve of Industrial Production, I also provide empirical support of the differentiation in trade effects on regional average productivit , hich is the central mechanism of the model.

The ork in this paper builds on several strands of existing literature. It relates closel to the literature on trade and structural change. Reduction in trade cost induces expansion in sectors ith comparative advantage due to differences in technolog , relative factor endo ments, or institution qualit . A more recent strand of theoretical literature examines ho institutional frictions affect the implications of trade for labor market reallocation (Cuñat and Melitz, 2012; Kambourov, 2009; Helpman and Itskhoki, 2010; Davis and Harrigan, 2011). This ork, ho ever, has largel focused on the composition of econom and sta s silent on the efficienc of the division of labor markets bet een sectors. In contrast ith the existing literature, the model in this paper is built in the dual econom frame- ork hich is characterized ith bet een-sector distortions. Individuals earn their average product in the agriculture sector and make migration decisions according to the expected values of searching jobs in the manufacturing sector, follo ing the influential ork in Harris and Todaro (1970). This set up is used to capture the elfare enhancement effects of trade through alleviating labor markets distortion across sectors.

This paper also connects ith models investigating the impact of international trade on internal geographical labor mobilit . A commonl used theoretical frame ork in this strand of literature is the ne economic geograph model, hich explains the importance of region's access to markets and the agglomeration of economic activit . Ho ever, onl a small number of papers have explicitl incorporating regional heterogeneit ithin a countr , such as Allen and Arkolakis (2013), Cosar and Fajgelbaum (2013), Redding (2012), and Tombe and hu (2015). M main departure from these papers is that it allo s for incomplete specialization at each location and examines the structural transformation ithin each region. In addition,

[3] There is also a large strand of literature empirically investigating labor reallocation induced by trade opening. See, for example, Wacziarg and Wallack (2004), Uy et al. (2012) and McCaig and Pavcnik (2013)

2 Motivating stylized facts

As sho n in Figure 1, since the opening polic in 1978, China has experienced a sharp increase in the export of GDP ratio, from 4. in 1978 to 24.11 in 2013, ith the agriculture emplo ment share dropped from 70 in 1978 to 34.3 in 2012. Data from the ational Rural Fixed-point Surve sho s that the average share of migrants out of total rural labor force rose from 15.45 in 2000 to 30.12 in 2009. In additional, the number of inter-provincial migrants increased from 42. million to 85.8 million during 2000-2010 according to the population census in 2000 and 2010. Mean hile, these changes are not equall distributed across all regions in China. There are t o main st lized facts manifested in the population census of the spatial pattern of these changes that motivate the anal sis in this paper.

First, the emplo ment share in non-agriculture sector is higher in coastal cities than that in most interior regions (Figure 2 Panel A). Prefectures ith more than 0 population above the age of 1 emplo ed in the non-agriculture sector are all located in the t o major coastal megacit regions, the Pearl River Delta and the Yangtze River Delta. Moreover, given the initial emplo ment share, the coastal area experienced a sharper decrease in the agriculture emplo ment share during 2000-2010 (Figure 2 Panel B). Prefecturesa.noi7T1ixed-pa-1 eltasn r(e)

at location i. The indirect utilit of the representative consumer is

$$V_i = E_i + \frac{1}{\quad} P_i^{\frac{1}{\quad}} + \frac{H_i}{N_i} \tag{2}$$

here E_i refers to the total income. Falls in trade barriers can increase elfare at location i either b raising total income or reducing the price index.

3.1.2 Labor markets

hether a particular firm is hiring. Workers are hired b firms ith a matching technol-og . As commonl assumed in the search and matching literature, the probabilit that a vacanc is filled can be expressed as $q('_i)$, here $'_i$ is the vacanc -unemplo ment rate and represents the labor market tightness in the manufacturing sector. $q('_i)$ is decreasing in $'_i$. Unemplo ed orkers are hired at the rate $x('_i) = '_i q('_i)$, hich is an increasing function of $'_i$. Before the beginning of the next period, each pair of match is destro ed ith probabilit due to match-specific shocks.

Once the matching technolog brings together firms and orkers successfull , age w_{Mi} is decided through ash-bargaining. The surplus from successful matches is split bet een orkers and the firm to solve:

$$\max_{w_{Mi}}(E_i(\ ) \quad U_i) \ (\frac{@J_i(l;\ )}{@l})^{1} \quad ; \quad 0 \qquad 1 \tag{5}$$

here $J_i(l;\ )$ is the asset value of a firm ith productivit and l orkers, to be defined belo . $@J_i(l;\ )=@l$ measures the firm's surplus b hiring an additional orker. sho s the bargaining po er of the orker. $E_i(\ )$ is the present value of being emplo ed b a firm ith productivit , and it satisfies the follo ing Bellman equations:

$$(1 + r)E_i(\ ) = w_{Mi} + [(1 \qquad) \max f E_i^0(\ ); B_i^0 g + \ \ B_i^0]$$

$$(1 + r)U_i = (1 \quad x(' \ )^0) B_i^0 + (1 \quad x('_i)) \max f E_i^0(\ ); X_i^0 g \qquad (\ )$$

here is the actual separation rate of each firm- ork match . The above equations impl that $(1 + r)E_i(\ )$ depends the age rate in each period and the probabilit at hich the current emplo ment status continues.The same holds for $(1 + r)U_i$.

market ith the probabilit . Firms at location i bear fixed cost f_{ij} for sales to location j.

Assume the cost of posing a vacanc is c. The producer maximizes its market value b solving

$$J_i(l : \ ) = \max_{v_i} \frac{1}{1+r} \ R_i(h : \ ) \quad w_{Mi}(l; \ )l \quad cv_i \quad f_{ii} \quad \sum_{j \neq i} I_{ij}(\ )f_{ij} + (1 \quad)J_i(l^0 : \ )$$

$$\text{s.t.} \quad l_i^0 = (1 \quad)l_i +$$

3.2.1 Optimal vacancy post and wage bargaining result

As proved in the Appendix A, the first order condition of the firm's problem in (7) yields the optimal hiring rule of a firm in the steady state as

$$\frac{\partial R(l;\ )}{\partial l} = w_{Mi}(l:\ ) + \frac{c}{q(\varphi_i)}\frac{r+\ }{1\ } + \frac{\partial w_{Mi}(l;\ )}{\partial l} l \tag{8}$$

This equation differs from the solution in a friction-free market with the consideration of the expected cost to hire extra workers. Additionally, reinserting the first order condition for vacancy posting into the bargaining rule and plugging in the relations in equation ( ), we obtain the relationship between φ_I and w_{MI} as

$$w_{Mi} = rU_i + \frac{}{1\ }\frac{r+\ }{1\ }\frac{c}{q(\varphi_i)} \tag{9}$$

with $rU_i = \frac{}{1\ }\frac{1}{1\ }\varphi_i c$. From equation (9), we can see that the manufacturing wage is a function of labor market tightness φ_i and it's independent of firms' productivity levels. This is due to the assumption that the posting cost are the same across firms. Additionally, wage is increasing in the market tightness. Larger φ means lower probability of successful match, which indicates higher expected costs of hiring new workers. This implies that increases in φ raise marginal costs and reduce firm's profits. This is the same as the conclusion in Felbermayr et al. (2011).

3.2.2 Equilibrium in goods markets

Substituting the expression of wage (9) into equation (8), firm's optimal hiring rule can be rewritten as

$$\frac{\partial R(l;\ )}{\partial l} = \frac{}{1\ }\frac{1}{1\ }\frac{}{}[\varphi_i c + \frac{r+\ }{}\frac{c}{q(\varphi_i)}] \tag{10}$$

where $= \frac{1}{1\ }$. Define $a(\varphi)\ \ \frac{\partial R(l;\ )}{\partial l}$. Since $q(\varphi_i)$ is decreasing in φ, $a(\varphi)$ is an increasing function in φ. Substituting the expression of $a(\varphi)$ into the zero cutoff condition, the productivity thresholds are given by

$$(\ _{ii})^{\overline{1\ }} = Bf_{ii}\, a(\varphi_i)^{\overline{1\ }} Y_i^{\overline{1\ }}$$

$$(\ _{ij})^{\overline{1\ }} = Bf_{ij}\ \ _{ij}^{\overline{1\ }} a(\varphi_i)^{\overline{1\ }} Y_j^{\overline{1\ }} \tag{11}$$

where $B = (\frac{1+r}{1}\frac{}{1})\ \ ^{\frac{1}{1}}$. Therefore, for any pair of locations i and j the productivity cutoffs satisfy

$$\frac{\ _{ii}}{\ _{ji}} = (\frac{f_{ii}}{f_{ji}})^{\overline{1\ }}\ \ _{ji}^{\ 1}(\frac{a_i(\varphi)}{a_j(\varphi)}) \tag{12}$$

[10] See Appendix A for more details.

Equation (12) implies that the cutoffs depend on the relative size of marginal revenues at the equilibrium, hich are influenced b the labor market conditions. In addition, as proved in Appendix A, the free entr condition can be simplified as

$$\sum_{j} \int_{ij:}^{1} f_{ij} [(\frac{}{ij})^{\overline{1}} \quad 1] dG( ) = \frac{r +}{1 + r} f_{e;} \; i = 1;2 \quad K \tag{13}$$

Relation (12) and (13) derive K K functions, hich can be used to pin do n $_{ij}$ as functions of $'_i$ and $'_j$ $(j = 1;2:::K)$. Once the productivit thresholds are determined, e can get the consumption level of Y_i ith equation (11). Additionall , total expenditure in the differentiated sector equals total revenues of all firms serving demand in this sector, hich determines the entr rate of ne firms as

$$Y_i = \frac{1 + r}{1} \frac{}{1} f \sum_{j} \frac{M_{ej}}{} \int_{ji:}^{1} f_{ji} (\frac{}{ji})^{\overline{1}} dG( ) g; \; i = 1;2 \quad K \tag{14}$$

With these K functions e can rite M_{ei} as function of $'_i$ and $'_j$ $(j = 1;2:::K)$ as ell .

3.2.3 Equilibrium in labor markets

Analogous to the Harris and Todaro (1970) model, the mobilit equilibrium condition requires that sta ing in the rural sector has the equal value as migrating to the urban sector and searching for urban job as an unemplo ment orker, i.e. $W_l = U_l$. Therefore, the age and labor -329.07f1.777ras1Tfi9n1.777ras1T77Td[(l)]TJ/F1 taln7n.

the flo -in emplo ment is the same as the flo -out emplo ment. Therefore,

$$\frac{x(\varphi_i)}{x(\varphi_i) + } N_{Mi} = L_{Mi} \tag{17}$$

here L_{Mi} is determined b

$$L_{Mi} = \frac{M_{ei}}{1}\frac{1+r}{1}\frac{}{1}\frac{}{a_i}\left\{\sum_j \int_{\ _{ij}:}^{1} f_{ij}\left(\frac{}{_{ij}}\right)^{\frac{}{1}} dG(\ )\right\}$$

Equation (15) and (17) depend onl on N_{Mi} and φ_i if e take the total labor at each location i as given. Therefore, these t o equations can be used to pin do n the value of N_{Mi} and φ_i. As proved in Appendix A, there exists a unique solution. ote that in contrast ith Helpman and Itskhoki (2010) in hich labor market tightness is constant, φ_i

here $_i = \frac{f_i}{_i} {}^1 \quad {}_i \quad {}^1 dG(\ ); i = d; x$. The sign of coefficients in (18) implies the follo - ing lemma.

Lemma 1. Assume all locations are symmetric. As in Melitz (2003), a reduction in trade

the higher income offsets the loss of firm's entr . This mechanism is absent in Helpman and labor market tightness and labor allocation across sectors are determined b

$$\frac{\partial R(l;\ )}{\partial l} = \frac{1}{\ }\varphi c + \frac{r+\ }{\ }\frac{c}{q(\varphi)}$$

$$F^{0}(N_A) = \frac{c\varphi + \frac{\partial R(l;\ )}{\partial l}\frac{x(\varphi)}{r+\ }}{r + \ \ + x(\varphi)} \tag{19}$$

here is the elasticit of $x(\varphi)$ ith respect to

distance of each district to China's coastline mitigates the potential bias in the estimated impacts of tariff.

The baseline specification used in this section is

$$y_{dt} = \quad {}_t + \quad Export_{dt} + \quad {}_d + "_{dt} \tag{21}$$

here d denotes district at the prefecture level and t denotes time (2000, 2010). y_{dt} is the variable of our concern, such as the agriculture emplo ment share, in-migration share and regional productivit . $Export_{dt}$ is the measure of prefecture d's exports exposure at time t, constructed in the a that is described ith more details in the next section. ${}_d$

4.2 Data

This section describes t o principal sources of data used in the subsequent anal sis: the ational Population Census and the Annual Surve of Industrial Production.

4.2.1 National Population Census (1990, 2000, 2010)

The sector emplo ment data and migration data, hich are used to construct the dependent variables in regressions, come from the fifth and sixth national population census conducted in 2000 and 2010 b the China's ational Bureau of Statistics (BS). It covers 2283 administrative units at the count level. Data on total population, registered household population, emplo ed population b sectors, total population above 15 ears old, stock of migrants of different t pes, and urban and rural population are aggregated to the prefecture level for anal sis in the next section. The agriculture emplo ment share is defined as the proportion of agriculture emplo ment in total population above 15. Migrants in the census refer to people sta ing in one count other than their registered residence (Hukou) and have left their registered residence for more than months. Onl information on the stock of in-migrants is available. The absolute volume of migrants is not comparable across prefectures, so I use the ratio of in-migrants to the Hukou population to measure the attractiveness of each

4.2.3 Other data

The prefecture-level control variables are constructed using data from the China Cit Statistics Year Book (2000, 2010) and the China Count Economic Statistical Yearbook (2000, emplo ment for the calculation of both $Export_{d2000}$ and $Export_{d2010}$ so that the change in the emplo ment composition over time does not affect the measure of district export exposure. Therefore, the first-differenced form of $Export_{dt}$ is

$$4\ Export_d = \sum_i \left(\frac{4\ EX_{it}}{Employ_{i2000}} \quad \frac{Employ_{id2000}}{Employ_{d2000}}\right) \tag{24}$$

To address the potential endogeneit problem of $4\ Export_d$ in equation (23), I emplo the tariff cut as the instrument, hich is constructed as

$$4\ Tariff_d = \sum_i \left(\frac{4\ \ln(1 + \ _i)}{Employ_{i1990}} \quad \frac{Employ_{id1990}}{Employ_{d1990}}\right)$$

here $4\ \ln(1 + \ _i)$ presents the log difference of other countries' tariffs for import from China during 2000-2010. This measure of foreign tariff cut is exogenous in the sense that it is the result of other countries trade polic and is unlikel to be influenced b the sectoral structural in China. It is also unlikel to influence the structural change and migration ithin China through channels other than export. In addition, it uses emplo ment from 1990 to address the possibilit that the contemporaneous emplo ment in equation (24) is affected b the anticipated China's trade polic changes. Figure (9) reveals strong positive correlation bet een the change in regional export exposure and the change in the foreign tariff change.

4.3.2 Measures of regional manufacturing productivity

The regional manufacturing productivit used in this paper is defined as the eighted aggregate TFP in each prefecture

$$Pr_{dt} = \sum_i s_{idt} \ln TFP_{it}$$

here s_{idt} is the plant i's share of industr output at district d, and $\ln TFP_{idt}$ is the log form of plant-level TFP constructed using the approach follo ing Pavcnik (2002). Specificall , the CobbDouglas production function:

$$\ln y_{it} = \ _0 + \ _1 \ln w_{it} + \ _2 \ln m_{it} + \ _3 \ln k_{it} + \ _{it} \tag{25}$$

here $\hat{}_{i}$ (i=1,2,3) are estimated coefficients in equation (25). Appendix D provides more details of the estimation procedure. Table 5 sho s the estimated coefficients in equation (25) and average $\ln TFP$ in each main industr . There is large variation of the input coefficients across industries. Additionall , e could see a stead increase in the measured TFP across ears.

4.4 Main ndings

4.4.1 Basic results

Table presents the primar estimates of the effects on increase in export on the agriculture emplo ment share and migration patterns. Each column reports a different version of equa-

4.4.2 Heterogeneity in the trade e ects

The model predicts that the effects of trade cost reduction on structural change decline over distance to the coastline. To test this prediction, I divide China into four bins based on the Eculidian distance of each cities to China's coastline and estimate the modification of equation (23):

$$4\, y_d = \; + \sum_{b=1}^{4} {}_b(4\, \text{Export}_d \;\; D_b) + \sum_{b=2}^{4} {}_b D_b + {}_1 4\, X_d + {}_2 y_{d;2000} + 4\, ''_d \qquad (2\ )$$

here D_b are dummies hich takes the value of 1 hen a prefecture belongs to the distance bin b. Results are presented in Table . The effect of the increase in the export exposure on the agriculture emplo ment share is largest in the distance bin 150-300km, here the point estimate is around -0.0 for both the OLS and 2SLS estimations. It then decreases over distance to the coastline, hich supports the theoretical implication of the heterogeneit in the effects of international trade. $_1$ is smaller than $_2$, but this is not inconsistent ith the model, since both the first and second distance bins belong to the coastal area, hile the second bin is closer to the interior region than the first one and associated ith lo er migrating cost for migrant orkers.

I also run the 2SLS estimates of equation (23) for four distance bins separatel . The point estimates of interests is still largest in the second distance bin but not statisticall significant. Results are reported in column 3 to column in Table 7.

4.4.3 Trade e ects on manufacturing productivity

The underl ing mechanism of the theoretical model is the productivit increase in the manufacturing sector induced b the trade impediments reduction. Emplo ing the same identification strateg used for the anal sis of labor mobilit across space and sectors, I get significantl positive coefficient on the export exposure index. The value in column (2) of Table 8 suggests that an average increase in average emplo ment- eight export exposure (from 0.354 to 1.7) raises the value of lnTFP b 0.04, hile the average increase in the regional eighted average productivit ($\ln TFP$) is 0.09.

The estimated effects of export on productivit b distance distribution are presented in column (3) and (4) in Table 8. The effect is more than t o times larger in the second distance bin, here the estimate is 0.0939, than in the last distance bin. The magnificence of coefficients on the interaction term is not monotonicall increasing across distance, hich is not perfectl consistent ith the model. Ho ever, the effect of the increase in export exposure is statisticall significant onl in the first t o distance bins, impl ing that the effects in regional further than 300 kilometers a a from China's coastline are not precisel estimated.

4.5 Robustness checks

In this section, I discuss several robustness checks of the empirical results presented in Table . The first concern is the unit of anal sis. As stated before, anal sis ith local markets requires labor to be "sufficientl immobile" across regions, other ise labor migration smooths out price variations caused b difference in trade exposure. Therefore, in the regression of immigration ratio, the magnificence of the export exposure coefficient is expected to decreases if the unit of anal sis is changed from prefecture to count . Ho ever, the model predicts that regions ith export increase ould experience larger change in the agriculture emplo ment in the case hen migration is allo ed than that in the case ithout interregional migration. Therefore, the effects of export exposure ould be overestimated hen e use a more detailed unit of anal sis. Table 9 presents the results. Compared ith Table , e can see that both coefficients are more statisticall significant due to the increase in sample size, hile there magnificence of coefficients move to ards the direction as predicted.

I next turn to results from regressions ith additional controls or alternative measure of openness. I onl present results estimated ith the IV method. The first column in Table 10 discusses factors in the agriculture sector that pushing migrants to ards the manufacturing sector. Pushing factors discussed intensivel in the literature includes lo productivit , poor economic conditions, exhaustion of natural resources, and mechanization of certain processes reduce labor requirement in rural areas. Column (1) presents the results of the regression ith rural population densit , production of grains per capita and agriculture machines o ned b each household. The incorporation of additional controls into the regression does not change our main results. Column (2) presents the results ith import exposure per orker as additional controls. The point estimates are quite similar as that in Table .

The next t o columns examine the issue ith alternative measures of international trade exposure. Column (3) uses the gross export, hich includes both exports and reexports, as the main explanator variable. Both the magnitude and statistical significance remain unchanged. The last column, ho ever, sho s that net-export, the difference bet een exports and imports, does not have significant impact on migration across space and sectors. This is not inconsistent ith the model, since import might have opposite effects on firms' behavior compared ith exports. In addition, the instrument is eak in predicting the raises the average productivit . As a consequence, firms post more vacancies and orkers migrate from the rural sector to the urban sector. In addition, reductions in international trade impediments have larger impacts on the labor market at locations ith geographical advantages, inducing spatial movements of labor to ards regions closer to the global market. Therefore, the econom gains from trade through increase in productivit , expansion of the manufacturing sector, and reallocation of labor across locations. Empirical evidence ith China's population census data further confirms the theoretical implications.

In addition, b comparing the decentralized competitive equilibrium ith the sociall optimal solution, I sho that falls in trade barriers exacerbate the existing distortions caused b matching frictions but decrease the misallocation of labor across sectors and space. Trade can significantl reduce labor market distortions if bet een-sector distortions are quite large. It implies a potential channel through hich the econom can gain from trade. It also suggests important polic implications that subsidies to encourage firms to search for orkers more insensitivel can offset part of the do nside of trade liberalization.

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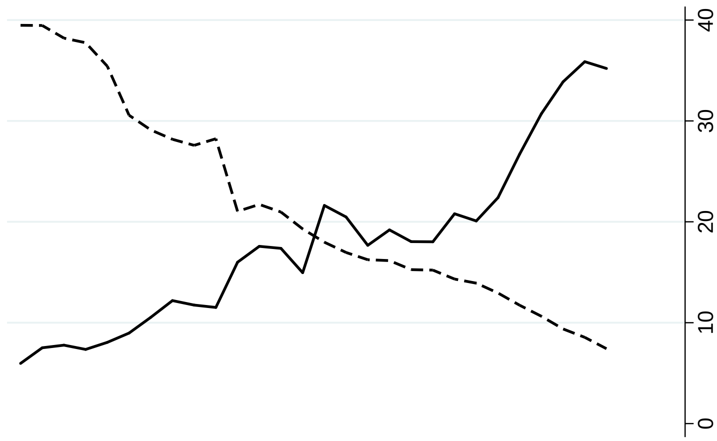
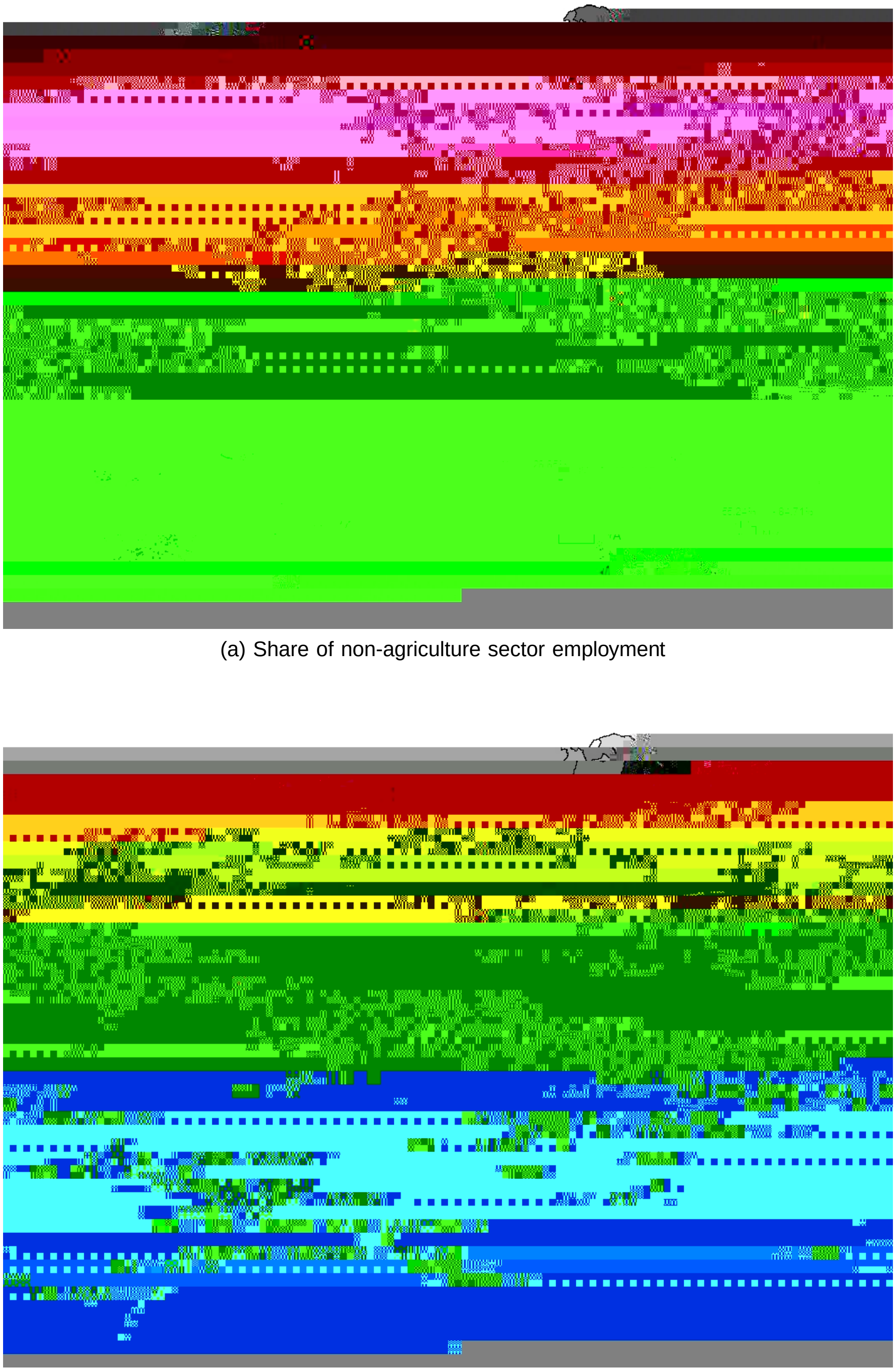


Figure 1: Agriculture emplo ment share and export share during 1978-2008

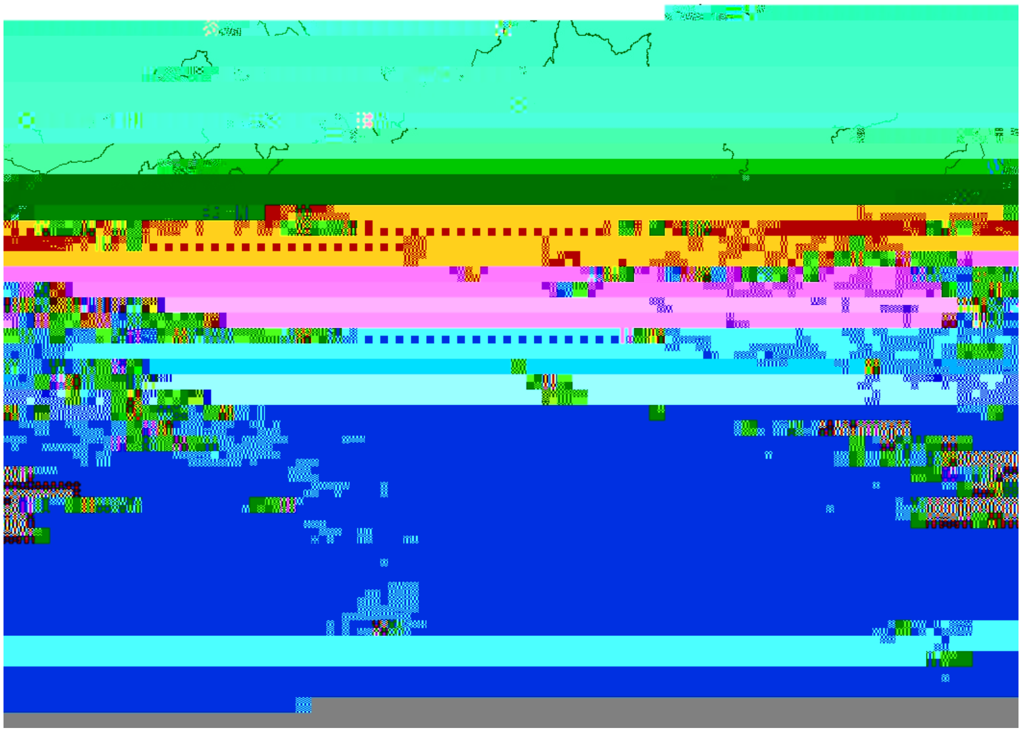


(a) Share of non-agriculture sector employment

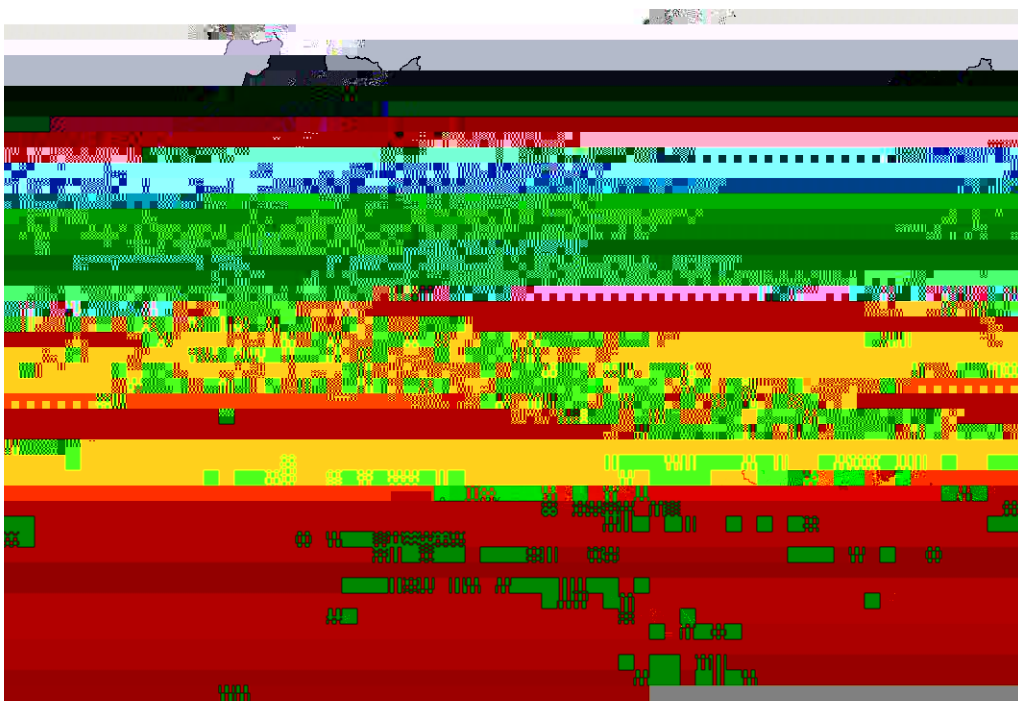
(b) Change in non-agriculture employment share during 2000-2010

Source: See main text; N/A=data is not available

Figure 2: Share of non-agriculture emplo ment in 2010



(a) 20 largest inter-province migration ows



(b) Share of inter-province migration

Source: See main text; N/A=data is not available

Figure 3: Share of Inflo   and outflo   population in 2010

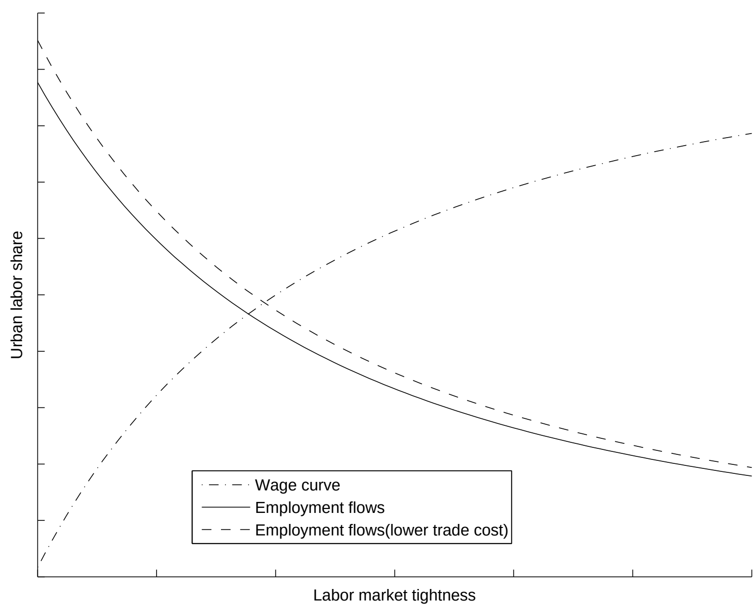
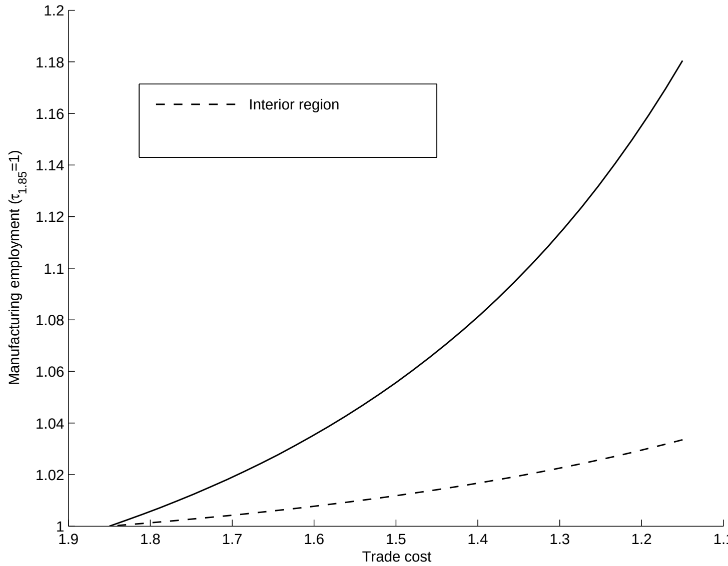
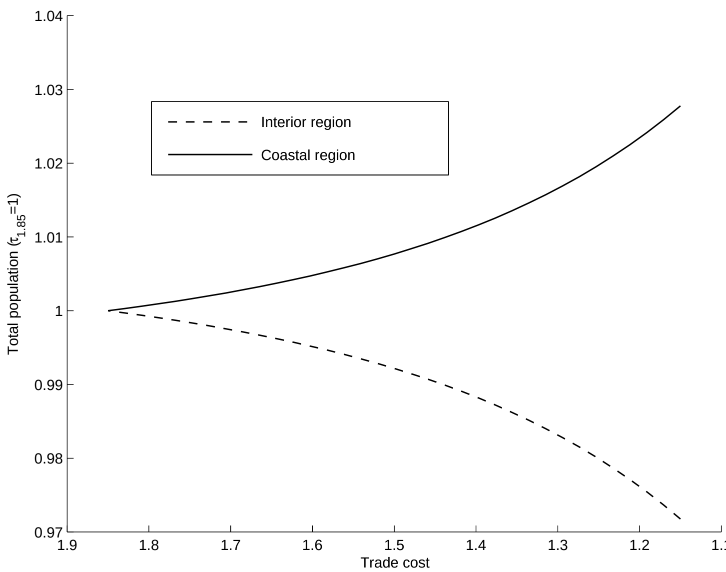


Figure 4: Effects of trade cost reduction ith s mmetric regions

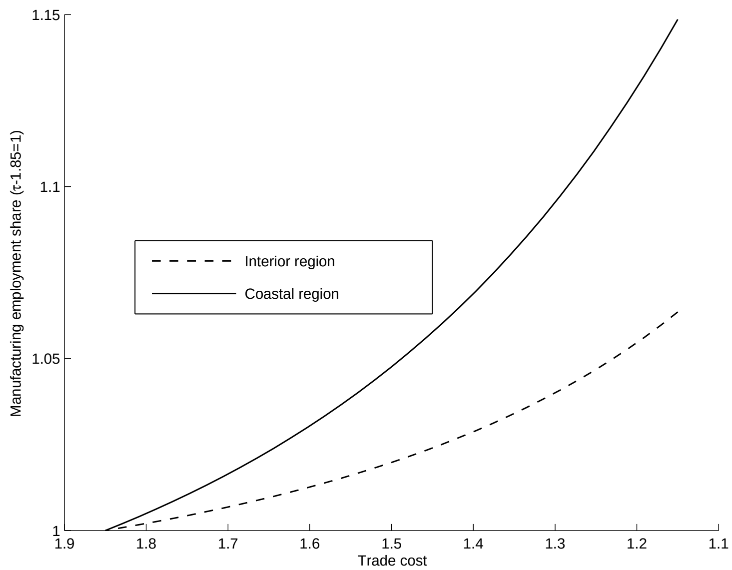


(a) International Trade cost and total regional urban employment



(b) International trade cost and total regional population change

Figure 5: Effects of trade cost reduction ith as mmetric regions



(c) International trade cost and urban labor share

Figure 5: Effects of trade cost reduction ith as mmetric regions (continue)

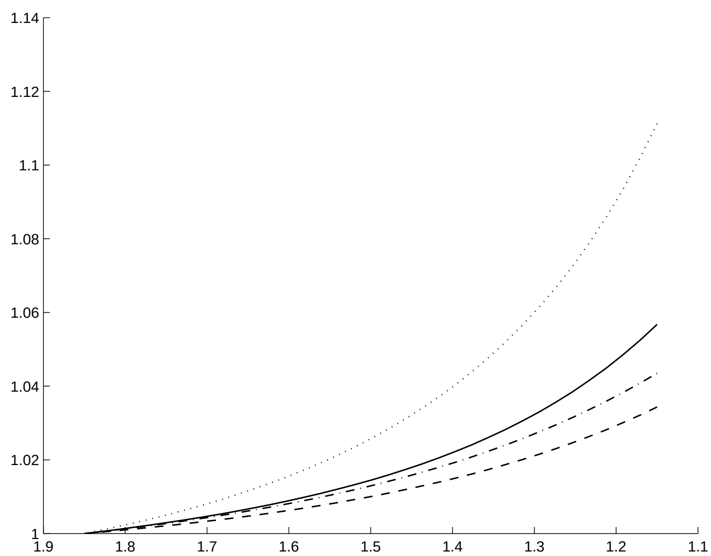
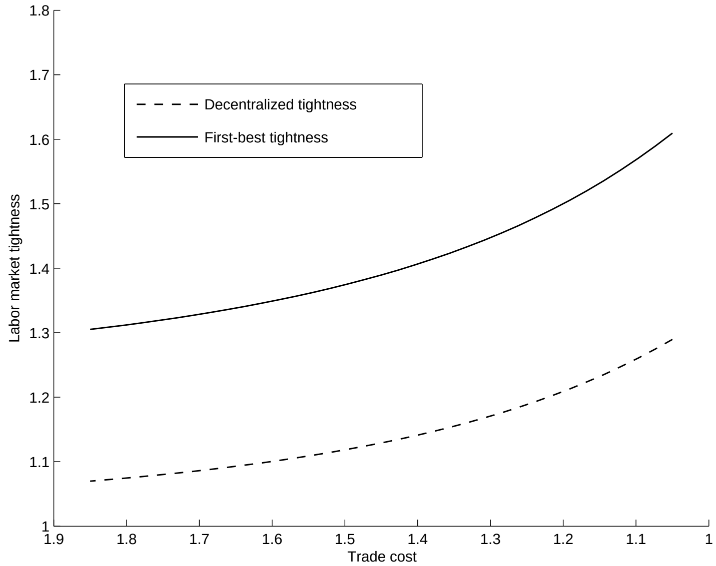
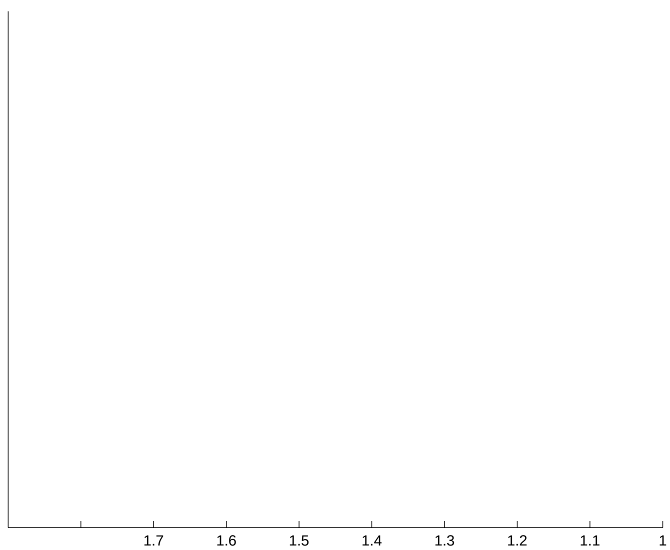


Figure : Decomposition of the elfare gains from trade

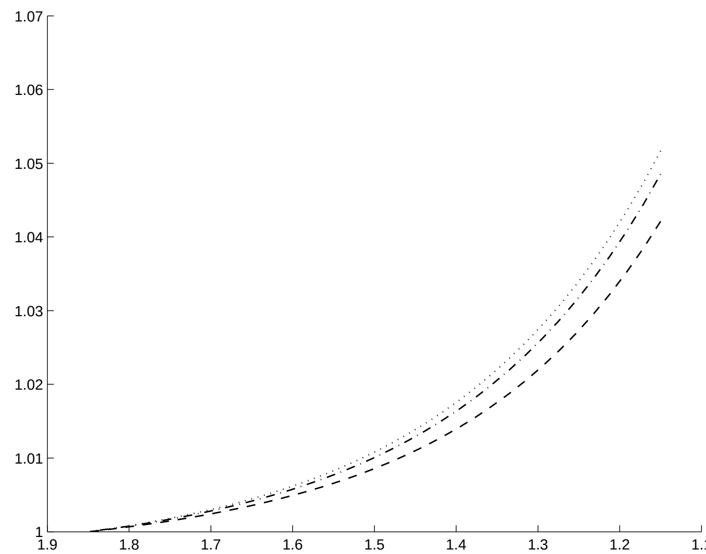


(a) Trade cost and labor market tightness

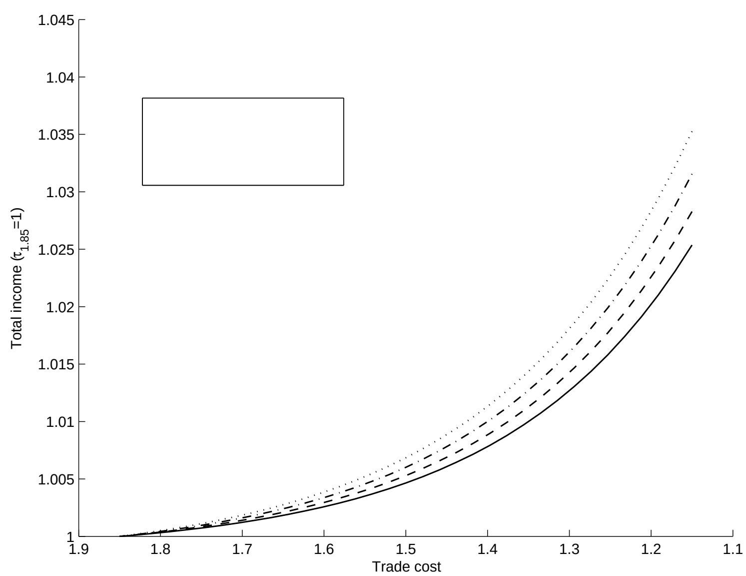


(b) Trade cost and manufacturing employment share

Figure 7: The decentralized competitive equilibrium and social optimal solution

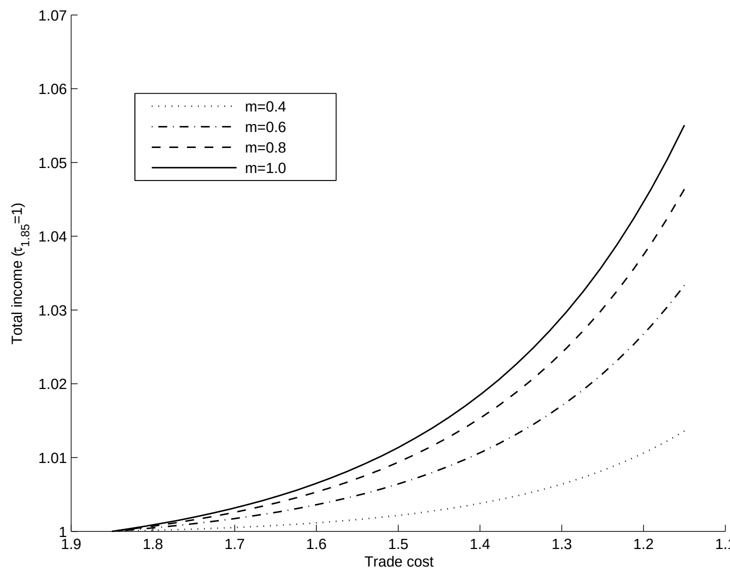


(a) Di erent values of labor elasticity in the agriculture production function



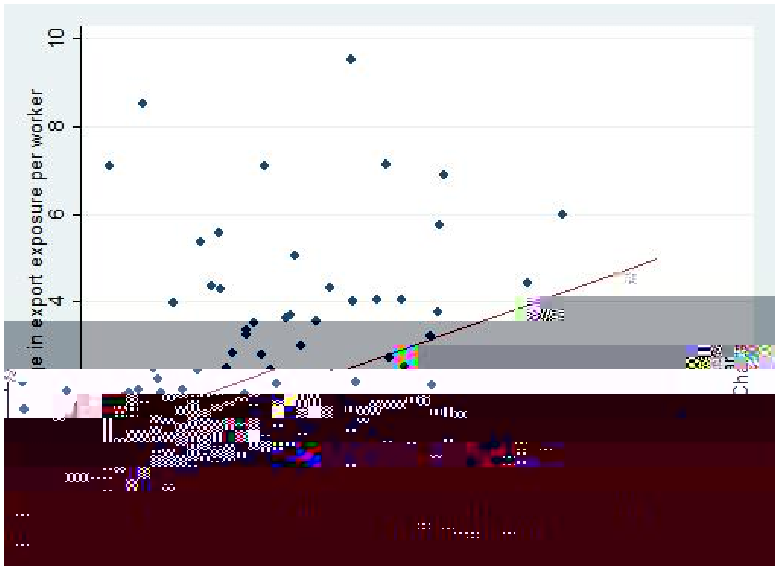
(b) Di erent values of vacancy posting cost

Figure 8: The elfare gains from trade and labor market distortions

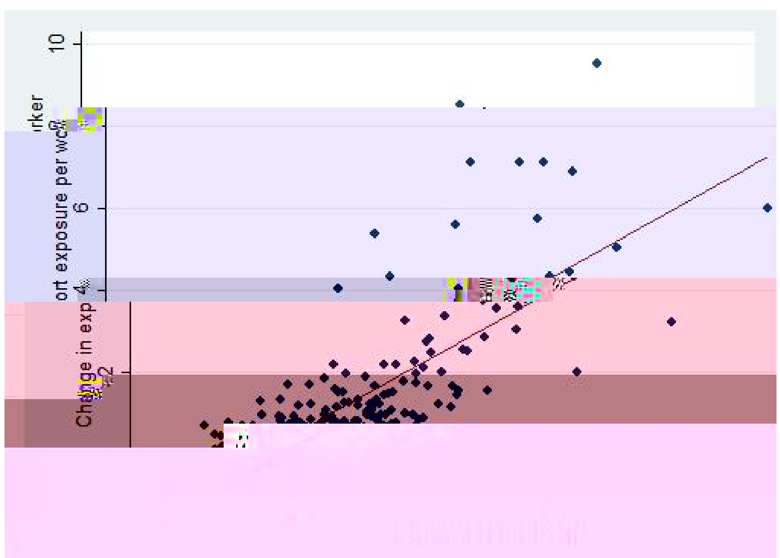


(c) Di erent values of matching e ciency

Figure 8: The elfare gains from trade and labor market distortions (continue)



(a) First Stage: Change in export exposure and foreign tari



(b) Change in export exposure and Predicted values

Figure 9: The prediction po er of the instrument variable

Table 1: Calibration-parameter values

Parameter	Definition	Value	Source/Target
	Elasticit of substitution	4	Bernard et al. (2003)
c	Cost of hiring	1.4	1.1 times monthl age (Felberma r et al., 2011)
	Parameter in the utilit function	0.7	0 < < (1)= < 1
	Deca of productivit distribution	3.2	> 1 to ensure that the variance of the sales distribution is finite
s	■ctual rate of job separation	0.07	Unemplo ment rate around 11 (Giles et al., 2005)
m	Scale of matching function	0.	labor market tightness 0.9-1.1 (Xiao, 2013)
	Wage bargaining po er	0.5	Standard
	Rate of firm exit	0.01	Felberma r et al. (2011)
r	Monthl discount rate	0.42	5 annual interest rate
N	Total population size	2	ormalization
H	Local amenit shared b orker	1	ormalization

Table 2: Simulation results of main variables

International trade cost	1.15	1.45	1.85	1.15	1.45	1.85
	Interior region			Coastal region		
Domestic sale productivit threshold	4.5001	4.3249	4.244	4.5781	4.3 93	4.27
International sale productivit threshold	.9	8. 9 3	11.124	.7052	8.324	10. 182
Urban labor	0.4193	0.3719	0.3289	0.52 3	0.4277	0.35 5
Total population	0.9577	0.9805	0.9904	1.0423	1.0195	1.009
Urban labor share	43.79	37.93	33.21	50.50	41.95	35. 5
Vacanc -unemplo ment rate	1.1774	0.9 19	0.810	1.2439	1.0008	0.8335
Unemplo ment rate	9.71	10. 3	11.47	9.47	10.44	11.33

Table 3: Gains from trade and changes in distortions

Decrease in the trade cost (initial =1.85)	0.2	0.4	0.	0.8
Change in manufacturing emplo ment share ( )	7.14	1 .2	30.80	48.20
Change in first-best manufacturing emplo ment share( )	2.7	.19	11.43	17.42
Gains from efficienc increase	4.37	10.07	19.37	30.78
Change in ' ( )	2.30	5.53	11.51	20.54
Change in first-best ' ( )	2.71	.4	13.27	23.32
Gains from efficienc increase	-0.41	-0.93	-1.75	-2.77
Relative total revenue (competitive/first-best) ( )	92.29	92.74	93.50	94.49
Change in tax on w				

Table 5: Estimates of Olle -Pakes TFP b industr

Industr	Labor	Materials	Capital	lnTFP1998	lnTFP2000	lnTFP2002	lnTFP2005
13	0.0533	0.8783	0.039	0.489	0.58	0. 241	0. 244
14	0.0 23	0.9048	0.0307	0.3791	0.429	0.4137	0.5119
15	0.0883	0.8815	0.0358	0.4334	0.4 39	0.4 44	0.579
17	0.0 5	0.8801	0.0254	0.5183	0.535	0.571	0. 417
18	0.1115	0.819	0.0391	0. 427	0. 579	0. 437	0.7755
19	0.0 93	0.875	0.03	0.5383	0.5458	0.5492	0. 1 5
20	0.1451	0.8105	0.0523	0.4833	0.7484	0.7073	1.0753
21	0.1034	0.8 83	0.0299	0.4991	0.479	0.5382	0.7 5
22	0.0731	0.8811	0.0242	0.5083	0.5488	0.5749	0.7735
23	0.105	0.8 85	0.0425	0.3 29	0.3 87	0.4049	0. 253
24	0.09 2	0.8531	0.0329	0.5599	0.5 18	0.549	0.70 3
25	0.0374	0.8837	0.0282	0. 9	0. 474	0.7204	0.5323
2	0.0789	0.8533	0.038	0.5297	0.581	0. 088	0. 388
27	0.099	0.8358	0.0589	0.4143	0.4979	0.52 9	0.7385
29	0.08	0.8459	0.0 53	0.294	0.3 39	0.4042	0.5537
30	0.0954	0.8352	0.04 1	0.5301	0.5324	0.	0.8543
31	0.077	0.8723	0.0328	0.4 37	0.5243	0.5347	0.7778
32	0.043	0.9019	0.0314	0.4333	0.4 94	0.49 8	0.4529
33	0.0 04	0.8735	0.0204	0. 09	0. 8	0.7487	0. 743
34	0.0777	0.84	0.047	0.5314	0.5384	0.5747	0. 221
35	0.074	0.8734	0.03	0.432	0.4505	0.4 99	0.5779
3	0.0887	0.878	0.0302	0.395	0.4402	0.4 19	0.5981
37	0.1002	0.8 44	0.0314	0.4551	0.4944	0.5299	0. 419
39	0.0751	0.8 23	0.0387	0.5335	0.585	0.5808	0.5915
40	0.143	0.8237	0.038	0.5982	0. 47	0. 27	0.9054
41	0.120	0.83	0.03 8	0.5494	0. 132	0. 498	0.8315
42	0.0703	0.8 7	0.0225	0. 8 5	0.73 4	0.7531	0.8095

Notes: The Chinese industries are classi ed as: (13) food processing; (14) food manufacturing; (15) beverage; (17) textiles; (18) apparel; (19) leather, fur, feather products; (20) wood processing and wood, bamboo and palm ber products manufacturing; (21) furniture; (22) paper and paper products; (23) printing and reproduction of recording media; (24) education and sporting goods; (25) petroleum and nuclear fuel processing; (26) chemicals and chemical products; (27) medicines; (28) chemical bers; (29) rubber; (30) plastic; (31) non-metallic minerals; (32) ferrous metal smelting and rolling processing; (33) non-ferrous metal smelting and rolling processing; (34) fabricated metal; (35) general machinery; (36) special machinery; (37) transportation equipment; (39) electrical machinery; (40) communications equipment, computers and other electronic equipment; (41) instrumentation and o

Table : The effects of export exposure on migration across sectors and space

	OLS	2SLS

Table 7: Heterogeneit in the effects of trade

Dependent Variable	Full sample		0-150Km	150-300km	300- 50km	50-1200km
4 Agriculture share	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	( )
4 Export exposure per orker	-0.0212**	-0.0342*				
Coastline 0-150km	(0.00823)	(0.0190)				
4 Export exposure per orker	-0.0 1 **	-0.0 22				
Coastline 150-300km	(0.0229)	(0.0400)				
4 Export exposure per orker	-0.0182	-0.0519				
Coastline 300- 50km	(0.03)	(0.0339)				
4 Export exposure per orker	-0.0098	-0.00844				
Coastline 50-1200km	(0.0200)	(0.0 8)				
4 Export exposure per orker			-0.0578**	-0.0748	0.212	0.0318
			(0.0275)	(0.0 78)	(0.537)	(0.087)
Constant	0.244**	0.289***	0.387***	0.317***	-0.335	0.070
	(0.0783)	(0.0807)	(0.0944)	(0.0917)	(0.885)	(0.179)
Agriculture share 2000	Yes	Yes	Yes	Yes	Yes	Yes
4 Prefecture controls	Yes	Yes	Yes	Yes	Yes	Yes
Distance bin dummies	Yes	Yes	o	o	o	o
Observations	221	20	7	39	47	44
R-squared	0. 22	0. 17	0. 43	0.748	0.207	0.74

Note: Standard errors in parentheses are cluster in region.
[*] p < 0:05 , [**] p < 0:01, [***] p < 0:001

Table 9: The effects of export exposure on migration across sectors and space(count level)

	(1)	(2)	(3)	(4)
Dependent Variable	4 Agriculture share		4 Migrants ratio	
	OLS	2SLS	OLS	2SLS
4 Export exposure per orker	-0.010 **	-0.0492**	0.0230***	0.0503***
	(0.00440)	(0.0247)	(0.00590)	(0.0185)
Constant	0.0553	0.229**	-0.0178*	-0.0387*
	(0.0448)	(0.0985)	(0.00932)	(0.0229)
Agriculture share 2000	o	Yes	o	Yes
4 Prefecture controls	o	Yes	o	Yes
Region dummies	Yes	Yes	Yes	Yes
Distance to coastline	Yes	Yes	Yes	Yes
Observations	1,730	1, 31	1,730	1, 31
R-squared	0.334	0.253	0.297	0.227

Note: Standard errors in parentheses are cluster in region.
[*] p < 0:05 , [**] p < 0:01, [***] p < 0:001

Table 10: Robustness checks

	(1)	(2)	(3)	(4)
	A. 4 Agriculture share			
4 Export exposure per orker	-0.0432*	-0.0424*	-0.0458*	-0.01 2
	(0.0223)	(0.0228)	(0.0244)	(0.0124)
Constant	0.222**	0.304***	0.320***	0.17 **
	(0.105)	(0.0714)	(0.0 97)	(0.0730)
Agriculture share 2000	o	Yes	o	Yes
4 Prefecture controls	o	Yes	o	Yes
Region dummies	Yes	Yes	Yes	Yes
Distance to coastline	Yes	Yes	Yes	Yes
Observations	259	228	238	213
R-squared	0.493	0. 90	0.475	0.590
	B. 4 Migrants ratio			
4 Export exposure per orker	0.138**	0.105**	0.109**	0.0493
	(0.05 7)	(0.0414)	(0.0471)	(0.03 1)
Constant	-0.0 0	-0.0717**	-0.0703*	-0.0939*
	(0.0588)	(0.035)	(0.03 3)	(0.0548)
Migrants ratio 2000	o	Yes	o	Yes
4 Prefecture controls	o	Yes	o	Yes
Region dummies	Yes	Yes	Yes	Yes
Distance to coastline	Yes	Yes	Yes	Yes
Observations	259	228	238	213
R-squared	0.1 3	0.881	0.109	0.853

Note: Standard errors in parentheses are cluster in region.
[*] p < 0:05 , [**] p < 0:01, [***] p < 0:001

Appendix

A. Solve the model

Equation (1) implies that $y_{ij} = \ _{ij}^{\ \overline{1}} y_{ii} (\frac{Y_i}{Y_j})^{\ \overline{1}}$, given $p_{ij} = \ _{ij} p_{ii}$. Therefore, the general form of total revenues of a firm ith productivit   reads

$$R_i(\ ) = \quad h_i(\ ) \quad Y_i^{\frac{(\ \ )}{1}} + \sum_{j \neq i} I_{ij}(\ ) \ _{ij}^{\ \overline{1}} Y_j^{\frac{(\ \ )}{1}} \ ^{1} \tag{27}$$

Follo ing Felberma r et al. (2011), the first condition of d namic problem in equation (7) leads to

$$\frac{\partial R_i(l;\ )}{\partial l} = \frac{c}{q(\ '_{\ i})} \frac{r +}{1} + w_i(l:\ ) + \frac{\partial w_i(l;\ )}{\partial l} l \tag{28}$$

Therefore,

$$\frac{\partial J_i(l;\ )}{\partial l} = \frac{1}{+\ r} \quad \frac{\partial R_i(l;\ )}{\partial l} \quad w_i(l:\ ) \quad \frac{\partial w_i(l;\ )}{\partial l} l \tag{29}$$

dditionall , solving the problem in (5) ields

$$(1 \quad)[E_i(l:\ ) \quad U_i] = \frac{\partial J_i(l;\ )}{\partial l} \tag{30}$$

 hile in stead state the equations in ( ) can be ritten as

$$rE_i(l:\ ) = w_i(l;\ ) \quad [E_i(l:\ ) \quad U_i]$$

$$rU_i = \ '_{\ i} q(\ '_{\ i})[E_i(l:\ ) \quad U_i] \tag{31}$$

Combining equation (30) ith (31) leads to

$$\frac{\partial J_i(l;\ )}{\partial l} = \frac{1}{\quad} \frac{1}{r +} (w_i(l;\ ) \quad rU_i)$$

Substituting this expression into the left hand side of equation (29) and solving the the differentiate equation, $w_i(l;\ )$ can be ritten as

$$w_i = (1 \quad) rU_i + \frac{\quad}{\quad} \frac{\partial R_i(l;\ )}{\partial l} \tag{32}$$

Take derivative of equation (32) ith respect to l, e obtain

$$\frac{\partial w_i(l;\ )}{\partial l} l = \frac{\quad}{\quad} (\ \ \frac{1}{\ }) \frac{\partial R_i(l;\ )}{\partial l}$$

Reinserting it into equation (28) gives

$$w_i(l; \;) = \frac{}{}\frac{@R(l; \;)}{@l} \quad (\frac{r+}{1})\frac{c}{q('\;_i)} \tag{33}$$

Combined ith equation (32), the above equation ields the expression of age

$$w_i(l; \;) = rU_i + \frac{}{1}\frac{r+}{1}\frac{c}{q('\;_i)}$$

hich is equation (9) in the main text.

With the age curve in equation (9) and the relation bet een $R_i(l : \;)$ and w as sho n in equation (33), e have

$$a('\;_i) = \frac{}{1}\frac{1}{1}\frac{}{}['\;_i c + \frac{r+}{}\frac{c}{q('\;_i)}]$$

Let $l_{ii}(\;)$ and $l_{ij}(\;)$ denote the emplo ment for domestic and export sales to market j respectivel . With the expression of $R_i(l : \;)$ in equation (27) and the optimal allocation rule bet een the emplo ment for domestic sale and export sales, e can solve for

$$l_{ii} = \;^{\frac{1}{1}}Y_i^{\frac{}{1}}\;_i^{\frac{}{1}}a('\;_i)^{\frac{1}{1}}$$

$$l_{ij} = \;_{ij}^{\frac{}{1}}\;^{\frac{1}{1}}Y_j^{\frac{}{1}}\;_i^{\frac{}{1}}a('\;_i)^{\frac{1}{1}} \tag{34}$$

have $\frac{R_{ij}\ (\ _1)}{R_{ij}\ (\ _2)} = (\ \frac{\ _1}{\ _2})^{\frac{1}{\ }}$. Combined ith equation (3), this condition implies

$$R_{ij}\ (\ ) = (\ \frac{\ }{\ }$$

C. The planner's problem

The planner's problem is to maximize total net revenue b choosing the appropriate number of vacanc posted b firms in the manufacturing sector and allocating orkers across firms and sectors. The corresponding Bellman equation is

$$V(L;D) = \max_{l(\ );';N_A} \frac{1}{1+r} \int_{d}^{1} R(\ ;l)\,dG(\ ) + F(N_A) \quad c'D + V(L^0;D^0)$$

$$\text{s.t.} \int_{d}^{1} l(\ )\,dG(\ ) = L$$

$$L^0 = (1 \qquad)L + x('\ )D$$

$$D = \quad (N \quad N_A \quad D) + (1 \quad x('\ ))D$$

here L is the total emplo ment in the manufacturing sector and D is the total unemplo - ment. The first order conditions leads to equal marginal product across firms and the t o