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China's spatial (dis)integration as a multiethnic paradox: what do the interprovincial data say?

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Abstract

Background: Compared with its surging foreign trade, China's domestic trade growth from 2000 to 2010 had been less encouraging. Then, what are the driving forces behind the dynamic pattern of China's domestic trade?

Methods: Using the gravity model of trade and China's interprovincial panel data, this paper shows that the negative effect of distance-related transactions costs on interprovincial trade tends to rise from 2000 to 2010. After constructing China's 56 ethnic groups into a single, interprovincial similarity index, I cannot find any evidence that supports the view that ethnic links should serve as a factor promoting bilateral trade.

Results: However, my estimated coefficients on 37 major ethnic groups show that both positive and negative ethnic influences on trade exist in China. Specifically, 14 ethnic groups (Lahu, Qiang, Jingpo, Tu, Mongol, Manchu, Hui, Zhuang, Dongxiang, Daur, Kirgiz, She, Maonan, and Tibetan) are found to contribute to China's interprovincial trade, while five ethnic groups (Han, Va, Kazak, Dai, and Blang) tend to impede China's interprovincial trade.

Conclusions: These findings will be useful for policy-makers to reappraise which of China's ethnic groups are playing the most (least) important roles in, and to introduce the optimal informal institutions into, the promotion of interprovincial economic cooperation in China.

Keywords: Domestic trade, Spatial (dis)integration, Interprovincial ethnic linkage, Province, China

Background

The first decade of the twenty-first century was unusual to China. Promoted by its entry into the World Trade Organization (WTO) on December 11, 2001, China's economic growth has significantly driven by its remarkable performance in foreign trade. WTO data shows that China's exports and imports enjoyed the average annual growth rates of 18 % and 16 % from 2000 to 2010, respectively, much higher than the average annual growth rate of the global trade volume in the same period, which was only 3 %.[1] In 2000, for example, China was the seventh leading exporter and eighth largest importer of merchandise trade. Since 2001, China has steadily increased its share of global manufactured exports. Notwithstanding the global reductions in trade, which resulted from the US financial crisis in 2008, China replaced Germany as the world's largest exporting nation in 2009. In 2010, China continued to be the leading merchandise exporter (US$1.58 trillion, or 10.4 % of world exports), followed by the USA (8.4 % of world exports), Germany (8.3 % of world exports), and Japan (5.1 % of world exports).[2]

When looking inside China, however, one can only find less encouraging news. For example, compared with its surging foreign trade as mentioned above, which has increased by more than four (for exports) or three (for imports) times from 2000 to 2010, China's domestic trade has only achieved a growth of 86.26 % during the same period (see Table 1). This means that China's domestic trade—both intra-provincial and interprovincial—has only had an average annual growth rate of about 6 % from 2000 to 2010. Frankly speaking, this may not have been treated as a low figure in many other countries during that period of time. However, compared with its 16–18 % of annual foreign trade growth rate and 10 %

Table 1 Changes of China's domestic and interprovincial trade from 2000 to 2010

Provincial economy	Domestic trade (thousand tons)			Ratio of interprovincial trade (%)		
	2000	2010	Change (%)	2000	2010	Change (%)
Anhui	6087	12,092	98.65	56.84	47.93	−8.91
Beijing	2612	1571	−39.85	72.21	95.23	23.02
Chongqing	1613	2197	36.21	56.79	65.95	9.16
Fujian	2475	3704	49.66	46.22	53.48	7.26
Gansu	3236	6186	91.16	52.10	61.27	9.17
Guangdong	4521	7505	66.00	74.70	79.72	5.02
Guangxi	2815	6109	117.02	67.10	75.82	8.72
Guizhou	3585	7991	122.90	69.29	82.98	13.69
Hainan	311	542	74.28	NA	10.89	NA
Hebei	11,399	16,481	44.58	60.61	56.09	−4.52
Heilongjiang	12,701	16,888	32.97	54.47	49.19	−5.28
Henan	9655	13,374	38.52	78.92	71.53	−7.39
Hubei	3937	5698	44.73	62.81	66.57	3.75
Hunan	4668	5783	23.89	65.62	61.27	−4.35
Inner Mongolia	9171	37,698	311.06	69.55	77.00	7.46
Jiangsu	4076	6372	56.33	63.67	85.75	22.08
Jiangxi	2959	5376	81.68	57.92	51.95	−5.97
Jilin	5630	7674	36.31	60.55	69.53	8.98
Liaoning	12,520	18,118	44.71	34.03	29.94	−4.09
Ningxia	1782	4414	147.70	73.12	86.45	13.33
Qinghai	647	3096	378.52	81.14	61.66	−19.48
Shaanxi	3280	8836	169.39	65.95	69.09	3.15
Shandong	10,585	18,285	72.74	52.24	62.67	10.43
Shanghai	1054	959	−9.01	89.56	93.53	3.97
Shanxi	28,469	60,812	113.61	91.96	92.76	0.80
Sichuan	5516	7389	33.96	46.79	51.59	4.80
Tianjin	2004	7240	261.28	81.64	54.46	−27.18
Tibet		30	NA		100.00	NA
Xinjiang	3353	6775	102.06	73.67	74.05	0.39
Yunnan	2882	5209	80.74	59.51	67.92	8.41
Zhejiang	1929	3806	97.30	62.10	41.59	−20.51
All	165,472	308,210	86.26	65.53	69.06	5.39

(1) "Trade" only includes freight exchange via national railways. (2) NA = data are not available
Source: calculated by the author based on China Association of Communications and Transportation and the National Development and Reform Commission of the People's Republic of China (2001, 2011)

of annual gross domestic product (GDP) growth rate from 2000 to 2010, China's domestic trade performance can only but be labeled as "poor".

Even worse news comes from China's interprovincial trade performance. China's official statistics on interprovincial trade (in terms of freight exchange via national railways) are puzzling. For example, except for China's two peripheral territories (i.e., Hainan and Tibet) whose data are not available in 2000, the proportions of interprovincial trade to the total domestic trade have risen in only 17 provincial economies (i.e., Beijing, Jiangsu, Guizhou, Ningxia, Shandong, Gansu, Chongqing, Jilin, Guangxi, Yunnan, Inner Mongolia, Fujian, Guangdong, Sichuan, Shanghai, Hubei, and Shaanxi) from 2000 to 2010. By way of contrast, the proportions for the remaining provincial economies have either decreased (i.e., in Tianjin, Zhejiang, Qinghai, Anhui, Henan, Jiangxi, Heilongjiang, Hebei, Hunan, and Liaoning) or been kept almost unchanged (i.e., in Shanxi and Xinjiang) during the same period (see Table 1 for more details).[3]

Indeed, the above phenomenon is unusual, especially after the following facts are taken into account:

(i) Since the 1990s, there has been a significant improvement of transport infrastructures (including, inter alia, the completion of various expressways and high-speed railways across the nation) in China

(ii) Since 1999, the "Western Regional Development Policy" has been implemented by the Chinese central government in order to speed up the development of the western and central provinces by encouraging the economic cooperation between the East-West provinces

(iii) Since 2008, and as a result of the global reductions in trade, which resulted from the US financial crisis, the Chinese government has made various efforts in order to stimulate China's domestic consumption

Then, what are the driving forces behind the dynamic patterns of China's domestic trade and how to explain its interprovincial trade puzzle?

Methods

Literature review

Past studies of the determinants of spatial economic interdependence seem controversial, or at least incomplete. According to the Heckscher–Ohlin theorem, if the two factors of production are capital and labor, countries with dissimilar levels of per capita income (or, more precisely, dissimilar capital/labor ratios) will trade more than countries with similar levels (Heckscher 1919; Ohlin 1933). However, a number of empirical results indicate that the inclusion of income level as a determinant of trade contradicts the assumptions of traditional Heckscher–Ohlin theory (e.g., Linder 1961; Deardorff 1998, p. 15). In order to fill up this gap, economists have put forward new theories that base international trade on, among others, economies of scale, market imperfections, and cross-national differences in technology (e.g., Markusen 1986; Helpman 1987; Krugman 1995).

However, past studies have raised more questions than they have answered. For example, the effects of geographical proximity on trade have not been shown to fall over time. Rather, these effects have been shown to strengthen over time for 1950–1988

(Boisso and Ferrantino 1997) and 1965–1992 (Frankel et al. 1997a). Similarly, Rauch (1999) provides no evidence that, as a result of technological innovation, declining distance-related transactions costs should have led to increased trade flows. One possibility is that these analyses exclude important explanatory variables, thereby biasing the estimates.[4] To clarify related issues, it is necessary to isolate the influences of all distance-related variables on trade. In particular, the inclusion of some relevant cultural variables might allow us to gain a better understanding of the black box containing the distance-related transactions costs that affect spatial economic activities.

China has officially identified, except other unknown ethnic groups and foreigners with Chinese citizenship, 56 ethnic groups. Although the majority of China's population is of the Han nationality (which accounts for more than 90 % of China's total population), the non-Han ethnic groups have a population of more than 100 million. Thanks to the easing migration policy that has been implemented since the 1980s, China's interprovincial labor flows have increased dramatically. It is noteworthy that these flows have also been conducted by people coming from the inland, ethnic-minority, areas and moving into the coastal, Han-majority areas. Consequently, China's interprovincial ethnic networks have been enhanced. As of 2010 when the Sixth National Population Census of the People's Republic of China was conducted, each of China's 31 provinces has become home to almost all ethnic groups. How have these growing ethnic networks contributed to (or impeded) China's interprovincial economic cooperation and integration?

There is a widely held view that easily observable impediments, such as transportation costs, do not adequately capture transactions costs in international trade. Trade is also reduced by hidden transaction costs associated with unobserved trade barriers.[5] In addition, some studies use international panel data and find that cultural distance or dissimilarity—as proxied by, among other things, the ethnic/linguistic and religious differences across national populations—is a robust determinant of the volume of international trade (see, for example, Rauch and Trindade 2002; Noland 2005; Guiso et al. 2006; and Guo 2009, pp. 77–102).

Since the 1990s, numerous quantitative studies have examined the role that cultural factors play in international trade (e.g., Havrylyshyn and Pritchett 1991; Foroutan and Pritchett 1993; Frankel and Wei 1995; Frankel et al. 1997a; Rauch 1999; Guo 2007; Melitz 2008; Felbermayr et al. 2010). These studies used linguistic or/and religious links as one or more explanatory variables. The estimated results suggest that countries which are similar to one another have been more likely to trade with each other in the postwar period. In other words, there is evidence of cultural barriers to trade.

Indeed, trade and economic cooperation may be affected by cultural dissimilarities, as it is easier and more efficient for people with the same cultural identity (ethnicity, language, religion, or any other cultural elements) to trust and communicate each other than for those with different cultural identities. In this paper, our particular interest is to test how ethnic differences have influenced China's interprovincial trade and economic cooperation. Even though language is an effective tool of communication and that religion can provide insights into the characteristics of a culture, we would rather select ethnicity as the explanatory variable. The rationale is that most, if not all, of China's ethnic groups are identified in terms of either linguistic or religious traditions. Another reason lies in the fact that, in China, it is more difficult, if not impossible, to

collect interprovincial panel data on linguistic and religious groups than those on ethnic groups.

The gravity model is most commonly used by international and regional economists to study trade. The classic early application of the model was by Linnemann (1966), who continued work first reported in Tinbergen (1962) and then in Pöyhönen (1963).[6] Generally, a gravity model assumes that the volume of trade between any two economies will be directly proportional to the product of their economic masses (measured by GDP or GNP) and inversely proportional to the distance between them. Per capita incomes (measured by product of per capita GDPs or GNPs) have become a standard covariate in the gravity models of, for example, Eaton and Tamura (1994); Frankel et al. (1997a, b) and Rauch (1999).

The model

In this paper, our particular interest is to test how various ethnic groups have influenced China's interprovincial trade and economic cooperation. Recent gravity equations, compared to the earlier ones, have included multilateral trade resistance (MTR) terms (e.g., Feenstra 2004; Baldwin and Taglioni 2006; Head and Mayer 2013). The MTR terms arise because in a general equilibrium model, trade flows between any two provinces not only depend on trade costs between the two provinces under consideration, but also on trade costs between all other trading pairs. However, in this paper, we intend to simplify the MTR terms. The rationale is that China's domestic MTR terms, if they do exist, are much weaker than the international ones. To this end, we only add country-fixed effects to the gravity models. As noted by Adam and Cobham (2007), these effects can be thought of theoretically as approximations to MTR terms. The basic form of the gravity model to be used in our empirical analysis of interprovincial trade is as the following[7]:

$$\ln\left(\text{TRADE}_{ij}\right) = \alpha_0 + \alpha_1 \ln\left(\text{GDP}_i \text{GDP}_j\right) + \alpha_2 \ln\text{DISTANCE}_{ij} + \alpha_3 \text{ADJACENT}_{ij}$$
$$+ \alpha_4 \ln\left(\text{GDPPC}_i \text{GDPPC}_j\right) + \alpha_5 \text{PD} + \beta \text{ETHNIC56}_{ij}$$

$$(1)$$

In Eq. (1), "ln" represents the natural logarithm; TRADE_{ij}, measured in thousand tons, is the total freight exchange between provinces i and j. $\text{GDP}_i \text{GDP}_j$ is the product of GDP (in Chinese currency) of the ith and jth provinces. DISTANCE_{ij} represents the distance between the geographical centers of gravity of the ith and jth provinces (in kilometers).[8] ADJACENT_{ij} is a dummy variable, which takes the values of "1" for provinces i and j to have a common border and of "0" otherwise. $\text{GDPPC}_i \text{GDPPC}_j$ is the product of GDP per capita (in Chinese currency) of the ith and jth provinces. PD denotes a province dummy, which takes the values of "1" for provinces to be either a mountain-dominated or an island province (Chongqing, Guizhou, Hainan, Qinghai, Sichuan, Tibet, or Yunnan—we include these provinces since they have China's most complicated geographical conditions and therefore have the most difficulties in transportation) and of "0" otherwise.

ETHNIC56_{ij} represents the extent to which the ith and jth provinces are ethnically linked each other (details about the measurement will be discussed in Eq. (6) in "The data" sub-section). Note that since ETHNIC56 is a comprehensive index for all of China's

56 ethnic groups, it can only be used to derive a general pattern of correlation between interprovincial trade and ethnic linkage. If one wants to examine the role that each ethnic group plays, the gravity model can be now written as the following:

$$\ln(\text{TRADE}_{ij}) = \alpha_0 + \alpha_1 \ln(\text{GDP}_i\text{GDP}_j) + \alpha_2 \ln\text{DISTANCE}_{ij} + \alpha_3\text{ADJACENT}_{ij}$$
$$+ \alpha_4 \ln(\text{GDPPC}_i\text{GDPPC}_j) + \alpha_5\text{PD} + \sum_{k=1}^{37}\beta_k\text{ETHNIC}_{ijk} \quad (2)$$

In Eq. (2), ETHNIC_{ijk} represents the extent to which the kth ethnic group is linked between the ith and jth provinces (details about the measurement will be discussed in Eq. (5) in "The data" section). Only 37 ethnic groups—each with a population of less than 100,000 persons (see Appendix for more detailed information)—are included in this equation.

Theoretically, cultural dissimilarity can result in both social transactions costs (a factor directly impeding trade) and "economic complementarity" (an important factor directly facilitating trade) simultaneously. As a result, the relationship between trade and cultural similarity may follow a non-linear pattern (Guo 2004, 2009, pp. 96–101). Our interest now goes to the clarification of specific cultural groups which may have different types of influences on trade with provinces differing in income levels. To go further, this paper employ a new explanatory variable: $\ln(\text{GDPPC}_i\text{GDPPC}_j)\text{ETHNIC56}_{ij}$. Consequently, a modified form of gravity model is written as:

$$\ln(\text{TRADE}_{ij}) = \alpha_0 + \alpha_1 \ln(\text{GDP}_i\text{GDP}_j) + \alpha_2 \ln\text{DISTANCE}_{ij} + \alpha_3\text{ADJACENT}_{ij}$$
$$+ \alpha_4 \ln(\text{GDPPC}_i\text{GDPPC}_j) \, \text{ETHNIC56}_{ij} + \alpha_5\text{PD} + \sum_{k=1}^{37}\beta_k\text{ETHNIC}_{ijk}$$
$$(3)$$

In Eq. (3), the ethnicity variable is now entered into the gravity model linearly and also as a product with the natural log of per capita GDPs. Thus, the effect of an ethnic group on interprovincial trade is now allowed to exist separately and to depend on the income levels of trading partners, measured by the natural log of their per capita GDPs. As a matter of fact, since ETHNIC56_{ij} can be written as $\text{Ethnic}_{ij1} + \text{Ethnic}_{ij2} + \ldots + \text{Ethnic}_{ijk} + \ldots + \text{Ethnic}_{ij56}$, the non-linear effects of some, if not all ethnic variables on interprovincial trade may be derived from Eq. (3).

Specifically, as for the kth ethnic group ($k = 1, 2, \ldots, 37$), if the estimated coefficients on Ethnic_{ijk} (that is, β_k) and on $\ln(\text{GDPPC}_i\text{GDPPC}_j)\text{ETHNIC56}_{ij}$ (that is, α_4) have different signs (such as $\alpha_4 < 0$ and $\beta_k > 0$; or $\alpha_4 > 0$ and $\beta_k < 0$) and are statistically significant in Eq. (3), one obtains a threshold value ($\ln(\text{GDPPC}_i\text{GDPPC}_j)_k^*$) by letting the first-order differential of the dependent variable ($\ln(\text{TRADE}_{ij})$) with respect to Ethnic_{ijk} be zero, which is:

$$\ln(\text{GDPPC}_i\text{GDPPC}_j)_k^* = -\beta_k/\alpha_4 > 0 \; (\text{with} \; \alpha_4 < 0 \text{ and } \beta_k > 0; \text{ or } \alpha_4 > 0 \text{ and } \beta_k < 0).$$
$$(4)$$

As for the case of $\alpha_4 < 0$ and $\beta_k > 0$:

(i) If $\ln(\text{GDPPC}_i\text{GDPPC}_j)_k$ is smaller than $\ln(\text{GDPPC}_i\text{GDPPC}_j)_k^*$, the kth ethnic group has a positive effect on the trade between the ith and jth provinces
(ii) If $\ln(\text{GDPPC}_i\text{GDPPC}_j)_k$ is larger than $\ln(\text{GDPPC}_i\text{GDPPC}_j)_k^*$, the kth ethnic group has a negative effect on the trade between the ith and jth provinces.

The data

The major task of this paper is to quantitatively investigate the sources for changes in China's spatial economic integration over time. Thus, the use of the cross-sectional data from China' s provincial economies in different years enables that the estimated results are not artifact of any particular time period and to allow for changes in coefficients. Generally, a decade-long period is appropriate for this kind of research because analysis for a shorter period would not reflect relevant social and economic changes, while significant changes in transportation and communication technologies would have to be accounted for if a longer one is used. Of course, a longer period is still more helpful if three or more sets of cross-sectional data are available. However, this would increase inevitably the costs in data collection. In this paper, after taking into account data availability, we select 2 years—2000 and 2010.

The data on interprovincial trade are cited from *China Communications Yearbooks* (2000 and 2010).[9] China's 2000 and 2010 provincial GDP and per capita GDP data are from *China Statistical Yearbook*s (NBS 2001, 2011). Unlike those of many Western democratic economies, China's provincial capitals usually are also the economic centers of their respective provinces. To this end, the following terms are used to express China's interprovincial geographical proximity: "distance between capitals" and "interprovincial adjacency". Distance between capitals is represented by the distance (in kilometers) between two provinces' capitals via national railway. The data on distance between capitals are calculated by the author based on the data released by the Ministry of Railways of the People's Republic of China.

In this paper, a comprehensive method is used to construct interprovincial ethnic linkages. Suppose that there are k ethnic groups in both provinces i and j. If the ith and jth provinces' population shares for the kth ethnic group are expressed by x_k (it ranges between 0 and 1) and y_k (it ranges between 0 and 1), respectively, the kth ethnic group's linkage index between provinces i and j can be measured by the following formula:

$$\text{ETHNIC}_{ijk} = \min(x_k, y_k), \text{ where } x_k \in (0, 1) \text{ and } y_k \in (0, 1). \tag{5}$$

In Eq. (5), min (•) denotes the minimization of the variables within parentheses. The data on the population shares (x_k and y_k) are calculated by the author based on the data released by the Fifth and Sixth National Population Census of the People's Republic of China (conducted at 0:00 a.m. on November 1 of 2000 and 2010, respectively).

Since there are 56 ethnic groups in China, the overall ethnic linkage between provinces i and j can be measured by the following formula:

$$\text{ETHNIC56}_{ij} = \text{ETHNIC}_{ij_1} + \text{ETHNIC}_{ij_2} + \dots + \text{ETHNIC}_{ij_{56}}$$
$$= \sum_{k=1}^{56} \min(x_k, y_k) \tag{6}$$

In Equation (6), min (•) denotes the minimization of the variables within parentheses. For all k, $x_k \in (0, 1)$, $y_k \in (0, 1)$, and $\sum x_k = \sum y_k = 1$. Consequently, ETHNIC56_{ij} ranges between 0 and 1. In the extreme cases, when $\text{ETHNIC56}_{ij} = 1$, provinces i and j have a

common ethnic structure (i.e., for all k, $x_k = y_k$); when ETHNIC56$_{ij}$ =0, the two provinces do not have any ethnic linkage with each other (i.e., for all k, x_k (or y_k) = 0). In other words, greater values of ETHNIC56$_{ij}$ indicate greater degrees of ethnic linkages between the two provinces. This formula has been used in Guo (2004; 2009, p. 89) and Noland (2005). [10]

A brief statistical description of selected variables included in Eqs. (1), (2), and (3) is given in Table 2 (for 2000) and Table 3 (for 2010). The largest numbers of observations (i.e., interprovincial samples) are 465 for both 2000 and 2010. However, because the data on interprovincial trade are unavailable for the two provinces of Hainan and Tibet (including 59 province pairs) from 2000 as well as for 13 province pairs (i.e., Beijing-Hainan, Guizhou-Tibet, Hainan-Heilongjiang, Hainan-Jilin, Hainan-Liaoning, Hainan-Ningxia, Hainan-Shanghai, Hainan-Tianjin, Hainan-Tibet, Hainan-Xinjiang, Jilin-Tibet, Ningxia-Tibet, and Tibet-Yunnan) from 2010, the total numbers of observations that can be actually used for our regressions are reduced to 406 (i.e., 465–59 = 406) for 2000 and 452 (i.e., 465–13 = 452) for 2010 accordingly.

Results and discussion

The gravity models constructed in "Methods" section can be tested by using the data described in "The data" section. We first run Eq. (1) by using both the data of 2000 and 2010 (the estimated results are shown in the second and third columns of Table 4, respectively) and the pooled data (the estimated results are shown in Table 5 in which the year-fixed effects on trade are also included in regression shown in the third column).

Early comparative studies, using the international panel data of China and East Asia, show that geographical influence on international trade was reduced from the 1980s to 1990s (Guo 2007; 2013, p. 210). One of the major driving forces contributing to this tendency might be technological advance in transportation and communications. Intuitively, wide application of E-commerce and the declining of distance-related transactions costs have increasingly contributed to the growth of international trade. However, in this paper, the negative effect of "distance" on interprovincial trade is found to rise from 2000 to 2010. Obviously, this does not reflect China's improvement of transport infrastructures; neither does it conform to the general pattern of international trade. The main cause of China's interprovincial trade barriers may be the market-segmenting behavior that the Chinese provinces carry on in order to maintain social stability and maximize fiscal incomes (Poncet 2005). Undoubtedly, our finding shows a sign of China's spatial economic disintegration during the first decade of the twenty-first century.

The estimated coefficients on "ADJACENT", which are statistically significant, slightly increase from 2000 to 2010 (see Table 4). However, the year-fixed effect derived from the regression based on the pooled data (see the third column of Table 5) does not show any statistical significance for this kind of increase.

The estimated coefficients on "ETHNIC56" are statistically significant for 2000 and 2010. However, they are negative, suggesting that the interprovincial links of 56 ethnic groups as a whole have only but impeded China's interprovincial economic activities. Obviously, this provides no evidence that supports the widely

Table 2 Descriptive statistics for the data on selected variables, 2000

Variable	N	Minimum	Maximum	Mean	SD
$\ln(TRADE_{ij})$	406	2.99573	11.59910	6.84499	1.36932
$\ln(GDP_iGDP_j)$	465	5.73532	13.62832	10.70744	1.43231
$\ln(GDPPC_iGDPPC_j)$	465	16.19674	20.00507	17.70224	0.69716
$\ln(DISTANCE_{ij})$	465	4.91998	8.75037	7.47203	0.64053
$ETHNIC56_{ij}$	465	0.06160	0.99930	0.75563	0.24827
$k = 1$. Bai	465	0.00001	0.00532	0.00004	0.00028
$k = 2$. Blang	465	0.00000	0.00001	0.00000	0.00000
$k = 3$. Buyi	465	0.00001	0.00129	0.00005	0.00008
$k = 4$. Dai	465	0.00000	0.00008	0.00000	0.00001
$k = 5$. Daur	465	0.00000	0.00120	0.00001	0.00006
$k = 6$. Dong	465	0.00001	0.01331	0.00011	0.00077
$k = 7$. Dongxiang	465	0.00000	0.00303	0.00001	0.00015
$k = 8$. Gelao	465	0.00000	0.00009	0.00001	0.00001
$k = 9$. Han	465	0.06061	0.99682	0.74690	0.25065
$k = 10$. Hani	465	0.00000	0.00003	0.00001	0.00001
$k = 11$. Hui	465	0.00025	0.15621	0.00371	0.00904
$k = 12$. Jingpo	465	0.00000	0.00001	0.00000	0.00000
$k = 13$. Kazak	465	0.00000	0.00012	0.00000	0.00001
$k = 14$. Kirgiz	465	0.00000	0.00004	0.00000	0.00000
$k = 15$. Korean	465	0.00002	0.01072	0.00013	0.00064
$k = 16$. Lahu	465	0.00000	0.00002	0.00000	0.00000
$k = 17$. Li	465	0.00000	0.00159	0.00001	0.00007
$k = 18$. Lisu	465	0.00000	0.00023	0.00000	0.00001
$k = 19$. Manchu	465	0.00006	0.03705	0.00118	0.00443
$k = 20$. Maonan	465	0.00000	0.00089	0.00000	0.00004
$k = 21$. Miao	465	0.00004	0.03037	0.00069	0.00280
$k = 22$. Mongol	465	0.00008	0.01789	0.00064	0.00164
$k = 23$. Mulao	465	0.00000	0.00081	0.00000	0.00004
$k = 24$. Naxi	465	0.00000	0.00047	0.00000	0.00002
$k = 25$. Qiang	465	0.00000	0.00004	0.00000	0.00000
$k = 26$. Salar	465	0.00000	0.00047	0.00000	0.00003
$k = 27$. She	465	0.00000	0.00372	0.00004	0.00024
$k = 28$. Shui	465	0.00000	0.00035	0.00001	0.00003
$k = 29$. Tibetan	465	0.00002	0.22530	0.00074	0.01057
$k = 30$. Tu	465	0.00000	0.00121	0.00002	0.00006
$k = 31$. Tujia	465	0.00003	0.04172	0.00066	0.00438
$k = 32$. Uygur	465	0.00002	0.00027	0.00004	0.00002
$k = 33$. Va	465	0.00000	0.00005	0.00000	0.00000
$k = 34$. Xibe	465	0.00000	0.00187	0.00001	0.00009
$k = 35$. Yao	465	0.00000	0.01114	0.00009	0.00064
$k = 36$. Yi	465	0.00002	0.02577	0.00022	0.00196
$k = 37$. Zhuang	465	0.00005	0.02701	0.00025	0.00142

Definitions of the variables shown in this table are given in the text
N number of observations, and *SD* standard deviation

Table 3 Descriptive statistics for the data on selected variables, 2010

Variable	N	Minimum	Maximum	Mean	SD
$\ln(TRADE_{ij})$	452	2.30259	12.62984	6.95446	1.76181
$\ln(GDP_iGDP_j)$	465	8.83243	16.76316	13.75672	1.38476
$\ln(GDPPC_iGDPPC_j)$	465	19.15152	22.40275	20.60043	0.62203
$\ln(DISTANCE_{ij})$	465	4.91998	8.75037	7.47203	0.64053
$ETHNIC56_{ij}$	465	0.08280	0.99870	0.75979	0.24414
$k = 1$. Bai	465	0.00000	0.00526	0.00005	0.00027
$k = 2$. Blang	465	0.00000	0.00016	0.00000	0.00001
$k = 3$. Buyi	465	0.00001	0.00231	0.00007	0.00016
$k = 4$. Dai	465	0.00000	0.00011	0.00001	0.00002
$k = 5$. Daur	465	0.00000	0.00105	0.00001	0.00005
$k = 6$. Dong	465	0.00001	0.01301	0.00013	0.00076
$k = 7$. Dongxiang	465	0.00000	0.00282	0.00002	0.00015
$k = 8$. Gelao	465	0.00000	0.00033	0.00001	0.00003
$k = 9$. Han	465	0.08176	0.99660	0.75070	0.24660
$k = 10$. Hani	465	0.00000	0.00014	0.00001	0.00001
$k = 11$. Hui	465	0.00020	0.14827	0.00356	0.00865
$k = 12$. Jingpo	465	0.00000	0.00002	0.00000	0.00000
$k = 13$. Kazak	465	0.00000	0.00071	0.00002	0.00004
$k = 14$. Kirgiz	465	0.00000	0.00089	0.00000	0.00004
$k = 15$. Korean	465	0.00001	0.00856	0.00013	0.00058
$k = 16$. Lahu	465	0.00000	0.00003	0.00000	0.00000
$k = 17$. Li	465	0.00001	0.00396	0.00003	0.00018
$k = 18$. Lisu	465	0.00000	0.00026	0.00001	0.00001
$k = 19$. Manchu	465	0.00011	0.03156	0.00111	0.00378
$k = 20$. Maonan	465	0.00000	0.00080	0.00000	0.00004
$k = 21$. Miao	465	0.00005	0.03136	0.00088	0.00296
$k = 22$. Mongol	465	0.00005	0.01774	0.00056	0.00157
$k = 23$. Mulao	465	0.00000	0.00073	0.00001	0.00003
$k = 24$. Naxi	465	0.00000	0.00038	0.00000	0.00002
$k = 25$. Qiang	465	0.00000	0.00005	0.00001	0.00001
$k = 26$. Salar	465	0.00000	0.00053	0.00001	0.00003
$k = 27$. She	465	0.00000	0.00306	0.00004	0.00021
$k = 28$. Shui	465	0.00000	0.00029	0.00001	0.00003
$k = 29$. Tibetan	465	0.00002	0.24438	0.00080	0.01149
$k = 30$. Tu	465	0.00000	0.00120	0.00003	0.00007
$k = 31$. Tujia	465	0.00006	0.04210	0.00079	0.00438
$k = 32$. Uygur	465	0.00001	0.00036	0.00004	0.00003
$k = 33$. Va	465	0.00000	0.00006	0.00001	0.00001
$k = 34$. Xibe	465	0.00000	0.00158	0.00001	0.00008
$k = 35$. Yao	465	0.00001	0.01086	0.00011	0.00064
$k = 36$. Yi	465	0.00002	0.03288	0.00027	0.00220
$k = 37$. Zhuang	465	0.00005	0.02644	0.00031	0.00141

Definitions of the variables shown in this table are given in the text
N number of observations, and *SD* standard deviation

Table 4 Basic regressions—56 ethnic groups as a single variable, 2000 and 2010

Explanatory variable	Coefficient in 2000	Coefficient in 2010
Constant	14.461[a] (1.462)	29.057[a] (2.447)
$\ln(GDP_iGDP_j)$	0.647[a] (0.046)	0.759[a] (0.063)
$\ln(GDPPC_iGDPPC_j)$	−0.253[a] (0.072)	−1.041[a] (0.108)
$\ln(DISTANCE_{ij})$	−1.212[a] (0.097)	−1.377[a] (0.127)
$ADJACENT_{ij}$	0.504[a] (0.149)	0.579[a] (0.196)
$ETHNIC56_{ij}$	−1.560[a] (0.324)	−1.393[a] (0.367)
PD	−0.350[a] (0.099)	−0.521[a] (0.134)
Coefficient of correlation (R^2)	0.644	0.586
Standard error of regression	0.823	1.141
F statistic	120.556	104.786
Sig. of regression	0.000	0.000
Number of observations	405	451

Dependent variable is the natural log of interprovincial trade. Figures within parentheses are standard errors. The variance inflation factors (VIFs) are all less than 2.5, which are not reported in the table
"[a]"Denotes statistically significant at greater than the 1 % level

recognizable view that ethnic linkage index tends to encourage trade between provinces that are multiethnically linked. In fact, since the partial correlation between the natural log of TRADE and the ETHNIC56 scores yields an inverted-U shape curve for 2010 (see Fig. 1), the above estimated coefficients on ETHNIC56 may be misleading (at least for 2010).
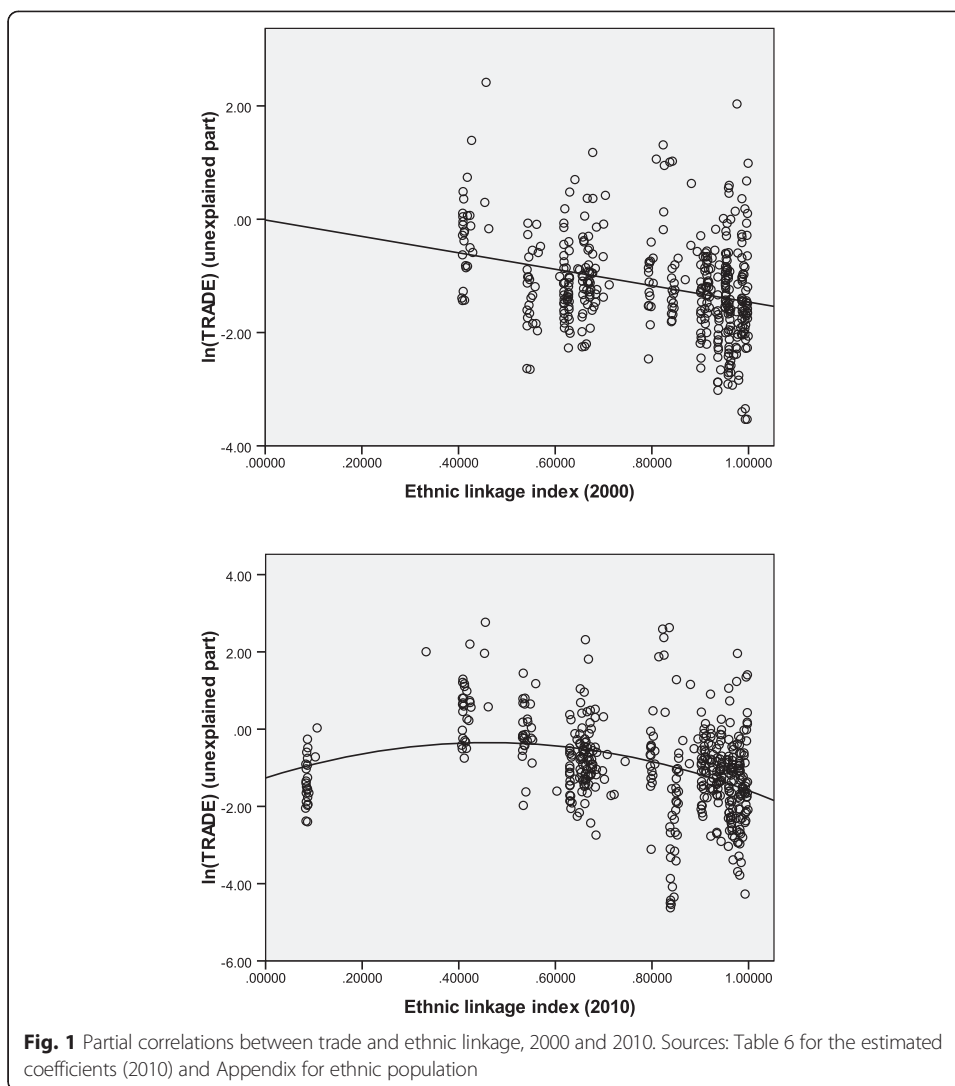
Let us now run Eq. (2) constructed in the "Methods" section. In China's Fifth National Population Census conducted in November 2000, only permanent populations were counted (whereas in 2010, those who had stayed at their current residences for

Table 5 Regressions based on pooled data—56 ethnic groups as a single variable

Explanatory variable	Coefficient (excl. year-fixed effects)	Coefficient (incl. year-fixed effects)
Constant	30.733[a] (1.840)	30.764[a] (1.839)
$\ln(GDP_iGDP_j)$	0.865[a] (0.047)	0.862[a] (0.047)
$\ln(GDPPC_iGDPPC_j)$	−1.131[a] (0.081)	−1.129[a] (0.081)
$\ln(DISTANCE_{ij})$	−1.486[a] (0.095)	−1.450[a] (0.097)
$\ln(DISTANCE_{ij})$ in 2010	–	−0.064[b] (0.031)
$ADJACENT_{ij}$	0.429[a] (0.148)	0.466[a] (0.190)
$ADJACENT_{ij}$ in 2010	–	−0.065 (0.236)
$ETHNIC56_{ij}$	−1.694[a] (0.274)	−1.939[a] (0.313)
$ETHNIC56_{ij}$ in 2010	–	0.487[c] (0.298)
PD	−0.587[a] (0.102)	−0.587[a] (0.101)
Coefficient of correlation (R^2)	0.598	0.600
Standard error of regression	1.229	1.228
F statistic	225.620	151.267
Sig. of regression	0.000	0.000
Number of observations	856	856

Dependent variable is the natural log of interprovincial trade. The variance inflation factors (VIFs) are all less than 2.5, which are not reported in the table. Figures within parentheses are standard errors
"[a]", "[b]", and "[c]"Denote statistically significant at greater than the 1, 5, and 10 % levels, respectively

Fig. 1 Partial correlations between trade and ethnic linkage, 2000 and 2010. Sources: Table 6 for the estimated coefficients (2010) and Appendix for ethnic population

6 months or longer were also counted). This could affect the final estimated co-efficients in 2000 (remember that the "floating" populations may sometimes play more important roles in interprovincial marketing and trade than in permanent residents). To this end, we will not use the pooled data of 2000 and 2010; instead, we will only run regressions based on the data of 2000 and 2010, respectively. The estimated results shown in Table 6 are derived by excluding the variables whose variance inflation factors (VIFs) exceed 10 (a value that is often regarded as indicating multicollinearity). These results, compared with those shown in Tables 4 and 5, can help us to better explain the diverse ethnic influences on interprovincial trade:

- As for 2000, seven ethnic groups (Jingpo, Gelao, Manchu, Hui, Dongxiang, Daur, and Maonan) have positive effects; four ethnic groups (Han, Li, Hani, and Buyi) have negative effects on interprovincial trade; and 26 ethnic variables (Bai, Blang, Dai, Dong, Kazak, Kirgiz, Korean, Lahu, Lisu, Miao, Mongol, Mulao, Naxi, Qiang,

Table 6 The estimated coefficients on the ethnic variables defined in Eq. (2)

Explanatory variable	2000		2010	
	Coefficient	Standard error	Coefficient	Standard error
1. Bai			−192.637	341.756
2. Blang	−11,4466.708	83,123.810	−36,909.300[b]	17,153.46
3. Buyi	−1989.870[c]	1044.715	767.807	753.124
4. Dai	−17,883.500	14,948.590	−16,349.312[a]	5046.068
5. Daur	1432.134[b]	656.009	2586.816[a]	951.629
6. Dong	48.212	69.223	68.102	91.598
7. Dongxiang	1284.739[a]	488.076	1515.314[a]	433.379
8. Gelao	27,798.940[a]	9578.905	−4593.947	4339.398
9. Han	−1.350[a]	0.319	−1.421[a]	0.359
10. Hani	−24,297.300[b]	11,902.110	−1843.340	8839.561
11. Hui	10.359[b]	4.765	13.374[b]	6.508
12. Jingpo	245,643.800[a]	75461.210	60,181.957[a]	33170.5
13. Kazak	−9719.600	11,494.670	−10010.414[a]	3264.211
14. Kirgiz	−17,486.600	19,645.340	5896.574[b]	2606.726
15. Korean	−44.290	70.080	−91.085	103.646
16. Lahu	1913.425	34,644.910	69,627.249[a]	27,110.080
17. Li	−25132.900[a]	9002.619	−249.689	262.76
18. Lisu	8126.747	6308.788	7117.415	7282.878
19. Manchu	52.555[a]	11.183	48.142[a]	17.541
20. Maonan	2042.121[c]	1088.550	4115.362[b]	1693.773
21. Miao	2.001	23.957	−7.926	34.356
22. Mongol	35.200	26.217	132.086[a]	36.313
23. Mulao				
24. Naxi			−2385.250	8354.333
25. Qiang	4665.429	16,645.120	35,288.611[a]	12,540.510
26. Salar				
27. She	58.482	152.286	452.580[c]	245.120
28. Shui			−4178.755	2932.771
29. Tibetan	45.738	35.168	9.441[b]	4.825
30. Tu	−415.235	1047.778	3469.553[c]	2133.557
30. Tujia	−8.852	11.024	−8.700	14.283
31. Uygur	1081.944	2407.569	1386.841	1977.202
32. Va	12,915.170	13,274.480	−42,682.902[a]	11,427.990
33. Xibe	−65.376	411.421	−194.667	660.486
34. Yao	21.566	75.760	80.423	101.235
35. Yi	9.209	36.782	−4.697	40.519
36. Zhuang	45.252	33.230	98.107[b]	42.746
Coefficient of correlation (R^2)	0.745		0.645	
Standard error of regression	0.725		1.095	
F statistic	29.877		20.337	
Sig. of regression	0.000		0.000	
Number of observations	405		451	

Only the coefficients on ethnic variables are included in this table. The ethnic variables whose variance inflation factors (VIFs) are larger than 10 are omitted from regressions

"a", "b", and "c"Denote statistically significant at greater than the 1, 5, and 10 % levels, respectively

Salar, She, Shui, Tibetan, Tu, Tujia, Uygur, Va, Xibe, Yao, Yi, and Zhuang) are not found to have any significant influences on trade.

- As for 2010, 14 ethnic groups (Lahu, Qiang, Jingpo, Tu, Mongol, Manchu, Hui, Zhuang, Dongxiang, Daur, Kirgiz, She, Maonan, and Tibetan) have positive effects on interprovincial trade; five ethnic groups (Han, Va, Kazak, Dai, and Blang) have negative effects; and 18 ethnic variables (Bai, Buyi, Dong, Gelao, Hani, Korean, Li, Lisu, Miao, Mulao, Naxi, Salar, Shui, Tujia, Uygur, Xibe, Yao, and Yi) are not found to have any significant influences on trade.

Remember that there is a negative relationship between China's interprovincial ethnic links and trade, which can be witnessed by the negative coefficients on ETHNIC56 in Tables 4 and 5. Then why there are fewer ethnic groups with negative influences on interprovincial trade than those with positive influences? This may plausibly stem from the very fact that the Han majority whose estimated coefficients are negative for both 2000 and 2010 (see Table 6) has a much larger weight than any other ethnic minorities.

Using the estimated coefficients reported in Table 6, one may calculate each ethnic group's contribution to interprovincial trade (the results are reported in Table 7). Here, take the Hui ethnic group as an example. As shown in Table 3, the minimum, maximum, and mean values of interprovincial ethnic links—represented by $ETHNIC_{ij11}$ in Eq. (2)—are 0.00020 (i.e., the one for Jiangxi and Zhejiang), 0.14827 (i.e., the one for Ningxia and Qinghai), and 0.00356, respectively, in 2010. Given that the estimated coefficient on $ETHNIC_{ij11}$ is 13.374 (shown in Table 6), the Hui's contribution to interprovincial trade in 2010 ranges from 0.268 (that is, $\exp(0.00020 \times 13.374) \times 100 - 100$) percent to 626.423 (that is, $\exp(0.14827 \times 13.374) \times 100 - 100$) percent, with the mean value being 4.876 (that is, $\exp(0.00356 \times 13.374) \times 100 - 100$) percent.

It must be noted that the estimated coefficients on some important ethnic minorities—such as Miao, Tibet, Uygur, Xibe, Yao, Yi and Zhuang—are statistically insignificant in either 2000 or 2010 (see Table 6). Technically, if an ethnic group is not found to exert any significant influences on China's interprovincial trade, it may have, subject to different economic conditions, both positive and negative effects on the trade of different groups of provinces. In order to test this kind of non-linear effects, let us run Eq. (3). Since, as mentioned earlier, the quality of 2000's ethnic data is less reliable than that of 2010's, we only test the regression by using 2010's data. Unfortunately, we cannot derive more encouraging results (the estimated coefficients are not reported here).

Nevertheless, we do find that some ethnic groups (such as the Hui, the Mancu, the Mongol, and the Zhuang) have some non-linear influences on interprovincial trade. Specifically, the above regression yields not only positive coefficients on these ethnic minorities (i.e., $\beta_k > 0$) but also a negative coefficient (i.e., $\alpha_4 < 0$) on the interaction of ETHNIC56 and the income levels of trading partners (measured by the natural log of their per capita GDPs). However, since the threshold value—i.e., $\ln(GDPPC_i GDPPC_j)_k^*$ defined in Eq. (4)—is extremely large, the fundamental changes of these ethnic groups' positive effects on interprovincial trade will not occur in the near future.

Conclusions

During the past decades, along with the gradual reform in the decentralization of authority (that is, transferring economic management and decision making from the

Table 7 Quantifying the ethnic groups' contributions to interprovincial trade (%)

Ethnic group	2000			2010		
	Minimum value	Maximum value	Mean value	Minimum value	Maximum value	Mean value
1. Bai						
2. Blang				0.000	−99.734	−2.643
3. Buyi	−2.057	−98.996	−12.583			
4. Dai				−3.191	−83.380	−18.414
5. Daur	0.085	350.646	1.170	0.154	1417.056	2.123
6. Dong						
7. Dongxiang	0.047	3668.286	2.256	0.056	7127.996	2.666
8. Gelao	6.748	882,465.122	51.102			
9. Han	−10.450	−73.957	−63.703	−10.968	−75.736	−65.587
10. Hani	−6.241	−96.533	−22.619			
11. Hui	0.207	364.588	3.762	0.268	626.423	4.876
12. Jingpo	0.000	6032.297	53.249	0.000	174.133	11.025
13. Kazak				−4.219	−99.922	−22.057
14. Kirgiz				0.035	19,224.296	1.813
15. Korean						
16. Lahu				2.019	737.508	28.358
17. Li	−19.574	−10.000	−57.647			
18. Lisu						
19. Manchu	0.584	425.169	5.992	0.535	356.895	5.475
20. Maonan	0.027	412.995	0.697	0.054	2598.034	1.410
21. Miao						
22. Mongol				0.626	941.393	7.657
23. Mulao						
24. Naxi						
25. Qiang				3.181	425.512	28.270
26. Salar						
27. She				0.096	298.641	1.680
28. Shui						
29. Tibetan				0.015	904.629	0.759
30. Tu				0.919	6409.243	10.314
30. Tujia						
31. Uygur						
32. Va				−6.882	−91.864	−37.559
33. Xibe						
34. Yao						
35. Yi						
36. Zhuang				0.531	1238.236	3.037

Figures in each row, which are calculated based on Tables 2 and 6, represent percentages by which provinces that are linked by the left-side ethnic group would increase (or decrease if the figures are negative) bilateral trade as opposed to those that are not linked by the same ethnic group. Blank denotes unavailability since either the ethnic variables are omitted from the regressions or the estimated coefficients are statistically insignificant in Table 6

central government to provincial and local governments), China's interprovincial relations have been transformed accordingly. Naturally, the examination of the driving forces to the causes and consequences of interprovincial economic (dis)integration in

China is an important taskforce not only to the economists but also to the policy-makers who have concerns about their internal spatial economic efficiencies.

It has been found that ethnic Chinese (mainly encompassing the Han ethnic Chinese) networks play an important role in international trade. Rauch and Trindade (2002), for example, find that ethnic Chinese networks have a quantitatively important impact on bilateral trade through the mechanisms of market information and matching and referral services, in addition to their effect through community enforcement of sanctions that deter opportunistic behavior. Their estimated results show that for trade between countries with ethnic Chinese population shares at the levels prevailing in Southeast Asia, the smallest estimated average increase in bilateral trade in differentiated products attributable to ethnic Chinese networks is nearly 60 %.[11]

However, in this paper, we have not found any evidence that supports that the Han majority has played positive roles in China's interprovincial trade. Although it seems that more in-depth investigation is still needed, we believe that our small and negative coefficients on the Han (see Table 6) stem from the very fact that the Han majority accounts for more than 90 % of China's total population (more than 1.3 billion). A large population per se also implies a great degree of diversity or dissimilarity of its members (Alesina and Spolaore 1997, p. 1029). As a result, a common standard cannot be fully realized among different provinces' Han people in China.

To develop this argument further, let us assume that China's domestic trade can be divided into interprovincial and intra-provincial trade, on the one hand, and interethnic and intra-ethnic trade, on the other hand. Obviously, according to the cost of transactions, intra-provincial trade is always preferable to interprovincial trade and intra-ethnic trade is preferable to interethnic trade. Therefore, ceteris paribus, the intra-provincial and intra-ethnic trade is always more profitable than the interprovincial and interethnic trade. If the population of an ethnic group is very small, then the intra-provincial and intra-ethnic trade is not able meet the demand of economic growth. As a result, the interprovincial and intra-ethnic and intra-provincial and interethnic trade may still be needed. In this case, the interprovincial and intra-ethnic trade is preferable to the intra-provincial and interethnic trade if the interprovincial transactions cost is lower than interethnic transactions cost, and vice versa. Figure 2, in which smaller ethnic groups have greater (in both positive and negative directions) effects on interprovincial trade, has provided evidence that small ethnic groups are always more important in promoting interprovincial trade than large ethnic groups.

We need to clarify the inherent forces and narratives behind the differing influences of all the ethnic minorities on China's spatial economic (dis)integration. For example, the Han-Uyghur unrest in and outside Xinjiang would have been responsible for the Uyghurs' insignificant effects on interprovincial trade; and Tibetans' positive influences on interprovincial trade in 2010 has benefited from the Qinghai–Tibet railway which went into operation in 2006. With the operation of the Qinghai–Tibet railway, the costs of transportation of both passengers and goods should be greatly reduced, allowing for an increase in volume—the costs per ton-kilometer will be reduced from 0.38 yuan to 0.12 yuan (Cnradio, 10 November 2006). As a result, more commodities will be carried to and from Tibet by the

Fig. 2 Ethnic influence on interprovincial trade decreases with the size of ethnic population
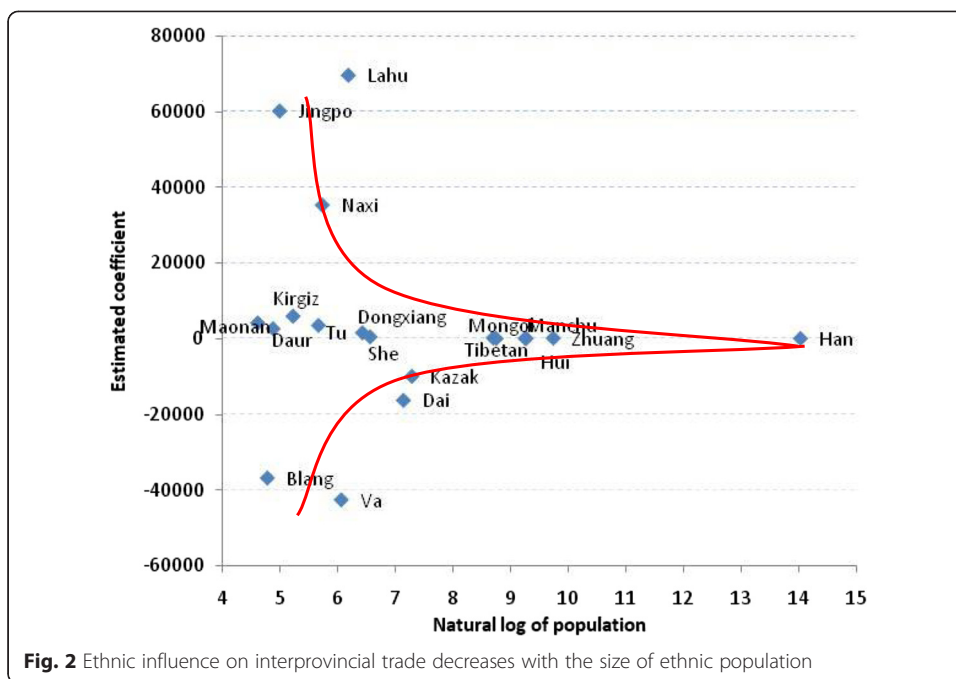
railway. However, it seems that I am not able to clarify all the influences of each and all of China's 56 ethnic groups in a single paper.

Since China adopted different approaches when conducting the population census in 2000 and 2010, our ethnic data may not be comparable from 2000 to 2010. Therefore, cares should be taken when the changes of ethnic influences on interprovincial trade from 2000 to 2010 are to be clarified. But our estimated coefficients for 2010 seem to be more reliable than those for 2000 (shown in Table 6). If the 2010's results shown in Table 7 are correct, we may conclude that 14 ethnic groups (Lahu, Qiang, Jingpo, Tu, Mongol, Manchu, Hui, Zhuang, Dongxiang, Daur, Kirgiz, She, Maonan, and Tibetan) tend to contribute to China's interprovincial trade, that five ethnic groups (Han, Va, Kazak, Dai, and Blang) tend to retard China's interprovincial trade. These findings will be useful for policy makers to reappraise which of China's ethnic groups are playing the most (least) important roles in, and to introduce the optimal informal institutions into, the promotion of interprovincial economic cooperation in China.

It must be noted that interprovincial trade may also foster the interprovincial migration of ethnic groups in China, raising an issue of potential endogeneity in the analysis of ethnic influences on interprovincial trade in this paper. However, since our ethnic data only include permanent populations and that most, if not all, seasonable, short-stay migrants have only been officially defined as the "floating populations" (liudong renkou), this kind of potential endogeneity problem does not render the estimated results biased and inconsistent.

In order to overcome the problems with multicollinearity, we have omitted a number of ethnic groups from our regressions. The general rule of thumb is that variance inflation factor (endogeneity) exceeding 4 warrant further investigation, while those exceeding 10 are signs of serious multicollinearity requiring correction (Simon 2004). In weaker models, especially in those that are not supported by

large sets of data, VIF above 2.5 may also merit further investigation (Berry and Feldman 1985, p. 49; Arceneaux and Huber 2007). In this paper, we have re-run all the regressions in Table 6 by omitting the explanatory variables with VIF exceeding 4 (the estimated results are not reported here). But we have found that the estimated results are quite stable after the variables with the VIF exceeding 10 are omitted from the regressions. Thus, even though the variables with VIF exceeding 4 are included, the estimated coefficients reported in this paper are not affected by multicollinearity.

Endnotes

[1]Calculated by author based on the data released by the World Trade Organization (Available at http://www.wto.org/english/thewto_e/countries_e/china_e.htm. Accessed 2013-5-20).

[2]Data sources: Rumbaugh and Blancher (2004) and WTO (2011).

[3]Note that Beijing and Shanghai's reductions of domestic trade from 2000 to 2010 are mainly due to their removals of large industrial, pollution-making plants during the above period.

[4]For a more detailed analysis of the distance puzzle, see Head and Disdier (2008).

[5]These trade barriers take a number of forms including legal and institutional differences (Anderson and Marcouiller 2002; Linders et al. 2005; Combes et al. 2005; and Guiso et al. 2006), ethnic/linguistic fractionalization (Rauch 2001; Rauch and Trindade 2002; Melitz 2008; and Felbermayr et al. 2010), and linguistic and religious dissimilarities (Guo 2004; 2007).

[6]The earliest application of the gravity model can be traced back to the 1940s (see, e.g., Zipf 1946; Stewart 1948). More recent summaries can be found in Baldwin and Taglioni (2006) and Head and Mayer (2013).

[7]Since GDPPC equals GDP/POP (where POP is population), Eq. (1) can be written as $\ln(\text{TRADE}_{ij}) = \alpha_0 + (\alpha_1 + \alpha_4)\ln(\text{GDP}_i\text{GDP}_j) + \alpha_2\ln\text{DISTANCE}_{ij} + \alpha_3\text{ADJACENT}_{ij} - \alpha_4\ln(\text{POP}_i\text{POP}_j) + \alpha_5\text{PD} + \beta\text{ETHNIC56}_{ij}$. However, we will not use this equation since the inclusion of GDP and POP—unlike that of GDP and GDPPC—can easily result in multicollinearity problems.

[8]A direct measure of transport costs (instead of distance) has been suggested as a proxy for trade costs, especially for within-country studies (Combes et al. 2005). However, since we only consider the trade via national railways in our research and that the per-kilometer costs of transportation via national railways are almost fixed throughout China, these two measures are not different from each other.

[9]They are compiled by China Association of Communications and Transportation and the National Development and Reform Commission of the PRC and published by China Communications Yearbook Press in 2001 and 2011, respectively.

[10]Several other methods can also be used. Boisso and Ferrantino (1997), for example, use $\Sigma x_k y_k$ as the construct of similarity index. However, Eq. (6) can prevent the index of interprovincial ethnic linkages from further reduction when the values of x_k and y_k are small.

[11]More recently, there is an empirical work in which the Chinese network is found to lead to a modest amount of trade creation of only about 15 % (Felbermayr et al. 2010).

Appendix

Table 8 Names and demographic distributions of China's 56 ethnic groups

Name	Population (thousand persons)	Five major host provinces
Achang*	39.56	Yunnan, Guangdong, Henan, Shandong, Jiangsu
Bai	1933.51	Yunnan, Guizhou, Hunan, Guangdong, Zhejiang
Baonan*	20.07	Gansu, Qinghai, Xinjiang, Inner Mongolia, Yunnan
Blang	119.64	Yunnan, Guangdong, Shandong, Zhejiang, Chongqing
Buyi	2870.03	Guizhou, Zhejiang, Guangdong, Yunnan, Fujian
Dai	1261.31	Yunnan, Sichuan, Guangdong, Zhejiang, Shandong
Daur	131.99	Inner Mongolia, Heilongjiang, Xinjiang, Beijing, Liaoning
Deang*	20.56	Yunnan, Guangdong, Shandong, Zhejiang, Sichuan
Derung*	6.93	Yunnan, Guizhou, Henan, Guangdong, Sichuan
Dong	2879.97	Guizhou, Hunan, Guangxi, Zhejiang, Guangdong
Dongxiang	621.50	Gansu, Xinjiang, Qinghai, Ningxia, Guizhou
Ewenki*	30.88	Inner Mongolia, Heilongjiang, Liaoning, Beijing, Shandong
Gaoshan*	4.01	Henan, Fujian, Guangxi, Liaoning, Hebei
Gelao	550.75	Guizhou, Zhejiang, Guangdong, Guangxi, Yunnan
Han	1,220,844.52	Guangdong, Shandong, Henan, Jiangsu, Sichuan
Hani	1660.93	Yunnan, Guangdong, Zhejiang, Shanghai, Shandong
Hezhe*	5.35	Heilongjiang, Guangdong, Jilin, Beijing, Liaoning
Hui	10,586.09	Ningxia, Gansu, Xinjiang, Henan, Qinghai
Jing*	28.20	Guangxi, Guizhou, Yunnan, Guangdong, Jiangxi
Jingpo	147.83	Yunnan, Guangdong, Shandong, Guizhou, Jilin
Jino*	23.14	Yunnan, Sichuan, Chongqing, Guangdong, Jiangsu
Kazak	1462.59	Xinjiang, Henan, Guangdong, Gansu, Hunan
Kirgiz	186.71	Xinjiang, Tibet, Heilongjiang, Guangdong, Zhejiang
Korean	1830.93	Jilin, Heilongjiang, Liaoning, Shandong, Beijing
Lahu	485.97	Yunnan, Shandong, Zhejiang, Guangdong, Jiangsu
Lhoba*	3.68	Tibet, Guizhou, Fujian, Beijing, Liaoning
Li	1463.06	Hainan, Guizhou, Guangdong, Zhejiang, Guangxi
Lisu	702.84	Yunnan, Sichuan, Hebei, Shandong, Guangdong
Manchu	10,387.96	Liaoning, Hebei, Jilin, Heilongjiang, Inner Mongolia
Maonan	101.19	Guangxi, Guizhou, Guangdong, Zhejiang, Fujian
Miao	9426.01	Guizhou, Hunan, Yunnan, Chongqing, Guangxi
Monba*	10.56	Tibet, Jiangsu, Gansu, Jiangxi, Guangxi
Mongol	5981.84	Inner Mongolia, Liaoning, Hebei, Xinjiang, Jilin
Mulam	216.26	Guangxi, Guizhou, Guangdong, Zhejiang, Hunan
Naxi	326.30	Yunnan, Sichuan, Tibet, Zhejiang, Beijing
Nu*	37.52	Yunnan, Hainan, Guangdong, Tibet, Shandong
Oroqen*	8.66	Heilongjiang, Inner Mongolia, Liaoning, Beijing, Hebei
Pumi*	42.86	Yunnan, Sichuan, Guangdong, Shandong, Chongqing
Qiang	309.58	Sichuan, Guangdong, Guizhou, Zhejiang, Jiangsu
Russian*	15.39	Xinjiang, Inner Mongolia, Beijing, Heilongjiang, Shanghai
Salar	130.61	Qinghai, Gansu, Xinjiang, Shanghai, Guangdong
She	708.65	Fujian, Zhejiang, Jiangxi, Guizhou, Guangdong
Shui	411.85	Guizhou, Guangxi, Jiangsu, Zhejiang, Yunnan

Table 8 Names and demographic distributions of China's 56 ethnic groups *(Continued)*

Tajik*	51.07	Xinjiang, Zhejiang, Guangdong, Jiangxi, Shandong
Tatar*	3.56	Xinjiang, Guangdong, Guangxi, Beijing, Jiangsu
Tibetan	6282.19	Tibet, Sichuan, Qinghai, Gansu, Yunnan
Tu	289.57	Qinghai, Gansu, Guangdong, Yunnan, Guizhou
Tujia	8353.91	Hunan, Hubei, Guizhou, Chongqing, Zhejiang
Uygur	10,069.35	Xinjiang, Beijing, Hunan, Guangdong, Zhejiang
Uzbek*	5.67	Xinjiang, Zhejiang, Guangdong, Beijing, Hunan
Va	429.71	Yunnan, Shandong, Guangdong, Zhejiang, Henan
Xibe	190.48	Liaoning, Xinjiang, Heilongjiang, Jilin, Inner Mongolia
Yao	2796.00	Guangxi, Hunan, Guangdong, Yunnan, Guizhou
Yi	8714.39	Yunnan, Sichuan, Guizhou, Zhejiang, Guangdong
Yugur*	14.38	Gansu, Xinjiang, Qinghai, Beijing, Shandong
Zhuang	16,926.38	Guangxi, Yunnan, Guangdong, Zhejiang, Guizhou

The Sixth National Population Census of the People's Republic of China (conducted at 0:00 a.m. on November 1, 2010)
"*"Denotes that ethnic groups are not analyzed as individual variables in this paper

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