Regional Industrial Growth
Evidence from Chinese Industries

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Abstract

This paper examines several theories of regional industrial development in the case of China. It studies regional factors representing three broadly defined sources of regional growth: dynamic externalities arising from knowledge spillovers, natural advantage and local market conditions, and foreign trade and direct investment. Using provincial-level data on two-digit Chinese Industrial Classification industries over 1985-1993, we find that local competition is positively related to regional industrial growth. There is also strong evidence that provinces with a smaller state sector grow faster, and a better transport system helps growth. Finally after controlling for various other regional factors, we find that exports and foreign direct investment have strong positive effects on regional industrial growth.

1. **Introduction**

This paper examines the empirical significance of several theories of regional industrial development in Chinese industries. Specifically, it assesses the importance of the following factors in explaining regional industrial growth: dynamic externalities arising from technological spillovers, natural advantage and local market conditions, and access to foreign markets and technology. Dynamic externalities, which are viewed as the engine of growth in the recent literature on endogenous growth, have implications for long-run industrial growth. Local natural advantage and market conditions can cause regional specialization while industries are in the process of taking advantage of favorable local conditions such as natural resources, infrastructure, and market access. On the other hand, regional participation in foreign trade and exposure to foreign direct investment (FDI), which are often limited by a country's policies regarding international trade and FDI, have both static and dynamic effects on regional growth.

The role of dynamic externalities in economic growth has attracted considerable research interest in recent years. This is in large part due to recent advances in the theory of economic growth (e.g., Romer (1986), Lucas (1988), and Grossman and Helpman (1991)). The literature takes the view that externalities such as knowledge spillovers or learning by doing are the driving force for long-run economic growth. To the extent that such externalities have geographic limits, they have implications for regional economic growth. There is evidence that some knowledge spillovers are geographically localized (Jaffe, Trajtenberg, and Henderson (1993), and Branstetter (2001)). This implies that regions with a larger agglomeration of firms grow faster because regional concentration of firms facilitates knowledge spillovers.

Natural advantage and local market conditions, such as natural resources, infrastructure, market size, and market access, can also lead to regional specialization and play an important role in regional growth in the transition while firms are in the process of taking advantage of these benefits, and regional specialization is developing. Furthermore, in the presence of transport costs, some of these location advantages may interact with increasing returns to scale at the firm level to give rise to pecuniary externalities, leading to regional industrial agglomeration (Krugman (1991), Krugman and Venables (1995), and Fujita and Thissu (1996)). For example, Helpman and Krugman (1985) show that in the presence of transport costs, differentiated-product industries tend to concentrate in large markets. In general, firms prefer to locate near their suppliers and customers to economize on transport costs. Moreover, firms also benefit from sharing labor markets and better communicating with suppliers and customers in the situation of industrial agglomeration.

Given the importance of market size and access, it is immediately apparent that foreign trade policy plays a role in production location since trade policy often benefits certain regions in terms of access to foreign markets and foreign suppliers. In fact, the relation between international trade and production location has been a subject of great interest to trade economists in the recent literature on economic geography and trade. Hanson (1998), for example, studies the impact of the integration of Mexico with the United States on Mexico's regional industry growth, and finds that trade policy indeed has strong effects on industry location: industries in regions closer to the United States experienced greater employment growth.

In addition to the market-access aspect of trade policy, foreign trade and FDI have dynamic effects on productivity growth. In many developing countries, FDI is an important vehicle for technology transfer. Along with capital, foreign companies bring in advanced production technology and management, which are potential sources of technological spillovers. The presence of foreign companies also increases local competition and forces domestic firms to improve their efficiency. Foreign trade, on the other hand, exposes domestic firms to international competition and provides an additional incentive for them to improve efficiency and adopt more advanced technology.

China's experience in the reform period presents an excellent case study of regional industrial growth for a number of reasons. First, while overall economic growth since the economic reforms started has been impressive, a close look reveals striking variation in regional industrial growth.[1] As China gradually moves towards a market-oriented economy, firms have become increasingly profit driven, and there are potentially large gains from both dynamic and static externalities to be realized.

Second, what makes the experience of China interesting is that all the above-mentioned dynamic and static factors are likely to be present and identifiable. Take foreign trade and FDI first. A remarkable outcome of China's economic reforms is the rise of China as a large trading nation and major recipient of FDI in the world. However, regional involvement in foreign trade varies greatly, and inward FDI is very unevenly distributed across regions. This provides a rare opportunity to identify the effects of trade and FDI on local industrial growth through a cross-regional examination.

The usual difficulty in finding the role of natural advantage and local market conditions is that the effects of dynamic externalities and natural advantage are often indistinguishable or observationally equivalent (Ellison and Glaeser (1997)). This is because regional specialization, which gives rise to some of the dynamic externalities mentioned previously, is usually caused by natural advantage and local market conditions in the first place. Moreover, natural advantage and local market conditions play a role only during the process in which the pattern of regional specialization is developing. They have no implications for the long run unless continuous exogenous technological progress interacts with them to generate regional effects over time. Thus, their effects are easier to be identified in a transition period.

What makes China's economy particular useful for our research is that it has undergone a major transition in the recent past. Prior to the economic reforms, China was

[1] Evidence of regional differences in industrial growth in China will be discussed in detail in section 5.

a strictly Soviet-style command economy. Industry location was largely subject to state planning, and natural advantage such as local infrastructure was not critical in determining where industries were located. In other words, prior to the reforms the pattern of regional specialization reflected natural advantage and local market conditions only to a limited degree. Anecdotes of economically inefficient industry-location decisions abound. For example, in the three decades preceding the economic reforms, many heavy industries were directed to inland provinces partly because of the vulnerability of coastal provinces to possible future wars, despite the fact that the inland areas had relatively poor infrastructure and were far away from major industrial centers.

As a result, reform is likely to induce entry in places where favorable local conditions have not been fully exploited. Imagine a place that has natural advantage and favorable local market conditions well suited for industrial production, but has little presence of industries simply because of government planning. Then economic reforms that reduce the role of central planning can cause entry and growth of industries in the region, and such growth can not be attributed to dynamic externalities because industries are absent in the region to begin with. Thus, the effects of natural advantage can be separated from those of dynamic externalities from the existing regional specialization.

This is in contrast to previous studies on U.S. cities (e.g., Glaeser et al. (1992) and Henderson, Kuncoro and Turner (1995)), in which the effects of natural advantage, international trade and FDI are assumed unimportant and simply ignored, and to the case of Mexico (Hanson (1998)), in which dynamic externalities and trade policy are considered to be important, but not other location advantages such as those due to infrastructure. Therefore, we view our study not only as an investigation of a country-specific regional issue but also as a contribution to the empirical literature on static and dynamic externalities in industrial growth.

The paper is organized as follows. Section 2 contains a summary of different types of externalities in industrial development. Section 3 briefly describes the market reforms and foreign trade and investment policy changes in China, pointing out that Chinese industries have been operating in an increasingly competitive environment since the reforms started. Section 4 lays out the empirical specification. Data and empirical results are presented in section 5. Concluding remarks are collected in section 6.

2. **Dynamic and Static Externalities in Industrial Development**

Following Glaeser et al. (1992) and Henderson, Kuncoro and Turner (1995), we distinguish among three types of dynamic externalities. Technological spillovers among firms *within* an industry, sometimes referred to as the Marshall-Arrow-Romer externality, may explain the growth of a particular industry in a single location. The regional concentration of an industry facilitates intra-industry exchange of knowledge among firms through spying, copying, and interfirm movement of skilled labor, and therefore promotes innovation and growth. This argument, as Glaeser et al. point out, does not particularly favor local competition. Local monopoly may lead to more innovation and faster growth because technological externalities are internalized.

A somewhat different argument along this line emphasizes the role of local competition. Fierce competition in the same market provides firms with strong incentives to innovate quickly, and therefore accelerates technological progress and promote industrial growth. Assuming that product markets are local, the geographic concentration of a highly competitive industry is likely to generate more positive spillovers than geographic concentration where a small number of firms dominate, as long as economies of scale in the industry are modest.

A third view maintains that knowledge spillovers mainly run across industries. Jacobs (1969), in her work on city economic growth, suggests that innovations depend upon "large numbers and great diversity of economic organizations (p. 79)." That is, cross fertilization among a variety of industries is the engine of growth in the city. Applied to regional economies, it implies that industrial diversity in the local economy is important for growth.

Evidence on the extent and character of externalities in regional industrial development, however, is quite mixed. Among recent empirical studies, Glaeser et al. (1992) examine city-industries in the United States over the period of 1956-1987, and find evidence of knowledge spillovers between industries, but not within industries. Hanson (1998) presents mixed findings on externalities in Mexican state-industries: co-agglomeration of industries with upstream- downstream links promotes industrial employment growth, but agglomeration of a single industry does not. Henderson, Kuncoro and Turner (1995), however, find in their U.S. city-industry sample that within-industry externalities (or intra-industry spillovers) are significant and that between-industry spillovers are found only in new high-tech industries. Our paper will address the question of whether there is any evidence that technological spillovers contribute to regional industrial growth in China.

Aside from these dynamic externalities, static ones may arise due to the interplay between increasing returns to scale internal to firms and transport costs under product differentiation and imperfect competition. Increasing returns at the firm level imply that an individual firm will concentrate its production in a small number of places to take advantage of scale economies. The location choice of the firm thus becomes sensitive to transport costs because the firm is the only producer of its brands and serves many markets. In general, a place with lower transport costs and a larger number of consumers and suppliers offers the producer higher demand and better access to intermediate inputs, and therefore is a better production location. If there exist input and output linkages among producers (Krugman and Venables (1995)), or geographic labor mobility is high (Krugman (1991)), then pecuniary externalities set in, and agglomeration of production can be self-reinforcing.

But where exactly do industrial agglomerations take place? The theoretical literature on economic geography often suggests multiple equilibria. It is likely that agglomeration will be found in regions that initially possess rich natural resources, good infrastructure, and/or good access to large markets. Trade policy thus comes in to play a role because removal of trade barriers gives domestic producers better access to foreign markets. This would benefit regions that receive preferential policy treatment or enjoy proximity to foreign markets. The scale of agglomeration is eventually constrained by negative externalities such as congestion, high commuting costs, as well as increasing prices for immobile resources.

Implicit in the above hypotheses is the presence of free markets and competition. Are Chinese industries operating in an environment competitive enough for the dynamic and static externalities to become a force for regional industrial growth? There is no doubt that some industries with a large state sector are still protected from competition by the government, and that the Chinese economy is plagued by the inefficiency of state-owned enterprises. But the economic reforms have largely changed the market structure of Chinese industry. Price reform, the growing importance of the non-state sector, incentive mechanisms designed for state-owned enterprises, and the significant presence of firms established by foreign direct investment all point to the fact that firms are facing increasing competitive pressure. We next turn to a brief review of China's industrial reforms and its changes in foreign trade and investment policies in recent years.

3. **China' Economic Reforms and Trade Policy Changes in Recent Years**

China's economic reforms since 1978 have been gradual but far reaching. Price control has been lifted, and the share of production subject to state planning has been reduced dramatically. According to Otsuka et al. (1998), the share of retail transactions based on free market prices reached 90% in 1992 from a negligible level in 1978, and markets of consumption goods were almost completely decontrolled by 1998. The share of total industrial production under state plans and government imposed prices declined from 80% in 1978 to 12% in 1992.

One indication of increased competition in Chinese industries is the growing importance of the non-state sector. The non-state sector, which consists of collective-owned enterprises, private enterprises, joint ventures, and foreign-funded enterprises, grew rapidly in the 1980s and early 1990s. Its share of total industrial output rose from 22.3% in 1978 to 53.0% in 1993. The market reform, which destroyed the monopolistic structure of Chinese industries dominated by state-owned enterprises, clearly contributed importantly to the rapid growth in the non-state sector.

The state sector has also been subject to considerable changes in the reform era. Many measures have been introduced to increase the operational autonomy of state-owned enterprises. One example of these is the introduction of profit retention. As a result, managers are able to use some profits to finance investments and pay bonuses to workers. In the mid-1980s, long-term contracts were widely implemented which allowed enterprise managers who were able to improve profitability consistently over time to retain these incremental profits (Naughton (1995)). This is not to deny the fact that the state sector continues to be plagued by inefficiency and losses. State-owned enterprises have been burdened by excessive social responsibilities such as maintaining employment, providing housing to workers, and sharing the costs of education and health care. Also, in a number of heavy industries, state-owned enterprises dominate and face little competition. Nonetheless, reform measures taken in the state sector have introduced a great deal of competition into Chinese industries.

Turning to foreign trade and FDI policies, the opening up to international trade and investment has transformed China from a virtually closed economy into a major trading nation in the world. Beginning with a highly centralized state monopoly in the foreign trade sector, China relaxed foreign exchange control, reduced nontariff barriers, devalued its currency, and increased the number of foreign trade companies and competition among them. As a result, the volume of exports rose from $27.4 billion in 1985 to $98.0 billion in 1993 (Lardy (1992)). On the FDI front, foreign-invested firms received incentives such as permission to engage directly in foreign trade, duty-free import of raw materials, components, and capital goods, tax exemptions, income tax concession, and various subsidies from local jurisdictions. Actual inward FDI grew from $1.6 billion in 1985 to a stunning $27.5 billion in 1993 (Naughton (1996)).

Trade policy changes made in China, however, had strong regional bias. From the outset, foreign trade reform was implemented in a way that favored the better developed coastal area. Among the policies to promote exports and attract FDI, most radical was the creation of special economic zones (SEZs). In 1980 four SEZs were established in the southern coastal provinces of Guangdong and Fujian, in the cities of Shenzhen, Zhuhai, Shantou and Xiamen. Although this decision involved some noneconomic considerations, these cities' proximity and cultural ties to Hong Kong, Macao and Taiwan were certainly important factors.

Many other developments regarding foreign trade and investment also occurred in the coastal area. For example, in 1984 another fourteen coastal cities were set up as "coastal open cities" that offered incentive packages to foreign investment similar to those in the SEZs. The concept of SEZ was also extended to the Hainan Island of Guangdong province. In 1985, the Yangtze River delta, the Pearl River delta and the Minnan delta were opened to foreign investors as development zones. In 1988, Hainan Island became a province and the fifth and largest SEZ. Two years later in 1990, the Shanghai Pudong area also became a development zone. As a result, coastal provinces have played a much bigger role in China's exports and received most inward FDI. In 1990 the southeast coastal provinces of Jiangsu, Shanghai, Zhejiang, Fujian, and Guangdong (including Hainan), which produced 34.7% of China's industrial output, accounted for 46.8% of China's total exports, and received 69.4% of actual FDI.

What do these changes on the policy front have to do with regional industrial growth? As discussed earlier, they imply that coastal regions enjoy more benefit from participation in international markets and technology transfer from foreign-invested firms, a potential factor behind regional industrial growth that will be examined in section 5.

4. **Empirical Specification and Variables**

To construct a minimal specification to guide the empirical work, we suppose that industry j in location i at time t has a well-defined profit function,

$$\pi_{ij} = \pi(p_{ij}, w_{ij}, R_{ij}, A_{ij}),$$

where p_{ij} is the price of output, w_{ij} is the wage rate, R_{ij} is a vector of other input prices $(r_{ij}^1, \cdots, r_{ij}^K)$, A_{ij} represents the state of technology, and the time subscript is omitted.

The output supply, due to Hotelling's Lemma, is $y^s = \frac{\partial \pi}{\partial p_{ij}}(p_{ij}, w_{ij}, R_{ij}, A_{ij})$. Assume that the inverse demand for output is $p_{ij} = p(y_{ij}^d, H_i)$, where y_{ij}^d is the quantity of output demanded, and H_i is a vector $(h_i^1, \cdots, h_i^M)$ of regional characteristics that affect local demand in region i, such as infrastructure and market size. Then, reduced-form output in region i can be written as

$$y_{ij} = y(w_{ij}, R_{ij}, A_{ij}, H_i). \tag{1}$$

Expressing eqn. (1) in the logarithmic form and differencing, we have

$$\Delta log(y_{ij}) = \alpha \Delta log(w_{ij}) + \sum_{k=1}^{K} \gamma_k \Delta log(r_{ij}^k) + \beta \Delta log(A_{ij}) + \sum_{m=1}^{M} \phi_m \Delta log(h_i^m). \tag{2}$$

In our estimation, due to the lack of accurate information on wages and other input prices by province-industry, we first report results omitting the terms $\alpha \Delta log(w_{ij})$ and

$\sum_{k=1}^{K} \gamma_k \Delta log(r_{ij}^k)$, and then discuss and partially address some of the concerns resulted from omitting these variables in the sensitivity part of section 5.

We assume that technological progress ($\Delta log(A_{ij})$) has national and local components: $\Delta log(A_{ij}) = a_j + a_{ij}$. The national component a_j captures nationwide technology improvement in industry j, and the local component a_{ij} is assumed to be a function of a number of regional variables at the beginning of the sample period. They include factors giving rise to dynamic externalities such as local specialization, local competition, and local industrial diversity.

Following Glaeser et al. (1992), we construct the dynamic externalities variables as follows.[2] Local specialization is a measure of the local concentration of an industry at the beginning of the sample period. It is defined as the following

$$S_{ij} = \left(\frac{y_{ij}}{y_{i.}}\right) / \left(\frac{y_{.j}}{y_{..}}\right),$$

where y_{ij} is output in industry j in region i, $y_{i.}$ is total regional industrial output in region i, $y_{.j}$ is national output in industry j, and $y_{..}$ is total national industrial output. Hence, S_{ij} measures industry j's share of output in region i relative to that in the entire country. A higher measure of S_{ij} indicates that region i is more specialized in industry j.

We define local competition in industry j in region i as

$$P_{ij} = \left(\frac{n_{ij}}{y_{ij}}\right) / \left(\frac{n_{.j}}{y_{.j}}\right),$$

where n_{ij} is the number of firms in industry j in region i, $n_{.j}$ is the number of firms in industry j in the nation. y_{ij} and $y_{.j}$ are the same as previously defined. A higher measure of P_{ij} implies that firms in industry j in region i are smaller in size compared to the national average, and thus are believed to be more competitive (Glaeser et al. (1992)).

[2] Instead of using employment, we use output to construct these variables because of our focus on regional output growth.

A third variable describes local industrial diversity. Let $s_{ij} = (y_{ij}/y_{i.})$ be industry j's share of industrial output in region i. Then a Hirschman-Herfindahl index can be used as a measure of local industrial diversity

$$D_{ij} = \sum_{k \neq j} s_{ik}^2.$$

A higher D_{ij} indicates less industrial diversity in the region. The definition of this variable follows Henderson, Kuncoro and Turner (1995).

Competition in international markets and technology transfer from foreign-invested firms help improve the productivity of domestic firms. So we take regional exports and FDI as another two determinants of a_{ij}. Since exports and FDI at the province-industry level are not available, we instead use provincial exports and FDI, adjusted for the size of industry in the province (see table 1 for the exact definitions). Therefore, they are non-industry specific regional variables. Let X_i be the vector of these two variables.

We also include a variable Q_i as an additional determinant of a_{ij}, which measures the state sector's share of industrial output in region i (in the rest of the paper, it is referred to as one of the local market conditions, also see table 1). This is to take into account the fact that many state-owned enterprises have been handicapped by various social responsibilities and therefore plagued by incentive problems. A portion of their output, albeit an increasingly smaller part, continues to be subject to state planning. Non-state enterprises, in contrast, face fewer constraints and are much more flexible in adjusting to market conditions. This partly explains the explosive increases in the relative output of non-state enterprises. We hypothesize that state-owned enterprises are relatively slow in improving technology and efficiency, compared to firms of other types of ownership. So regional industrial growth will be negatively related to the state sector's share of output at the beginning.

If regional characteristics H_i do not change over time, the last term in eqn. (2) is zero and drops out. That is, normally natural advantage and local market conditions have implications for the level of regional output but not for output growth. However, in light of our discussion of the roles of these regional characteristics in a transition economy, they should matter for growth during the observed period in China.

Therefore, based on eqn. (2), the empirical specification to be used in the estimation is the following

$$\Delta log(y_{ij}) = c_1 + c_2 a_j + g(S_{ij}, P_{ij}, D_{ij}, Q_i, X_i, H_i) + \epsilon, \tag{3}$$

where g is assumed to be a linear function of S_{ij}, P_{ij}, D_{ij}, Q_i, X_i and H_i, and ϵ is an error term.

If the Marshall-Arrow-Romer externality exists, technological spillovers among local firms in the same industry facilitate innovation and improve productivity. Everything else equal, a higher degree of local specialization leads to a higher rate of industrial growth. Therefore, we would expect the output growth rate of industry j in region i to be positively associated with S_{ij}. The measure of P_{ij} is also expected to be positively related to local industrial growth if the effect of technological spillovers due to competition is significant. Jacobs's idea of cross fertilization promoting industrial growth suggests that a higher degree of diversity helps industrial growth, so industrial growth should be negatively related to the measure of D_{ij}.

It is also expected that, all else equal, a region with a higher level of exports or FDI grows faster, as does a region with a smaller state sector in industry to begin with. The variables described in this section are listed in table 1.

5. **Data and Estimation Results**

(a) Data

Data are available on thirty-two two-digit Chinese industrial classification industries for all twenty-nine provinces, autonomous regions, and municipalities (hereinafter provinces) over the period of 1985-1993.[3] Data on nominal industrial output, employment, and the number of firms by province-industry for 1985 are from the officially published 1985 Chinese industrial census materials, and data for 1993 are from the 1994 *Statistical Yearbook of China Industrial Economy*, published by the China Statistical Publishing House. According to the official definition, industry refers to (i) resource extraction and processing, (ii) manufacturing, and (iii) water and gas production and electricity generation and supply. Even though the data collected do not cover all two-digit industries, the thirty-two industries on which we do have data accounted for 94.2% of total industrial output in 1985.

Ex-factory price indexes of industrial products, which are available for fourteen industries from the *Statistical Yearbook of China* (1998, pp. 317), are used to adjust nominal output. For those industries for which industry-specific price indexes are not available, we use the general industrial output price index. Information on exports and FDI by province for 1983-1985 is obtained from *China Foreign Economic Statistics* (1979-1991). Data on other provincial-level variables, such as the illiteracy rate of workers by region, the length of transportation routes, telecommunications facilities, and the state sector's share of output, are from the *Statistical Yearbook of China*.

A preliminary check on the data reveals a few notable features of industrial growth in China during the sample period. First, there was substantial variation in regional industrial growth. This is clearly reflected in the changes in regional shares of industrial output from 1985 to 1993. Table 2 shows regional output and employment shares for seven regions, which aggregate provinces in a useful way to illustrate regional differences in industrial growth.[4] The three coastal regions' total share of industrial output rose from 58.2% in 1985 to 63.5% in 1993, indicating that as a group they had better-than-average

[3] Hainan, which was a region of Guangdong province prior to 1988 and became a separate province in 1988, is treated as part of Guangdong for data reasons.

[4] This follows a seven-region division mentioned in Guo (1999).

growth rates. The four inland regions all experienced a decrease in their shares of industrial output. However, regional shares of industrial employment remained fairly stable over the period. Also note that the coastal regions were more industrialized than the rest of the country at the beginning of the period. In 1985, with 37.6% of China's population, the coastal regions produced 58.2% of industrial output. At first glance, the faster growth in the coastal regions seems to be consistent with the dynamic-externalities hypotheses.

A breakdown by province in table 3 is probably more revealing. The five largest output-share gainers were all on the coast. The output share of Guangdong, a booming province on the southern coast, almost doubled from 5.4% in 1985 to 10.6% in 1993. Its share of industrial employment also showed a substantial increase, growing from 4.8% in 1985 to 6.5% 1993. But it is found that the two largest output-share losers, Shanghai and Liaoning, are also coastal. Shanghai's share of industrial output dropped from 9.6% to 7.2% over that period.

This leads us to the second observation. While overall output growth in the coastal regions was faster, regional variation in output growth within the coastal group was also evident. Table 2 shows that the Northern Coastal region grew slower than the rest of the nation, showing a decline in its output share. Also, in table 3, four out of ten coastal provinces experienced a decrease in output share. Thus, initial industrial size and the coastal status alone are unlikely to give a good account of the regional differences in industrial growth.

Third, an increase in the output share was not always accompanied by a gain in the employment share. For example, in table 2, while the Eastern Coastal region increased its share of output from 24.5% to 25.9%, its share of employment actually declined from 20.2% to 18.4%. This is also true for many provinces shown in table 3. Jiangsu province's output share went up from 9.8% to 12.3% while its employment share fell from 9.7% to 9.3%. This seems to suggest that factors other than employment growth had contributed significantly to relative regional output growth. It also implies that employment growth and output growth require different sets of explanatory variables.

Fourth, the faster output growth in Southeast China over 1985-1993 was very broad in scope. In tables 4(a)-(b) we combine the Eastern and Southern Coastal regions into what we call the "Southeast Coast," and calculate changes in its shares of output by detailed industry. Table 4(a) shows this region's shares in 1985 and 1993 in resource extraction industries. The Southeast Coast is not richly endowed with natural resources. We can see from the table that its output share decreased in three out of the six industries. But as shown in table 4(b), the region gained in its share of output in almost all manufacturing industries (24 out of 26) except for the tobacco industry and petroleum processing and coking industry, indicating a broad shift towards manufacturing in the Southeast. While this might suggest that some sort of industrial agglomeration was taking place over the period, the results we present in the next section will point to a few alternative explanatory factors.

Table 5 lists some non-industry specific regional variables: regional shares of exports and FDI as well as the state-sector's share of output in each region. The coastal regions as a whole accounted for 82.1% of China's exports in 1985 and received 85.5% of inward FDI for 1983-1985, much more than their relative weight in China's industrial output (58.2%). The Southern Coastal region alone attracted 53.1% of FDI. As discussed earlier, the uneven distribution of exports and FDI across regions was mainly due to the combination of trade and investment policies and location.

Regions also differed greatly in the state sector's share of industrial output in 1985. The state sector in the coastal regions had a relatively small role in industry. The state sector's share of output in the Southern Coastal region was the lowest, at 61.4% in 1985. In the Far West region, by contrast, state-owned enterprises produced about 84% of total industrial output.

(b) Estimation Results

The unit of analysis in this study is the two-digit industry in the province. The data set has 928 (32 industries and 29 provinces) potential observations. However, not all provinces have all industries. Some data for Tibet are not available, so Tibet is dropped from the sample. Province-industries with number of firms less than or equal to ten are also dropped because the local competition measure (C_{ij}) is not very meaningful for these industries.[5] The petroleum processing and coking industry in several provinces shows extremely large or small values for the competition and specialization measures. We attribute this to data errors, so this industry is also eliminated from the sample. After these adjustments, 752 observations remain in the sample. Some descriptive statistics of the sample are provided in table 6.

Table 7 shows the results on dynamic externalities based on eqn. (3). The dependent variable is real industrial output growth over the period of 1985-1993. Similar to Glaeser et al. (1992), growth in industry j outside the province is used to control for a_j, which represents nationwide technological progress in industry j. It could capture non-regional demand shifts in the industry as well. Column (1) shows that this variable is highly significant in the regression and has a coefficient of 0.607. The log of the initial level of industrial output in the province-industry is also included as a control in the regression. This variable, however, is not statistically significant. In fact, in results that are not reported in this paper, it is found that excluding this variable from the regression does not change any major results presented in the rest of this paper.

In the next three columns (2)-(4), the externalities variables enter the regression separately. In column (2) the local specialization variable S_{ij} is negative and statistically sig-

[5] The choice of ten is rather arbitrary. But the results reported in this section are not sensitive to this choice. We also try dropping industries with less than five, fifteen, or twenty firms. No results are significantly changed.

nificant. Relative growth is lower where industry specialization in the province is higher, contrary to what the theory predicts. The variable becomes insignificant when other externality variables are included in column (5). Thus, no evidence of regional specialization promoting industrial growth is found in this period in China. Hanson (1998) and Glaeser et al. (1992) both report that the measure of specialization is negative and statistically significant (Glaeser et al. (1992), table 3; Hanson (1998), table 7).

In column (3), the competition variable C_{ij} has the predicted sign and is statistically significant at the 1% level. That is, local competition is found to be positively related to regional industrial growth. The competition effect is also economically significant: based on the coefficient on C_{ij} in column (5), an increase in the measure by one standard deviation (1.106, table 6) raises the rate of output growth by about 13% over the eight-year period, or more than one-fifth a standard deviation of province-industry growth.

However, caution must be taken when interpreting this finding. Since C_{ij} measures the relative size of firms, the result is also consistent with the notion that smaller firms grow faster. While it is difficult to disentangle the competition effect and the firm size effect, one should note that the relatively fast growth in the non-state sector in China was largely driven by township and village enterprises, which on average were much smaller than state-owned firms. The positive and significant C_{ij} here likely reflects the explosion of the non-state sector in the sample period.

Industrial diversity (D_{ij}) has a negative coefficient, as shown in column (4). A higher D_{ij} implies less diversity. So the sign is consistent with the theoretical prediction. But the variable is not significantly different from zero. This result is unchanged when all the three variables are included in the regression in column (5). It offers little support for the idea that regional industrial diversity facilitates cross-fertilization and fosters industrial growth.

In sum, our results at best present a weak case for the importance of dynamic externalities in industrial growth. Regional industrial growth is found to be positively associated with local competition, suggesting a possible role of competition in promoting growth. But an alternative interpretation, which has very little to do with knowledge spillovers, also seems plausible. No significant positive correlation is found between industrial growth and either regional specialization or industrial diversity.

We next turn to the roles of natural advantage and local market conditions in industrial development. The regional illiteracy rate of workers is used as a proxy for the quality of labor. Measures of transportation and telecommunication are chosen to represent infrastructure. For the former, we use the density of transportation routes in 1985. This variable is defined as the total length of railways, highways, and waterways per ten thousand squared kilometers. For telecommunication, we use the number of telephones per ten thousand persons, similar to that in Head and Ries (1996).

Two variables are used to represent local market conditions. One is the log of provincial industrial output. It measures the size of the local market. In light of our discussion of state-owned enterprises in section 4, we also include the state-sector's share of output in the regression. Given the potential role of natural advantage and local market conditions in the transition, it is expected that industries grow faster in regions with better infrastructure, a larger market, or a smaller state sector.

Table 8 shows the coefficients on these regional variables. The illiteracy rate of workers in the province, a proxy for regional labor quality, is negative as expected, but statistically insignificant. The transportation variable is positive and significant at the 1% level in column (2). These remain unchanged when other variables are also included in the regression. The coefficient on the telecommunication variable, however, is negative and significant at the 1% level. Since these are the only two variables chosen to represent regional infrastructure, our findings on infrastructure are not clear-cut. One possible explanation of the negative telecommunication variable is that at the beginning of the reform period, the number of telephones was quite small (a national average of 5.9 phones per thousand persons), and a good number of those were for non-production bureaucratic use. So the variable, measured in year 1985, does not reflect much regional advantage for industrial production.

The state sector's share of output in the province in 1985 is negative and highly significant in columns (4) and (6). Output growth in the province-industry then is negatively related to the importance of state-owned enterprises in the province. A decrease in this variable by one standard deviation (0.096) increases output growth by about 20% or more than one-third the standard deviation of province-industry growth, if the value of the coefficient in column (6) is taken for the calculation.

As for the market size measure, the log of provincial industrial output in 1985 is positively related to output growth and statistically significant when it enters the regression alone in column (5). But its sign is reversed when other regional variables are included, implying that it is correlated with other explanatory variables.

In table 9, we include provincial exports and FDI (both adjusted for the size of provincial industry) in the regression. To be sure, the volumes of exports and FDI only measure how much a province participates in export markets and attracts FDI . They are by no means direct measures of trade policy changes. In addition to the regional preferences of trade policy, other things such as geography are also important determinants of exports and FDI. Exports and FDI are chosen as proxies for trade and FDI policies for two reasons. First, it is extremely difficult, if not impossible, to directly quantify policy changes regarding foreign trade and investment. Second, factors such as geographic proximity to foreign markets, though important, do not matter if trade and FDI are prohibited by policy, as they were, in large measure, prior to the reforms. In that sense, these measures should capture well the overall effects of China's opening up.

Columns (1)-(3) in table 9 show the effects of exports and FDI when they separately enter the regression and when both are included. In either case, both have a positive coefficient that is statistically significantly at the 1% level. They are also very significant economically, judging from the values of the coefficients. For example, if we use the coefficient on FDI in column (1), an increase in the FDI measure by one standard deviation raises the growth rate by about 18%, or more than one-fourth a standard deviation of province-industry growth. Output growth is higher in a province with either more exports or more inward FDI. Our findings are consistent with those in Wei (1995), who examines industrial growth in a sample of Chinese cities, and finds that the volumes of exports and FDI, separately, are positively related to industrial growth. What we find here shows that this is still the case at the provincial level even when a variety of other possible contributors to local industrial growth are controlled for, and industries under investigation are at a finer level.

We also report estimation results in columns (4)-(6) in table 9 when the externalities variables, infrastructure, local market conditions, and exports (or FDI) are included altogether. Note that the worker illiteracy rate becomes positive (even marginally statistically significant in column (6)). This is likely because this variable is correlated with other explanatory variables. So our results have not uncovered any unambiguous relationship between worker illiteracy and industrial growth. Other than that, the transportation variable continue to be positive and statistically significant, and the coefficients on the state sector's share and the telecommunication variable continue to be negative and significant. Also, the previous findings on dynamic externalities continue to hold. That is, the output growth effects of these regional factors discussed earlier are qualitatively unchanged if all explanatory variables are included in the estimation at once.

Although the findings in table 9 suggest that exports and FDI are good predictors of regional growth, there is some concern over whether the observed impacts of exports and FDI are causal. Since our results are most interesting if trade and FDI policies are relevant, it is natural to consider some instrumental variables that are correlated with the exports and FDI variables but not with the error term in eqn. (3).

We first experiment with a policy index based on the number of SEZs, open coastal cities, and development zones in each province in 1985, similar to Cheng and Kwan (2000). Using this index as an instrument for exports or FDI also yields large effects of trade and FDI policies (the results available but not reported). However, the index too can be problematic because regions that are granted more liberal trade and FDI policies are also allowed to experiment with other market reforms, so the index may capture effects of other reform measures that promote industrial growth, exports and FDI simultaneously.

Alternatively, we also use geographic attributes of a province to instrument its exports/FDI. These attributes are exogenous and unrelated to other regional economic policies. But how does the geographic component of exports/FDI capture the effects of trade and FDI policies? An argument can be made that trade and FDI policies had undoubtedly played a role in China's moving from a virtually closed economy in 1978 to one with significant trade in 1985, and the geographic component of trade/FDI can only be a result of the relaxation of restrictions on trade and FDI.

Taking that as a valid point, we proceed to use as instruments a region's population, distance to major ports (Hong Kong and Shanghai), and its coastal/noncoastal status. The distance variable is the log of the smaller of the great-circle distances from the region' capital to Hong Kong and Shanghai, since these two port cities handle the majority of China's external trade (this follows Wei and Wu (2001)). A coastal dummy is also used as one of the geographic attributes because the empirical trade and FDI literature has identified that having access to the ocean usually is highly significant in explaining foreign trade and FDI. Compared to the aforementioned policy index, the coastal dummy is less problematic in this case because it applies uniformly to all coastal provinces, which can be fast or slow growing as evident in table 3.

Instrumental-Variables estimates of the effects of exports and FDI are shown in table 10, which continue to be large, positive and significant. Therefore, we conclude that trade and FDI policies do have strong impact on regional growth. Also shown in columns (3)-(4), the significance of other explanatory variables of interest is mostly unchanged.

(c) Sensitivity

In tables 7-10, we use output growth in the industry outside the province to control for industrywide factors that affect growth. A concern arises that this control variable may be correlated with the error term if a shock increases the growth rate of the industry in all provinces. To address this concern, we simply drop this variable and use industry dummies. The dummy variables should pick all the industrywide shocks. The main results reported above are robust to this change (results are available but not reported).

In the empirical specification, the wage and intermediate price terms in eqn. (2) are omitted due to the lack of information. If, for example, wage changes ($\Delta log(w_{ij})$) are partially correlated with other explanatory variables of interest, the omission can cause biased estimates. In Glaeser et al., omitting the wage term is justified by assuming that workers participate in a national labor market and, as a result, $\Delta log(w_{ij}) = \Delta log(w)$ is absorbed into the constant in the regression. Although the assumption may seem reasonable for the U.S. labor market, it is unlikely to be true in the context of Chinese industries. Here we take up this issue by focusing on the wage rate in two cases.

If, instead, wage changes are industry specific (i.e., $\Delta log(w_{ij}) = \Delta log(w_j)$), then the omission becomes less a concern because we have already shown that including industry dummy variables in the regression, which would account for $\Delta log(w_j)$, does not alter the main results in any significant way. On the other hand, if wage changes are region specific, $\Delta log(w_{ij}) = \Delta log(w_i)$, we do have information on the average industrial wage by region and therefore can add $\Delta log(w_i)$ to the list of explanatory variables. The inclusion of $\Delta log(w_i)$ does not qualitatively change the results on dynamic externalities (S_{ij}, P_{ij}, D_{ij}), nor on exports and FDI. It, however, does change the estimated effect of the variable representing local transportation: the positive effect of the transportation variable disappears. In fact, $\Delta log(w_i)$ is indeed highly correlated with the transportation variable, with a sample correlation coefficient of 0.68. Therefore, in the above two cases of wage changes, most of the conclusions remain true.

In fact, the problem here goes beyond the specification bias resulted from omitted variables. A perhaps more serious concern is that wage changes are endogenous in this case, so including wage changes on the right-hand side of eqn. (3) leads to biased and inconsistent estimates, even if information on wage growth in province-industries is available. Over the sample period in China, there was low worker mobility across sectors as well as across locations. Wage increases were greater in province-industries with faster growth. As a result, factors improving industry profitability also contributed to wage increases. Likely, including wage changes as one of the regressors causes a downward bias in the estimates of the effects of these factors. On the other hand, eqn. (3) without wage changes on the right-hand side can be thought of as a reduced-form equation, although simultaneous-equations bias potentially exists. Ideally, a well designed instrumental-variables estimation should be used to correct this bias. However, the lack of information and the difficulty of finding good instruments prevent us from doing it.

Resource extraction and processing industries are mostly tied to locations where natural resources are found. Therefore, the importance of infrastructure, market conditions, and foreign exposure in the location of these industries are likely to be secondary. Moreover, resource extraction industries in China are mostly state owned and highly protected by the government, facing very little competition. This may limit the role of externalities and trade/FDI policies in the growth of these industries.

To check whether the findings reported in the previous section are significantly affected by the inclusion of the resource extraction industries, we exclude all six of them and re-run the estimation. The results are reported in columns (1)-(2) in table 11. The findings are robust to this change. The only notable difference is that the coefficient on local competition is smaller.

Another robustness check is to exclude Guangdong and Fujian, two fast-growing coastal provinces which received a disproportionally large share of FDI and were two major export zones. This was largely due to the setup of the four Special Economic Zones in these provinces at the beginning of the reform era. Is it possible that the results, especially those on exports and FDI, are driven by these two outliers? Columns (3) and (4) in table 11 show the results when these two provinces are excluded. Compared to columns (3) and (4) in table 9, the signs and magnitudes of the coefficients are virtually unchanged.

6. **Concluding remarks**

This paper uses China's experience of regional industrial development as a case study to examines three broadly defined regional factors that potentially contribute to industrial growth: technological spillovers among firms, regional infrastructure and local market conditions, and exports and FDI. Externalities arising from technological spillovers have implications for long-run growth. Following the literature, we study three possible causes of technological spillovers: local specialization, local competition and local industrial diversity. Regional infrastructure and market conditions facilitate industrial growth in the short run in a transition economy such as China, where central planning gradually gives way to free markets. On top of these are the potential pecuniary externalities of industrial production highlighted in the recent literature on economic geography. Finally, regional foreign exposure affects industrial growth through both technological transfer and access to international markets.

We consider China an excellent case for our purposes for several reasons. The transition to a market economy in recent years has been accompanied by uneven industrial development across regions, as Southeast Coastal China experienced much more rapid industrial growth. A casual check on the pattern of regional growth suggests several possible explanations: initial industrial base, infrastructure, and regional foreign exposure. The southeast coast possessed advantages in all these aspects at the beginning. Sorting out the role of each thus allows us to study the empirical importance of these theories of regional industrial growth.

Using thirty-two two-digit Chinese Industrial Classification industries over 1985-1993, we obtain following results. Local competition is found to be positively correlated with regional output growth. However, there is little evidence that output growth is positively associated with either local specialization or local industrial diversity. In fact, we find that industry overrepresentation tends to hurt growth, opposite of the prediction of the theory. Nevertheless, given the alternative interpretation of the local competition variable, we conclude that the case for dynamic externalities is weak.

As for regional infrastructure and market conditions, it is found that local transportation is important in explaining output growth in province-industries. In addition, there is strong evidence that industries in a province with a smaller state sector grow faster. This suggests that state ownership hurts industrial growth.

Finally after controlling for various other regional advantages, we still find that exports and FDI have large positive effects on regional growth. This strongly confirms the previous wisdom that the opening up to foreign trade and investment has benefited regions differently, which was often based on casual observation and lacked rigorous empirical support before.

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Table 1

Explanatory Variables

Variable	Description
Dynamic Externalities variables	
Local Specialization (S_{ij})	$(y_{ij}/y_{i.})\,/\,(y_{.j}/y_{..})$
Local Competition (C_{ij})	$(n_{ij}/y_{ij})\,/\,(n_{.j}/y_{.j})$
Local Industrial Diversity (D_{ij})	$D_{ij} = \sum_{k \neq j} s_{ik}^2$. (where $s_{ij} = y_{ij}/y_{i.}$)
Natural Advantages and Local Market Conditions (H_i)	
Quality of Labor	Illiteracy Rate of Workers (All Industries) in the Province
Transportation	Local Length of Transportation Routes per Squared Kilometer Relative to the National Average
Telecommunication	Local Number of Telephones per Ten Thousand Persons Relative to the National Average
State Sector's Share of Output	Output by State-Owned Enterprises/Total Output
Local Market Size	Log (Local Industrial Output)
Exports and FDI (X_i)	
Exports	(Local Exports/Local Output)/(Nat'l Exports/Nat'l Output)
FDI	(Local FDI/Local Output)/(Nat'l FDI/Nat'l Output)

Table 2

Regional Shares of Output and Employment: 1985 and 1993

Region	Population Share (1985)	Output Share (1985)	Output share (1993)	Employment share (1985)	Employment share (1993)
<u>Coastal</u>	0.376	0.582	0.635	0.505	0.504
Northern Coastal	0.180	0.265	0.246	0.233	0.235
Eastern Coastal	0.110	0.245	0.259	0.202	0.184
Southern Coastal	0.086	0.071	0.130	0.069	0.085
<u>Inland</u>	0.624	0.418	0.365	0.495	0.496
Far West	0.043	0.028	0.025	0.030	0.032
Northern Inland	0.127	0.128	0.100	0.163	0.156
Central	0.258	0.168	0.148	0.191	0.194
Southern Inland	0.196	0.094	0.091	0.112	0.114

Note: Author's Calculations. The seven regions in the table are the Northern Coastal region (Liaoning, Hebei, Beijing, Tianjin, and Shandong), the Eastern Coastal region (Jiangsu, Shanghai, and Zhejiang), the Southern Coastal region (Fujian and Guangdong including Hainan), the Far Western region (Xingjiang, Tibet, Qinghai, Gansu, and Ningxia), the Northern Inland region (Heilongjiang, Jilin, Inner Mongolia, Shaanxi, and Shanxi), the Central region (Henan, Anhui, Jiangxi, Hubei, and Hunan), and the Southern Inland region (Sichuan, Guizhou, Yunnan, and Guangxi).

Table 3

Shares of Output and Employment by Province: 1985 and 1993

Province	Coastal(C)/ Inland(I)	Output Share (1985) (1)	Output Share (1993) (2)	Change (2)-(1) (3)	Employment Share (1985) (4)	Employment Share (1993) (5)
Guangdong	C	0.054	0.106	0.051	0.048	0.065
Jiangsu	C	0.098	0.123	0.025	0.097	0.093
Shandong	C	0.070	0.083	0.013	0.059	0.069
Zhejiang	C	0.051	0.064	0.013	0.054	0.051
Fujian	C	0.017	0.024	0.007	0.021	0.020
Guangxi	I	0.015	0.017	0.002	0.016	0.017
Yunnan	I	0.014	0.015	0.001	0.015	0.014
Xinjiang	I	0.009	0.009	0.000	0.009	0.010
Ningxia	I	0.003	0.003	0.000	0.003	0.004
Tibet	I	0.000	0.000	0.000	0.000	0.000
Anhui	I	0.028	0.028	0.000	0.032	0.036
Hebei	C	0.041	0.041	0.000	0.045	0.048
Qinghai	I	0.003	0.002	0.000	0.003	0.003
Inner Mongolia	I	0.012	0.011	-0.001	0.019	0.019
Jiangxi	I	0.019	0.017	-0.002	0.027	0.025
Henan	I	0.039	0.037	-0.002	0.046	0.049
Guizhou	I	0.010	0.008	-0.002	0.013	0.011
Gansu	I	0.014	0.011	-0.003	0.014	0.015
Sichuan	I	0.055	0.051	-0.004	0.067	0.073
Shaanxi	I	0.020	0.016	-0.004	0.025	0.022
Shanxi	I	0.023	0.019	-0.005	0.032	0.032
Jilin	I	0.028	0.022	-0.005	0.034	0.032
Hunan	I	0.033	0.027	-0.006	0.038	0.042
Tianjin	C	0.034	0.027	-0.007	0.023	0.021
Beijing	C	0.037	0.029	-0.008	0.026	0.025
Hubei	I	0.049	0.040	-0.009	0.048	0.043
Heilongjiang	I	0.044	0.031	-0.013	0.051	0.049
Liaoning	C	0.083	0.066	-0.017	0.081	0.071
Shanghai	C	0.096	0.072	-0.024	0.050	0.040

Note: Author's Calculations.

Table 4(a)

The Southeast Coast's Share of Output by Industry:
Resource Extraction Industries (1985 and 1993)

Industry	Share of Output (1985) (1)	Share of Output (1993) (2)	Change (2)-(1) (3)
Coal Mining and Dressing	0.061	0.069	0.008
Petroleum and Natural Gas Extraction	0.008	0.013	0.006
Ferrous Metals Mining and Dressing	0.217	0.163	-0.054
Nonferrous Metals Mining and Dressing	0.121	0.088	-0.033
Building Materials and Non-metal Minerals Mining and Dressing	0.306	0.266	-0.040
Logging and Transport of Timber and Bamboo	0.118	0.142	0.024

Note: The Southeast Coast is the combination of the Eastern Coastal region and the Sothern Coastal region described in Table (2).

Table 4(b)

The Southeast Coast's Share of Output by Industry:
Manufacturing Industries (1985 and 1993)

Industry	Output Share (1985) (1)	Output Share (1993) (2)	Change (2)-(1) (3)
Food Processing and Manufacturing	0.301	0.348	0.047
Beverage Manufacturing	0.268	0.350	0.082
Tobacco Processing	0.190	0.184	-0.006
Textile Industry	0.427	0.565	0.138
Apparel and Other Textile Products	0.388	0.661	0.273
Leather, Furs, Down and Related Products	0.317	0.609	0.292
Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products	0.266	0.409	0.143
Furniture Manufacturing	0.349	0.414	0.065
Papermaking and Paper Products	0.303	0.366	0.053
Printing and Record Medium Reproduction	0.313	0.391	0.078
Cultural, Educational and Sports Goods	0.593	0.760	0.167
Petroleum Processing and Coking	0.253	0.252	0.000
Raw Chemical Materials and Chemical Products	0.300	0.375	0.075
Medical and Pharmaceutical Products	0.356	0.395	0.038
Chemical Fiber	0.547	0.684	0.136
Rubber Products	0.316	0.368	0.052
Plastic Products	0.502	0.568	0.065
Building Materials and Other Non-Metal Mineral Products	0.307	0.356	0.049
Smelting And Pressing Of Ferrous Metals	0.233	0.265	0.032
Smelting And Pressing Of Nonferrous Metals	0.245	0.316	0.071
Metal Products	0.369	0.460	0.091
Ordinary Machinery	0.332	0.397	0.065
Transportation Equipment	0.217	0.339	0.123
Electrical Equipment and Machinery	0.453	0.561	0.108
Electronic And Telecommunicatons Equipment	0.539	0.647	0.108
Instruments, Meters, Cultural and Office Machinery	0.439	0.594	0.155

Note: The Southeast Coast is the combination of the Eastern Coastal region and the Sothern Coastal region described in Table (2).

Table 5

Shares of Industrial Output, Exports, FDI, and the State Sector's Share of Output by Region in 1985

Region	Output Share (1985)	Export Share (1985)	FDI Share (1985)	State Sector's Output Share (1985)
Coastal	0.582	0.821	0.855	0.648
Northern Coastal	0.265	0.439	0.151	0.680
Eastern Coastal	0.245	0.237	0.173	0.624
Southern Coastal	0.071	0.146	0.531	0.614
Inland	0.418	0.179	0.145	0.754
Far West	0.028	0.012	0.010	0.840
Northern Inland	0.128	0.053	0.053	0.757
Central	0.168	0.076	0.040	0.727
Southern Inland	0.094	0.037	0.042	0.770

Table 6

Description of Variables: Means and Standard Deviations

Variable	Mean	Standard Deviation	Number of Observations
Output Growth in Province-Industry (1985-1993)	0.581	0.582	752
Output Growth in the Industry outside the Province (1985-1993)	0.721	0.284	752
Employment Growth in Province-Industry (1985-1993)	0.225	0.403	752
Employement Growth in the Industry outside the Province (1985-1993)	0.255	0.176	752
Specialization (S_{ij})	1.112	0.970	752
Competition (C_{ij})	1.384	1.106	572
Industrial Diversity (D_{ij})	0.068	0.012	752
Log(Output) in Province-Industry in 1985	1.382	1.467	752
Share of the State Sector	0.725	0.096	28
Log(Output) in Province in 1985	5.435	0.845	28
Exports	0.783	0.604	28
FDI	0.954	1.783	28
Illiteracy Rate of Workers	0.171	0.102	28
Transportation	2.175	1.392	28
Telecommunications	1.313	1.099	28

Table 7

Dynamic Externalities and Province-Industry Output Growth (1985-1993)

Dependent Variable: Output Growth over 1985-1993 in Province-Industry	(1)	(2)	(3)	(4)	(5)
Constant	0.128	0.186	-0.110	0.140	-0.053
	(2.20)	(2.90)	(1.58)	(1.00)	(0.35)
Log(Output) in Province-Industry in 1985	0.011	0.019	0.054	0.011	0.055
	(0.81)	(1.31)	(3.52)	(0.72)	(3.37)
Output Growth in the Industry outside the Province	0.607	0.583	0.625	0.607	0.614
	(8.51)	(8.10)	(8.95)	(8.49)	(8.65)
Specialization (S_{ij})		-0.046			-0.021
		(2.11)			(0.99)
Competition (C_{ij})			0.120		0.116
			(5.90)		(5.57)
Industrial Diversity (D_{ij})				-0.176	-0.315
				(0.10)	(0.18)
No. of Obs.	752	752	752	752	752
Adj. R^2	0.087	0.091	0.126	0.086	0.125

Note: t-statistics are in the parentheses.

Table 8

Natural Advantages, Local Market Conditions,
and Province-Industry Output Growth (1985-1993)

Dependent Variable: Output Growth over 1985-1993 in Province-Industry						
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.190	0.018	0.188	1.847	-0.639	2.053
	(2.95)	(0.30)	(2.10)	(11.49)	(4.17)	(6.42)
Log(Output) in	0.004	-0.015	0.018	-0.034	-0.038	-0.043
Province-Industry in 1985	(0.25)	(0.98)	(0.62)	(2.57)	(2.33)	(2.81)
Output Growth in the	0.606	0.600	0.623	0.637	0.610	0.651
Industry outside the Province	(8.49)	(8.51)	(8.78)	(9.66)	(8.71)	(10.11)
Illiteracy Rate	-0.296					-0.116
of Workers	(1.39)					(0.46)
Transportation		0.069				0.129
		(4.42)				(6.14)
Telecommunication			-0.062			-0.123
			(3.32)			(5.22)
State Sector's Share				-2.315		-2.140
of Output				(11.35)		(9.44)
Log(Provincial Output)					0.153	-0.079
					(5.39)	(2.03)
No. of Obs.	752	752	752	752	752	752
Adj. R^2	0.088	0.109	0.099	0.220	0.120	0.259

Note: t-statistics are in the parentheses.

Table 9

Exports, FDI, and Province-Industry Output Growth (1985-1993)

Dependent Variable: Output Growth over 1985-1993 in Province-Industry	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.021	-0.036	-0.035	0.897	1.530	0.839
	(0.38)	(0.60)	(0.60)	(2.28)	(4.12)	(2.13)
Log(Output) in Province-Industry in 1985	0.002	-0.016	-0.009	-0.005	-0.010	-0.003
	(0.131)	(1.186)	(0.709)	(0.29)	(0.50)	(0.20)
Output Growth in the Industry outside the Province	0.640	0.613	0.636	0.683	0.671	0.683
	(9.46)	(8.91)	(9.45)	(10.87)	(10.56)	(10.89)
FDI	0.101		0.078	0.079		0.064
	(9.32)		(6.16)	(6.68)		(4.79)
Exports		0.253	0.123		0.191	0.098
		(7.55)	(3.15)		(5.18)	(2.37)
Specialization (S_{ij})				-0.001	0.000	0.001
				(0.04)	(0.00)	(0.06)
Competition (C_{ij})				0.096	0.104	0.102
				(5.07)	(5.39)	(5.37)
Industrial Diversity (D_{ij})				0.258	-1.957	0.102
				(0.16)	(1.20)	(0.06)
Illiteracy Rate of Workers				0.364	0.404	0.517
				(1.47)	(1.56)	(2.02)
Transportation				0.067	0.109	0.068
				(3.01)	(5.25)	(3.07)
Telecommunication				-0.075	-0.094	-0.076
				(3.240)	(4.07)	(3.27)
State Sector's Share of Output				-1.659	-1.837	-1.598
				(7.17)	(7.99)	(6.89)
Log(Provincial Output)				0.012	0.191	0.064
				(0.30)	(5.18)	(4.79)
Adj. No. of Obs.	752	752	752	752	752	752
Adj. R^2	0.180	0.150	0.190	0.321	0.305	0.325

Note: t-statistics are in the parentheses.

Table 10

Exports, FDI, and Province-Industry Output Growth (1985-1993): Instrumental-Variables Estimates

Dependent Variable: Output Growth over 1985-1993 in Province-Industry	(1)	(2)	(3)	(4)
Constant	-0.066	-0.081	-0.114	1.467
	(0.97)	(1.30)	(0.21)	(3.85)
Log(Output) in Province-Industry in 1985	-0.036	-0.031	0.004	-0.008
	(2.24)	(2.15)	(0.24)	(0.45)
Output Growth in the Industry outside the Province	0.609	0.605	0.699	0.671
	(7.81)	(8.74)	(10.84)	(10.56)
FDI	0.270		0.147	
	(8.41)		(5.55)	
Exports		0.343		0.213
		(8.25)		(4.53)
Specialization (S_{ij})			0.003	0.001
			(0.17)	(0.04)
Competition (C_{ij})			0.101	0.106
			(5.23)	(5.43)
Industrial Diversity (D_{ij})			2.845	-1.864
			(1.48)	(1.14)
Illiteracy Rate of Workers			0.715	0.455
			(2.54)	(1.70)
Transportation			0.129	0.107
			(0.44)	(5.06)
Telecommunication			-0.051	-0.093
			(2.00)	(4.01)
State Sector's Share of Output			-1.255	-1.804
			(4.57)	(7.70)
Log(Provincial Output)			0.098	-0.008
			(5.55)	(2.02)
Adj. R^2	0.147	0.160	0.303	0.301

Note: t-statistics are in the parentheses.

Table 11

Province-Industry Output Growth (1985-1993): Robustness Check

Dependent Variable: Output Growth over 1985-1993 in Province-Industry	(1)	(2)	(3)	(4)
Constant	2.292	1.450	0.741	0.705
	(6.48)	(3.99)	(1.83)	(1.74)
Log(Output) in Province-Industry in 1985	0.022	0.029	-0.003	-0.006
	(1.23)	(1.64)	(0.17)	(0.38)
Output Growth in the Industry outside the Province	0.573	0.589	0.585	0.588
	(8.73)	(9.29)	(9.15)	(9.18)
Exports	0.193		0.112	
	(5.57)		(2.73)	
FDI		0.097		0.098
		(8.86)		(2.66)
Specialization (S_{ij})	-0.020	-0.030	0.002	0.000
	(0.07)	(1.09)	(0.10)	(0.02)
Competition (C_{ij})	0.050	0.037	0.115	0.106
	(2.24)	(1.77)	(6.01)	(5.58)
Industrial Diversity (D_{ij})	-1.849	0.946	1.483	1.633
	(1.21)	(0.62)	(0.83)	(0.92)
Illiteracy Rate of Workers	0.369	0.413	0.462	0.402
	(1.51)	(1.80)	(1.82)	(1.62)
Transportation	0.139	0.086	0.080	0.062
	(7.21)	(4.25)	(3.73)	(2.71)
Telecommunication	-0.145	-0.121	-0.067	-0.072
	(6.75)	(5.74)	(2.90)	(3.09)
State Sector's Share of Output	-2.164	-1.892	-1.472	-1.613
	(10.03)	(8.93)	(6.23)	(6.76)
Log(Provincial Output)	-0.156	-0.046	-0.010	0.098
	(4.18)	(1.20)	(0.25)	(0.74)
No. of Obs.	646	646	693	693
Adj. R^2	0.373	0.415	0.247	0.247

Note: t-statistics are in the parentheses.