

## Protectionism and Industry Location in Chinese Provinces

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**ABSTRACT** *This paper investigates the determinants of activities' location in Chinese provinces based on a unique panel data set, paying particular attention to the role of local protectionism. We estimate a model of production location across Chinese provinces that combines factor endowments and geographical consideration. Results emphasize that the dynamics of comparative advantages and the forces of the new geographic economy are at work in Chinese provinces. Estimations, however, lend strong support to the role of local protectionism. The location of economic activities in Chinese provinces does thus not exclusively follow the logic of the market.*

**KEY WORDS:** China, protectionism, international trade, location of activities, externalities

### Introduction

This study analyses the relation between protectionism and localization of economic activities in Chinese provinces. It is, to our knowledge, the first to measure directly the impact of impediments to domestic trade on the process of industrial location.

The analysis is motivated by the existence of a double paradox concerning China's economy over the reforms. First, several studies show reduced regional specialization over the liberalization process of the 1990s. Moreover, the structure of regional specialization<sup>1</sup> appears to be detrimental to the growth of value added. Some empirical works find a negative impact of the degree of regional concentration on the performance of industries (Batisse, 2002; Mody & Wang, 1997). Second,

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various studies also show a reduction in regional specialization in China (World Bank, 1994; Young, 2000).

These findings are all the more counter-intuitive as Chinese authorities initiated, in the late 1970s, a programme of reforms that broke dramatically with the Maoist introverted development strategy. The reforms promoted spatial domestic market integration alongside state withdrawal, economic modernization and international openness. This radical move is rooted in the recognition of the economic inefficiencies and wastage of resources resulting from the autarkic development and planification policies. Central authorities advocated the introduction of market and competition mechanisms, economic openness and the reorientation of the production structure in accordance with comparative advantages in order to reinforce growth dynamics and competitiveness. The successful promotion of international opening-up is widely acknowledged. The process of trade liberalization resulted in the entry of China in to the WTO at the end of 2001. In parallel to its international trade integration, the country has opened itself up to foreign investments to become the first recipient of FDI among developing countries. The beneficial impact of economic openness has been emphasized in various studies (Mody & Wang, 1997; Démurger, 2000).

However, recent findings of a negative relation between industry-level specialization and growth and of converging production structures in Chinese provinces conflict with the increased international openness of the country over the period as well as with the objectives pursued by the reforms (promotion of competition, rationalization of the production structure, specialization according to comparative advantages). These phenomena lead us to wonder about the mechanisms of industry-level specialization and concentration in China. We investigate whether the localization of industries in China is rooted in a market process or, on the contrary, is influenced by industrial and trade policies disconnected from the logic of comparative advantages. What are the driving forces behind industry localization in Chinese provinces? Does the strong presence of a sector in a province result from market rules and competition forces or from protections and interventions of the local authorities disconnected from the logic of the comparative advantages?

There is a sizeable literature that studies the geographic concentration in production, the location of economic activities, especially in Europe and in the United States (for the most recent surveys see Hanson, 2001, and Overman *et al.*, 2001). Most of these contributions agree to recognize the increasing regional specialization in conjunction with the growing economic integration (Amiti, 1999; Davis & Weinstein, 2001; Brülhart & Torstensson, 1996; Midelfart-Knarvik *et al.*, 2001). Two main strands of theoretical reasoning guide these attempts to disentangle the various forces determining location of activities: neoclassical trade models and the New Economic Geography (NEG) models. The neoclassical approach moves from a perfect competition framework, with homogeneous products and non-increasing returns to scale. It emphasizes that the spatial distribution of natural endowments, technologies and/or factors determines the location of economic activities (Ricardo, 1817; Heckscher, 1919; Ohlin, 1933). The New Economic Geography literature dispense instead with all exogenous elements, and models an endogenous pattern of location determined by specific features of the economy such as imperfect competition, differential products and increasing returns. Besides traditional production factors and endowments, sectors use intermediates to produce differential goods. With imperfect competition and increasing returns, input-output linkages

are sources of pecuniary externalities that encourage economic agglomeration.<sup>2</sup> Proximity to other firms affects a firm's market size and costs.<sup>3</sup>

While the benefits of trade and specialization are well understood, a precondition for realizing benefits of trade and specialization, namely free flow of goods and services across regions may not hold in the context of China. We argue, following Bai *et al.* (2004), that a Chinese singularity, namely the existence of regional protectionism, may affect the country's economic structure. Kumar's (1994) World Bank report 'Internal Market Development and Regulation' underlines the limited degree of regional specialization and the weak mobility of factors and goods in China. Various studies<sup>4</sup> describe 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 at the end of the 1980s 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.<sup>5</sup> Young (2000) argues that, over the past 20 years of economic reform, China has evolved into 'a fragmented internal market with fiefdoms controlled by local officials'. Poncet (2003) corroborates this claim, as she found that despite the promotion of spatial integration by authorities, domestic trade flow intensity inside China has declined between 1992 and 1997: locally produced goods supply a growing share of the local consumption to the detriment of goods produced in the rest of the country. It therefore appears necessary to take into account local impediments to trade in the study of economic specialization of Chinese provinces.

The literature on industry location in China is rather scarce, in part due to data constraints. Decomposition of employment or output data by sector for Chinese provinces over a long period is very difficult to come by. Young (2000) studies the evolution of the five sectors in the socialist measure of national income (agriculture, industry, construction, transport and commerce) and the evolution of the three sectors in GDP accounting (primary, secondary and tertiary). His results support the conclusion of reduced regional specialization. However the low degree of disaggregation is a very serious limitation of his study. The lack of a theoretical yardstick with which to evaluate changes is also proposed by Naughton (1999) as a problem with arguments based on structure of production.<sup>6</sup>

Bai *et al.* (2004) adopt an industry-level approach. They compute indicators of industry-level concentration<sup>7</sup> based on output data and regress them on industry-characteristics in order to test the role of resource endowments, scale economies, external economies and the local protectionism. However, they lack direct measures of local government protection of activities and therefore need to rely on indirect hypotheses focusing on the supposed governments' benefits from erecting barriers on interregional competition. First, they conjecture that the governments protect priority industries that have high profits and/or tax margins. Second, the authors argue that as authorities are concerned with employment in their respective regions of governance, they tend to be receptive to calls for protection in the enterprises that they administer (state-owned). We claim that Bai *et al.*'s (2004) study suffers from three drawbacks that our analysis aims at solving. First, similar to most studies in the literature that regress localization coefficients on industry characteristics, estimations lack real theoretical foundation. Second, serious data constraints force the authors to adopt a two-step approach to investigate the determinants of industry localization over the period 1985–1997. Indeed, they only obtained information on R&D intensity and energy consumption for one year preventing them from using

the fixed-effect method. Third, and more problematic considering their main objective, they fail to examine local protectionism directly as they need to rely on two indirect hypotheses in their investigation of the role of protectionism in determining specialization.

In this paper, we examine regional protectionism directly as we rely on all-inclusive indicators of provincial industry-level trade barriers computed based on inter-provincial trade flows. To our knowledge, this paper is the first to measure the impact of impediments to domestic trade on the process of specialization of Chinese provinces beside other traditional factors such as resource endowment, supply and demand linkages.

We exploit a unique panel data set extracted from provincial input–output tables for 1992 and 1997. The final-demand columns of these matrices provide the decomposition of provincial inputs, consumption, trade, demand and output for 31 comparable industries goods in 1992 and 1997. We consider that our paper allows a better and fuller assessment of the patterns of location of economic activities in China than previous studies on Chinese economic structure as it is not limited to manufacturing industries.<sup>8</sup>

The next section exposes the data sources and performs a descriptive analysis of industry location across Chinese provinces. The section after presents and tests econometrically a model of industry localization in which industry characteristics are nested within each provincial dimension. The fourth section concludes.

## Data Sources and Descriptive Analysis

### Data

Most of the data that we use in this study come from Input–Output tables of Chinese provinces. The final-demand columns of these matrices provide the decomposition of provincial output, international and domestic trade for 21 tradable and 10 non-tradable comparable industries in 1992 and 1997.<sup>9</sup> These data were obtained for 25 provinces in 1992 and 24 provinces in 1997.<sup>10</sup> Provincial input–output tables report the intermediate use of inputs of production (notably natural resources) as well as the utilization of capital by industry.

Industry-level employment data for 1992 and 1997 are obtained from the *China Industrial Statistical Yearbook* (SSB, yearly issues between 1989 and 1998).

Distances between provinces are computed following the quickest route based on very detailed maps. This measure, which takes into consideration the reality of geographical space (mountains, lakes, density and quality of road infrastructures), is surely a better proxy than Great Circle distance, which is generally used in economic geography or trade studies.

### Descriptive Analysis

We first look at the production structures of Chinese provinces and address some questions. How specialized are provinces? How similar are the economic structures across Chinese provinces? How has specialization evolved between 1992 and 1997? Second, we make statements about the localization of a given economic activity. How concentrated is the economic activity as a whole and how concentrated is a given sector? Which sectors are becoming more or less spatially concentrated? Do we find an increase or decrease in concentration over time?

A province (sector) is said to be relatively specialized (concentrated) if its structure differs from the average Chinese one.

A sector is relatively concentrated if it differs from the average spread of production between provinces. We construct a measure that allows us to compare each province's production structure with that of the rest of the country's average. For each sector  $k$ , we calculate its respective share in the gross output value of province  $i$ ,  $y_i^k$ , and in the gross output value of China as a whole,  $y_n^k$ . We measure how much province  $i$ 's production structure differs from the national one by computing the Balassa index. This index correspond to a sum over all sectors:  $spec_i = \sum_k (y_i^k/y_i)/(y_n^k/y_n)$ . It takes the value of zero if province  $i$ 's production structure is identical to the rest of the country and the maximum value of two when province  $i$  has no sector in common with the rest of the country.

Values of these indices for each province are given in Appendix A. They are calculated for 1992 and 1997, based on 31 comparable sectors from input-output tables (20 industry sectors, agriculture and 10 service sectors). On average, we observe a decrease in specialization between 1992 and 1997, indicating that locations become more similar. Our indicator of specialization declined for 19 provinces of our sample. Over the same period however, it increased slightly for eight provinces, mostly western provinces. The greatest increases of the index are found for Qinghai, Xinjiang, Gansu and Shandong.

Provincial duplication is a feature of China's economic structure. Almost every industrial sector is represented in all provinces, although sometimes at the expense of comparative advantages exploitation. This interregional dispersion of output, referred to by authors as the 'cellularization of Chinese economy' finds its roots in the great size of Chinese provinces, the weakness of inter-provincial communication and the strategy of self-sufficiency adopted under the Mao reign.

It appears that despite the engagement in economic reforms, economic specialization did not really improve in China. Between 1992 and 1997, only the western provinces experienced a growing specialization, while others (central and coastal) displayed converging economic structures. The increase in specialization in some western resource-rich provinces appears coherent with the promotion of regional complementarity exploitation by central authorities as described earlier.

Our sample can be separated into two different groups. On the one hand, provinces doing little extraction, and more oriented towards the processing of agricultural products, and intermediates such as Beijing, Tianjin, Shanghai, Zhejiang and Guangdong on the coast and Hubei in the interior of the country. On the other hand, provinces with great natural resources endowment, but with weak processing activities, such as Liaoning, Hebei and Shandong on the coast, and Sichuan, Heilongjiang, Shanxi and Xinjiang in the interior. These latter provinces are the most specialized provinces of China. The specialization of Xinjiang seems to come primarily from petroleum exploitation. The development of heavy industry after 1949 in the province of Heilongjiang led to an over-representation of certain industrial sectors, such as the industries of mining, chemistry and metallurgy. In addition to its extraction activities, Shanxi experiences a certain specialization in heavy industries, such as exploitation of ferrous metals, the chemical industry and mechanical engineering. This specialization of production on three of four sectors is thus a common feature for provinces of Ningxia, Jilin, Qinghai and Inner Mongolia.

We now switch the focus from provinces to sectors and make statements about the localization of a given economic activity.

The variable of interest will be  $conc.k = \sum_i (y_i^k / y_n^k) / (y_i / y_n)$  where  $y_i^k$  is the output of sector  $k$  in province  $i$ , and  $n$  characterizes the whole nation.

Appendix A summarizes the levels of geographical concentration of our sectors. The aggregate index shows a general tendency for a decrease in the concentration of the industries over the period 1992–1997.

We note that the strongest activity concentration in 1997 is found for extractive industries such as oil extraction (1.4), coal mining (1.3) and metal ore mining (1.2). These sectors, as well as agricultural activity (1.2) which is also spatially concentrated, are sectors for which proximity of natural resources is essential. These sectors are spatially tied to the natural resources that they exploit. Energy production centres are primarily concentrated in the north and the north-east areas, in particular Heilongjiang (for oil and natural gas extraction) and Shaanxi (coal) and in the western provinces such as Xinjiang (petroleum, natural gas). Major increases in the concentration index between 1992 and 1997 are found for these resource-dependent industries, especially petroleum extraction and processing, metallurgy, agriculture and electricity.

In contrast, the weakest indexes of concentration are found for market-oriented sectors for which access to final consumers dominates location decisions. Indeed, concentration indexes around 0.7 are computed for electric equipment and machinery, textile goods, electronics and instruments. On average, the concentration degree of these sectors decreased between 1992 and 1997.

Appendix C reports indicators of provincial protectionism computed by Poncet (2002) based on domestic trade flows. These trade barriers increase between 1992 and 1997. Sectors subjected to high internal barriers are also characterized by relatively strong levels of concentration. This result appears in contradiction with the theory resulting from the new theories of the international trade and the NEG. Any liberalization of the internal and international trade,<sup>11</sup> by the diminution of the transaction costs which it involves, should lead to an increase in the industry-level concentration.<sup>12</sup>

## Empirical Analysis

### *The Model*

We follow the model derived by Midelfart-Knarvik *et al.* (2001) to study how comparative advantages and geography interact to determine location.

A log-linear estimable expression is derived from a canonical economic geography model, in which industry and province level characteristics interact. In this model, countries differ in terms of endowments and support transportation costs on their exchanges. Our adaptation consists of introducing trade barriers beside these transportation costs.

All industries use both primary factors and intermediate goods to produce differentiated products. Location decisions of economic activities are determined both by comparative advantages and economic geography forces. Factor endowments matter in accordance with the HOS model. Production structure is also influenced by the location of demand. Scales economies and positive transport costs encourage firms to locate in the largest markets where they can meet a higher potential demand and lower transportation costs.

The model considers  $R$  provinces denoted  $i$  and  $j$ , and  $K$  industries, each denoted by  $k$ . Goods are tradable but incur transport costs  $t_{ij}^k$  and trade barriers

imposed by province  $j$  when transported from province  $i$  to  $j$ . We adopt an iceberg cost specification of these transport costs so that  $t_{ij}^k$  depends on distance between home province  $i$  and destination province  $j$ . We assume constant ad valorem barriers of  $B_{ij}^k$  for all cross-border trade between  $i$  and  $j$ .

Following Overman *et al.* (2001), the demand side of this canonical geography model is a price index (or expenditure function) for each industry that aggregates different varieties in the industry in each province  $j$ . This takes the usual CES form defined by:

$$G_j^k = \left[ \sum_{i=1}^R n_i^k \left( p_i^k t_{ij}^k B_{ij}^k \right)^{1-\sigma} \right]^{1/(1-\sigma)} \quad (1)$$

In this equation,  $n_i^k$  is the number of varieties of industry  $k$  produced in province  $i$  while  $p_i^k$  is their f.o.b price,  $t_{ij}^k$  the iceberg cost factor on trading industry  $k$  products from province  $i$  to province  $j$  and  $B_{ij}^k$  captures the protectionism applied by province  $j$  on industry  $k$  products imported from province  $i$ . The  $n_i^k$  industry  $k$  product varieties produced in province  $i$  are therefore supposed to be symmetrical, i.e. they face the same cost and demand functions. Note that  $\sigma$  is the elasticity of substitution between product varieties, assumed to be the same in all industries.<sup>13</sup>

Let us denote by  $E_j^k$ , the total expenditure on industry  $k$  products (produced in  $j$  or in other provinces  $i$ ) in province  $j$ . We can derive the value of the sales,  $x_{ij}^k$ , of an industry  $k$  good produced in province  $i$  and sold in  $j$  by using Shepard's lemma on the price index (see for example Dixit & Stiglitz, 1977):

$$x_{ij}^k = (p_i^k)^{-\sigma} \left( B_{ij}^k t_{ij}^k \right)^{1-\sigma} E_j^k \left( G_j^k \right)^{\sigma-1} \quad (2)$$

Adding over all provinces  $j$  and over all  $n_i^k$  varieties of industry  $k$  goods produced in province  $i$ , we derive the following expression for the total value of industry  $k$  output produced by province  $i$ ,  $y_i^k$ :

$$y_i^k = n_i^k p_i^k \sum_j x_{ij}^k = n_i^k p_i^k x_i^k = n_i^k (p_i^k)^{1-\sigma} \sum_{j=1}^R \left( B_{ij}^k \right)^{1-\sigma} \left( t_{ij}^k \right)^{1-\sigma} E_j^k \left( G_j^k \right)^{\sigma-1} \quad (3)$$

On the production side, prices are set proportional to marginal costs so that:

$$p_i^k = \theta^k c(v_i; \phi^k) \quad (4)$$

where  $v_i = [w_i, q_i]$  is the vector of input prices (comprising primary factors of prices  $w_i$  and a composite intermediate good of price  $q_i$ ) and  $\phi^k$  refers to the costs of industry  $k$  regarding both primary and intermediary production factors.

We follow Midelfart-Knarvik *et al.* (2001) in conveniently taking the total value of production as a numeraire, so that  $\sum_i \sum_k y_i^k = 1$ . As such,  $y_i^k$  now corresponds to the industry-country production share. We also assume throughout that all sectors are perfectly competitive. These authors argue that this assumption is necessary to have a precise and tractable link between the theory and the econometrics.<sup>14</sup> As a consequence, the parameter  $\theta^k$  which denotes the mark-up applied by the producers is set to one. Moreover, the numbers of varieties produced in each province  $n_i^k$  are

exogenously set in proportion to the size of industry  $k$  and province  $i$ , up to an error term  $\epsilon_i^k$ .<sup>15</sup> In the context of estimations with province and industry fixed effects by period, this assumption means that the number of varieties is an exogenous function of industry and province specificities, so that:

$$n_i^k = \sum_k y_i^k \sum_k y_i^k \exp[\epsilon_i^k] = s_i s^k \exp[\epsilon_i^k] \quad (5)$$

where  $s_i$  is the share of province  $i$  and  $s^k$  is the share of industry  $k$  in total production. Substituting equations (4) and (5) into equation (3), we obtain the expression of the total value of industry  $k$  output in province  $i$ , expressed relative to the size of industry  $k$  and of the province  $i$ . This double relative measure is noted  $r_i^k$

$$r_i^k = y_i^k / s_i s^k = c([w_i, q_i] : \phi^k)^{1-\sigma} \sum_{j=1}^R (B_{ij}^k)^{1-\sigma} (t_{ij}^k)^{1-\sigma} E_j^k (G_j^k)^{\sigma-1} \exp(\epsilon_i^k) \quad (6)$$

We observe that the relative output value  $r_i^k$  is influenced by two elements. The first parameter can be referred as a parameter of technological efficiency, inversely linking output to the vector of input prices and to the quantity used in primary factors and intermediate goods in each industry.

Following Midelfart-Knarvik *et al.* (2001), we consider that the first component of equation (6) is an aggregate version of an industry-specific technology efficiency parameter, whose determinants at the regional level might be brought back to factor endowments. Indeed, the authors argue that ‘for primary factors, we want to go back to factor endowments rather than use factor prices, since the latter are endogenous’. We work on the estimation with several primary factors: namely capital,<sup>16</sup> labour and natural resources. For natural resources, rather than using endowments, we use output of oil, coal and ferrous and non-ferrous minerals. Details are given in Appendix D (construction of variables) and values of explanatory variables appear in Appendix B. The model assumes a single composite intermediate good. It determines the relative output level through the interaction of province level endowments in this good and the industry-level intermediate input shares. As noted by Midelfart-Knarvik *et al.* (2001), the relationship corresponds simply to ‘forward linkages’: ‘industries with high intermediate shares are drawn into locations with good access to supply of intermediates, and vice versa’.

The second term, captured by the sum, relates relative regional output to the demand location. As explained in Altomonte & Bonassi (2002), this term essentially corresponds to the one of market potential originally developed by Harris (1954) and the fact that the demand arising in a given region  $i$  derives not only from local consumers, but also from the demand originating from all consumers in the regions surrounding  $i$ . The ‘external’ source of demand has to be weighted by the transport costs and trade barriers on the delivery of the industry  $k$  products from province  $i$ , where they are produced, to the other provinces  $j$ . As our specific interest is in studying the impact of trade barriers imposed by regional governments, we decided to decompose this term into two parts: the indicator of provincial protectionism<sup>17</sup> ( $B_{ij}^k$ ) and the traditional market potential. We assume transport costs to be an isoelastic function of the distance  $d_{ij}$  between location<sup>18</sup>  $i$  and  $j$  and take the total demand  $Demand_j^k$  as a proxy of the total expenditure function of each province  $j$  for every industry  $k$ .

Under these assumptions, it is possible to rewrite equation (6) as:

$$r_i^k = \sum_{x=1}^4 c(w_i : \phi^k) c(q_i : \phi^k) B_i^k MP_i^k \exp(\epsilon_i^k) \quad (7)$$

where  $MP_i^k$  is the market potential of province  $i$  in  $k$  industry products as in Altomonte & Bonassi (2002):

$$MP_i^k = \sum_{j=1}^R \left( t_{ij}^k \right)^{1-\sigma} E_j^k \left( G_j^k \right)^{\sigma-1} = \sum_{j=1}^R Demand_j^k d_{ij}^k \quad (8)$$

### Empirical Estimation

*Estimation.* We now turn to the econometric implementation and estimation of the structure presented above. We log-linearize equation (7) and run the following equation for every year  $t$ , industry  $k$  and province  $i$ :

$$\begin{aligned} \ln \frac{y_{i,t}^k}{y_{i,t} y_{k,t}^k} &= \alpha_1 \ln labour_{i,t}^k + \alpha_2 \ln capital_{i,t}^k \\ &+ \alpha_3 \ln natural\ resources_{i,t}^k \\ &+ \alpha_4 \ln supply\ linkages_{i,t}^k + \beta \ln market\ potential_{i,t}^k \\ &+ \gamma \ln domestic\ protectionism_{i,t}^k + \epsilon_{i,t}^k \end{aligned} \quad (9)$$

Appendix D details the construction of the various variables of our model. Input-output tables provide us with data on the resource intensity of industries by province. In that respect, we solve the potential problems of other studies that, in the absence of information on natural resources intermediate consumption, had to rely on imperfect proxies.<sup>19</sup>

In addition to traditional variables of comparative advantages and market linkages, we aim at paying particular attention to the role of impediments to inter-provincial trade in China. As explained more fully in Appendix D, trade barriers (tariff- and non-tariff-barriers) are apprehended through an industry-level all-inclusive indicator of border-related impediments to trade of Chinese provinces computed by Poncet (2002) for the years 1992 and 1997 based on domestic trade flows extracted from the same input-output tables that we use for other variables.

Our model is applied on a three-dimensional panel for 21 industries, 25 provinces and 2 years. We rely on a panel fixed effects specification. We simultaneously introduce specific fixed effects by industry/year and province/year. This approach allows us to control for heterogeneity of industries and provinces separately for each year of the study.

This equation confronts us with two econometric problems. First, our indicator of inter-provincial trade barriers is the residual of a preliminary econometric estimation. It may therefore be measured with error. To address this issue, we therefore provide bootstrap estimates of standard errors. Second, our indicator of

Table 1. Fixed effects (within) IV regression industry-year and province-year bootstrap estimation of standard errors. Dependent variable: Industry location by province  $\ln(y_i^k/s_i^k)$

	1992-1997		1992		1997		1992-1997			
	1	2	3	4	5	6	7	low	medium	high
Labour	0.45*** (0.05)	0.45*** (0.05)	0.04 (0.07)	0.62*** (0.06)	0.35*** (0.12)	0.43*** (0.07)	0.45*** (0.17)			
Capital	0.32*** (0.05)	0.33*** (0.05)	0.62*** (0.07)	0.24*** (0.07)	0.47*** (0.09)	0.31*** (0.07)	0.29*** (0.15)			
Natural resources	-0.008 (0.02)	-0.009 (0.02)	0.01 (0.02)	-0.02 (0.03)	0.09* (0.04)	0.06* (0.02)	0.06 (0.05)			
Supply linkages	0.47*** (0.18)	0.47*** (0.18)	0.32 (0.21)	0.61*** (0.26)	1.24** (0.52)	0.62*** (0.24)	0.23 (0.35)			
Demand linkages	0.62*** (0.11)	0.62*** (0.11)	0.77*** (0.12)	0.46*** (0.17)	0.49** (0.26)	0.48*** (0.11)	0.62** (0.27)			
Local protectionism	0.08*** (0.02)	0.05*** (0.02)	0.07*** (0.02)	0.09*** (0.02)	92: 0.08*** (0.03)	0.04** (0.02)	0.002 (0.07)			
		97: 0.10*** (0.03)			97: 0.12** (0.05)	0.12*** (0.03)	0.07 (0.04)			
Obs. Nb	959	959	498	461	382	466	110			
R <sup>2</sup>	0.75	0.75	0.81	0.74	0.79	0.80	0.95			
Test overid. $\chi^2$	3.11	1.09	0.19	4.40	9.47	1.66	9.93			
Test Davidson MacKinnon	0.54	0.83	0.16	0.07	0.7	1.71	1.35			

Heteroscedastic consistent standard errors in parentheses, with \*\*\*, \*\* and \* denoting the significance at 1, 5 and 10% levels.

border-related impediments to trade may be endogenous with respect to the production structure.<sup>20</sup>

We therefore rely on a Fixed Effects (within) Instrumental Variables<sup>21</sup> specification with bootstrap estimation of standard errors. We show for each estimation the Sargan test for validity of instruments (test of overidentifying restrictions)<sup>22</sup> and the test of exogeneity of Davidson–MacKinnon.<sup>23</sup> The Huber/White/Sandwich estimator of variance is used to correct potential heteroscedasticity.

*Results.* Results are reported in Table 1. We first estimate our equation on our complete dataset; that is, pooling across the two years 1992 and 1997 (columns 1 and 2).

The second column differentiates the impact of our indicator of domestic protectionism by year. The following two columns (3 and 4) run separate regressions for 1992 and 1997. The final three columns examine the heterogeneity in the industry localization process depending on the degree of international liberalization of provinces.

The three first determinants correspond to the influence of comparative advantages, respectively endowment in labour, capital and natural resources. These factor intensities variables all enter significantly (at the confidence level of 1%) in the regression with the sign predicted by theory. The only exception is the variable of natural resources, which is not significant when all provinces are pooled together: the final last columns reveal that the impact of natural resources on location depends on the provincial degree of international liberalization. The variable of labour also fails to enter significantly in the regression for 1992. Results emphasize that labour and capital endowments are driving forces of the industry location in China.

Estimations also consider two forces predicted by the new trade theory and the New Economic Geography: the supply linkages (availability of intermediary inputs) and the demand linkages (size of the market potential). Both indicators enter with a significant and positive sign in the location equation. Results thus stress that access to suppliers and markets matters. Industries tend to locate close to the production of their vital intermediary inputs and to their customers.

The last determinant considered in the regression is an all-inclusive indicator of border-related impediment to domestic trade.

It reflects the protectionist policies put in place by provincial authorities against goods from the rest of the country. The significant positive sign in front of the indicator of local protectionism emphasizes that the greater the protection against the competition of non-local products enjoyed by an industry in a province, the larger its local relative output share. Local protectionism reinforces the presence of protected industries. This may occur at the expense of the market logic and induce inefficiencies.

The explanatory power of our estimations is quite good. The  $R^2$  lies above 74%. Results confirm that the industry location in Chinese provinces is not completely disconnected from the logic of market. Comparative advantages, resources endowments and market externalities matter in firms' location choices. Evidence supports predictions from the new trade theory and the New Economic Geography. Localization of activities not only corresponds to resource-endowments criteria (labour, capital) but also to supply and demand linkages.

The positive role of our indicator of local protectionism however underlines that protection policies adopted by provincial authorities in terms of domestic trade flows disrupt these pure market mechanisms. Impediments to domestic trade significantly affect the productive structure of provinces. Coefficients in front of our indicator of impediments to trade are, however, quite small, and lie systematically lower than those in front of the other factors. They nevertheless increase significantly at the confidence level of 1% (columns 2 and 4) between 1992 and 1997, attesting to the growing influence of protection policies on industry location. This result emphasizes that Chinese provinces' structures of production are increasingly influenced by the interventionism local authorities in the economy to the detriment of pure competition forces. This evolution appears all the more alarming as protectionism turns out to increase over the period. The value of the indicator of border-related impediments to trade increases between 1992 and 1997 (see Appendix C) in coherence with the argument of greater economic fragmentation proposed by Young (2000). A growing share of industry specialization emanates from local protectionist strategies that go against external-economies and comparative advantages principles.

It is possible to measure the respective contribution of each determinant in the regression to the localization of activities. This statistical exercise allows us to grasp the hierarchy of factors behind Chinese provinces' economic structures. The contribution of each variable is computed as the product of its average value and of the coefficient behind it. Results in column 1 underline that New Economic Geography forces are the driving factors of industry location.

The contribution of local protectionism is significant, however, its value is lower than that of the other traditional determinants.

While dependence on capital input and demand linkages are the most important factors in 1992, supply linkages and dependence on labour become the leading forces in 1997 (columns 3 and 4). This evolution is coherent with the decentralization process and the new objectives of industrial policies in the mid 1990s. Provincial authorities with newly acquired economic and regulatory powers exhibited, in the drawing up of the Ninth Five Year plan (1996–2000) their new conceptions. Priority was given to industrializing industries with high consumption of intermediary inputs. These 'pillar industries' were expected to have high income elasticities, significant technological (learning by doing) content and spillover effects in economic development. These activities were judged capable of absorbing excess local raw material productions and redundant labour force induced by agricultural reforms. This strategy contrasted with the industrial policy of 1990 which focused overwhelmingly on capital intensive basic industries such as energy and steel (Naughton, 1999).

The last three columns authorize a differentiated process of industry location (and notably the influence of domestic protectionism) depending on the degree of international openness policy.

More specifically, we estimate our model on three different sub-samples of provinces. The three subsamples correspond to low, medium and high international preferential policy on the basis of the indicator developed by Démurger *et al.* (2002). The construction of this index relies on available information on designated open economic zones across China, gathered from different sources, as well as a subjective classification based on their importance in terms of special treatment given to investors and industrial enterprises (see Appendix D for details and Appendix C for values).

Results show that the greater the international preferential policy, the more demand linkages matter and the lower the importance of supply linkages (dependence on intermediary inputs) in the determination of the location of activities. In less liberalized provinces, the coefficient for backward linkages is much smaller than that for forward linkages, suggesting that access to intermediate supplies is more important in determining location of production than access to customers. These features confirm results reported in the literature on Chinese reforms. Authorities in provinces characterized by low advancements in reforms, weak liberalization and low degree of international openness have given priority to upward vertical integration of production without consideration for prospects of goods produced.

The influence of natural resources endowments (that comprise oil, coal and ferrous and non-ferrous mining) on industry location is magnified among provinces that are less outward-looking internationally. On the contrary, the influence is negative in the three provinces for which there is stronger international preferential policy. It underlines that industries that depend greatly on these natural resources are underrepresented in these provinces. It is in line with the economic structure of these provinces and with the importance of foreign-owned companies there. Indeed, international firms produce mainly light manufactured goods that are intensive in labour and hardly use inputs from the four natural resources that we considered. They mostly process plastic and textile inputs. Outward-looking provinces are specialized in industries (such as electronics, instruments, textile and transport equipment) that do not rely on natural resources as shown in Appendix B. In other provinces, especially the least internationalized ones, the presence of natural resources is a significantly positive determinant of the location of activities. The coefficient on the capital variable is much higher in provinces with weak international preferential treatment. It is consistent with the fact that these provinces are often backward and characterized by a greater importance of capital intensive extraction activities and heavy industries as well as by a larger share of the public sector.

Our indicator of impediments to domestic trade has no impact on the structure of production for the more internationally outward-looking provinces (Shanghai, Fujian and Guangdong). The location of economic activities in these three provinces appears to respond exclusively to market mechanisms and to the free play of competition. However, on the contrary, the impact of domestic protectionism on the location of activities is significant for the provinces that are judged to be less internationally extrovert. The elasticity of location to protectionism has furthermore increased between 1992 and 1997 for provinces with intermediary international preferential policies. The increase is significant at the confidence level of 5%.

Our results are consistent with the evidence of a negative influence of the concentration on value-added growth of activities (Batisse, 2002; Mody & Wang, 1997). It appears logical considering the fact that the location of activities in Chinese provinces is, to some extent, related to the degree of protection granted by the local authorities and not only to the forces of free competition. Low-productivity and low-potential activities that are shielded from outside competition may well reinforce their relative position on the market in terms of production; however, there is no reason for them to benefit from higher value added.

## **Conclusions**

This paper investigates the driving forces behind industry location in China between 1992 and 1997, paying particular attention to the role of regional protectionism.

This analysis is motivated by the evidence of a negative relation between concentration and value-added growth of industries and of reduced regional specialization in a context of rapid international opening and liberalization.

We consider that our paper overcomes several limitations of previous studies of Chinese economic structure. In particular, it is not limited to manufacturing industries as it exploits a unique data set from Input-Output tables for 1992 and 1997 that decomposes production, intermediary consumption and factor intensity for 20 industrial sectors and agriculture. It is, furthermore, to our knowledge, the first paper to measure directly the impact of impediments to domestic trade on the process of industry-level specialization of Chinese provinces as well as other traditional factors.

Results underline that New Economic Geography forces are the driving factors of industry location. The contribution of local protectionism is significant; however, its value is lower than that of the other traditional determinants.

The location of economic activities in Chinese provinces does not exclusively follow the logic of the market. It is also influenced by interregional trade barriers put in place by local governments. Greater location quotients are found for industries that enjoy high protection from interregional competition.

The influence of the various determinants to location of activities differs depending on the degree of international preferential policy of provinces. In particular, local protectionism does not appear to matter for the most outward-looking provinces, while it has a significant impact on the activities location in the other provinces. Its influence has, moreover, increased between 1992 and 1997 for provinces with intermediary international preferential policies.

These findings put in question the existence of a systematic positive relation between trade liberalization, specialization and growth. It raises, in the longer run, the issue of maintaining economic competitiveness and high growth in Chinese provinces.

## Notes

1. In this article, we refer to regional specialization when a region concentrates on one or a few industries. The term *concentration* is used to describe the process of spatial agglomeration of firms of a given industry.
2. Models of trade with constant returns to scale and perfect competition predict that economic activities will be dispersed across different locations. Increasing returns to scale (*i.e.* strong indivisibilities in the production process) and imperfect competition turn out to be essential for explaining the uneven geographical distribution of economic activities and explaining why very similar regions have very different production structures on the basis of their different access to markets.
3. The New Economic Geography predicts that input-output linkages should have two types of effects: backward linkages affecting market size for the industry and forward linkages through which the cost of production is affected. Krugman & Venables (1995) show that a large number of downstream firms attract a large number of upstream firms due to 'demand linkages'. The more upstream firms are in the one location, the more intense is the competition, providing a feedback effect for the upstream firms, which is referred to as 'cost linkages'. Moreover, downstream firms have access to a larger variety of differentiated inputs.
4. See Lee (1998); Yang (1997) and the special issue of Chinese Economic Studies (1993).
5. At the annual session of the National People's Congress in March 2000, Wang Zhongfu, director of the State Administration for Industry and Commerce, pointed out that 'administrative monopolies, forced deals and market blockades have become a cancer in China's market' (*People's Daily*, 1 July, 2000). More recently, in April 2001, the State Council issued a directive to outlaw regional blockades in market activities.

6. He argues that some changes that contribute to measured convergence in China are efficiency enhancing. The author refers to changes in production in China during the reform era that sometimes reflect movement away from inappropriate patterns of regional specialization imposed under the planned economy. As such, measured convergence should not always be considered as ominous.
7. They study the degree of industry-level concentration based on panel data covering 32 industries in 29 provinces for 1985–1995 and 1997. They find that the overall time trend of regional specialization of China's industries has reversed an early drop in the mid 1980s and registered a significant increase in the later years. This evolution is confirmed by Batisse (2002). The author computes an Isard index of localization based on value added data coming from the exact same yearbooks as Bai *et al.* (2004). The computed index of localization for 30 sectors over the period 1988–1997 shows a general increasing trend in concentration of industrial sectors.
8. Data used by the Bai *et al.* (2004), taken from the National Bureau of Statistics, offer an incomplete coverage of industries. The NBS only collects and reports statistics on 'all industrial enterprises with independent accounting system at or above the township level'. The under-reporting is obvious when comparing the data from the *China Statistical Yearbooks on Industrial Economy* and from the input–output tables compared by Chinese provinces for the years 1992 and 1997.
9. Chinese provinces produced square input output tables for 1992 and 1997. A few of them are published in provincial statistical yearbooks. We obtained access to final-demand columns of these matrices from the input–output division in China's National Bureau of Statistics. In 1997, a total of 40 industries are considered against 33 in 1992. This study concentrates on industries of tradable products and thus excludes service sectors.
10. IO tables are available for 28 provinces as data are missing for (Tibet, Hainan and Chongqing). Three provinces in 1992 (Anhui, Heilongjiang and Inner Mongolia) and four in 1997 (Anhui, Heilongjiang, Shandong and Guizhou) list only net outflows and are thus not useful for studying inter-provincial trade.
11. The international opening policy was launched in the 1980s in China, recently illustrated by the entry of the country in OMC in December 2001.
12. See Naughton (1999) for further details on the logic of intervention of the provincial authorities in the economy during the 1990s'.
13. As explained by Midelfart-Knarvik *et al.* (2001), letting this elasticity differ across industries would be straightforward in the theoretical sections, but a common value is assumed in the empirical estimation.
14. While this restriction means that some of the forces of New Economic Geography are absent from the approach, the authors claim that adding imperfect competition would raise a number of issues that go beyond the scope of their paper. This assumption implies that product varieties are imperfect substitutes but market power is reduced to zero by some exogenous 'invisible hand'.
15. Models of monopolistic competition yield a proportionality between production and the number of varieties, as the number of varieties is endogenously determined by free entry. In models of perfect competition, as considered here in line with Midelfart-Knarvik *et al.* (2001), the number of varieties produced in each province is set exogenously. Our hypothesis is that the number of varieties of industry  $k$  produced in province  $i$  is related to both the share of province  $i$  and the share of industry  $k$  in the national output up to an error term as described in equation (5). This assumption is not that strong, especially in the context of an empirical estimation that introduces both industry-level and province-level fixed effects by year. Indeed, the results do not depend on the introduction of the proxy of the number of varieties since it is captured by the fixed effects. Moreover, the bootstrap estimates ensure that any remaining measurement error is controlled for.
16. Midelfart-Knarvik *et al.* (2001) exclude capital from their estimation on the grounds that it is internationally mobile and has the same price throughout the EU countries that they study. We argue, following Kumar (1994), that the capital market in China is far from being integrated. As such, capital is considered as an immobile factor in our estimation.
17. It corresponds to the trade barriers put in place by authorities of province  $i$  on inter-provincial trade. It thus captures local protectionism.
18. As such, the distance is the same for every industry  $k$ .
19. Kim (1995) uses the cost of raw materials (value of all inputs) divided by total value added as the measure of resource intensity. As pointed out by Bai *et al.* (2004), all inputs are not equally immobile, thus Kim's measure fails to reflect the industry's true dependence on immobile resources. Bai *et al.* (2004) adopt another method and rely on the ratio of total consumption of standard coal (in tons) to total output by industry. The authors acknowledge the limits of this ratio. If coal is the most important energy source for Chinese industries, it only accounts for a small share of all natural resources

- that also include agricultural resources and minerals. Moreover, their data on coal consumption relates to the year 1995 only and is disaggregated only to the level of industry and not to the level of industry by region.
20. As argued by Chen (2004), firms that are not attached to any specific location (low concentration) can be expected to choose their location of production so as to minimize cross-border transaction costs and, as a result, border effects could be magnified.
  21. Instruments to be valid need to be correlated with the potentially endogenous variable and uncorrelated with the error term. We rely on indicators of provincial unemployment and budgetary autonomy, industry-level size of the public sector as well fiscal contribution, profits and sales by industry and province.
  22. A rejection of the null hypothesis casts doubt on the validity of the instruments. See Davidson & MacKinnon (1993). In our case, the null-hypothesis of valid instruments cannot be rejected.
  23. The null hypothesis states that an ordinary least squares (OLS) estimator of the same equation would yield consistent estimates. In our estimation, the test never rejects the null-hypothesis of exogeneity of our indicator of impediments to trade with respect to the localization index.
  24. The number of workers per province and sector is extracted from the *China Statistical Yearbook on Industrial Economy*. The increase is significant at the confidence level of 5/0.
  25. 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) can be generated on the basis of the characteristics of the provinces that make it up. We deduce the computation formula of the rest of China's characteristics from the expression of  $m_{ij}$  (imports by province  $i$  from  $j$ ) in the case where  $j = \text{roC}$ . Refer to Poncet (2003) for greater details.
  26. This denotation comes from Head and Mayer (2000) who call  $IV_i$  the "inclusive value" of the importer  $i$ . This term encompasses the characteristics of all potential suppliers of importer  $i$  such as their economic size, distance and border effect.
  27. Input-Output tables only report the industry-level imports and exports of Chinese provinces with the 'rest of the world' as a whole. No data on production, production price of that 'rest of the world' exists based on nomenclature comparable with that of the Chinese provinces.
  28. This index tries to provide further evidence for the distinct roles of preferential-policy effects and pure geography effects such as coastal localisation.

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