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China's Regional Trade and Domestic Market Integrations

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Abstract

The global economic crisis in 2007 forced China to move from export-led growth to promoting domestic demand. The move is significant, but the success of this new growth strategy depends critically on the level of domestic market integrations. In this paper, we use the methodology proposed by Anderson and Wincoop to examine China's domestic market integrations. We find evidence of border effects at both national and regional levels with significant regional differences, but they are smaller than some earlier studies suggest. Income growth, lower transportation costs, and higher intra-industry trade all have positive effects on China's regional trade. Among the factors affecting regional trade, a better business environment has the largest positive impact on lifting China's domestic trade between regions, especially in intermediate goods, suggesting that improving business environment should be the priority of government at all levels in China.

1. Introduction

In response to the global economic crisis of 2007, the Chinese government launched a bailout plan of 4 trillion yuan in November 2008 and expressed its desire to promote domestic demand and expand internal markets. Household consumption is a key component of GDP in the West and accounts for more than 70% of GDP in the US. But it has been less than 40% of China's GDP, although China's population is four times larger than the US's whereas its GDP is about half. Hence, this new strategy signifies China's move onto the path of long-run sustainable growth, but its success depends on the integrations of China's internal markets.

Market integrations can be examined by border effects. In the presence of border effects, one can observe higher volumes of intra-regional trade than inter-regional trade. In developed countries, domestic markets are fairly integrated and border effects tend to be small. For example, Wolf (2000) found that the border effect for the US in 1993 was three to five times. Head and Mayer (2000) found that the border effect in Europe was 21 times at the end of the 1970s, but had reduced to 11.3 times by 1995.

China's central planning past implies internal market segmentation. In the literature, there are two divergent views about the effects of post-reform decentralization on China's internal markets. Some contend that decentralization has created regional and provincial administrative fragmentation, leading to growing local protectionism and trade barriers in China's regional markets. For instance, Young (2000) argues that

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China's high ratio of foreign trade to GDP is a sign of intra-national trade barriers rather than international economic openness; although China's foreign trade increased drastically after the economic reform, the intensity of provincial trade in China actually declined between 1987 and 1997. Zheng and Li (2003) find that improvements in technical efficiency after the decentralization are not enough to make up the efficiency loss of industrial structural distortions and misallocation of resources in the regions; consequently, regional segmentation in China becomes more evident. Poncet (2005) finds increasing trade barriers in China's inter-provincial trade, equivalent to a tariff of 48% in 1992 and 53% in 1997, higher than the 45% tariff found for the European Union and the Canada–US border at the beginning of the 1990s.

But other researchers disagree. They argue that decentralization has drastically increased market competition in China and forced local governments to become more competitive and open; as a result, domestic markets have become more integrated in post-reform China. For example, Naughton (2000) challenges the view that China is a group of insufficiently specialized regional economies by comparing inter-provincial trade data between 1987 and 1992. He finds that the growth of inter-provincial trade in 1987–1992 exceeds that of provincial GDP and foreign trade during the same period, suggesting that China is much more like a single country than a close-knit international trading bloc. Xu (2002) uses an error-component model to analyze the pattern of provincial economic integration in China between 1991 and 1998 and finds evidence of market integrations of the Chinese provinces. Using 2-digit regional manufacturing data, Fan (2004) finds evidence of increased levels of specialization in China's six regions; the level of specialization rose in all six regions between 1980 and 2001 and the national weighted-average index of specialization rose from 0.287 in 1980 to 0.455 in 2001. In another study, Fan and Wei (2006) adopt the method of panel unit root tests and nonlinear mean reversion to investigate price convergence in China. They uncover evidence of price convergence to the law of one price in China for an overwhelming majority of goods and services. Gui et al. (2006) discover similar evidence on regional price convergence. In a more recent study, Li and Hou (2008) also find evidence of relative price convergence at industry level across various regions in China.

In this paper, we use a gravity model, an input–output dataset, and survey data from Li and Hou (2008) to investigate border effects in China's regional markets. In addition to income and distances, we explicitly investigate the effects of intra-industry trade, transportation costs, and investment environment on regional trade and border effects. We also examine border effects for regional trade in final goods and intermediate goods independently. Our results reveal smaller border effects in China's regional markets than those found in some earlier studies. They support the view that domestic markets have become more integrated in the post-reform China. Among all factors under investigations, better business environment has the largest positive effects on lifting China's regional trade. Therefore, to achieve the goal of promoting domestic demand, improving business environment further should be the priority of governments at all levels in China.

2. The Gravity Model

The empirical analysis in this study is based on the gravity model. Because of its robust explanatory power on bilateral trade, it is widely adopted by researchers to investigate various trade related issues (e.g. McCallum, 1995; Wei, 1996; Helliwell, 1997; Head and Mayer, 2000; Wolf, 2000; Evans, 2003; Anderson and Wincoop, 2003; Chen, 2004).

The popular gravity equation proposed by McCallum (1995) takes the following form

$$ln\, x_{ij} = \alpha + \beta_1\, ln\, y_i + \beta_2\, ln\, y_j + \beta_3\, ln\, d_{ij} + \beta_4 \delta_{ij} + \varepsilon, \tag{1}$$

where x_{ij} is region i's export to region j, y_i and y_j are the gross income in regions i and j, d_{ij} is the distance measure between regions i and j, δ_{ij} is a dummy variable to measure home bias, and ε is the *iid* error term. Anderson and Wincoop (2003) argue that the McCallum-type gravity model ignores the effects of multilateral trade resistance; in the absence of such multilateral resistance, the estimates are biased due to omitted variables. Following them, we adopt the gravity model given by:[1]

$$ln(z_{ij,k}) = \alpha + \beta_1\, ln(d_{ij}) + \beta_2 Home + \beta_3\, ln(\theta_i) + \beta_4\, ln(\theta_j) + \gamma_k H_{ij} + \varepsilon, \tag{2}$$

where $z_{ij} \equiv x_{ij}/y_i y_j$, i and j indicate the supply and demand regions, respectively, k indicates industry, and α is a constant. In (2), $x_{ij,k}$ is the supply of industry k's products from region i to region j, y_i is the value of production in region i, and y_j is region j's income. Thus our dependent variable, $z_{ij,k}$ is the supply of industry k's products from region i to region j weighted by the product of income in regions i and j. d_{ij} measures the remoteness between region i and region j, while θ_i and θ_j measure the income share in regions i and j, respectively. H_{ij} is a vector of control variables to be discussed below, and γ is a vector of the parameters. *ln* stands for natural logarithms, and ε is a Gaussian white noise error term.

Bilateral trade is subject to the law of gravity. While economic growth, improved economic environment, rising income, and sound economic policies promote trade, geographical barriers, cultural and social differences, transportation costs, and other trade barriers impede the flow of bilateral trade. Hence, *ex ante*, the estimate of β_1 is expected to be negative.[2] *Home* is the dummy variable, measuring the border effect. It is equal to one for intra-regional trade and zero for inter-regional trade. The estimate of β_2 will be insignificant in the absence of border effects but significantly positive when border effects are present. The antilog of β_2, i.e. $(\exp(\beta_2) - 1)$, measures the size of the border effect (Chen, 2004). A rising income share of region i will lead to a higher consumption demand in the region and reduces its exports to region j. Similarly, a rising income share of region j will lead to a higher consumption demand in the region and increases its imports from region i. Hence, *ex ante*, we expect the estimate of β_3 to be negative and that of β_4 to be positive.

In addition to income and distance, many factors affect the volume of trade. If those factors are not properly controlled, empirical results can be misleading (Xu, 2002) and the size of the border effect derived from the estimate of β_2 will be inaccurate and unreliable.[3] Therefore, we construct the following proxies as our control variables.

Intra-industry trade has become increasingly important in modern trade, and a large fraction of trade nowadays is intra-industry in nature. Many studies have found correlations between trade barriers and the levels of intra-industry trade (e.g. Loertscher and Wolter, 1980; Balassa, 1986; Balassa and Bauwens, 1987; Davis, 1995; Evenett and Keller, 2002). The best known index for measuring intra-industry trade is the Grubel-Lloyd index (Grubel and Lloyd, 1975), which is given by:

$$IIT_{ij} = 100 * \left(1 - \frac{\sum_{k=1}^{n} |X_{ij,k} - M_{ij,k}|}{\sum_{k=1}^{n} (X_{ij,k} + M_{ij,k})} \right) \tag{3}$$

where k is an identifier for a particular industry, and there are n different industries. $X_{ij,k}$ and $M_{ij,k}$ indicate the export (supply) and import (demand) in industry k, respectively. Since our focus is regional trade at a specific industry level, we modify the index in (3) by not summing up the trade in all industries, namely,[4]

$$IIT_{ij,k} = \left(1 - \frac{|X_{ij,k} - M_{ij,k}|}{(X_{ij,k} + M_{ij,k})} \right). \tag{4}$$

We expect a positive sign for the estimate.

Geographical barriers are an important factor in explaining economic growth and regional disparities (Démurger, 2001; Redding and Venables, 2004). In addition to distances between regions, an appropriate measure of geographical barriers is transportation cost. High transportation costs are a deterrent of regional trade. Chen (2004) argued that the distance variable may not capture the effect that different goods are subject to different transportation costs when trade flows are disaggregated at the industry level. To control for such effects, Chen adopted the weight-to-value ratio proposed by Hummels (1999). Based on the available data, we construct the following index to measure inter-regional transportation costs,[5]

$$TC_{ijk} = \frac{FT_{ijk}}{V_{ijk}}. \tag{5}$$

TC_{ijk} stands for transportation costs, FT_{ijk} is the value of freight traffic, including the goods in the warehouse waiting to be transported, and V_{ijk} is the value of total trade of the k industry between regions i and j, for $i \neq j$. For intra-regional transportation costs of the k industry in region i, the variable is calculated as the value of freight traffic of the k industry in region i divided by the value of total trade of the k industry in region i. Since increases in transportation costs discourage regional trade, we expect a negative sign for the estimate.

Numerous studies show that political and economic environments are important factors that affect trade and growth (e.g. Li and Xu, 2007; Xu and Li, 2008). Favorable political and economic policies promote economic growth and trade both within a region and between regions. Therefore, we construct a proxy to measure regional business environment in China. In 2003, the Development and Research Center of the State Council conducted a national survey concerning China's regional economic environment for investment and business operation. The survey covers various enterprises in China's 31 provinces and municipalities and lasted for more than four months. 3,156 enterprises from all over China responded to the survey. The principle authors, Li and Hou (2008), reported the survey data in a book, entitled *China Coordinated Regional Development and Market Integration*, which was published by Economic Science Press in Beijing in 2008. Our variable for business environment in this study is a composite index, which is derived from the survey data reported in Chapter 13 of the book using the method of Principal Component Analysis. This composite index is computed based on the scores of five indices for China's regional environment for investment and business operation: legal, credit, financial, market, and social environments. The score for each index ranges from one to five. A higher score indicates better regional environment for investment and business operation. This regional composite index used in the estimations is the arithmetic mean of the scores for the corresponding provinces in the region. Since improvements in business environment promote regional trade, we expect the estimate for this variable to be positive.

3. The Data

The data are obtained from the Economic Forecast Division of China State Information Center, which compiled “Multi-regional Input–Output Model for China.” The input–output model has been compiled at the industry level, covering 30 sectors and 18 industries. Unlike the dataset used in earlier studies, which typically include only aggregated unidirectional trade volumes from one province to another, this dataset contains information about bidirectional regional trade volumes at the industry level, i.e. imports by a region from other regions, as well as exports from the region to the others. In addition, it also includes both final demand and intermediate demand of each industry in a region. Because the final demand is not available for three industries (Smelting and Pressing of Ferrous and Non-Ferrous Metals, Machinery Repairing, and Recycling and Waste Disposal), they are excluded from the study. Consequently, our data covers 15 industries and 21 sectors, which are listed in Table 1. The first three digits (0XX) in the parenthesis correspond to China’s industry code. The two digits after the letter C (CXX) correspond to the code of a sector in China.

Table 1. The 15 Industries and 21 Sectors

Industries	*Sectors*
Food and Tobacco (006)	Food Production (C14); Manufacture of Tobacco (C16)
Textile (007)	Manufacture of Textile (C17)
Garments, Leathers and Fiber Products (008)	Garments and Other Fiber Products (C18); Leathers, Furs, Down and Related Products (C19)
Timber Processing and Furniture Manufacture (009)	Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products (C20); Manufacture of Furniture (C21)
Paper, Printing, and Cultural and Sports Goods (010)	Papermaking and Paper Products (C22); Printing, Reproduction of Recording Media (C23); Cultural, Educational and Sports Goods (C24)
Petroleum and Coking (011)	Petroleum Refining and Coking (C25)
Chemical (012)	Raw Chemical Materials and Chemical Products (C26)
Nonmetal Mineral Products (013)	Nonmetal Mineral Products (C31)
Metal Products (015)	Manufacture of Metal Products (C34)
Machinery Manufacture (016)	Manufacture of General Purpose Machinery (C35); Manufacture of Special Purpose Machinery (C36)
Transport Equipment (017)	Manufacture of Transport Equipment (C37)
Electrical Machinery and Equipment (018)	Electrical Machinery and Equipment (C40)
Telecommunications (019)	Electronic and Telecommunications (C41)
Instruments, Meters, Cultural and Clerical Machinery (020)	Instruments, Meters, Cultural and Clerical Machinery (C42)
Other Manufacture (022)	Other Production (C43)

Table 2. The Eight Regions and the Provinces in Each Region[a]

Regions	*Provinces*
(1) Northeast Region	Heilongjiang, Jilin, and Liaoning
(2) North Municipalities	Beijing and Tianjin
(3) North Coastal Region	Hebei and Shandong
(4) Central Coastal Region	Shanghai, Jiangsu, and Zhejiang
(5) South Coastal Region	Fujian, Guangdong, and Hainan
(6) Central Region	Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi
(7) Northwest Region	Inner Mongolia, Shaanxi, Ningxia, Gansu, Qinghai, and Xinjiang
(8) Southwest Region	Sichuan, Chongqing, Yunnan, Guizhou, Guanxi, and Tibet

Notes: (a) Tibet is not included in the input-output table and thus in our study because of a lack of data.

Table 3. Summary Statistics[a]

	Obs	*Mean*	*Std Dev.*	*Minimum*	*Maximum*
$Ln(X_{ij,k})$	960	11.571	2.056	5.352	17.467
$Ln(Y_{i,k})$	960	15.345	1.126	11.875	17.698
$Ln(Y_j)$	960	18.191	0.479	17.269	18.741
$Ln(\theta_i)$	960	–2.395	0.838	–4.310	0.798
$Ln(\theta_j)$	960	–2.181	0.479	–3.103	–1.631
$Ln(Wei_{ij})$	960	6.767	0.800	4.497	7.718
$Ln(Transport_{ij,k})$	960	–3.582	1.144	–6.644	–0.062
Env	960	3.282	0.180	3.032	3.569
$Ln(IIT_{ij,k})$	960	–0.561	0.486	–3.064	0.000
$Ln(FE_{ij,k})$	960	10.017	2.303	1.946	16.730
$Ln(IE_{ij,k})$	960	11.163	2.047	5.226	17.412

Notes: (a) $\boldsymbol{Ln(X_{ij,k})}$ is the supply from region i to region j, including both inter-regional $X_{ij,k}$ ($i \neq j$) and intra-regional $X_{ij,k}$ ($i = j$) trade volumes. $\boldsymbol{Ln(Y_{i,k})}$ is the value of production in region i in industry k, while $\boldsymbol{Ln(Y_j)}$ is region j's income measured by the value-added in the region. $\boldsymbol{Ln(\theta_i)}$ and $\boldsymbol{Ln(\theta_j)}$ are the income shares of regions i and j. $\boldsymbol{Ln(Wei_{ij})}$ is the distance measure based on Wei (1996). $\boldsymbol{Ln(Transport_{ij,k})}$ is the index of transportation costs. $\boldsymbol{Env}$ is the composite index for business environment. $\boldsymbol{Ln(IIT_{ij,k})}$ is the index for intra-industry trade. $\boldsymbol{Ln(FE_{ij,k})}$ and $\boldsymbol{Ln(IE_{ij,k})}$ are expenditures on final goods and intermediate goods supplied by region i to region j. $\boldsymbol{Ln}$ is the identifier for natural logarithms.

Mainland China has 31 provinces and municipalities. The input-output data compiled by China State Information Center, however, are only at the regional level. According to their geographical locations, the 31 provinces and municipalities are divided into eight regions. They are listed in Table 2.

Therefore, our data include 960 observations, covering 15 industries in eight regions. The summary statistics are presented in Table 3. All variables, except the composite index of business environment, are expressed in natural logarithms.

4. Empirical Results

The estimations in this study were performed using *Stata*. Due to the presence of heteroskedasticity, all tests were performed based on White heteroskedasticity-consistent errors.[6] In addition, there is evidence of the presence of regional and industry fixed effects, which are controlled in the estimations. For comparisons, however, we report the results without the fixed effects under column (1) in Table 4.

The results reported under columns (1) and (2) in Table 4 are obtained from the basic model in (1) without any control variables. The estimates are statistically significant at the 1% level, and the adjusted R^2 ranges from 0.717 to 0.786, suggesting that the gravity model explains the dependent variable well. The significantly negative estimate for the distance variable reveals regional trade in China is impaired by geographical distances. The estimate for the *Home* variable is significantly positive, indicating the presence of border effects in China's regional markets. But these results can be misleading because of omitted variable bias (Anderson and Wincoop, 2003). To correct the problem, we estimate various forms of the gravity model in (2) by including regional and control variables, as well as the income shares, to measure multilateral resistances.

The results are reported under columns (3)–(8) in Table 4, and they reveal a few interesting observations. First, the estimates in the basic model all carry the same signs and remain statistically significant at the 1% level in the extended model, indicating our results are robust. Second, the estimates for the income shares, θ_i and θ_j, carry the signs as expected, i.e. an increase in region *i*'s income reduces its exports to other regions and an increase in region *j*'s income increases its imports from region *i*. The estimate for θ_i is statistically significant at the 1% level under all models. The estimate for θ_j is statistically significant only at the 17% level for the models under columns (3)–(4) and (7)–(8) but at the 1% level for the models under columns (5) and (6) when the average border effect at the national level is broken down to regional border effects. Third, the estimates for transportation costs, business environment, and intra-industry trade all carry the signs as expected and are statistically significant at the 1% level. Since all variables, except the dummies, were measured in natural logarithms, the values of the estimates can be interpreted as the "elasticity" of bilateral trade volume with respect to a particular variable. Hence, a 1% increase in transportation costs will reduce the regional trade volume by approximately 0.75%. On the other hand, a 1% increase in the index of intra-industry trade will cause regional trade volume to rise by about 0.10%, whereas a 1%centage increase in the composite index of business environment will promote regional trade flow by about 2.61%–3.04%. Fourth, among all the variables in the extended model, the variable for business environment has the largest impact on promoting regional trade volume. This result signifies not only the importance of business environment in nursing regional trade in China but also the need for governments at all levels in China to continue improving business environment. Finally, compared with the basic model, the extended model is better. The adjusted R^2 increases sharply with the control variables being included in the regressions. For example, the adjusted R^2 is 0.786 for the basic model under column (2), but it becomes more than 0.920 for the extended model under columns (3)–(4) and (7)–(8) and 0.934 for the model under columns (5)–(6). In fact, we have used Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) to check for appropriate models. In all cases, both SBC and AIC pointed to the model under column (5) as the best model, with the value of SBC (AIC) being 1.325 (1.142) as compared to higher values from other specifications.

The estimate for the *Home* variable deserves special attention. First, the estimate remains significantly positive at the 1% level under all forms of the extended model, indicating the presence of border effects in China's regional markets. Second, with the inclusion of regional variables to control for transportation costs, business environment, intra-industry trade, and regional and industry fixed effects, as well as the

Table 4. Border Effects in China's Regional Markets[a]

Dependent variable: Ln($z_{ij,k}$)	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Ln(Wei$_{ij}$)	–0.864[b]	–0.755[b]	–1.022[b]	–1.018[b]	–0.974[b]	–0.973[b]	–1.017[b]	–1.014[b]
	(0.064)	(0.062)	(0.039)	(0.039)	(0.037)	(0.037)	(0.040)	(0.039)
Home	2.270[b]	2.496[b]	2.010[b]	1.841[b]				
	(0.135)	(0.142)	(0.090)	(0.119)				
Ln(θ_i)			–0.142[b]	–0.130[b]	–0.143[b]	–0.140[b]	–0.140[b]	–0.128[b]
			(0.031)	(0.031)	(0.029)	(0.029)	(0.031)	(0.032)
Ln(θ_j)			0.049	0.049	0.167[b]	0.167[b]	0.046	0.047
			(0.036)	(0.036)	(0.035)	(0.035)	(0.036)	(0.036)
Ln(Transport)			–0.746[b]	–0.740[b]	–0.750[b]	–0.749[b]	–0.736[b]	–0.731[b]
			(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)
Ln(Env)			2.651[b]	2.653[b]	3.036[b]	3.031[b]	2.608[b]	2.618[b]
			(0.308)	(0.306)	(0.309)	(0.310)	(0.310)	(0.309)
Ln(IIT)			0.089[b]	0.098[b]	0.101[b]	0.103[b]	0.093[b]	0.100[b]
			(0.033)	(0.033)	(0.032)	(0.033)	(0.033)	(0.033)
Home∗Ln(IIT)				–0.953[b]		–0.208		–0.939[c]
				(0.385)		(0.258)		(0.416)
Home∗Region1					2.682[b]	2.639[b]		
					(0.101)	(0.104)		
Home∗Region2					3.129[b]	3.096[b]		
					(0.104)	(0.112)		
Home∗Region3					1.299[b]	1.277[b]		
					(0.113)	(0.116)		
Home∗Region4					1.225[b]	1.198[b]		
					(0.108)	(0.106)		
Home∗Region5					2.087[b]	2.045[b]		
					(0.128)	(0.139)		
Home∗Region6					1.805[b]	1.769[b]		
					(0.097)	(0.108)		
Home∗Region7					2.322[b]	2.270[b]		
					(0.112)	(0.134)		
Home∗Region8					2.291[b]	2.255[b]		
					(0.115)	(0.122)		
Home∗I006							1.977[b]	1.859[b]
							(0.215)	(0.221)
Home∗I007							2.114[b]	2.047[b]
							(0.282)	(0.279)
Home∗I008							1.888[b]	1.724[b]
							(0.250)	(0.257)
Home∗I009							1.992[b]	1.816[b]
							(0.221)	(0.243)
Home∗I010							2.116[b]	1.944[b]
							(0.207)	(0.213)
Home∗I011							1.814[b]	1.633[b]
							(0.218)	(0.261)
Home∗I012							1.897[b]	1.770[b]
							(0.194)	(0.202)

Table 4. Continued

Dependent variable: Ln($z_{ij,k}$)	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
*Home*I013*							2.186[b]	1.945[b]
							(0.191)	(0.207)
*Home*I015*							2.273[b]	2.062[b]
							(0.180)	(0.230)
*Home*I016*							2.114[b]	1.859[b]
							(0.204)	(0.227)
*Home*I017*							1.981[b]	1.829[b]
							(0.195)	(0.213)
*Home*I018*							1.994[b]	1.867[b]
							(0.225)	(0.218)
*Home*I019*							1.829[b]	1.730[b]
							(0.182)	(0.183)
*Home*I020*							2.100[b]	1.864[b]
							(0.184)	(0.199)
*Home*I022*							1.977[b]	1.781[b]
							(0.217)	(0.253)
Constant	–16.406[b]	–17.521[b]	–21.527[b]	–21.492[b]	–22.151[b]	–22.138[b]	–21.467[b]	–21.450[b]
	(0.448)	(0.446)	(0.490)	(0.488)	(0.469)	(0.470)	(0.491)	(0.489)
Fixed Effects 1:	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects 2:	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.717	0.786	0.921	0.922	0.934	0.934	0.920	0.921
F-statistic	1215.3	154.5	400.3	389.3	390.3	379.2	265.2	260.4

Notes: (a) The dependent variable is ***Ln($z_{ij,k}$)*** $\equiv x_{ij}/y_i y_j$, the log of the supply of industry *k*'s products from region *i* to region *j* weighted by the product of income in regions *i* and *j*. There are a total of 960 observations in each regression. The values in the parentheses are the standard errors for the estimates. Because heteroskedasticity is found in the regressions, the White Heteroskedasticity-consistent standard errors are reported. ***Fixed Effects 1*** stands for the control for regional-specific fixed effects, while ***Fixed Effects 2*** stands for the control for industry-specific fixed effects. ***Adj R^2*** is the adjusted R^2. (b) The estimates are significant at the 1% level. (c) The estimates are significant at the 5% level.

income shares, the values of the estimate for the *Home* variable are lower than those obtained under the basic model; the difference is statistically significant at the 1% level based on the Wald test. The value of the estimate for the *Home* variable under column (3) is 2.01, which translates to an overall regional border effect of 6.46 times at the national level, much lower than those found in earlier studies in the literature.

The border effect can be made more intuitive by calculating the tariff-equivalent of a border (Wei, 1996). The *ad valorem* of tariff equivalent of a border can be obtained by taking the anti-log of the ratio of the estimate for the *Home* variable to the elasticity of substitution between home and foreign goods, i.e. $\exp\left(\hat{\beta}_4/(\sigma-1)-1\right)$, where $\hat{\beta}_4$ is the estimate for the *Home* variable and $(\sigma-1)$ measures the elasticity of substitution between home and foreign goods. This requires an assumption about the elasticity of substitution between the home and foreign goods, and we assume $(\sigma-1)=8$.[7] Based on the estimate for the *Home* variable under column (3) in Table 4 and $(\sigma-1)=8$, the tariff-equivalent "border effect" in China at the national level is about 29%, which is seven percentage points lower than that obtained from the basic model under column (2).

With the knowledge of overall regional border effects at the national level, we further investigate if there are differences in the border effect across various regions. Therefore, we break down the average border effect obtained under column (3) from the national level to regional levels by including the dummy *Home∗Region*. The results are reported under columns (5). The region with the lowest border effect is the Central Coastal Region (Region 4), which includes Shanghai, Jiangsu, and Zhejiang, while the region with the highest border effect is the North Municipalities (Region 2), which includes China's capital city Beijing and its neighbor Tianjin. The difference between the two regions is about 20 times.

We have the following explanations for this drastic difference in border effects between the Central Coastal Region and the North Municipalities. First, total GDP in the North Municipalities is the smallest among the eight regions.[8] Anderson and Wincoop (2003, p. 177) show that a uniform increase in trade barriers would raise multilateral resistance more for a small country than a large country. This implies that given the level of trade barriers, multilateral resistance (and thus border effects) will be higher for the regions with smaller total GDP than for the regions with higher total GDP. Second, Jiangsu, Zhejiang and Shanghai are considered as the most open areas in China, whereas government regulations and controls are relatively tighter in China's capital city of Beijing and its vicinity. It goes without saying that more government regulations and controls translate to larger border effects for the North Municipalities and increase the cost of doing business in the region.

To check if there are differences in border effects across various industries, we have introduced the interaction dummies between the *Home* variable and the industry dummies. The results are reported under column (7) in Table 4. The largest border effect is detected in the industry of Metal Products (015), while the smallest one is in the Petroleum and Coking industry (011). The former has a border effect of 8.71 times (exp(2.273) – 1), while the latter has a border effect of 5.13 times (exp(1.814) – 1). Again, there is clear evidence of significant differences in border effects for China's different industries.

The index for intra-industry trade allows us to control for commodity substitutions between similar products. Yet we want to know if the border effect discussed above is affected by local intra-industry trade activities. Hence, we introduced another regional variable, the interaction of the *Home* variable and the log of the index for intra-industry trade. The results are reported under columns (4), (6) and (8) in Table 4. The estimate for the dummy *Home∗Ln*(*IIT*) is statistically significant at the national level under columns (4) and (8). The control for local intra-industry activities produces two outcomes. First, the effect of intra-industry trade on regional trade volumes increases by about 10%. Second, the average border effect has reduced from 6.46 times to 5.30 times at the national level. Based on the estimate for the *Home* variable under column (4) in Table 4, the tariff-equivalent "border effect" in China at the national level is now less than 26%.

The estimate for the dummy *Home∗Ln*(*IIT*) is statistically insignificant at the regional level. This is expected because intra-industry trade should have little influence, if any, on the border effect of a particular region, which mainly results from local government protections and other trade barriers. To see if it is indeed the case, we performed tests by including the dummies $Home{*}Region_x{*}Ln(IIT)$ for every region, where $\boldsymbol{x} = 1, 2, \ldots, 8$. In all cases, none of the estimates for the dummies is statistically significant. Hence, we conclude that intra-industry trade does not affect regional border effects and the differences in regional border effects reported under column (5) are mainly attributed to government policies and other regional trade barriers.

Since intra-industry trade does not affect China's regional border effects, the noticeable reduction of border effects at the national level, when the dummy *Home***Ln*(*IIT*) is included in the regression, must result from significant reductions of the border effect at the industry level. To verify, we performed tests by adding the dummy to the models under column (7) in Table 4, and the results are reported under column (8). The estimates for *Home***Ln*(*IIT*) are now statistically significant at the 2% level. The inclusion of the variable produces the following results. First, the effect of intra-industry trade on the volumes of regional trade increases from 0.093 to 0.100. Second, although the order of the border effect upholds for each industry, the size of the industrial border effect has been reduced significantly when the dummy is included. While the industries of Textile (007), Telecommunication (019), and Other industry (022) have a smaller reduction of less than 6%, the largest reduction (over 10%) occurs in the industries of Non-metal Mineral Products (013), Metal Products (015), Machinery Manufacture (016), and Instruments, Meter, Cultural and Clerical Machinery (020).

By controlling local intra-industry trade activities, our results reveal much smaller industrial border effects for all industries. Local intra-industry trade activities appear to have great impact on China's industries for producing capital and intermediate goods and little impact on the industries producing consumption goods. Greenaway et al. (1994) and Fontagne et al. (1998) argue that intra-industry trade is especially important when trade involves intermediate goods. Because of the heterogeneous nature of capital and intermediate goods, it is hard for the industry to substitute one product for another. Hence, one may observe heavy intra-industry trade activities. Since the level of substitution is generally high for consumption goods, it is not surprising to observe higher levels of government protections and other trade barriers in those industries.

5. Empirical Results as Robust Tests

The results reported in the previous sections are the central results of the paper. But we want to know if they are robust when alternative measures of trade are used. Since our data include regional expenditures on final goods and intermediate goods at the industry level, we construct two alternative measures of regional trade. Our dependent variables are now the log of total expenditures on industry *k*'s final and intermediate goods imported from region *i* to region *j* weighted by the product of income in region *i* and region *j*. The regression results with various specifications of the model are reported in Table 5.

We summarize the results in Table 5 as follows. First, all results reported in Table 4 are retained. Specifically, all estimates carry the signs as expected, i.e. income share in region *j*, business environment, and intra-industry trade all have positive effects on regional expenditures on final goods and intermediate goods at the industry level, while distances, income share in region *i*, and transportation costs have negative effects on the dependent variables. They signify that the empirical results reported in Table 4 are robust. Second, the estimates for business environment and intra-industry trade are statistically insignificant when expenditures on final goods are used as a measure of regional trade, whereas they are statistically significant when expenditures on intermediate goods are used as a measure of regional trade, indicating that the control variables we adopted in this paper are appropriate.

Third, the estimate for the *Home* variable remains significantly positive. The values of the estimates are equal to 2.102 (column 9) and 1.994 (column 15) at the national

Table 5. Border Effects in China's Regional Markets—Expenditure on Final Goods and Intermediate Goods[a]

Dependent variable: $Ln(zf_{ij,k})$ & $Ln(zi_{ij,k})$

	$Ln(zf_{ij,k})$						$Ln(zi_{ij,k})$					
	(9)	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*	*(19)*	*(20)*
$Ln(Wei_{ij})$	–1.006[b]	–1.001[b]	–0.956[b]	–0.954[b]	–1.001[b]	–0.997[b]	–1.012[b]	–1.009[b]	–0.964[b]	–0.963[b]	–1.008[b]	–1.006[b]
	(0.053)	(0.052)	(0.051)	(0.051)	(0.053)	(0.053)	(0.043)	(0.043)	(0.041)	(0.041)	(0.043)	(0.043)
Home	2.102[b]	1.852[b]					1.994[b]	1.836[b]				
	(0.124)	(0.165)					(0.096)	(0.122)				
$Ln(\theta i)$	–0.158[b]	–0.140[b]	–0.159[b]	–0.152[b]	–0.156[b]	–0.136[b]	–0.140[b]	–0.128[b]	–0.140[b]	–0.137[b]	–0.138[b]	–0.127[b]
	(0.045)	(0.045)	(0.043)	(0.043)	(0.045)	(0.046)	(0.033)	(0.034)	(0.030)	(0.031)	(0.033)	(0.034)
$Ln(\theta j)$	0.038	0.039	0.163[b]	0.162[b]	0.034	0.037	0.049	0.050	0.163[b]	0.163[b]	0.046	0.047
	(0.046)	(0.046)	(0.046)	(0.047)	(0.046)	(0.047)	(0.036)	(0.036)	(0.035)	(0.035)	(0.037)	(0.037)
$Ln(Transport)$	–0.722[b]	–0.712[b]	–0.726[b]	–0.723[b]	–0.710[b]	–0.702[b]	–0.737[b]	–0.731[b]	–0.740[b]	–0.738[b]	–0.727[b]	–0.724[b]
	(0.025)	(0.025)	(0.025)	(0.025)	(0.026)	(0.026)	(0.021)	(0.021)	(0.020)	(0.021)	(0.021)	(0.022)
$Ln(Env)$	0.063	0.066	0.555	0.541	0.016	0.032	3.687[b]	3.688[b]	4.055[b]	4.049[b]	3.648	3.656[b]
	(0.411)	(0.409)	(0.419)	(0.419)	(0.412)	(0.410)	(0.321)	(0.320)	(0.327)	(0.327)	(0.323)	(0.322)
$Ln(IIT)$	0.040	0.052	0.055	0.059	0.040	0.053	0.138[b]	0.146[b]	0.149[b]	0.151[b]	0.142[b]	0.149[b]
	(0.042)	(0.042)	(0.042)	(0.042)	(0.043)	(0.043)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.037)
$Home{*}Ln(IIT)$		–1.407[b]		–0.533		–1.547[b]		–0.889[c]		–0.220		–0.791[c]
		(0.526)		(0.418)		(0.563)		(0.386)		(0.270)		(0.413)
$Home{*}Region1$			2.598[b]	2.488[b]					2.773[b]	2.727[b]		
			(0.172)	(0.187)					(0.115)	(0.118)		
$Home{*}Region2$			3.230[b]	3.145[b]					3.104[b]	3.068[b]		
			(0.179)	(0.193)					(0.114)	(0.122)		
$Home{*}Region3$			1.287[b]	1.229[b]					1.332[b]	1.308[b]		
			(0.173)	(0.178)					(0.126)	(0.128)		

Table 5. Continued

Dependent variable: $Ln(zf_{ij,k})$ & $Ln(zi_{ij,k})$												
	$Ln(zf_{ij,k})$						$Ln(zi_{ij,k})$					
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
*Home*Region4*			1.185[b]	1.114[b]					1.264[b]	1.235[b]		
			(0.215)	(0.218)					(0.106)	(0.107)		
*Home*Region5*			2.094[b]	1.987[b]					2.079[b]	2.035[b]		
			(0.173)	(0.193)					(0.147)	(0.154)		
*Home*Region6*			1.961[b]	1.867[b]					1.755[b]	1.716[b]		
			(0.139)	(0.160)					(0.107)	(0.118)		
*Home*Region7*			2.633[b]	2.499[b]					2.204[b]	2.149[b]		
			(0.176)	(0.226)					(0.124)	(0.146)		
*Home*Region8*			2.602[b]	2.508[b]					2.211[b]	2.173[b]		
			(0.154)	(0.172)					(0.134)	(0.142)		
*Home*I006*					2.025[b]	1.830[b]					1.973[b]	1.873[b]
					(0.221)	(0.231)					(0.209)	(0.217)
*Home*I007*					2.391[b]	2.281[b]					1.960[b]	1.904[b]
					(0.398)	(0.402)					(0.290)	(0.286)
*Home*I008*					1.895[b]	1.625[b]					2.025[b]	1.887[b]
					(0.298)	(0.313)					(0.226)	(0.227)
*Home*I009*					1.996[b]	1.707[b]					1.969[b]	1.821[b]
					(0.343)	(0.370)					(0.216)	(0.239)
*Home*I010*					2.235[b]	1.952[b]					2.107[b]	1.963[b]
					(0.248)	(0.270)					(0.217)	(0.220)
*Home*I011*					2.025[b]	1.728[b]					1.780[b]	1.627[b]
					(0.214)	(0.253)					(0.228)	(0.270)

Home∗I012					1.959^{b}	1.750^{b}					1.885^{b}	1.778^{b}
					(0.252)	(0.266)					(0.207)	(0.214)
Home∗I013					2.175^{b}	1.778^{b}					2.206^{b}	2.003^{b}
					(0.205)	(0.232)					(0.205)	(0.221)
Home∗I015					2.402^{b}	2.054^{b}					2.263^{b}	2.085^{b}
					(0.302)	(0.361)					(0.185)	(0.227)
Home∗I016					2.213^{b}	1.794^{b}					2.090^{b}	1.875^{b}
					(0.261)	(0.281)					(0.208)	(0.242)
Home∗I017					2.111^{b}	1.861^{b}					1.927^{b}	1.798^{b}
					(0.180)	(0.202)					(0.236)	(0.255)
Home∗I018					2.020^{b}	1.809^{b}					2.008^{b}	1.900^{b}
					(0.244)	(0.234)					(0.242)	(0.237)
Home∗I019					1.865^{b}	1.702^{b}					1.806^{b}	1.722^{b}
					(0.228)	(0.231)					(0.214)	(0.216)
Home∗I020					2.288^{b}	1.898^{b}					2.057^{b}	1.858^{b}
					(0.377)	(0.403)					(0.209)	(0.224)
Home∗I022					2.046^{b}	1.724^{b}					1.942^{b}	1.777^{b}
					(0.292)	(0.345)					(0.199)	(0.228)
Constant	–19.134^{b}	–19.082^{b}	–19.857^{b}	–19.824^{b}	–19.060^{b}	–19.031^{b}	–23.634^{b}	–23.601^{b}	–24.263^{b}	–24.249^{b}	–23.582^{b}	–23.567^{b}
	(0.637)	(0.634)	(0.621)	(0.622)	(0.638)	(0.635)	(0.520)	(0.519)	(0.510)	(0.512)	(0.522)	(0.521)
Fixed Effects 1:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects 2:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.892	0.893	0.903	0.903	0.891	0.892	0.915	0.915	0.927	0.927	0.914	0.914
F-statistic	283.4	276.1	256.5	249.5	187.6	184.9	368.8	358.0	351.1	341.1	244.2	239.3

Notes: The dependent variable, $\boldsymbol{Ln(zf_{ij,k})} \equiv FE_{ij,k}/y_i y_j$, is the log of total expenditure on industry k's final goods imported from region i to region j weighted by the product of income in regions i and j, while the dependent variable, $\boldsymbol{Ln(zi_{ij,k})} \equiv IE_{ij,k}/y_i y_j$, is the log of total expenditure on industry k's intermediate goods imported from region i to region j weighted by the product of income in regions i and j, . See footnote 1 in Table 4 for other explanations. (b) The estimates are significant at the 1% level. (c) The estimates are significant at the 5% level.

level. With the inclusion of a regional variable to control for local intra-industry activities, however, the border effect has markedly reduced. The values of the estimates are now 1.852 (column 10) and 1.836 (column 16), translating to the border effect of 5.37 times for the final goods and 5.27 times for the intermediate goods. Still, there are significant differences in border effects in various regions and industries. The region displaying the highest border effect is the North Municipalities (Region 2), whereas the region showing the lowest border effect is the Central Coastal Region (Region 4). The border effect is 24.29 times for the final goods but 21.27 times for intermediate goods for the North Municipalities. Yet it is only 2.27 times for final goods and 2.54 times for intermediate goods for the Central Coastal Region.

Fourth, as in Table 4, the border effect becomes smaller with the control for local intra-industry trade activities. The largest reduction occurs in the industries of Non-metal Mineral products (013) and Instruments, Meters, Cultural and Clerical Machinery (020). The reduction is more than 20% for final goods and more than 10% for intermediate goods.

Finally, better business environment is found to have significantly positive effects on improving regional trade in intermediate goods. The estimate for business environment is positive and statistically significant at the 1% level under columns (15)–(20). Furthermore, the value of the estimate has been elevated when expenditures on intermediate goods are used as the dependent variable. For instance, compared with 3.031 under column (6) in Table 4, the estimate under column (18) in Table 5 is now 4.049, an increase of 33%. The results reported in Tables 4 and 5 show that better business environment has the largest positive effects on regional trade in intermediate goods in China.

6. Conclusions

Facing the global economic crisis of 2007, the Chinese government revealed its intention to promote domestic demand, along with a massive bailout plan in 2008. The new strategy signifies China's move onto the path of long-run sustainable growth, but its success depends critically on the integrations of China's internal markets.

In this paper, we adopted the methodology proposed by Anderson and Wincoop (2003) to examine China's domestic market integrations. With this more fitting methodology and a better dataset, our empirical results support the view that China's domestic markets have become more integrated in the post-reform era. We find evidence of border effects in China's regional markets, but they are smaller than some earlier studies suggest. With the inclusion of regional variables to control for transaction costs, intra-industry trade, and business environment, the estimated border effect ranges from 5.3 to 6.5 times at the national level. The North Municipalities (Beijing and Tianjin) show the highest border effect, ranging from 21–22 times, while the Central Costal Region (Shanghai, Jiangsu and Zhejiang) displays the lowest border effect, about 2.3 times. The finding of such a drastic difference in border effects between the North Municipalities and the Central Costal Region is consistent with the observation that Jiangsu, Zhejiang and Shanghai are the most open area in China and government regulations and controls are more stringent in China's capital city and its vicinity. Tighter government regulations and controls translate to larger border effects and increase the cost of doing business in the region.

Our results also show that the growth of income, reduction of transportation costs, and increase of intra-industry trade all have positive effects on the volume of regional trade in China. Yet better business environment robustly shows the largest positive impact on lifting China's regional trade, especially for trade in intermediate goods. As such, improving business environment further should be the priority of governments at all levels in China.

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Notes

1. Sanso et al. (1993) show that there is little benefit in selecting a more complex general specification of the gravity equation than the simple log form.
2. In addition to the distance variable, Wolf (2000) included the GDP weighted average distance to measure the remoteness of state *i* for its exports to state *j*. Yet the estimate for the variable does not carry the expected sign, although it is statistically significant. Wolf (2000, p. 557) argued that the inclusion of the remoteness variable added little to the overall explanatory power of the regression and did not significantly affect the other coefficients. We checked the results by including the same variable in various forms of our gravity model. The results reported in the paper do not change much, i.e. they are qualitatively the same and quantitatively similar. As in Wolf (2000), however, our estimate for the variable also carries the opposite sign to that expected. Furthermore, it is sensitive to model specifications. This supports Anderson and Wincoop's (2003, p. 170) argument that "the remoteness index does not capture any of the other trade barriers that are the focus of the analysis."
3. For example, Gorodnichenko and Tesar (2005) found that the border effect between the US and Canada and the US and Japan is negligible after controlling for the confounding factors such as the volatility and persistence of the nominal exchange rate and the cross-country heterogeneity in the distribution of within-country price differentials.
4. The index is similar to the one used in Hummels and Levinsohn (1995). To ensure that our results are robust and do not change as a result of different measures of intra-industry trade, we have in fact compared our results reported in the paper with the ones obtained using the index

in Hummels and Levinsohn (1995). They are qualitatively the same and quantitatively similar with only a slight variation in the values of the estimates.

5. The index we constructed in equation (5) is similar to the *ad-valorem* freight rate discussed by Hummels. See Hummels (1999) for further detail.

6. Silva and Tenreyro (2006) demonstrated that the estimates of a log gravity model obtained using OLS could be highly misleading in the presence of heteroskedasticity.

7. The estimate for the log of relative price in the gravity model may be a good candidate for $\sigma - 1$. However, Head and Mayer (2000) found that the elasticity of substitution between home and foreign goods obtained based on the estimate for the log of relative price was unreasonably small. Hence, they assumed $\sigma - 1 = 8$, the average value of the elasticity of substitution found in Head and Ries (1999). Following Head and Mayer (22005), Poncet (2005) also made the same assumption about the value of the elasticity of substitution in calculating China's tariff-equivalent "border effect."

8. For example, total regional GDP in 2008 (in billions of current RMB) is 2819.56 for the Northeast Region, 1684.24 for the North Municipalities, 4726.07 for the North Coastal Region, 6549.77 for the Central Coastal Region, 4797.88 for the South Coastal Region, 6318.80 for the Central Region, 2405.27 for the Northwest Region, and 3380.80 for the Southwest Region.