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NORTH-HOLLAND
China Economic Review 14 (2003) 1–21
China Economic Review

Measuring Chinese domestic and international integration

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Received 3 May 2002; accepted 25 June 2002

Abstract

In this paper, we rely on a new set of provincial trade flow to analyze and compare the magnitude and evolution of Chinese provinces' engagement in domestic and international trade by computing all-inclusive indicators of trade barriers. We find that Chinese provinces' greater involvement in international trade went hand in hand with a decrease in domestic trade flow intensity between 1987 and 1997. Even if Chinese provinces still rely more on goods from the rest of China than on international imports, provincial borders matter more and more inside the country in the sense that they imply greater discontinuities in the Chinese domestic market.

JEL classification: F02; F14; F15; O52; R58
Keywords: Chinese provinces; International trade; Domestic integration; Border effects

1. Introduction

How integrated is China's domestic market? How does interprovincial integration compare with international integration? These questions take on particular importance as China is joining the World Trade Organization. Indeed, Chinese international opening can only be effective if the free flow of goods inside the country is guaranteed.

A debate has emerged about whether or not economic reforms have led to greater domestic integration. Several papers,[1] among which Young's (2000) striking analysis,

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[1] Naughton (1999) and Young (2000) provide excellent overviews of this literature.

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doi:10.1016/S1043-951X(02)00083-4

argue that over the past 20 years of economic reform China, has evolved into "a fragmented internal market with fiefdoms controlled by local officials" Naughton (1999) takes a skeptical view of such a claim arguing that there are serious problems with the data used in these studies and with their interpretation. Indeed, beside stories of provincial trade struggles,[2] they consist of indirect and thus questionable analyses of market integration relying mainly on price and provincial economic structures data.[3] Naughton directly examines interprovincial flow to show that interprovincial trade is not only large but also dominated by intra-industry trade in manufactured products, which is coherent with national economic integration. His study is, however, limited to the period 1987–1992, thus, falling short of analyzing the evolution of impediments to trade within China since the deepening of the reforms. My aim is to fill this gap through the use of an updated version of the Naughton data for 1997.

In this paper, I apply the "border effects" method to study domestic market integration in China as well as the openness to international trade of Chinese provinces for the years 1987, 1992, and 1997. My model analyzes and compares the magnitude and evolution of Chinese provinces' engagement in domestic and international trade by computing all-inclusive summaries of trade barriers. I measure the negative impact of Chinese provincial borders on import flow (from the 'rest of China' and from international partners) by calculating the proportion by which a province consumes more local goods than goods from the 'rest of China', on the one hand, and from international partners, on the other. I consider that each province is an integrated economy within its boundaries but that its frontiers hinder trade flow with the outside. The domestic and international integration of Chinese provinces are thus evaluated using the volume of intraprovincial trade flow as the reference.[4]

We find high and decreasing international border effects in China in coherence with the only recent engagement in international trade of the country. More interesting are the size and dynamics of interprovincial border effects. Our results suggest that international opening has happened in conjunction to internal fragmentation in China.

This paper proceeds as follows: Section 2 discusses domestic and international integration of Chinese provinces. Section 3 briefly reviews the literature on border effects. Section 4 develops the empirical model used. The empirical application to Chinese provinces and the results are described in Section 5.

[2] Anecdotes about tariffs imposed on outside goods and price, investment and price discriminations are plenty. See Chinese Economic Studies (1993), Kumar (1994), and Wedeman (2002) for descriptions of trade barriers in current China.

[3] Kumar led a World Bank report entitled "Internal Market Development and Regulation" (1994) in which she relied on data provided by the State Statistical Bureau (1999) to examine trends in interprovincial retail purchases, finding evidence of a decline in interprovincial trade. However, as revealed by Young (2000), "unbeknownst to the World Bank mission, the data provided by the SSB included the value of interprovincial trade transactions with nonstate commercial departments in the value of intraprovincial purchases, i.e., excluded them from the measure of interprovincial trade," thus, making the interpretation of the declining "trade ratio" problematic.

[4] The border effect measures the "excessive" trade volume observed within a province in relation with what would be expected in absence of barriers by the model.

2. Domestic and international integration of Chinese provinces

Prior to the implementation of the economic reforms in 1978, China's economy was characterized by an introverted development strategy. The political isolation of the country as well as fears of foreign invasion legitimized, on the international side, the restriction of economic relations with the capitalist world, and, on the domestic side, the pursuit of a strategy of regional self-sufficiency. Inside the country, the emphasis was placed on self-reliance, that is to say the ability for each province to support itself with its own resources. Interprovincial trade was then considered only as a residual so that production completely neglected principles of comparative advantage, economies of scale and specialization.

The recognition of the economic inefficiencies and wastage of resources resulting from these introverted development policies led to the adoption of radical reforms starting in 1978. The pursuit of rapid economic development not only entails the creation of markets, but also in a country as huge as China, their spatial integration. With this aim in view, the government progressively withdrew from the allocation, distribution and price setting of goods. Parallel to the reduction in the role of planning, the Chinese economy opened itself up. The promotion by the authorities of domestic openness alongside international openness was motivated by the search for dynamic and static gains resulting from increased competition, the diffusion of technological progress and the determination of production according to comparative advantages. Most authors agree that the promotion of the international openness of Chinese provinces was a success. The average trade openness rate of Chinese provinces more than doubled between 1987 and 1997, increasing from 14% to 37%.[5]

Achievements in domestic integration are however more controversial. Despite measures to promote domestic market integration, not only have several studies concluded that interprovincial trade in China is suboptimal, but some authors (Young, 2000; Kumar, 1994) have identified a move towards internal fragmentation since the beginning of the reforms. Some difficulties in the implementation of reforms (such as the decentralization process, launched in 1980, policies of import-substitution industrialization followed by the least developed provinces in order to put an end to perceived deprivation of profits relative to the coast as well as persisting price distortions) are held responsible for the renewal of regional protectionism observed at the end of the 1980s. Kumar's World Bank report "Internal Market Development and Regulation" (1994) underlines the limited degree of regional specialization and the weak mobility of factors and goods in China. The author describes the numerous 'creative' actions taken by local governments to keep their production of scarce raw materials to themselves or prevent the inflow of goods produced in other provinces. Some struggles were so intense as to be called "wars" by observers.

Local protectionism and impediments to the economic unification of the national market remain topical issues. At the annual session of the National People's Congress in March 2000, Wang Zhongfu, Director of the State Administration for Industry and

[5] Trade openness is computed as imports plus exports divided by GDP.

Commerce, pointed out that "administrative monopolies, forced deals, and market blockades have become a cancer in China's market" (People's Daily, July 1st, 2000). More recently, in April 2001, the State Council issued a directive to outlaw regional blockades in market activities.

The simplest and most logical approach to studying regional integration is to directly examine data on interprovincial trade. I obtained access to domestic trade flow from Provincial Input–Output tables for 1987, 1992, and 1997 that surely are the best available data in interprovincial flows in China.[6]

The data suggest, as Naughton (1999), that interprovincial trade is large relative both to GDP and total trade. Average Chinese interprovincial imports amounted to 54%, 50%, and 38% of GDP, respectively, in 1987, 1992, and 1997. These numbers are far higher than intraregional trade figures for Western Europe, NAFTA, or ASEAN.[7] On average, interprovincial trade accounted, respectively, for 88%, 80%, and 66% of Chinese provinces total trade in 1987, 1992, and 1997. Young's (2000) argument about the decreasing domestic integration in China cannot, however, be refuted. Interprovincial trade relative to GDP or to total trade has significantly decreased between 1987 and 1997, especially since 1992.

We need to better understand the reasons behind the decline in interprovincial intensity. Goods consumed in a given province have three potential sources. These are (i) goods produced locally (intraprovincial trade), (ii) goods produced in another Chinese province and imported (domestic trade), and (iii) foreign products imported from an international partner (international trade). Provincial total goods absorption is thus made up of these three types of goods. A decrease in the share of one of the components automatically corresponds to an increase in the share of at least one of the other sources. Provincial total goods absorption is computed as the sum of goods production in the province and total inflow of goods (from the rest of China and international partners) minus total outflow of locally produced goods (to the rest of China or the rest of the world), that is to say goods produced locally but consumed outside.

In 1987, average provincial absorption of goods was composed as follows: 34% of goods produced in other provinces, 64% of locally made products, and 2% of international imports. In 1992, the percentages were respectively 27%, 68%, and 5%. In 1997, the importance of goods from the rest of China in provincial absorption further declined to 20%, while the shares of locally produced goods and foreign goods rose to 72% and 8%, respectively. Table 2 in Appendix B details the evolution of the composition of the absorption by province.

These data confirm a downward trend in the intensity of interprovincial trade since the end of the 1980s. The declining importance of domestic goods in provincial absorption is compensated by growing shares of both international and locally produced goods.[8] It thus

[6] See Appendix A for details.

[7] Intra-Western Europe imports reached 18% of GDP in 1999, intra-NAFTA imports were 5.6% of GDP in 1998, while the ratio of intra-ASEAN imports to GDP was 12% in 1998.

[8] Guangdong, Tianjin and Yunnan are the noticeable exceptions to this trend. For these provinces, the increase in the importance of international goods in the province's consumption went parallel with the reduction of the shares of both local and national goods.

seems that the reduction in the intensity of interprovincial trade flow finds its roots not only in the internationalization process but also in the increase in intraprovincial trade intensity (greater autarchy or self-sufficiency of provinces).

3. The literature on border effects

The literature on border effects has developed since the pioneering article of McCallum (1995), who showed that in 1988, gravity-adjusted trade within Canada was more than 20 times larger than similarly adjusted cross-border trade with the US. Precisely, he found that Canadian provinces traded 22 times more with each other than with American states after size and distance are controlled for.[9] In a study of the years through 1996, Helliwell (1998) found that the US–Canadian border effect declined over time, though it remained significantly large and positive.

These estimates of the US–Canadian border effect were made possible by the exceptional availability of Canadian interprovincial trade flow statistics. In order to extend these studies to other countries and to compensate for the unavailable trade data, Wei (1996) developed an imaginative method to approximate intranational trade flow. He computed the trade of each country "with itself" by subtracting the country's total exports (to foreign partners) from its total production.[10] This difference measures the share of national production that is "exported" to national consumers. The border effect is measured by the coefficient on the dummy variable that equals 1 for intranational observations (and 0 otherwise). Wei considers the border effect as a global indicator of trade barriers that includes the impact not only of tariff and nontariff barriers on trade but also of all the factors that differentiate intranational trade (which should be free) from international trade and that are not controlled for in the regression.

There exist two kinds of applications of the border effects method. The first one measures internal fragmentation within a single country and thus relies on trade flow between subnational territorial units. The second type studies the integration of a country with its international partners. In both cases Wei's method enables one to compute the 'internal trade' (of the subnational region or of the country) that will be used as the reference level to evaluate the impediments to trade implied by the existence of a frontier between the two partners.

To measure Canadian internal fragmentation, Helliwell (1997) uses Wei's procedure to generate Canadian provinces' trade with "themselves." The author finds a provincial border effect of 2.1, which is to be added to the national border effect of 22 to obtain the global border effect. The latter measures the extent to which inhabitants of a given province consume more local goods than goods from an unrelated American state, given size and distance.

[9] This result was confirmed by other researches. Using an updated version of the McCallum data, Helliwell (1997) estimated a similar border effect in the years 1989 and 1990.

[10] Total production that remains within the local boundaries (not exported) is at the same time equal to imports "from itself" and exports "to itself". Infra-national trade is thus to be calculated as: gross value of goods production minus international exports of goods.

American domestic market integration is analyzed by Wolf (2000). Despite protection guaranteed to interstate trade by the American constitution,[11] exchange rate fixity as well as cultural and institutional homogeneity between states, Wolf finds border effects between 3 and 4.5 depending on the specification.

The second type of study that analyzes the commercial integration between international partners has been conducted mainly to evaluate the impact of preferential trade agreements. The Single European Act has been widely investigated. Head and Mayer (2000) focus on the magnitude of fragmentation and its causes in the European Union between 1978 and 1995. They are the firsts to work at a disaggregated industry-level. Their paper innovates in that they abandon the gravity model and develop a theoretical model integrating nontariff-barriers (NTBs) and heterogeneity in consumer preferences as explanatory factors of border effects.[12]

Their model, which we will use in this paper, is based on the monopolistic competition model of trade introduced by Krugman (1980). The authors find that European border effects decreased over time from 21 at the end of the 1970s to 11.3 in the years 1993–1995. Their results confirm the positive impact of the Single Market Programme in reducing national border effects.

This literature emphasizes the persistence of rather large home biases inside and between countries that have engaged in free trade for some time and have low tariff barriers. The analyses however all indicate that border effects decline over time in conjunction with trade liberalization.

Finding large and declining international border effects in China should be no surprise since the country has only recently attempted to engage in freer trade. However, our results will contrast with other studies in that greater global integration of Chinese provinces in international trade is found to have gone together with domestic market disintegration.

4. The model

We follow the model used by Head and Mayer (2000),[13] who apply the border effects method to the European countries. These authors adopt a monopolistic competition framework inspired by Krugman (1980) and derive a gravity equation from an asymmetric specification of consumer preferences.

4.1. Consumers

For each differentiated variety h, let c_{ijh} be the total consumption of good from partner j by the representative agent in province i of good h from partner j and a_{ij}, the preference

[11] In Article 6 of the US constitution, the Interstate Commerce clause specifically forbids interstate trade impediments.

[12] Formal tariff barriers (quotas and customs dues) are not taken into account since they are forbidden inside the Union since 1968.

[13] The model is described in greater details in Head and Mayer (2001).

weight of consumers in i for products imported from j.[14] The bilateral CIF value of imports of province i from partner j, m_{ij}, is obtained through the maximization of the following CES utility function under the budget constraint:

$$U_i = \left(\sum_{j=1}^{N} \sum_{h=1}^{n_j} (a_{ij} c_{ijh})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad \text{s.t. } m_i = \sum_k m_{ik} = \sum_k c_{ik} p_{ik} \forall\ h \tag{1}$$

with k covering all partners so that k=1, i, j, …N; p_{ik} is the delivery price of goods imported by i from k[15]; and σ is the elasticity of substitution between any two varieties.

We obtain the bilateral imports of i from j by summing imports for each variety, with n_j is the number of varieties in j:

$$m_{ij} = \frac{a_{ij}^{\sigma-1} n_j p_{ij}^{1-\sigma}}{\sum_k a_{ik}^{\sigma-1} n_k p_{ik}^{1-\sigma}} m_i. \tag{2}$$

The numerator of Eq. (2) relates bilateral trade flows to the demand of i (m_i) to the supply size of j (n_j), to the bilateral preference (a_{ij}), and to the delivery price of imports of i from j, p_{ij} which is composed of the production price in j, p_j and an iceberg-type transaction cost paid by the consumer.

Three steps are necessary to derive an estimable gravity equation from this expression. First, we follow Head and Mayer (2000) in solving for the problematic estimation of the denominator of Eq. (2). The authors transform the relationship into relative terms with respect to intraprovincial trade flow. Subtracting from Eq. (2) its expression for the case where i=j (that is to say subtracting m_{ii}), from both sides of the equality, leads to Eq. (3):

$$\frac{m_{ij}}{m_{ii}} = \left(\frac{a_{ij}}{a_{ii}} \right)^{\sigma-1} \left(\frac{n_j}{n_i} \right) \left(\frac{p_{ij}}{p_i} \right)^{1-\sigma}. \tag{3}$$

The second step deals with the determination of the number of varieties in i and j, n_i and n_j, respectively. These numbers are not observed. We can, however, measure and know the production value of each partner. The behaviour of producers in our model will provide a relationship between these two variables.

4.2. Producers

The Dixit Stiglitz model of monopolistic competition hypothesizes the existence of economies of scale in production, an internationally shared technology and the possibility of product-differentiation without cost of the firms. Differentiation costs of varieties are supposed to be so small that each variety is produced by only one firm. Let labour be the only production factor. The labour quantity necessary in j to produce a quantity q_j of a representative variety is l_j=F+γq_j. Increasing returns to scale emanate from the existence of

[14] This consumer utilities specification allows heterogeneity in bilateral preferences and enables consumers to value products differently depending on their origin.

[15] It is composed of production price and transaction costs to bring goods from k to i.

F the fixed share of l_j beside γ the coefficient of unitary input. Let w_j be the wage in j, profits π of the firm that produces this representative variety in j are given by:

$$\pi_j = p_j q_j - w_j(F + \gamma q_j). \tag{4}$$

In this model of monopolistic competition, firms neglect their impact on the global level of prices. The first order condition gives the traditional constant margin respective to the marginal cost of production:

$$p_j = \frac{\sigma}{\sigma - 1}\gamma w_j. \tag{5}$$

All varieties produced in a given country are thus valued at the same price (before transport cost). Free entry of firms forces firm economic profits to be zero at the equilibrium. It implies that equilibrium production quantity of each firm is equal to:

$$q_j = \frac{F(\sigma - 1)}{\gamma}. \tag{6}$$

If every country shares the same technology, productions of all firms are identical. At the equilibrium, the monopolistic model of competition predicts that production cost parameters and thus production size q are identical for every firm so that $q_j=q$, $\forall j$. Let p_j be the production price of each variety, we obtain a rather simple expression of the production value in each country j, noted v_j that is:

$$v_j = q p_j n_j \tag{7}$$

We can take into account the proportionality between production v_j and the number of varieties n_j yielded by the Dixit and Stiglitz's (1977) model ($n_j p_j = v_j/q$) in order to replace the number of varieties n_j in Eq. (3).

As a last step, we define the price paid by consumers in province i for goods produced in partner j as a multiplicative function of the production price in j, p_j, of transport costs between the two partners tc_{ij} and of trade barriers (tariff and nontariff) applied by province i on its imports from j. We adopt an iceberg cost specification of these costs so that $tc_{ij}=d_{ij}^{\delta}$. Assuming constant ad valorem barriers of u for all cross-border trades, we get:

$$p_{ij} = (1 + u) d_{ij}^{\delta} p_j. \tag{8}$$

Trade barriers u are supposed to be null inside provinces ($i=j$) but positive if $i \neq j$. Let B_{ij} be a dummy variable that equals one when trade flow cross borders and zero otherwise, that is to say $B_{ij}=1$ when $i \neq j$ and $B_{ii}=0$.

We specify consumer preferences a_{ij} as composed by a domestic bias (noted DB_{ij}) and by an error term normally distributed ϵ_{ij}: $a_{ij}=\exp(DB_{ij}+\epsilon_{ij})$. Let $DB_{ij}=0$ when $i=j$ (intra-provincial trade), whereas it is negative when $i \neq j$ so that $DB_{ij}=-\beta$. In this latter case, the representative consumer prefers local goods to outside goods and experiences a positive aversion β vis-à-vis products imported from the other side of the frontier. We hypothesize that a common border mitigates this home bias so that it is null for local goods but equal to $(-\beta+\eta Adj_{ij})$ if goods come from the outside, with Adj_{ij} a dummy variable that takes a

value of one for pairs of adjacent partners. Thus, when Adj_{ij}=1, aversion vis-à-vis outside products falls from β to $\beta-\eta$.

Substituting for all the previously defined terms in the definition of m_{ij}, calling $\theta=-(\sigma-1)\delta$, the distance elasticity of trade and transforming the equation into logarithms lead to:

$$\ln\frac{m_{ij}}{m_{ii}} = \ln\frac{v_j}{v_i} - \theta\ln\frac{d_{ij}}{d_{ii}} - \sigma\ln\frac{p_j}{p_i} - (\sigma-1)[\beta+\ln(1+u)] + (\sigma-1)\eta Adj_{ij} + e_{ij} \quad \text{with } e_{ij} = (\sigma-1)(\epsilon_{ij}-\epsilon_{ii}) \tag{9}$$

In Eq. (10), provincial import spending is allocated between local goods and foreign goods. The constant term includes the effect of tariff and nontariff barriers u as well as the impact of aversion to foreign goods β. This negative term measures the global border effect. It represents the deviation of observed relative trade flow from their value predicted in absence of barriers by our model.

We apply this model to estimate international and domestic trade integration of Chinese provinces between 1987 and 1997. We will verify the capacity of Chinese reforms to reach their initial goal of greater internal and international trade liberalization and spatial rationalization. We would expect to find decreasing border effects both for interprovincial and international trade flow over the period of study. The reduction in both domestic and international trade barriers should moreover have accelerated since the deepening of the reforms in 1993.[16]

Our results will emphasize the still limited but increasing international trade integration of Chinese provinces, in coherence with China's recent engagement in freer trade and the border effects literature. However, this paper stresses that this has happened hand-in-hand with large and rising all-inclusive impediments to interprovincial trade.

5. Empirical estimation

5.1. Application to the Chinese context

We develop an original method to reconcile the model with the available data.

Chinese interprovincial trade data are limited to trade flow between each province and the 'rest of China'. No data on bilateral trade flow between provinces are available.[17] Trade data between each province and the rest of the country are extracted from provincial Input–Output tables computed by the Chinese National Bureau of Statistics. Domestic trade flow was obtained for 27 provinces in 1987, 25 provinces in 1992, and 23 provinces in 1997. More details on the data sources are provided in Appendix A.

[16] Indeed, the aim of the resolution adopted in November 1993 by the Third Plenary Session of the Central Committee to establish a "socialist market economy" was to alleviate remaining distortions and to extend to the rest of the country liberal policies that were until then confined to the coast.

[17] We will not estimate the impact of provincial borders on trade flow between the provinces that they separate but in fact the effect of each province's boundaries on its trade with all the other provinces.

The 'rest of China', denoted by roC, differs for each province considered and can be thought of as a distinct country whose characteristics (production, production price, and distance to partners) are generated as a sum or an average of the characteristics of the provinces that make it up.

The production of the 'rest of China' V_{roC} corresponds to the sum of the productions v_j of the provinces that make up the 'rest of China':

$$V_{\text{roC}} = \sum_{j \neq i} v_j.$$

We deduce the formula of other characteristics of the 'rest of China' directly from our model. We have $m_{i-\text{roC}} = \sum_{j \neq i} m_{ij}$ with i and j that are Chinese provinces. When we specify consumer preferences, prices and number of varieties as described in the previous section, Eq. (2) becomes:

$$m_{ij} = \frac{\exp(-\beta + \epsilon_{ij})^{\sigma-1} v_j (B_{ij}(1+u) d_{ij}^{\delta})^{1-\sigma} p_j^{-\sigma}}{\sum_k \exp(-\beta + \epsilon_{ik})^{\sigma-1} v_k (B_{ik}(1+u) d_{ik}^{\delta})^{1-\sigma} p_k^{-\sigma}} m_i. \tag{10}$$

If we simplify the notation and let $\gamma = \exp(-\beta + \epsilon_{ij})^{\sigma-1}(1+u)^{1-\sigma}$, we get:

$$m_{i-\text{roC}} = \frac{\gamma \sum_{j \neq i} v_j d_{ij}^{\delta(1-\sigma)} p_j^{-\sigma}}{\sum_k a_{ik}^{\sigma-1} v_k (B_{ik}(1+u) d_{ik}^{\delta})^{1-\sigma} p_k^{-\sigma}} m_i. \tag{11}$$

We hypothesize that the weighted arithmetic mean $\Sigma_{j \neq i} \frac{v_j [d_{ij}^{\delta(1-\sigma)} p_j^{-\sigma}]}{V_{\text{roC}}}$ can be proxied by the weighted geometric mean $\Pi_{j \neq i} [d_{ij}^{\delta(1-\sigma)} p_j^{-\sigma}]^{\frac{v_j}{V_{\text{roC}}}}$.[18]

In the absence of correlation between d_{ij} and p_j (we find a coefficient of correlation that is lower than .02), $\Pi_{j \neq i} [d_{ij}^{\delta(1-\sigma)} p_j^{-\sigma}]^{\frac{v_j}{V_{\text{roC}}}}$ equals $\Pi_{j \neq i} d_{ij}^{\frac{v_j}{V_{\text{roC}}}\delta(1-\sigma)} \Pi_j p_j^{-\frac{v_j}{V_{\text{roC}}}\sigma} = \Pi_{j \neq i} d_{ij}^{\frac{v_j}{V_{\text{roC}}}\delta(1-\sigma)} \Pi_j p_j^{-\frac{v_j}{V_{\text{roC}}}\sigma}$.

As a consequence, we can say that $m_{i-\text{roC}}$ is almost equivalent to the expression

$$\frac{\gamma V_{\text{roC}} \Pi_{j \neq i} d_{ij}^{\frac{v_j}{V_{\text{roC}}}\delta(1-\sigma)} \Pi_j p_j^{-\frac{v_j}{V_{\text{roC}}\sigma}}}{\sum_k a_{ik}^{\sigma-1} v_k (B_{ik}(1+u) d_{ik}^{\delta})^{1-\sigma} p_k^{-\sigma}} m_i.$$

[18] Recall that $\Sigma_{j \neq i} \frac{v_j}{V_{\text{roC}}}$ is equal to 1. It is true that the geometric mean always yields results inferior to those given by the arithmetic mean. However, the degree of underestimation is all the lower that $d_{ij}^{\delta(1-\sigma)} p_j^{-\sigma}$ is small. In our case, it is quite close to zero. In the literature, estimates of the distance elasticity of trade place $\theta = -(1-\sigma)\delta$ between 0.5 and 1.5, while estimates of the elasticity of substitution between varieties σ range between 6 and 11.

Taking logarithm of this expression and subtracting its counterpart when $i=j$ (that is to say $\ln m_{ii}$) from both sides of the equality and letting $v_{j*}=v_j/V_{\mathrm{roC}}$ the share of j in the output of the 'rest of China', we obtain:

$$\ln\frac{m_{i-\mathrm{roC}}}{m_{ii}} = \ln\frac{v_{\mathrm{roC}}}{v_i} - \theta\ln\frac{\prod_{j\neq i} d_{ij}^{v_{j*}}}{d_{ii}} - \sigma\ln\frac{\prod_{j\neq i} p_j^{v_{j*}}}{p_i} - (\sigma-1)[\beta+\ln(1+u)] + e_{ij} \text{ with } e_{ij} = (\sigma-1)(\epsilon_{ij}-\epsilon_{ii}) \quad (12)$$

It follows that the formula for the effective distance between each province and the 'rest of China' is given by the production-weighted geometric mean $\prod_{j\neq i} d_{ij}^{v_{j*}}$ of bilateral distances d_{ij} between province i and all the other Chinese provinces j.

The average production price inside the 'rest of China' equals the production-weighted geometric mean $\prod_{j\neq i} p_j^{v_{j*}}$ of production prices p_j in the provinces that form the 'rest of China.'

5.2. Results

The model corresponds to Eq. (9) presented above.[19]

Our dataset includes 869 international flows and 75 flows from the 'rest of China'. We decompose the model's constant into two elements depending on whether provincial trade occurs with the rest of China (interprovincial border effect) on the one hand or with a foreign partner on the other (international border effect). The latter is a global indicator of average trade barriers on international imports. The former captures the average bias by which a Chinese province gets its supplies more from "itself" than from the rest of the country. It reflects the magnitude of domestic market fragmentation since it underlines that despite homogeneity of culture, currency, language and institutions, provincial borders impede trade flows, even after distance, prices and economic sizes are controlled for.

We start with an estimation of Eq. (9) of our model on pooled data (international and domestic partners for 1987, 1992, and 1997).[20] We decompose both international and interprovincial border effects into three elements depending on the year (Table 1). This allows one to control for temporal heterogeneity and to study the evolution of domestic and international trade integration.

The Ramsey Reset regression specification error test for omitted variables rejects the functional form of the estimation presented in column 1.[21] The coefficient on the log of relative production is significantly lower than its predicted unitary value specified in the Dixit-Stiglitz version of the trade model. We suspect that econometric problems lead to an understatement of the production coefficient that in turn could bias other coefficients of

[19] We apply the same logic as Helliwell (1997) to correctly identify the border effect and properly separate it from the common border effect. The goal is to measure the greater intensity of trade between a province and "itself" rather than with an unrelated partner (whether or not they are neighbors). As a consequence, the common border dummy variable is set equal to 0 when transactions occur between the province and "itself" or between the province and the 'rest of China'.

[20] A Chow test does not reject that domestic and international trade flow can be pooled in a single regression.

[21] Probabilities of not rejecting a specification problem are given in the last line of the table.

Table 1
Chinese provinces' international domestic border effects

Dependent variable	$\ln(m_{ij}/m_{ii})$	$\ln(m_{ij}/m_{ii})-\ln(v_j/v_i)$				
Specification	1	2	3	4		5
Foreign border				Coastal interior		
1987	−6.54*** (0.33)	−6.48*** (0.37)	−7.97*** (0.55)	−6.49*** (0.37)		−6.46*** (0.37)
1992	−6.83*** (0.33)	−6.36*** (0.35)	−7.65*** (0.36)	−6.37*** (0.36)		−6.32*** (0.36)
1997	−6.55*** (0.33)	−6.02*** (0.36)	−7.28*** (0.37)	−6.02*** (0.36)		−5.96*** (0.37)
Domestic border						
1987	−1.22*** (0.22)	−2.51*** (0.21)	−3.09*** (0.20)	−1.90*** (0.29)	−2.92*** (0.18)	−2.52*** (0.21)
1992	−1.47*** (0.22)	−2.78*** (0.22)	−3.38*** (0.22)	−2.37*** (0.24)	−3.10*** (0.25)	−2.65*** (0.22)
1997	−1.93*** (0.24)	−3.30*** (0.23)	−3.91*** (0.23)	−2.93*** (0.38)	−3.52*** (0.22)	−2.91*** (0.23)
Relative production	0.51*** (0.04)					
Relative distance	−0.58*** (0.07)	−0.78*** (0.07)	−0.49*** (0.07)	−0.79*** (0.07)		−0.77*** (0.07)
Relative prices	−0.29 (0.17)	−1.21*** (0.15)	−1.14*** (0.15)	−1.20*** (0.15)		−1.24*** (0.16)
Adjacency	1.77*** (0.49)	1.83*** (0.57)	2.34*** (0.55)	1.83*** (0.58)		1.85*** (0.59)
Hong Kong			2.98*** (0.22)			
ρ		−.06 (0.14)	0.06 (0.13)	0.05 (0.13)		−0.09 (0.13)
R^2	.56	.50	.56	.51		.50
Obs. Nb.	944	944	944	944		944
Ramsey Reset	0.02	0.80	0.42	0.75		0.84

Heteroskedastic consistent standard errors in parentheses.
*** Denoting significance at the 1% level.

interest.[22] As emphasized by Harrigan (1999), output and trade are jointly determined in equilibrium. This could lead to a correlation between relative production and the error term. In order to respond to the simultaneity problem, we constrain the coefficient on the log of relative production to be equal to one. This approach is preferred to the instrumental variables method. Not only does the imposition of a unitary elasticity on production avoid the need for instrumental variables but it can also mitigate another potential econometric problem -measurement error on production. To the extent that the production data are inaccurate, a bias towards zero may be exhibited in the coefficient on $\ln v_j/v_i$. Depending on cross-correlations, other right-hand-side variables may display biased coefficients as well. Moving $\ln v_j/v_i$ to the left-hand-side of Eq. (9) gives:

$$\ln\frac{m_{ij}}{m_{ii}} - \ln\frac{v_j}{v_i} = \theta\ln\frac{d_{ij}}{d_{ii}} - \sigma\ln\frac{p_j}{p_i} - (\sigma-1)[\beta + \ln(1+u)] - (\sigma-1)\eta A dj_{ij} + e_{ij} \text{ with } e_{ij} = (\sigma-1)(\epsilon_{ij} - \epsilon_{ii}) \quad (13)$$

Production disappears from the right-hand-side and therefore no longer causes a simultaneity problem. The restricted specification results presented in column 2 differ from the previous ones by attributing greater trade reduction to distance, price and domestic border effects and less to international border effects. Common border effect also becomes larger. The coefficient on relative price turns out significant and increases above one, in accordance with the theory. Indeed, it represents the price elasticity. The distance coefficient is quite consistent with the empirical literature. The R^2 is reduced because the explanatory power of relative production no longer contributes to its calculation. The Ramsey Reset test no longer rejects the functional form, attesting to the reliability of our border effects estimates. The absence of endogeneity of the selection process with respect to our model equation is also not rejected.[23]

Our results (columns 2 to 5) confirm that, all things being equal, Chinese provinces have become more and more integrated with the rest of the world. The average international border effect has fallen greatly between 1987 and 1997 especially since 1992. Conversely, the interprovincial border effect that is a global indicator of interprovincial trade barriers has increased over the same period. We quantify border effects following

[22] Theoretically, a lower than unitary value of the coefficient could arise because countries with larger production are manufactured at a greater scale. Thus, rises in relative production overstate the number of varieties offered. We, however, assume the theory to be correct and give priority to the econometric problems' explanation emphasized by the rejection of the Ramsey Reset.

[23] The endogeneity concerning which province–partner pairs display positive trade has the potential to generate selection bias. Statistical yearbooks do not provide trade flow data using an exhaustive list of international partners and could select the partners on the basis of their international status or on the basis of their diplomatic relations with China. We therefore run estimations using Heckman's one-step procedure (full maximum likelihood). Explanatory variables in the probit are the relative explanatory variables of the model, their level values as well as dummies by continent of origin of international partners and provincial dummies. In every case, the non-significance of the correlation coefficient ρ underlines the absence of endogeneity of the selection process with respect to our model equation.

McCallum (1995) in using the ratio of imports from self to imports from others, holding other things equal. This involves taking the exponential value of the estimated border effects. Our average indicator of impediments to domestic trade increased from 12 [exp(2.51)] in 1987 to 16 [exp(2.78)] in 1992 and reached 27 [exp(3.30)] in 1997. It therefore appears that Chinese provinces' international integration has gone together with domestic market disintegration.

Our results reflect the failure of Chinese authorities to promote domestic openness and eliminate the fragmentation of the economic structure along the provincial limits. The rise of Chinese provinces' domestic border effect over time contrasts with results obtained for other economies (Canada, USA, European Union, and OECD). The reduction of the intensity of trade flow inside China can therefore be interpreted as a move towards the disintegration of the Chinese domestic market: locally produced goods supply a growing share of local consumption to the detriment of goods produced in the rest of the country. This move runs counter to the logic of regional specialization according to comparative advantage and economies of scale.

As a test of robustness, we include a dummy variable that takes on the value of 1 for trade with Hong Kong. Results (column 3) confirm the existence of specific trade-promoting relationships between the Chinese provinces and Hong Kong. The dummy enters with a significant positive coefficient and there is a logical upward adjustment of international borders effects, since they correspond to the average home biases for international partners other than Hong Kong. Impediments to trade with Hong Kong remain however greater than those to interprovincial trade flow. The average border effect between the Chinese provinces and their brother territory is around 100, that is more than 5 times the average domestic border effect.

As a final step we decompose the temporal evolution of domestic border effects between coastal and inland provinces[24] (column 4). Both categories of provinces experience a decrease in domestic trade intensity between 1987 and 1997. Maritime provinces not only benefit from favorable access to international markets and more developed transport infrastructure but also pioneered economic liberalization and international trade opening-up. The 'coastal' dimension can as a matter of fact be assimilated to an indicator of high reformist achievement. Expected results from the differentiation between coastal and interior provinces' domestic border effects are ambiguous. On the one hand, coastal provinces have better transport equipment, have been less accused of autarchic behavior than the interior and rely on the rest of the country for their inputs of production (raw materials, energy, etc.). On the other hand, their international opening could have proceeded at the expense of interprovincial trade. Our findings support the first argument: impediments to trade are lower in coastal provinces than in interior provinces. Our indicator of domestic trade barriers is two times lower for Maritime provinces than in the rest of China. It reaches 7, 11, and 18 on the coast against 18, 22, and 34 in inland provinces in 1987, 1992, and 1997 respectively, emphasizing that domestic trade fragmentation is higher in interior provinces than in the coastal fringe of China. These results refute the claim that lower interprovincial trade is a corollary of greater interna-

[24] The Maritime provinces are Beijing, Tianjin, Shanghai, Hebei, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Liaoning.

tional trade engagement. On the contrary, internationally engaged provinces are also the most domestically integrated.

We find that if Chinese reforms succeeded in promoting international trade openness, they failed at achieving greater domestic market integration both in coastal and interior provinces. While our indicator of total international trade barriers dropped by 37% between 1987 and 1997 (from exp(6.48) to exp(6.01)), our indicator of impediments to interprovincial trade almost doubled.

Rawsky and Mead (1998) argue that two decades of reforms have reduced the reliability of China's statistical system -designed to aid the management of an administratively controlled, nonmarket economy. They contend that statistics have progressively lost track of growth for sectors such as construction, transport and services. We need to ensure that increasing understatement of domestic trade flow are not responsible for the decrease in interprovincial trade intensity that we find.[25] We recall that no decline in interprovincial trade is evident in our data. In fact, domestic inflow (in current yuan) doubled between 1987 and 1992 and further increased by 90% between 1992 and 1997. However, over the same periods, production was multiplied by 2.4 and 2.6, respectively. As a basis for comparison, international imports soared by a factor of 4.6 between 1987 and 1992 and of 5.2 between 1992 and 1997. Domestic trade growth thus fell behind output and international trade expansion. In order to verify that our result does not stem from a decline in the coverage of our domestic trade data, we consider a scenario where our domestic trade flow (inflow and outflow) understate the real figures by 5%, 20%, and 40% respectively in 1987, 1992, and 1997. We compute the readjusted figures and use them to estimate our model. Results (column 5) continue to display an increase in our indicator of interprovincial trade barriers. The null hypothesis that the 1987 and 1997 domestic border effects are equal is rejected by the data.

International border effects, despite their decrease, remain very high, especially with partners that do not share a border with China. We find that Chinese provinces consumed about 650 times more local goods than goods from these countries in 1987 against 400 in 1997. If the partner is adjacent, these numbers are 84% lower [1−exp(−1.83)]. Our indicator of international trade barriers turns out to be huge especially in comparison with results found in other studies[26] and with interprovincial border effects over the same period.

We can express the magnitude of the provincial border effects based on its tariff-equivalent. In order to do so, we need to make an assumption concerning the elasticity of substitution σ. Indeed, the estimate of the ad-valorem value of the border effect is computed as Exponential of [border effect/(σ−1)]−1. We consider results obtained by Head and Ries (2002): values of σ ranging between 7 and 11.[27] We use σ=9 and find that the tariff-equivalent of border effects between Chinese provinces and international partners

[25] I thank Rawsky for suggesting this verification.

[26] International border effects of Chinese provinces in 1997 turn out to be 40 times higher than the figure computed for Canadian international trade.

[27] Head and Mayer (2000) rely on σ=9 and find a tariff-equivalent between 37% and 45% for European countries. Wei (1998) computes a tariff-equivalent of the border effect between OECD countries using σ=20 because of the predominance of intra-industry trade in the trade flow of these countries. He finds a tariff-equivalent of 5%.

amounts to 123% in 1987 and 112% in 1997. The tariff-equivalent of impediments to interprovincial trade is 37%, 41%, and 51%, respectively in 1987, 1992, and 1997.

These latter figures underline the imperfect integration of the Chinese domestic market. Indeed, impediments to interprovincial trade in China are quite high. Our indicators of Chinese domestic market integration between 1987 and 1997 (border effects doubling from 12 to 27 and tariff equivalents increasing from 37% to 51%) are directly comparable with the results found for the European Union, OECD countries or the Canada–US integration. The magnitude of Chinese provinces' border effects turns out to be closer to that existing between independent sovereign countries than to that measured inside individual countries such as the US or Canada. Integration between different countries is slowed down by their nationalism, by the heterogeneity of their institutions, norms and legislation as well as by linguistic and cultural differences between them. These factors should not exist or should affect trade less in a single unified country. The comparable magnitude of Chinese interprovincial trade flow intensity with that of trade flow between different sovereign countries emphasizes the imperfect integration of China's domestic market. An identical tariff-equivalent of around 40% in China and in the EU during the 1990s implies a lower degree of market integration in China than in Europe. The increase of domestic border effects between 1987 and 1997 is of concern as it testifies to the failure of the Chinese reforms to promote trade liberalization inside the country. Decreasing domestic trade flow intensity appears all the more alarming in that it deepens the dichotomy between the interior and the coastal provinces.

Despite a simultaneous move towards greater international trade integration and lower domestic integration, our results clearly indicate that Chinese provinces remain far more integrated with the rest of the country than with any other foreign partner, including Hong Kong. Indeed, in 1987, a Chinese province consumes on average 53 times more goods imported from the rest of the country than from the rest of world, the figure declined to 15 in 1997. Furthermore, our results furthermore underline that domestic fragmentation is not a corollary of internationalization since coastal provinces turn out to be the most engaged both in interprovincial and international trade. These findings confirm that the move towards domestic fragmentation finds its roots in a tendency for self-sufficiency and autarchy notably in interior provinces in addition to a substitution effect between domestic products and international products in favor of the latter.

6. Conclusion

The aim of this study was to measure the respective size and dynamics of Chinese provinces domestic and international trade integration between 1987 and 1997 using the border effects method. The main point of the paper is that the decrease in still high international border effects has occurred together with an increase in already large domestic border effects. While Chinese reforms succeeded in promoting international freer trade, they failed at reducing impediments to interprovincial trade flows.

Global barriers to international trade remain huge however, far higher than those observed between EU countries or between Canada and the rest of the world. These values underline that despite great cuts in China's trade protection, important obstacles remain to the free entry of foreign goods into the Chinese market.

Concerning the degree of Chinese domestic market integration, we find not only that inter-provincial trade flow intensity is low but also that it has decreased between 1987 and 1997. Barriers to trade between Chinese provinces turn out to be closer in magnitude to that on international trade (within the EU or between Canada and the US) than that on trade flow within a single country (inside Canada or the US). Chinese domestic market integration is low since, despite the absence of cultural, linguistic, currency, or institutional differences, provincial boundaries deter trade to the same extent as borders separating sovereign countries. Provinces' consumers purchased, in 1997, 27 times more local goods than goods from the rest of the country against 16 in 1992 and 12 in 1987. This evolution underlines the failure of reforms to promote domestic integration and the growing division of Chinese domestic market into cellular submarkets.

Even if Chinese provinces remain up to now far more integrated with the rest of the country than with any other foreign partner (including Hong Kong) and if at the current rate it would take more than 50 years to reverse the situation, our results seem to confirm the pertinence of alarming forecasts concerning the danger of China's move towards internal disintegration.

Acknowledgements

My thanks go to Barry Naughton for sharing the Provincial Input–Output tables for 1992 with me and for helpful discussions. I am greatly indebted to Marcel Fafchamps for solving the aggregation problems of the model. I have also benefited from comments of participants in the 2001 International Conference on the Chinese Economy organized by the CERDI-IDREC in Clermont-Ferrand (France), at the Canadian Economic Association 35th Annual Meetings held in Montreal in June 2001, and at the 50th yearly conference of French Association of Economic Sciences held in Paris in September 2001. I also wish to thank Patrick Guillaumont and Jean-Louis Combes, my PhD advisors for precious suggestions.

Appendix A. Data sources

A.1. Provincial trade with the 'rest of China'

Input–Output tables are available for 28 provinces as data are missing for Tibet, Hainan, and Tchongqing. One province in 1987 (Qinghai), three in 1992 (Anhui, Heilongjiang, and Inner Mongolia), and five in 1997 (Anhui, Hebei, Heilongjiang, Shandong, and Guizhou) list only net outflows and are thus not useful for studying interprovincial trade. Eleven provinces in 1992 and seven in 1997 separate inflows and outflows into domestic and foreign sectors. I have deduced domestic trade flow for the

other provinces using provincial import and export data from the Ministry of Foreign Trade (MOFTEC) in its Almanac of China's Foreign Economic Relations and Trade (various issue). Not only do the MOFTEC data match those given by the input output tables for the provinces that decompose trade flow between domestic and international but also they are the only ones available before 1992. MOFTEC is furthermore the only source of bilateral international trade flow by province. Since 1992, two additional series concerning international trade were released (aggregates by province, no bilateral flow): the customs series by origin/destination and the customs series by the location of the importer/exporter. The figures given by China's Customs Statistics for the imports are systematically greater than those from the MOFTEC.[28] Using the former series (instead of MOFTEC data) yields lower values of imports from the 'rest of China' and thus is unfavorable to the argument that domestic trade is large and thus that border effects are low. We have estimated the model using the Customs data to generate the imports from the 'rest of the country.' This leads to a slight revaluation of the domestic border effects for each year. The evolution over time is unchanged, the rise of domestic border effects between 1992 and 1997 is in fact even more rapid. Conversion from local currency to US dollars is based on exchange rates extracted from the World Development Indicators.

A.2. International trade

Provincial international trade flow by partner are taken from Almanacs of China's Foreign Economic Relations and Trade from the Ministry of Foreign Trade and completed by Provincial Yearbooks. Chinese Customs do not publish disaggregated data by province and partner at the same time.

A.3. Intraprovincial trade flow

Each province's imports from "itself" m_{ii} are computed following Wei's (1996) method, that is by subtracting the province's total exports (to domestic and foreign partners) from production.

A.4. Prices

We approximate international production prices by aggregate price levels expressed relatively to US prices extracted from the Penn World tables. We compute Chinese provincial prices by multiplying China aggregate price level expressed relatively to US

[28] The potential for mismeasurement in international trade by province is well known and is discussed at length in an appendix available from the author upon request. I provide a more complete discussion of the implications on the border effect value of the imperfections of the international trade series (inclusion of services, inclusion of processing trade, etc.). I show that these defects globally tend to overestimate the imports from the 'rest of China' and thus to underestimate border effects. This underestimation furthermore increases over time. In no way would the use of flawless data challenge our result of increasing barriers to domestic over the period of study. On the opposite, the correction of the imperfections would induce the amplification of the increase of our indicator of domestic trade barriers between 1987 and 1997.

prices by the provincial deviation for the national average wage. Yearly provincial and national wages in current yuan are taken from the China statistical Yearbooks.

A.5. Production

The lack of comparable production data for every foreign country leads us to use GDP data (in current US dollars) from the World Development Indicators. Chinese provincial GDPs are taken from the China Statistical Yearbooks.

A.6. Distance between provinces and the 'rest of China'

Bilateral distances between provinces i and j are measured on the basis of real distance by road in kilometers between their capital cities.

A.7. International distance

International distances between Chinese provinces and their international trade partners are computed as the 'greater circle' distances between their respective capital cities.

A.8. Intraprovincial distance

Measures of internal trading distance have greatly improved. Initial papers (Wei, 1996; Wolf, 2000) employ fractions of distances to the capital cities of neighbor countries. A second strand in the literature assumes that the country has a specific geographic shape and a specific spatial distribution of the activity in order to calculate the average distance among points within the country. This approach leads to compute the internal distance as a function of the surface area. If a disk-shape is assumed, the average distance will be a fraction of $\sqrt{\text{surface area}/\pi}$. A more desirable method has recently emerged pioneered by Helliwell and Verdier (2000). Internal trading distance should be computed relying on actual data on the internal spatial distribution of economic activities rather than on approximations. In absence of GDP data, they compute internal trading distance for Canadian provinces using actual data on the distribution of population within provinces.[29]

In China, provinces are administratively subdivided into prefectures. We compute the intraprovincial distance d_{ii} as the production-weighted geometric mean of bilateral distances between prefectures of provinces: $d_{ii} = \Pi_{l \epsilon i} d_{il}^{\frac{y_l}{y_i}}$ *with* $d_{il} = \Pi_{m \epsilon i} d_{lm}^{\frac{y_m}{y_i}}$. Data on GDP of provincial prefectures are taken from Cities China 1949–1998 (1999). Bilateral distances between prefectures l and m are measured on the basis of real distance by road in kilometers between their capital cities.

[29] Notably, they calculate internal distances of Canadian provinces as the population-weighted average of intracity, intercity, city-to-rural-area, and rural-area-to-rural-area distances.

Appendix B. Allocation of goods absorption by province

Table 2
Shares of various sources of goods in provinces' absorption

Provinces	Local goods			Rest of China goods			International goods		
In %	1987	1992	1997	1987	1992	1997	1987	1992	1997
East									
Beijing	49	65	66	49	27	26	2	7	8
Tianjin	28	55	48	67	40	37	4	6	15
Hebei	54	50	45	49	1	1			
Shanghai	33	51	64	60	39	26	7	10	10
Jiangsu	70	59	61	29	36	33	1	4	6
Zhejiang	64	85	88	35	13	9	1	2	3
Fujian	73	74	84	23	16	3	4	10	13
Shandong	73	75		26	24		2	1	
Guangdong	50	58	45	40	28	24	10	14	31
Guangxi	65	62	66	32	34	32	3	4	2
Liaoning	77	81	85	21	16	10	1	3	5
Center									
Shanxi	66	72	84	34	27	15	0	0	1
Jilin	61	32	61	38	63	36	1	5	3
Anhui	73			26			1		
Heilongjiang	65			34			1		
Jiangxi	74	75	76	25	24	23	1	1	1
Henan	61	76	82	39	24	17	0	1	1
Hubei	65	68	85	34	31	14	1	1	1
Hunan	81	74	86	18	24	12	1	2	1
I. Mongolia	58		67	41		30			3
West									
Sichuan	84	86	91	15	12	6	1	2	3
Guizhou	71	73		29	26		1	1	
Yunnan	71	85	76	27	13	21	2	2	3
Shaanxi	68	64	66	32	34	32	1	2	2
Gansu	65	73	72	34	27	27	1	1	1
Qinghai		64	64		36	35		0	1
Ningxia	52	55	65	48	44	33	1	1	1
Xinjiang	69	55	62	29	45	35	2	1	3

Source: Provincial Input Output tables China Statistical Yearbooks.

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