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Chapter Title: The Open Door Policy and Chinaâ€™s Rapid Growth: Evidence from City-Level Data

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3 The Open Door Policy and China's Rapid Growth: Evidence from City-Level Data

Shang-Jin Wei

China was one of the fastest growing economies in the 1980s. The average annual growth rate of (inflation-adjusted) GDP for China from 1980–90 was 9.5 percent. The corresponding growth rate for the world as a whole was 3.1 percent (World Bank 1992, 221, table 2). The growth rate for China in 1992 was 12.6 percent.

The rapid growth in China is obviously related to its relentless (but not necessarily consistent) pursuit of economic reform, which has unleashed productive forces previously suppressed by rigid central planning. One particularly important component of the reform program is China's open door policy. Indeed, China is literally a textbook example of export-led growth.[1]

The modest objective of this paper is to ascertain answers to two questions. First, what is the contribution of exports and foreign investment to rapid industrial growth in China? Second, is there any spillover effect from exports or foreign investment? Because the 12-year reform period is relatively short, it is difficult to do statistical analysis based on the limited number of aggre-

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1. In a widely used textbook on international economics (Krugman and Obstfeld 1991, 247), the authors wrote that Chinese economic growth in the 1980s "amounted to a virtual economic miracle—and a classical demonstration of the potential of export-oriented industrialization."

gate observations. One small innovation of this paper is to employ city-level data.[2]

To preview the conclusions of the paper, I have found some clear evidence that during 1980–90 more exports are positively associated with higher growth rates across Chinese cities. In the late 1980s, the contribution to growth comes mainly from foreign investment. Furthermore, the contribution of foreign investment comes in the form of technological or managerial spillovers across firms as opposed to an infusion of new capital. Finally, the superb growth rates of coastal areas relative to the national average can be entirely explained by their effective use of exports and foreign investment.

The rest of the paper is organized as follows. In section 3.1, the process of opening to the outside world is briefly reviewed. Section 3.2 discusses a minimalist conceptual framework that will be used to assess statistically the contribution of the open door policy to rapid Chinese growth. In section 3.3, the two data sets are described. Sections 3.4 and 3.5 present and interpret the statistical results from the two samples. Section 3.6 concludes the paper.

3.1 Opening Up the Chinese Economy in the 1980s

To assess the contribution of the Chinese open door policy, it is useful to review briefly the path China has taken in this direction.[3] In 1978, China was ranked thirty-second in the world in export volume. In 1989, it became the world's thirteenth largest exporter. Its share of world trade almost doubled during this period. Between 1978 and 1990, the average annual rate of trade expansion was above 15 percent, more than three times higher than that of total world trade (Lardy 1992).

This change in the degree of outward orientation is truly remarkable, particularly when one considers China's strong aversion to trade and foreign investment before the reform.[4] China's trade regime before 1978 was an extreme version of import substitution. Many official statements made this very explicit. One official in 1955 said that "the purpose of importing . . . is to lay the foundation of China's industrial independence, so that in the future China can produce all of the producer goods it needs and will not have to rely on imports from the outside" (Lardy 1992).

A few characteristics highlight the nature of the prereform trade regime:

2. There are 434 and 74 cities in the two data sets. After a draft of this paper was completed, I learned that Wang (1993) was using data on 231 cities and Wang and Mody (1993) have used data on seven coastal provinces to assess Chinese growth.

3. For an excellent discussion of the prereform trade system during 1950–78 and the evolution of trade reform in the 1980s, see Sung (1991), Lardy (1992), and Cheng (1992). The first book has also expertly delineated the important role of Hong Kong in China's drive to open up to the outside world. The following discussion of the evolution of China's trade regime is based mainly on Lardy (1992).

4. Kamm (1989) has described vividly the eerie feeling of doing export and import business with China in the 1970s.

(1) The state monopolized trade through state trade corporations. No firm or individual could export or import goods without the intermediation of one of these corporations. (2) There was no close link between the world and domestic prices of tradable goods. A state trade corporation purchased imports at the world price and sold them domestically at a price determined by a state plan, which typically did not vary with world price or domestic demand. Similarly, a state trade corporation purchased exportable goods from domestic firms at a plan-dictated price and sold them at the world market price. (3) Foreign exchange was tightly controlled by the state. All foreign exchange resulting from exports was retained by the state. All imports had to be part of a state plan to be materialized.

In 1979, China decided to open up to the outside world. Since then, a few important steps have been taken in this effort: (1) The government has decentralized decision making regarding exports and imports to local governments or regional foreign trade corporations. (2) A series of special economic zones and coastal open cities have been designated for the purpose of stimulating exports and attracting foreign investment. (3) Administrative restrictions on exports and imports have been replaced by tariffs, quotas, and licensing. (4) Controls on foreign exchange have been loosened over the years, particularly for foreign-invested/managed firms.

How open has China become after a decade of reform? A common measure of openness is the ratio of trade (exports plus imports) to GNP. If one uses the market exchange rate to convert China's GNP to U.S. dollars, China displays a phenomenal increase in the trade-GNP ratio, from about 9.7 percent in 1978 to 26.8 percent in 1989 (Lardy 1992, 151).

However, as Lardy points out, there are two problems with this ratio. First, the ratio is not useful for a cross-country comparison. Smaller countries tend to have higher ratios even if their government policies are equally favorable (or unfavorable) to trade.[5] Another problem is that using the market exchange rate to convert Chinese GNP may overstate Chinese openness since it underestimates China's true GNP.

Foreign direct investment (FDI) is another manifestation of the open door policy. FDI was virtually nonexistent in the decades preceding 1979. In 1983, the flow of foreign investment was a mere U.S. $1.7 billion. It increased to $5.3 billion in 1988, and to $11.4 billion in 1991. Accumulated FDI from 1979 to 1992 (calculated without depreciation) reached $34.5 billion.[6]

In terms of the source of FDI, Hong Kong is by far the absolutely dominant supplier. Between 1984 and 1990, Hong Kong's share of FDI was above 50

5. To control for the contribution of size or geographic location determinants to trade volume, one may want to use a gravity model to establish a norm of trade volume (e.g., Frankel 1992; Frankel and Wei 1993). Then, the deviation from the norm can be used as a more accurate measure of openness.

6. *Almanac of China's Foreign Economic Relations and Trade* (Hong Kong: China Resources Trade Consultancy, 1990); *People's Daily* (Overseas edition) February 1992, May 31, 1993.

percent for every single year except 1985 when the share was 48.9 percent. Of course, of Hong Kong investment, a fraction is Taiwanese capital in disguise for political reasons, and another fraction is mainland Chinese capital in disguise to take advantage of the preferential treatment of foreign investment in China. But the bulk of it is genuinely from Hong Kong.[7]

Japan is ranked second in terms of its share in total FDI in China, although it is much less significant than Hong Kong (Japan's shares in 1989 and 1990 were 11 and 13 percent). In third place is the United States, which follows Japan closely.

Foreign investment takes several forms. Equity joint ventures, which were an insignificant part of FDI in the early 1980s, accounted for 50 percent of all FDI in 1990. There are also contractual joint ventures, wholly foreign-owned ventures, and joint explorations (mainly in offshore oil explorations). Their shares in FDI in 1990 were 18 percent, 18 percent, and 7 percent, respectively. "Compensation trade," in which foreign firms provide machines or product designs to Chinese firms and obtain part of the output as payment, is also counted as FDI in Chinese statistics, although it is really a kind of barter trade. Compensation trade has become less and less important over time. Its share in FDI has declined from about 20 percent in the early 1980s to less than 5 percent in 1990 (Kueh 1992).

One serious obstacle to China's attracting foreign investment is its imperfect property and contract laws. Legal enforcement is weak in spite of the laws that exist in written form. So far, however, foreign investment has been reasonably robust for two reasons. First, low factor costs and tax concessions can often ensure high returns even in a short time. Second, overseas Chinese can use their connection and familiarity with "Chinese culture" (whatever that is) to get things done without the procedural protection of the laws. The latter is one important reason for Hong Kong's prominence as a source of foreign investment. There is little doubt that foreign investment from other than ethnic Chinese would have been greater had there been a better and more transparent legal environment for business, and improving the creation, and particularly the enforcement, of property and contract laws is important for the continued success of China's open door policy.

Foreign investment, like foreign trade, increasingly exposes Chinese workers and firms to international managerial and technological standards and knowhow. It increases the efficiency, not only of those firms that receive foreign investment or that are under foreign management, but also of those domestic firms that interact with foreign-invested/managed firms through various channels (positive externality), as I will show statistically later. It may also promote growth by alleviating the shortage of domestic savings or foreign exchange.[8]

7. See Kueh (1992), who also provided a comprehensive review of FDI in China and particularly in its coastal areas.

8. Wei and Fan (1993), however, fail to find statistical support for this view using the same 1988–90 city-level data as in this paper.

3.2 A Conceptual Framework

In this section, a minimalist model is set up to guide the subsequent empirical investigation. Let a generic firm j in city k operate with the following production function:

$$Y_{kj} = A_{kj} f(L_{kj}) \equiv A_{kj} Z_{kj},$$

where L_{kj} denotes its labor input and A_{kj} is the productivity shift parameter. $f(\cdot)$ is a twice-differentiable concave function. Capital stock is left out of the production function because no city-level data are available.

Assume that the firm maximizes its profit, taking all prices as given. That is, it maximizes

$$A_{kj} f(L_{kj}) - w_k L_{kj}.$$

In the equilibrium, the firm's growth is governed by

$$\frac{\dot{Y}_{kj}}{Y_{kj}} = \frac{\dot{A}_{kj}}{A_{kj}} + \frac{\dot{Z}_{kj}}{Z_{kj}}.$$

Assume that

$$A_{kj} = A_n A_k,$$

where A_n and A_k are the national and city-level productivity components.[9] Note that for simplicity I have assumed away firm-specific productivity shift. This is to focus attention on those activities whose benefits spill over to other firms or other cities. The growth rate of productivity will then be the sum of the growth rates of the two components.

Assume further that

$$Z_{kj} \equiv f(L_{kj}) = L_{kj}^{\alpha}.$$

Then,

$$\frac{\dot{Z}_{kj}}{Z_{kj}} = \alpha \frac{\dot{L}_{kj}}{L_{kj}}.$$

Let g denote any growth rate. The growth rate of city k can be expressed as a weighted average of the growth rates of all the firms in the city, that is, as

$$g_k \equiv \sum_j s_{kj} g_{kj} = \sum_j s_{kj} g_{A_{kj}} + \sum_j s_{kj} g_{z_{kj}}$$
$$= g_{A_n} + g_{A_k} + \alpha\, g_{L_k},$$

where s_{kj} is firm j's share in city k's output.

We will focus on a few variables that affect the productivity increase. Let

$$g_{A_k} = f(\mathrm{FDI}_k, \mathrm{Exp}_k, Y_{k0}, H_k),$$

9. This specification is similar to that in Glaeser et al. (1992).

where FDI_k and Exp_k are foreign direct investment in city k and exports by city k, respectively, Y_{k0} is the initial size of the industrial sector in city k, and H_k is the stock of human capital in city k.

Assuming a linear version of $f(\cdot)$, we have the following equation as the basis of our subsequent statistical analyses:

$$g_k = g_{A_n} + \beta_1 FDI_k + \beta_2 Exp_k + \beta_3 Y_{k0} + \beta_4 H_k + \alpha\, g_{L_k} + e_k,$$

where e_k is a city-specific error term. The error term is assumed to be independent across cities, but can have different variances.

Having the initial size of an industrial sector, Y_{k0}, in $f(\cdot)$ is a crude way to capture the notions of increasing returns to scale as advanced by Romer (1986), or of learning by doing as emphasized by Young (1991). The larger the initial scale of production, the more productive future production will be.

FDI is a primary mechanism for the transfer of technology from developed countries to developing countries. In the context of China, it is also a primary mechanism for the transfer of foreign management methods and worker discipline into the country. Exports expose exporting firms to the rigor of international competition as well as to new techniques in marketing and processing.

FDI can enter the regressions in one of two ways, as a share of the city's total investment or in absolute scale. If the role of FDI is merely as an infusion of capital into a city—that is, the technology it brings with it does not spill over to other firms in the city—then its contribution to the city's growth will be proportional to its share in the city's total capital stock. I will call this as an "intensity effect." On the other hand, there may be a substantial amount of spillover across firms through interactions of workers or managers between the foreign-owned/managed firms and those that do not receive foreign investment directly. The actual channels of spillover may include dinner table conversations of friends or family members who work in different firms. The physical presence of foreign firms in the city facilitates the transfer. Suppose all domestic firms that do not receive foreign investment directly always obtain a constant fraction of the benefits (in terms of extra growth rates) that foreign-invested firms obtain and suppose further that foreign-invested firms accounted for a small fraction of total output, then the contribution of FDI to a city's growth will be proportional to the total FDI the city receives. I will refer to this as a "scale effect." In other words, the presence of a scale effect signals the existence of positive spillover across firms in the same city.[10]

Similarly, exports can also enter regressions in two ways. Exporting firms can learn new ideas about marketing, design, or technology from interacting with buyers in the world market. If the benefits of learning are confined to those firms who actually do the exporting, then its contribution will be proportional to the share of exports in a city's total output. On the hand, the newly

10. The terminology of intensity vs. scale effects is borrowed from Backus, Kehoe, and Kehoe (1992), who used it to represent the absence or presence of externality in human capital.

learned ideas are likely to travel to other firms that may not do any exporting at all. This transfer of ideas can also be accomplished through dinner table conversations, or formal business meetings. Alternatively, nonexporting firms can simply imitate the management or marketing concepts exporting firms have demonstrated. As far as this spillover is concerned, the benefit of exports to the city is more closely related to the total exports of all the firms in the city collectively than to the share of exports in total industrial output. That is, one can also use the scale effect to detect the presence of positive spillover from exports.

The H_k variable captures the contribution of human capital to growth, as emphasized by Lucas (1988) and others. If an educated person is counted passively as one unit of skilled labor, then the contribution of skill workers is limited to their share in the total labor force. But as the theory emphasizes, there are tremendous positive externalities associated with human capital: I become more productive if my colleagues are more educated. Under this hypothesis, more scientists facilitate more and faster cross-fertilization of ideas. The contribution of scientists or skilled workers is likely to be greater, the greater the absolute number of scientists or skilled workers in the city.

It is important to point out that an increase in city k's exports, foreign investment, or the other two variables may improve the entire nation's productivity (cross-city spillover). But any such increase will simply be reflected in the intercept of regressions, because it does not generate cross-city differences in growth.

3.3 Data Sets

I employ two city-level data sets in this paper. The first has 434 cities for 1988–90, and the second 74 cities for 1980–90 (China State Statistical Bureau 1989, 1990, 1991). The first sample has a reasonably large number of observations. Furthermore, many variables of interest, such as shares of private and foreign firms in total industrial output, have been systematically collected in this period. On the other hand, a shortcoming of the data set is its short time period, which makes it more likely to be dominated by cyclical factors. Indeed, the period is one of the low-growth stages in a generally fast-growing decade.

The second sample covers essentially the entire reform period, which makes it ideal for examining the contribution of the open door policy to Chinese growth in a systematic way. The results from this decade-long sample are less likely to be influenced by cyclical factors. However, the sample size is considerably smaller than in the first data set. Furthermore, data on many variables of interest were not collected in the first half of the 1980s. Even for those variables that were collected in 1980, there is a large number of missing values for many cities, rendering the effective sample size much smaller than 74. Overall, one should not rely exclusively on either sample when drawing general lessons about Chinese growth.

3.4 Regression Results from 434 Cities during 1988–90

3.4.1 Initial Industrial Size and Population Growth

In table 3.1, the coefficients on the level of 1988 output are negative although not statistically significant except for one. In other words, for this two-year sample, there is no evidence that a larger initial industrial scale of the city helps it to grow faster.

The coefficient for the population growth rate is 0.60 and significant at the 5 percent level.

3.4.2 The Open Door Policy

Exports and FDI are used as measures of the open door policy. The export variable enters the regressions in two ways: in absolute scale or as a percentage of total output. If exports and FDI are entered separately, both are positive (although only the scale of exports is statistically significant at the 10 percent level). This is a finding often reported in some form in cross-country studies: openness correlates with high growth.[11] Here, a 1 percent increase in the scale of exports is associated with a two-year growth rate higher by 2.5 percentage points.

If the growth rate of exports is used as an explanatory variable, its estimated coefficient is 0.046 and is significant at the 10 percent level. Because of the possibility of reverse causality, I will not read too much into this result.

We next turn to the effect of FDI. Ideally, we would like to use the stock of FDI, but the data are not available at the city level, so we use flow data.[12] Similar to the export variable, the FDI variable can enter the regression in one of two ways: in absolute scale (in U.S. dollars) or as a percentage of total fixed capital investment.

If the two measures of FDI are entered into the regression separately, only the absolute scale of FDI is significant. A 1 percent increase in the size of FDI is associated with a 1.3 percentage point higher growth rate for the two-year period. This lends some support to the notion of an externality effect of FDI. Extra growth by 1.3 percentage points is not negligible, but neither is it overwhelming for Chinese cities. The growth rate of FDI over 1988–90, when included as an explanatory variable, is not significant.

Table 3.2 examines the effect of including measures of FDI and exports in the same regressions. If the absolute scales of both FDI and exports enter the

11. See Edwards (1989) and papers cited therein.

12. The problem may not be fatal, for two reasons: First, there is probably a large serial correlation in the spatial pattern of FDIs. The simple correlation between FDI in 1988 and in 1990 is 0.64. Second, FDI in virtually every city started in the early or mid-1980s. The annual flows of FDI in earlier years were considerably smaller than in later years. Judged from national data, the 1988 flow of FDI was slightly smaller than the combined FDIs of all previous years.

I plan to construct stock data for a subset of cities based on their annual flow data and to reexamine some of the issues here in a subsequent analysis.

Table 3.1 **Exports, Foreign Investment, and Industrial Growth, 1988–90**

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY88	−.043**	−.016	−.015***	−.007	−.009	.006
	.023	.011	.009	.013	.008	.011
GPop	.598*	.604*	.617*	.271	.618*	.274
	.230	.231	.258	.201	.233	.203
LExp88	.025**					
	.015					
RExp88		.685***				
		.422				
GExp			.046**			
			.027			
LFDI88				.013**		
				.008		
RFDI88					.289	
					.192	
GFDI88						.008***
						.005
N	347	347	342	.142	341	124
SEE	.19	.19	.19	.13	.18	.13
Adjusted R^2	.18	.20	.21	.07	.19	.06

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

***Significant at the 15 percent level.

regression, only FDI is statistically significant. If one also adds the growth rates of FDI and exports to the last regression, both the scale and growth rate of FDI are statistically significant, but neither measure of exports is.

To summarize, during 1988–90, foreign investment contributed more to cross-city differences in industrial output than did exports. Furthermore, the scale effect of foreign investment is significant and supports the hypothesis of spillover of technological or managerial knowhow across firms within cities.

3.4.3 Other Reform Policies

One often-mentioned aspect of the Chinese reforms is the vitality of China's nonstate sector.[13] Here, we will quantify the contribution of the nonstate sector to overall industrial growth, and will do so in connection with examining the open door policy.

13. In the Chinese context, the nonstate sector is not exactly the same thing as a private sector. The majority of nonstate firms are what are called collectively owned enterprises. They are community-based firms, but the relevant local governments often have the power to appoint or dismiss managers. Among the collectively owned firms, the TVEs have been developing particularly fast.

Table 3.2 **Exports, Foreign Investment, and Industrial Growth, 1988–90: FDI and Exports Together**

Variable	(1)	(2)	(3)
LY88	−.001	−.003	
	.027	.025	
GPop	.271	.262	
	.202	.197	
LExp88	−.006	−.028	−.028*
	.021	.022	.010
GExp		.005	.004
		.020	.021
LFDI88	.014**	.029*	.031*
	.008	.007	.008
GFDI88		.021*	.021*
		.006	.007
N	142	123	123
SEE	.13	.12	.12
Adjusted R^2	.07	.15	.09

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

The first regression in table 3.3 includes as an explanatory variable the ratio of nonstate firms' output to total output. Here the nonstate firms are defined as private firms, township and village enterprises (TVEs), and foreign-owned/managed firms. Urban collective firms are excluded because no data are available. We find this ratio to be positive and significant at the 1 percent level. A 1 percent rise in the output share of the nonstate firms is associated with a 0.19 percent higher growth rate.

If we decompose the nonstate firms into private firms, TVEs, and foreign-owned/managed firms, we see an interesting pattern. Only TVEs and foreign firms have made a positive contribution to overall city growth. A 1 percent increase in the output share of TVEs is associated with a 0.22 percent higher growth rate. Cities with a 1 percent higher share of foreign firms tend to grow 0.55 percent more rapidly. Since the share of foreign-invested/managed firms in total output circumvents the issue of stock versus flow of FDI, the relatively high contribution of the foreign firms may be a better testimony to the contribution of the open door policy to Chinese growth.

The share of private individual firms has a negative coefficient (it is insignificant when it enters the regression alone). The lack of a positive contribution by private firms is not intuitive. In search of an explanation, one may note that private firms in China are typically family-based small businesses (with fewer than eight employees) and were newly started during the reform years. The

Table 3.3 Nonstate Sector and Industrial Growth, 1988–90

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY88	−.004	.020	−.004	−.008	−.019	−.008
	.006	.025	.010	.006	.025	.010
GPop	.676*	.255	.296	.676*	.223	.248
	.251	.342	.347	.252	.344	.347
LExp88		−.028			−.027	
		.018			.018	
GExp			−.004			.002
			.023			.018
LFDI88		.010			.003	
		.007			.007	
GFDI88			.005			.005
			.005			.005
RYNS88	.194*	.274	.227*			
	.070	.075	.075			
RYIND88				−.824*	−.417*	−.426*
				.339	.204	.151
RYTVE88				.219*	.249*	.174*
				.080	.070	.066
RYFOR88				.550*	.731*	.672*
				.101	.138	.106
N	330	138	120	330	138	120
SEE	.16	.12	.12	.16	.12	.11
Adjusted R^2	.25	.13	.12	.26	.19	.21

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

regression result may simply reflect a pervasive underreporting of output by private firms in order to evade taxes. Indeed, it is possible that cities with better-performing TVEs and foreign firms find it financially less necessary to strictly enforce tax payment by their private firms.

If one adds the absolute scales of exports and FDI to the above regression, neither variable is statistically significant. The lack of significance can be due to a high collinearity between the FDI and output share of foreign firms.

A second way to measure the extent of reform in a particular city is to look at its share of retail sales conducted on the free market. Before 1978, almost no retail sales were on the free market. The share of the free market has increased gradually as the reform deepens. The rate of increase is certainly uneven across the country. This variable can signal the initiative of city governments in pushing certain reform measures, particularly price liberalization, holding other things constant. Of course, other things are not constant. In particular,

different cities have different sized rural areas under their jurisdictions. For example, the city government of Shanghai has a jurisdiction of 10 small surrounding counties, while the city governments in Sichuan control more and larger counties. To the extent that a significant portion of free market trading is in agricultural goods, the free market share of total retail sales may not give a precise measure of reform initiatives related to industrial production. We have to take this into account in interpreting the regression results.

In any case, when the free market share of total retail sales in 1988 is included in the regression, it actually has a negative sign (see table 3.4). In other words, we cannot find a positive effect of price liberalization on industrial growth as measured by the initial free market share. The growth in the share of the free market, when included as an explanatory variable, is positive and statistically significant. But the magnitude of the contribution to overall city growth is modest: 1 percent higher growth of the free market is associated with 0.09 percent higher industrial growth.

A third way to gauge the impact of reform on city growth is to look for evidence of better growth performance by cities that have been granted greater authority to conduct localized reform experiments.

In August 1980, the Beijing government declared four cities, Shenzhen, Zhuhai, Shantou, and Xiamen, "special economic zones" (SEZs).[14] In an SEZ, investment decisions are made largely outside the state plan. Special tax concessions and less restrictive regulations on foreign exchange and land use are adopted in order to attract foreign investment. For foreign-owned/managed firms, there is a two-year tax holiday, followed by another three years of low tax rate (7.5 percent). After the initial five years, foreign firms then pay a 15 percent tax rate. In comparison, outside the SEZs, the tax rate is 33 percent for foreign firms and 55 percent for domestic state-owned firms. Encouraged by the rapid development in the four SEZs, the central government further declared in 1983 that the entire island province of Hainan, close to the size of Taiwan, would be a "special area open to foreign investment" and, in 1988, made it the largest SEZ.

In May 1984, the Beijing government announced that 14 cities spread along the entire Pacific coast had been granted "open coastal city" status. The explicit purpose of this is also to attract foreign capital and technology. In contrast to most of the SEZs, these cities all have an established industrial base and a well-educated labor force. With their new status, they can offer essentially all the preferential policies toward foreign investment of an SEZ except for the special income tax rates. Typically, foreign-owned/managed firms must pay tax at a rate of 24 percent, somewhere between the rates in an SEZ and those

14. Shekou, the part of Shenzhen close to Hong Kong, was declared an "industrial export zone" in January 1979.

elsewhere in the country. Manufacturing firms, however, are taxed at a concessionary 15 percent rate.[15]

Starting in 1981, the central government (and provincial governments) has designated 72 cities "comprehensive reform experimenting cities." The governments of these cities have gained more authority in managing firms inside the city boundaries, have greater access to the revenue originating in them, and can take over certain firms previously managed directly by the ministries in Beijing. Notice that the creation of this status largely entails bureaucratic decentralization (i.e., a transfer of some regulatory authority from the central government to the city governments) and hence does not automatically imply that more market-oriented reforms will be implemented in these cities.

To estimate the effects of these localized reform experiments, I have constructed three dummy variables. They are SEZ for the special economic zone, COAST for the fourteen coastal open cities, and RFM for the comprehensive reform experimenting cities.

The results with the RFM dummy are in table 3.4, and those with SEZ and COAST in table 3.5. The coefficients for the RFM and SEZ dummies are not significant. This indicates that, at least during 1988–90, there was no systematic difference in the growth performance for cities with or without those forms of special status from the central government. In contrast, the COAST dummy does have a positive and significant coefficient: a coastal open city on average grows faster than other cities by 9.2 percent over the two years. However, the dummy is no longer significant once scales of FDI and exports, or growth rates of the two, are included in the same regression. Among the newly added variables, only the scale of FDI or its growth rate are significant. This means that the entire above-the-norm growth rate in the coastal open cities is due to their ability to attract foreign investment.

To summarize, cities with a larger share of the nonstate sectors tend to grow faster. The contribution of the nonstate sectors comes mainly from the TVEs and particularly foreign-owned/managed firms. The coastal open cities do grow faster than the national average, primarily because of their superb record in attracting foreign investment.

3.4.4 Human Capital

Recent growth theories have stressed the importance of human capital for growth (Romer 1986; Lucas 1988). This section examines the contribution of

15. Starting in the mid-1980s and accelerating after 1988, there have also been policies to open the entire Pacific Basin, particularly the Liaoning and Shandong peninsulas, the entire provinces of Guangdong and Fujian, and parts of Guangxi and Hebei provinces. Since April 1990, the Pudong New Area of Shanghai, the largest city in China, has been developed into an "open economic zone" with preferential policies even broader in scope than for an SEZ. I have not attempted to formally incorporate these developments in the statistical work of this paper. For a survey of these developments, see Bell and N'guiamba (1993).

Table 3.4 **Reform Experiments and Industrial Growth, 1988–90**

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY88	−.017	−.003	.001	−.017	−.006	.010
	.011	.029	.028	.014	.027	.025
GPop	.614*	.275	.265	.601*	.273	.264
	.232	.199	.194	.232	.200	.196
LExp88		−.005	−.026		−.007	−.030
		.022	.024		.021	.022
GExp			.006			
			.021			
LFDI88		.014**	.028*		.014*	.029*
		.007	.008		.007	.007
RFDI88					.289	
					.192	
GFDI88			.020*			.021
			.006			.006
RMKT88	−160**	−.046	−.027			
	.094	.086	.086			
RFM				.005	−.035	−.025
				.026	.022	.022
N	346	142	123	347	142	123
SEE	.19	.13	.12	.19	.13	.12
Adjusted R^2	.18	.06	.14	.17	.07	.15

Notes: Numbers below coefficient estimates are heteroscedasticity-consistant standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

human capital to Chinese growth and asks whether this addition may change our earlier conclusions. Our choice of variable for human capital is largely dictated by data availability. We measure the stock of human capital by what is called "scientific and technical personnel" in the Chinese source, both in absolute numbers (to examine the scale effect) and as a percentage of the non-agricultural population (to examine the intensity effect).

It is important to point out that the definition of "scientific and technical personnel" in the Chinese source is broad enough to include essentially all skilled workers. The ratio of scientific and technical personnel to the total labor force offers a more direct measure of the average skill/education level of the labor force than primary and secondary school enrollment, since there is a time lag between school enrollment and labor force entry. School enrollment is often used as a measure of the average human capital level in cross-country studies because the more direct measure is not available.[16]

16. I thank John Page for pointing out that the general education/skill level of the labor force is probably more important than the number of high-level scientists for a country's economic development.

Table 3.5 Coastal Areas and Industrial Growth, 1988–90

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY88	−.016	.001	.003	−.020**	−.000	.004
	.011	.026	.025	.012	.027	.025
GPop	.599*	.268	.256	.613*	.282	.268
	.233	.202	.197	.229	.194	.190
LExp88		−.006	−.022		.008	−.029
		.021	.023		.021	.021
GExp			.009			.004
			.018			.019
LFDI88		.012**	.023*		.013**	.028*
		.007	.008		.008	.008
GFDI88			.018*			.020*
			.006			.006
SEZ	.044	.028	.088			
	.111	.010	.068			
COAST				.092**	.029	.016
				.056	.040	.040
N	347	142	123	347	142	123
SEE	.19	.13	.12	.19	.12	.12
Adjusted R^2	.17	.06	.16	.18	.14	.14

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

In the original data source, there is a separate variable, "mid or higher level scientific and technical personnel," which is a subset of all "scientific and technical personnel" with advanced training and sophisticated skills. I have also used this variable in the regressions and found essentially the same results.

The statistical results are reported in table 3.6. Unfortunately, neither the scale nor intensity measure of human capital is statistically significant when included alone in the regression, and some even have a negative coefficient. When the growth of the number of scientific personnel is included in the regression alone, it is positive and significant at the 10 percent level. A 1 percent increase in the growth rate of scientific personnel is associated with a 0.06 percent increase in the industrial growth rate. However, when the scales of exports and FDI are included in the same regression, the growth rate of scientific personnel loses its statistical significance (at the 10 percent level). The scale of FDI is positive and significant at the 10 percent level.

To summarize, the scale or average level of human capital does not appear to contribute to the cross-city differences in industrial growth rates during 1988–90. The contribution of the open door policy (in particular, that of foreign investment) identified in earlier subsections is not altered.

Table 3.6 Human Capital and Industrial Growth, 1988–90

Variable	(1)	(2)	(3)	(4)
LY88	−.013	−.016	−.016	−.004
	.023	.011	.011	.026
GPop	.603*	.636*	.600*	.283
	.234	.239	.227	.205
LSCNT88	−.005			
	.021			
RSCNT88		−1.03		
		.682		
GSCNT			.063**	.037
			.035	.047
LExp88				−.003
				.021
LFDI88				.014**
				.008
N	346	346	346	142
SEE	.19	.19	.19	.13
Adjusted R^2	.17	.18	.19	.07

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

3.4.5 Robustness Checks

In this section, I examine the robustness of the statistical results. To ensure that the earlier results are not driven by a few outliers, I am prepared to err on the side of omitting too many observations.

The mean growth rate for 1988–90 is 0.29. But the variation among the cities is enormous. Langfang and Ankong were growing at the rates of 217 percent and 203 percent, respectively, while Jingzhou and Yunchen were growing at −36 percent and −29 percent. I will delete all observations that are outside a two standard deviation band from the mean. This criteria deletes eight supergrowing cities and the six slowest-growing ones. When all the regressions are redone on this restricted sample, the earlier results essentially have survived. In particular, the positive association between FDI and industrial growth is strengthened, while the weak association between exports and growth becomes even weaker.

Because in the main regressions the key regressor (FDI) is at its beginning-of-sample value, the problem of simultaneous bias is probably not serious. Nevertheless, I have also tried to estimate a system of two simultaneous equations for output growth and FDI, in which FDI is assumed to be a function of the trade-output ratio and reform dummies. The scale of FDI continues to have a significant and positive effect on industrial growth.

3.5 Statistical Results for the 1980–90 Sample

A few observations are eliminated because data errors are suspected. The data on Nanchong is omitted because it records an extremely high export-output ratio (0.58) in 1980. Although the city is not known for its openness, the recorded ratio was the highest in the sample. Furthermore, the ratio is substantially higher than the second highest (Weihai, 0.23) and is more than three standard deviations (0.09) away from the mean (0.08).

The second group of omitted data are for Haikou, because it is the only city that is reported to have had a negative growth rate over 1980–90 in the absolute scale of exports. In spite of many news stories about how Haikou has become substantially more open than a decade ago, its reported total growth rate of exports is −29 percent over 1980–90.

Shenzhen is omitted in all regressions because there are no data on its exports in 1980. It is worth pointing out that Shenzhen is the fastest-growing city in the sample in terms of its industrial output. Its 10-year growth rate over 1980–90 is a phenomenal 545 percent, twice as high as the second highest growth rate in the sample,[17] and more than six standard deviations (0.61) above the mean (155 percent). As an SEZ, the city is known to have been extremely outward oriented. Had it been included in the sample, it would undoubtedly have reinforced any finding of a positive contribution of exports or foreign investment to city growth.

We would like to replicate all the key regressions performed on the other sample. Unfortunately, the data on FDI and the ownership composition of industrial output are not available for 1980. The corresponding data for 1990 are used as substitutes. As an admittedly weak justification for this, we note that those variables are likely to be serially correlated. The simple correlation of the scale of FDI between 1988 and 1990 is 0.64, and that of the share of FDI in total investment is 0.68. The correlations for the output shares of the private firms, TVEs, and foreign-invested firms between 1988 and 1990 are 0.74, 0.94, and 0.62, respectively.

Because of this substitution, one has to interpret the regression results with caution. In particular, the use of the end-of-sample values of these variables tend to underestimate their contribution to growth (relative to using the beginning-of-sample values). For example, if the foreign firms grow faster than domestic firms, then cities that have a lot of foreign firms also tend to grow faster. The end-of-sample share of the foreign firms in total output will be larger than the beginning-of-period share, even if the number of foreign firms and other things are held constant. A larger end-of-sample share relative to the beginning-of-sample share is needed to explain the same growth rate. Hence, the resulting coefficient estimate will be smaller.

17. The city with in second highest growth rate in the sample is Guiling, with a 10-year growth rate reaching 267 percent.

Table 3.7 **Exports, Foreign Investment, and Industrial Growth, 1980–90**

Variable	(1)	(2)	(3)	(4)	(5)
LY80	−.242*	−.076**	−.047	−.147*	−.064**
	.099	.039	.040	.064	.037
GPop	.549**	.548*	.625	.662*	.703*
	.297	.271	.402	.329	.332
LExp88	.155*				
	.070				
RExp80		2.171*			
		1.032			
GExp			.128		
			.131		
LFDI90				.048*	
				.022	
RFDI90					2.143*
					.641
N	43	43	43	38	38
SEE	.32	.32	.33	.32	.31
AdjustedR^2	.17	.17	.12	.20	.23

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

On the other hand, with this substitution, the possibility of reverse causality is also more serious. Imagine that the initial size of FDI has nothing to do with growth, but that new FDI always goes to cities that grow rapidly. By the end of the sample, fast-growing cities may have more FDI. Hence, this can produce a correlation between FDI and growth. For whatever they are worth, regressions similar to those for the 1988–90 sample have been run.

3.5.1 Initial Size of the Industrial Sector

From tables 3.7 and 3.8, one may notice a somewhat surprising result. The coefficient on the level of 1980 output is negative and statistically significant, suggesting a tendency to convergence in growth rates in Chinese cities. One percent higher 1980 output tends to be associated with a reduction of the 10-year total growth rate by 24 percentage points (or of the annual growth rate by 2.4 percentage points). Notice that the convergence result would also have been strengthened if Shenzhen and Haikou were included in the regression, because they both started with a small industrial base but enjoyed phenomenal growth.

The negative coefficient suggests that increasing returns to scale is not operative at the city level in China. This need not be puzzling if one recognizes that much of the industrial sector in prereform China was extremely inefficient, burdened with obsolete technology, inadequate management, and poor worker

Table 3.8 **Exports, Foreign Investment, and Industrial Growth, 1980–90: FDI and Exports Together**

Variable	(1)	(2)
LY80	−.302*	−.351*
	.137	.147
GPop	.504**	.238
	.305	.336
LExp80	.154	.217*
	.102	.105
GExP		.187
		.117
LFDI90	.023	.004
	.028	.025
N	38	38
See	.31	.31
Adjusted R^2	.23	.25

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

discipline. Furthermore, in selecting cities to experiment with reform measures, particularly in the early 1980s, the Chinese government was often systematically biased against large industrial cities for fear of losing control of the state-owned sector. This can lead to a negative association between initial size and subsequent growth.

3.5.2 Exports and FDI: Scale versus Intensity Effects

The first set of results is in table 3.7. As expected, the growth rate of the nonagricultural population has a positive impact on growth rates. The coefficient on population growth is about 0.55, which is close to the corresponding estimate for the 1988–90 sample (0.60).

The scale of exports in logarithm, when included as an independent variable, has an estimated coefficient of 0.16, which is significant at the 5 percent level. A 1 percent increase in the scale of exports of a city is associated with a 16 percentage point increase in its 10-year growth rate.

If the ratio of exports to output is included in the regression, a much larger estimate is obtained. A 1 percent increase in this ratio is associated with a 2.17 percent higher growth rate. If the growth rate of exports over the decade is used as an independent variable, it is not significant.

Foreign direct investment again can enter the regressions in two ways. In terms of the scale effect of foreign investment, the coefficient is positive and significant at the 5 percent level. A 1 percent increase in the absolute scale of

Table 3.9 **Nonstate Sector and Industrial Growth, 1980–90**

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY80	−.131*	−.277*	−.128*	−.299*	−.203*	−.339*
	.031	.124	.033	.138	.053	.120
GPop	−.049	−.073	−.066	−.141	−.310	−.353
	.226	.202	.244	.228	.250	.237
LExp88		.107		.137		.114
		.081		.091		.074
GExp			.027	.077		
			.086	.099		
LFDI90		.002		−.004		−.001
		.021		.022		.024
RYNS90	1.30*	1.04*	1.28*	.962*		
	.321	.319	.331	.352		
RYIND90					−13.35**	−19.12*
					7.20	9.18
RYTVE90					1.36*	1.13*
					.292	.272
RYFOR90					2.07*	1.49*
					.426	.480
N	43	38	43	38	43	38
SEE	.28	.29	.29	.29	.27	.27
Adjusted R^2	.36	.36	.34	.35	.41	.43

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

FDI is associated with a rise in the 10-year growth rate by 4.8 percentage points. There is a positive intensity effect as well. A 1 percent increase in the FDI-output ratio is associated with a rise in the city's growth rate by 2.14 percent.

If we include both the levels of exports and FDI, and the growth rate of exports in the regression (table 3.8), only the scale of exports is significant at the 5 percent level. Unlike the 1988–90 sample, the contribution of exports appears more important than that of FDI for the decade. Furthermore, the scale effect of exports suggest that the contribution of exports is also through some positive spillover.

3.5.3 Contribution of Other Reforms

As with the sample over 1988–90, we measure the impact of reforms in three ways: (1) the role of the nonstate sectors, in particular, TVEs and foreign firms, (2) the ratio of free market sales to total retail sales, and (3) dummies indicating enhanced authority that cities have received from the central government to experiment with more reforms.

In table 3.9, the estimated coefficient on the nonstate sector is positive and

Table 3.10 Reform Experiments and Industrial Growth, 1980–90

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY80	−.071	−.408*	−.490*	−.051	−.283*	−.330*
	.048	.125	.135	.038	.130	.139
GPop	.752*	.457	.139	.707**	.458	.185
	.341	.296	.326	.372	.354	.398
LExp80		.168**	.264*		.128	.191**
		.095	.095		.105	.100
GExp			.218**			.190
			.123			.116
LFDI90		.044	.021		.028	.009
		.031	.028		.027	.022
RMKT90	−.623	−.636	−.445			
	.597	.528	.577			
RFM				−.089	−.079	−.084
				.117	.160	.151
N	41	36	36	43	38	38
SEE	.34	.31	.30	.33	.32	.31
Adjusted R^2	.10	.27	.30	.11	.22	.24

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

statistically significant: A 1 percent increase in the share of the nonstate sector in total output is associated with an increase of 1.3 percent in the 10-year growth rate.

If we decompose the nonstate sector into private individual firms, TVEs, and foreign-invested firms, we observe a result similar to the other sample: the shares of TVEs and foreign firms in total output have a positive and statistically significant impact on the growth rate. A 1 percent higher share of TVEs is associated with a 1.36 percent higher growth rate. A 1 percent higher share of foreign-invested/managed firms is associated with a 2.07 percent higher growth rate. The scale of FDI and the growth rate of exports, when added to the above regression, are not significant.

Second, the share of the free market in the city's total retail sales is used as a proxy for price liberalization and related reforms (table 3.10). Because no such data are available for 1980, the 1990 data are used. Similar to the other sample, this ratio is not significant (and the point estimate is even negative).

Third, the dummies COAST and RFM are added as regressors (table 3.11). The SEZ dummy is not added because there are some missing values for each of the special economic zones. The COAST dummy is positive and significant when added alone to the regression. That is, the 14 coastal open cities do grow faster than the national average. However, when the scales of exports and FDI

Table 3.11 **Coastal Areas and Industrial Growth, 1980–90**

Variable	(1)	(2)	(3)
LY80	−.070**	−.311*	−.373*
	.040	.143	.153
GPop	.641**	.511**	.242
	.427	.295	.320
LExp80		.160	.234*
		.110	.113
GExp			.195
			.121
LFDI90		.026	.010
		.028	.023
COAST	.178**	−.026	−.060
	.107	.124	.112
N	43	38	38
SEE	.33	.32	.31
Adjusted R^2	.14	.21	.23

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

are added, COAST is no longer significant. At the same time, the scale of exports is significant. This suggests that, over 1980–90, the extra growth rate that the coastal cities enjoyed was largely due to their above-average export performance. (In comparison, during the last two years of the 1980s, the extra growth is more likely explained by the above-average FDI presence in these cities.)

3.5.4 Human Capital

As a measure of human capital, the number of (broadly defined) "scientific and technical personnel" and the ratio this number to the total population are included separately in the regressions.[18] As can be seen from table 3.12, neither measure is positive, contrary to what the human capital strand of new growth theory would have suggested (one estimate is even negative and significant). However, when the growth in scientific personnel is used as a regressor, it turns out to be positive and significant. Note that, because there are only 17 cities that have data on the number of scientists in 1980, these estimates should be treated with caution.

18. As in the 1988–90 sample, "scientific and technical personnel" is defined broadly enough to encompass essentially all skilled workers, not just high-level scientists and technicians.

Table 3.12 Human Capital and Industrial Growth, 1980–90

Variable	(1)	(2)	(3)	(4)	(5)	(6)
LY80	−.079	−.104*	−.115**	−.096	−.111**	−.090
	.112	.041	.066	.122	.060	.127
GPop	1.371**	.606	.124	.564	.157	.182
	.812	.676	1.029	.611	1.030	.984
LSCNT80	−.004					
	.191					
RSCNT80		−9.45*				
		4.46				
GSCNT			.824*	.499*	.580*	.589*
			.347	.207	.250	.261
LExp80				−.023		−.024
				.128		.130
GExp					.190	.190
					.285	.288
LFDI90				−.050	−.054	−.049
				.073	.075	.073
N	17	15	17	14	14	14
SEE	.43	.38	.38	.38	.38	.41
Adjusted R^2	.16	.41	.35	.35	.36	.27

Notes: Numbers below coefficient estimates are heteroscedasticity-consistent standard errors. All regressions have an intercept which is not reported.

*Significant at the 5 percent level.

**Significant at the 10 percent level.

3.6 Conclusion

Using two city-level data sets, this paper has examined the contribution of the open door policy to Chinese growth. There is clear evidence that during 1980–90 more exports were positively associated with higher industrial growth across the cities. In comparison, in the late 1980s, the cross-city growth differences are explained by foreign investment rather than by exports. The contribution of foreign investment comes in the form of technological or managerial spillover across firms, as opposed to the infusion of new capital.

Cities with a larger share of nonstate sectors grow faster. The contribution of the nonstate sectors comes mainly from the TVEs, and particularly foreign-invested/managed firms. The coastal cities do grow faster than the national average, but the extra growth comes almost entirely from their ability to attract more foreign investment. To the extent that inland areas can also attract foreign investment and export via coastal cities, they also benefit from the open door policy.

Finally, it is important to point out that the contribution of the open door policy to Chinese growth is likely to be underestimated. As noted earlier,

much of the benefit of export expansion or a foreign investment boom in one city may spill over to other cities. The portion of growth that is generated by the cross-city spillover is reflected only in the intercept of the kind of regressions reported in this paper. Even though the open door policy may substantially raise overall Chinese growth, this may not be picked up by the coefficient estimates for city-level foreign investment or export variables.[19]

Appendix
Definition of Variables in the Regressions

All data refer to cities and surrounding counties in their jurisdiction.

Y = gross value of industrial output
Pop = nonagricultural population
Exp = purchase for exports in RMB yuan
FDI = foreign direct investment in U.S. dollars
IV = total fixed capital investment by all ownership types
RFDI = FDI/IV
RYIND = share of individual/private firms in total industrial output
RYTVE = share of TVEs in total industrial output
RYFOR = share of foreign-owned/managed firms in total industrial output
RYNS = share of private firms, TVEs, and foreign-owned/managed firms in total city industrial output
RMKT = share of free market in total retail sales
SCNT = scientific and technical personnel
MHSCNT = middle or higher levels of scientific and technical personnel
SEZ = dummy for four special economic zones
COAST = dummy for 14 coastal open cities.
RFM = dummy for 72 "comprehensive reform experimenting cities"

G and L prefixes to a variable denote, respectively, the growth rate and logarithmic value of that variable.

19. One channel through which cross-city spillover takes place is labor (and manager) movement across cities. So far, this channel is only marginally operative. Intercity job mobility has changed from virtually zero in prereform years to a small positive number in the 1980s. The diminished and eventually abolished use of food coupons in the 1980s has facilitated this increase in mobility. But the household registration system still in place, the underdevelopment of housing markets, and the social safety net continue to impede labor mobility across cities (Davis 1992).

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Comment Yun-Wing Sung

This paper has skillfully utilized city-level data to analyze the very important question of the contribution of exports and foreign investment to the phenomenal industrial growth in China. Analysis of the very successful growth of China is difficult because the reform period has been relatively short and quarterly data is mostly unavailable. Fortunately for economists, China is a land of vast regional variations, and the sample size of a regional data set can be quite large. Regional studies of the Chinese economy are becoming fashionable partly because of flourishing powerful regional economies, and partly because of rich data.

Wei uses two city-level data sets: The first has 434 cities for 1988–90, and the second has 74 cities for 1980–90. It is found that, during 1980–90, more exports are positively associated with higher growth rates across Chinese cities. In the late 1980s, the contribution to growth comes mainly from foreign investment. Furthermore, the contribution of foreign investment comes in the form of technological or managerial spillovers across firms, as opposed to an infusion of new capital.

While I agree with the main points of the paper, there are some weaknesses. First, the author should give more prominence to the problem of reverse causality. While the author noted that reverse causality can be a problem when he substituted 1990 end-of-sample values for some variables (foreign direct investment and ownership composition), he should warn the reader that reverse causality is a general problem since the paper does not use simultaneous equation estimation. The positive association between industrial growth on the one hand, and exports and foreign direct investment on the other, may be accounted for by a positive impact of industrial growth on exports and direct foreign investment.

Second, the term "city" or *shi* in China refers to a jurisdictional and administrative unit which may be largely rural, though populous cities such as Shanghai and Beijing contain substantial urban areas. The fact that cities are administrative units means that they can be amalgamated or split for administrative reasons. For example, the jurisdiction zones of many Chinese cities were substantially enlarged in 1983, with the result that the proportion of the Chinese

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population living in "cities" and "towns" (*shizhen zongrenkou*) rose from 20 percent in 1981 to 32 percent in 1984, and rose further to 50 percent in 1988. The 1983 enlargement of the jurisdiction zones of many Chinese cities has obviously affected the 1980–90 sample, probably substantially.

In China's city-level data sets, data for urban areas are often reported separately from data for the whole administrative district, and so data for the urban area should be reasonably free from the problem of enlargement in jurisdiction. Unfortunately, city-level trade data are only reported for the administrative districts, and regressions involving exports cannot be free from the problem of changes in jurisdiction. For foreign investment, industrial growth, and other variables, the author did not specify whether the data refer to the entire city or to the urban area only. He seems to have swept these problems under the rug.

Third, the second sample of 74 cities contains primarily the more populous cities with large urban areas, whereas the first sample of 434 cities contains largely less populous cities with small urban areas and large rural populations. This difference may be important for the contributions of exports and foreign direct investment to industrial growth. If Robert Lucas is correct in his assessment that spillover benefits are particularly important in urban areas due to the ease of communication, spillover effects should be more prominent in the second sample than in the first.

The difference in the two samples may also be important for exports at the city level. In the Chinese system of foreign trade, exports of a city usually refer to exports of the foreign trade corporations of that city. These include both goods made in that city and goods made elsewhere purchased by the foreign trade corporations of that city for export. The goods of less populous cities are usually sold to foreign trade corporations in large urban areas, especially large ports, for export and are thus regarded as exports of the large cities instead of the small cities of origin. This implies that exports will be prominent in the second sample, which is dominated by large, populous cities, whereas exports will be relatively unimportant in the first sample. This may account for the empirical finding in the paper that exports do not contribute to growth in the first sample, though exports are highly significant for growth in the second sample.

The rerouting of exports to other cities will cause strange fluctuations in exports. For instance, it is noted in the paper that Haikou's exports decreased by 29 percent from 1980 to 1990 despite the fact that Haikou has become substantially more open during the decade. This can probably be attributed to rerouting of exports to other cities.

Finally, there are some loose ends. In the text covering the regressions in table 3.4, it is mentioned that growth in the share of the free market is a statistically significant variable for explaining industrial growth, but the results are reported neither in table 3.4 nor elsewhere.

Despite the above shortcomings, the paper is undoubtedly an important work in the rapidly growing literature on empirical studies of the Chinese economy relying on regional data.

Comment John Page

China's extraordinary growth since undertaking its program of gradual economic reform arguably places it among the other East Asian "superstars." In two important respects—the rapid growth of manufactured exports and the significant role of direct foreign investment (DFI)—China in the 1980s and 1990s share common characteristics with other rapidly growing East Asian economies. The importance of export growth and DFI in engendering the East Asian Miracle has become a subject of intense, and frequently polemical, debate.[1] Thus, further work which helps to enlighten us on the contribution of these factors to growth and on the mechanisms by which they may carry out their growth-augmenting role is especially welcome. Because much of the academic debate on the role of exports and DFI has been argued in the context of cross-country growth regressions, it is also very useful to have a country study in which cross-sectional, time-series data are used to test a number of hypotheses concerning the contribution of exports and foreign investment to growth at the subnational level. In these two respects Wei's paper is an important addition to a literature which in general has been long on theory and argumentation and short on serious empirical analysis.

The debate over growth in East Asia centers on the sources of its rapid increase in per capita incomes. A "growth fundamentalist" school emphasizes the significance of East Asia's unusually high rates of physical and human capital deepening; while "growth mystics" tend to stress the importance of total factor productivity (TFP) change.[2] Wei clearly leans toward the mystic camp. His empirical results lead him to conclude that *both* exports and DFI increase growth rates in per capita income across cities in China through the impact of learning and competition on productivity change, rather than through increased rates of accumulation. A central question, then, is whether, given the limitations of the data, the empirical results support such a view unambiguously.

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1. See, e.g., Young (1993), Rodrik (1994), and the exchange between Pack and Page (1994) and Young (1994).

2. For an exposition of these quasi-religious views and an attempt to assess their validity see Page (1994).

The Analytical Underpinnings

Any concise paper inevitably must select among the arguments and evidence to be presented. Wei chooses to place emphasis on the description of China's economic reforms of the 1980s and gives rather short shrift to analytical discussion of the possible channels by which either exports or DFI may enhance productivity change. The absence of an explicit analytical framework and/or review of other literature relating export performance to productivity change leaves Wei open to the frequently heard criticism that the causality in his regressions may run from the dependent to the independent variable.

This is most frequently argued in the case of exports. Is it not equally plausible that rapid productivity growth due to some, perhaps unmeasured, factor results in increasing price competitiveness of tradable goods and improved export performance? But a similar case could be made for DFI. Rapid growth in income per capita may make cities more attractive as destinations for DFI. This uncertainty is compounded by the fact that in the interpretation empirical results Wei identifies the productivity-enhancing role of both variables with their absolute size, the "scale effect." I am sympathetic to the implicit model which underlies Wei's specification of the causal relationship, but in the absence of a more thorough discussion of the mechanisms by which exports—as opposed, say, to outward orientation, the impact of both imports and exports—or FDI enhance learning and productivity growth, I suspect that the skeptics will remain unconvinced.[3]

The lack of precision in specifying the mechanisms by which exports and DFI enhance productivity growth is reflected also in the interpretation of the alternative definitions of the two variables. Wei defines both his export and DFI variables in relative (share of output or investment) and absolute terms. The former he calls the "intensity effect" and the latter the "scale effect." He further associates only the scale effect with spillovers; the larger the absolute size of the variable, the greater the potential spillover. The rationale for this distinction is not entirely clear from the discussion in the paper.

Consider the case of DFI. If learning outside the foreign firm takes place by means of spillovers, why should these occur as a "constant fraction of the benefits . . . that foreign-invested firms obtain"? Why should they not be equally related to the probability that the new investment activity observed by an incumbent domestic firm will be of foreign origin? The first interpretation argues in favor of the absolute variable; the second in favor of the relative measure. Similarly for exports, if a high proportion of a city's output is concentrated in exports, does this not increase the probability that nonexporting firms will observe and learn from exporters? Without greater precision with respect to the means by which both within-firm learning and spillovers are realized, the case

3. For a discussion of the mechanisms by which exports may increase TFP growth rates at the firm level, see Pack and Page (1994).

for preferring the absolute to the relative definition of the variable is not as clear-cut as Wei's exposition would suggest.

A second analytical problem derives from a data problem. Wei notes that the city-level data he employs lacks estimates of the capital stock. Thus, he defines the production function in natural units of labor only and proceeds to interpret the residual of output growth net of labor's contribution as TFP growth. Wei is frank about the limitations imposed by such an assumption, but he is perhaps insufficiently cautious in interpreting his results. He has in effect specified a "Barro-type" cross-city regression without specifically using the concept of the endogenity of the capital stock. Moreover, because human capital enters his regressions in a rather ad hoc manner as one of the factors "explaining" productivity change, it is not clear on what basis the investment rate is omitted from the regression.

While Wei's discussion of his data leaves unclear whether total investment and the investment share in output are available, the fact that he can construct a variable which gives the share of DFI in total investment at the city level suggests that they are. If this is the case, a cross-city regression including the share of investment in output would place Wei's specification more squarely in the mainstream of the literature on cross-country growth regressions, would permit comparison with other work, and perhaps most significantly would bolster his arguments concerning the productivity-enhancing role of exports and DFI.

Without some attempt to control for differences in the rate of capital accumulation, the results remain open to the criticism that the export and (especially) the DFI variables—particularly when they are measured in absolute terms—reflect differences in rates of accumulation. In its simplest form the argument would run as follows: because DFI is an important component of total investment, cities with high levels or rates of growth of DFI have high total investment. Output per person increases as a consequence of capital deepening for which the DFI variable is a proxy, not as a consequence of more rapid productivity growth.

The Role of Human Capital

Wei's results are disappointing for those observers of the East Asian Miracle who stress the role of human capital.[4] His human capital variable consistently fails to explain variations in growth of output per person across cities. One problem may be definitional. In cross-country regressions, levels of educational attainment appear to be a more satisfactory definition of human capital than skill categories such as "scientific and technical personnel." In the cross-city context, however, there may be little variance in education stocks and the available variable relates to a broad definition of skilled labor, hence Wei's

4. See, e.g., World Bank (1993).

choice. But, some discussion of the cross-city variation in education stocks would have been welcome to buttress the choice of the skill variable.

A second problem may be conceptual. If, as Wei argues, the principal impact of exports and DFI on growth is through increased mastery of technology and productivity change, human capital may interact with these variables to accelerate growth. Thus, some attempt to explore interactions between skill levels and the other two variables should be attempted, as well as tests of their joint significance in explaining variations in per capita output growth.

The results may, however, continue to disappoint. A least one strand of human capital interpretations of success in Asia (Birdsall and Sabot 1993) emphasizes that it is high cognitive skills in the bottom-end ("low-skill") segment of the labor force which permits the East Asian high performers to adopt and master international best-practice technologies more effectively. According to that view, the interaction between exports, DFI, and human capital might best be captured by using measures of educational attainment in the bottom end of the wage distribution. This proposition cannot be tested with the data available to Wei, but it suggests a fruitful area for future, microeconomic research.

The Lessons

Academic readers looking for a definitive resolution of the fundamentalist-mystic debate on the origins of rapid growth in China will be disappointed. Wei's results are consistent with the view that TFP growth caused by DFI and rapid export expansion was a major engine of growth in China's coastal cities. But the data limitations and the absence of a tight analytical link between export expansion and productivity change will fail to persuade fundamentalist skeptics. Problems with the definition and interpretation of the human capital variable lead to similar problems in presenting a definitive view of its role in China's success.

In a broader sense, however, Wei's results contain important messages for policymakers in other developing economies. Economic liberalization is working in China. Regardless of the precise channel through which it takes place, the net impact of a set of reforms favoring export expansion and DFI has been to increase the growth of per capita income. These results, despite the quibbles, are robust and point out the policy directions for other economies embarking on programs of economic liberalization.

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