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OPEN DOOR POLICY AND CHINA'S RAPID GROWTH: EVIDENCE FROM CITY-LEVEL DATA

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ABSTRACT

There is clear evidence that during 1980-90 more exports are positively associated with higher growth rates across Chinese cities. In comparison, in the late 1980s, the contribution to growth comes mainly from foreign investment. The contribution of foreign investment comes in the form of technological and managerial spillover across firms as opposed to an infusion of new capital. Finally, there is nothing magical about the high growth rates of Chinese coastal areas other than their effective utilization of foreign investment and exports.

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Open Door Policy and China's Rapid Growth: Evidence from City-level Data

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 per cent. The corresponding growth rate for the world as a whole was 3.1 per cent (WDR, 1992, Table 2, p221). The growth rate for China in 1992 was 12.6 per cent.

The rapid growth in China is obviously related to its relentless (but not necessarily consistent) pursuit of economic reforms, 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 has literally been set forth as a textbook example of export-led growth[2].

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 aggregate observations. One small innovation of this paper is to

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[2] In a widely used textbook on international economics (Krugman and Obstfeld, 1991, p247), the authors wrote that the Chinese economic growth in the 1980s "amounted to a virtual economic miracle-and a classical demonstration of the potential of export-oriented industrialization."

employ city-level data[3].

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 comparison 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 spillover across firms as opposed to an infusion of new capital. Finally, the superb growth rates of the 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 1, the process of openning-to-the-outside-world is briefly reviewed. Section 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, the two data sets are described. Sections 4 and 5 present and interpret the statistical results from the two samples. Section 6 concludes the paper.

Section 1: The opening-up of the Chinese economy in the 1980s

To assess the contribution of the Chinese open door policy, it

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[3] There are 434 and 74 cities in the two data sets respectively. 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.

is useful to review briefly the path China has taken in this direction[4]. In 1978, China was ranked thirty-second in export volume. In 1989, it became the world's thirteen largest exporter. Its share of world trade almost doubled during this period. Between 1978 and 1990, the average annual rate of trade expansion is above fifteen percent, more than three times higher than that of total world trade[5].

This change in the degree of outward-orientation is truly remarkable particularly when one considers China's strong aversion towards trade and foreign investment before the reform[6]. China's trade regime before 1978 was an extreme version of import substitution. Many official statements have 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."[7]

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[4] For an excellent discussion of the pre-reform trade system during 1950-1978 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 opening up to the outside world. The following discussion on the evolution of China's trade regime is mainly based on Lardy (1992).

[5] Lardy, 1992.

[6] Kamm (1989) has described vividly the eerie feeling of doing exports and imports business with China in the 1970s. The discussion on the pre-reform trade regime in this section is based primarily on Lardy, 1992.

[7] see Lardy, 1992.

To highlight the nature of the pre-reform trade regime, a few characteristics are summarized below. (1) The state monopolized trade through state trade corporations. No firm or individual could export or import goods without the intermediation of those 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 are designated for the purpose of stimulating exports and attracting foreign investment. (3) Administrative restrictions on exports and imports are replaced by tariffs, quota and licensing. (4) The control on foreign exchange has been loosened over the years, particularly for foreign invested/managed firms.

How open has China become after a decade of reform? An often used measure of openness is trade (exports plus imports) to GNP

ratio. If one uses market exchange rate to convert China's GNP into the US dollar, China displays a phenomenal increase in the trade-GNP ratio from about 9.7% in 1978 to 26.8% in 1989 (Lardy, 1992, p151).

However, as Lardy pointed 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[8]. Another problem is that using 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 non-existent in the decades preceding 1979. In 1983, the flow of foreign investment was a mere US$ 1.7 billion. It increased to $ 5.3 billion in 1988, and to $11.4 billion in 1991. The accumulated FDI from 1979 to 1992 (calculated without depreciation) has reached $34.5 billion[9].

In terms of the source of FDI, Hong Kong is by far the absolute dominant supplier. Between 1984 and 1990, Hong Kong's share of FDI was above 50% for every single year except 1985 when

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[8] 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, 1992). Then, the deviation from the norm can be used as a more accurate measure of openness.

[9] Almanac of China's Foreign Relations and Trade, 1990; and People's Daily (Overseas edition) Feb., 1992, and May 31, 1993.

the share was 48.9%. Of course, of the 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 genuine Hong Kong capital[10].

Japan is ranked second in place in terms of its share in total FDI in China, although it is much less significant than Hong Kong (Japan's share in 1989 and 1990 was 11 and 13 percent). The third in 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% 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%, 18% and 7%, 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 foreign direct investment 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% in early 1980s to less than 5% in 1990 (Kueh, 1992).

One serious obstacle for China to attract foreign investment is its imperfect property and contract laws. The legal enforcement

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

is weak in spite of the laws that have been written on paper. So far, 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 why Hong Kong is so prominent as a source of foreign investment. There is little doubt that foreign investment from people other than ethnic Chinese would have been more had there been better and more transparent legal environment for business, and that improvement in the making and particularly 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 standard and knowhow. It increases the efficiency, not only of those firms that receive foreign investment or 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 shortage of domestic savings or foreign exchange[11].

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[11] although Wei and Fan (1993) fail to find statistical support for this view using the same 1988-90 city-level data as in this paper.

Section 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() 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 national and city-level productivity

components[12]. Notice that for simplicity I have assumed away firm-specific productivity shift. This is to focus our attention to 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,

$$g_k \equiv \sum_j s_{kj} g_{kj} = \sum_j s_{kj} g_{A_{kj}} + \sum_j s_{kj} g_{z_{kj}}$$

$$= g_{A_a} + g_{A_k} + \alpha\, g_{L_k}$$

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

We will focus on a few variables that affect the productivity

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[12] This specification is similar to Glaeser etc. (1992).

increase. Let

$$g_{A_k} = f(FDI_k,\ Exp_k,\ Y_{k0},\ H_k)$$

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. Finally, H_k is the stock of human capital in city k.

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

$$g_k = g_{A_0} + \beta_1 FDI_k + \beta_2 Exp_k + \beta_3 Y_{k0} + \beta_4 H_k + \alpha\, g_{L_k} + e_k$$

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(.) 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 the future production will be.

FDI is a primary mechanism for the technology to be transferred from developed countries to developing countries. In the context of China, it is also a primary mechanism for foreign management methods and worker discipline to be transferred into the country. Exports expose the exporting firms to the rigor of international competition as well as 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, or that 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 proportion to its share in the city's total capital stock. I will call this as an "intensity effect". On the 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.[13]

Similarly, exports can also enter regressions in two ways.

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[13] The pair of terminology, intensity versus scale effects, is borrowed from Backus, Kehoe and Kehoe (1992), who used it to represent an absence or presence of externality in human capital.

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 proportion to the share of exports in an city's total output. On the hand, the newly 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 meeting. Alternatively, non-exporting firms can simply imitate the management or marketing concept 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 all the firms in the city collectively do, than to the share of exports in total industrial output. That is, one can also use the scale effect to detect the presence of positve spillover of exports.

The H_t variable is to capture 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 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 the hypothesis, more scientists facilitate more and faster cross-fertilization of ideas. The contribution of scientists/skill workers is likely to be greater, the greater is the absolute number of scientists or skill 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 difference in growth.

Section 3: Data Sets

I employ two city-level data sets in this paper. The first one has 434 cities for 1988-1990, and the second one 74 cities for 1980-1990. A list of the cities is included in an appendix.

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 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 to examine the contribution of open door policy to the 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 the first data set. Furthermore, data on many variables of

interest were not collected in the first half 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.

Section 4: Regression Results from 434 cities during 1988 to 1990

Initial industrial size and population growth

In Table 1a, 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 five percent level.

Open door policy

Exports and foreign direct investment 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 they are entered separately, both are positive (although only the scale of exports is statistically significant at the ten

percent level). This is a finding often reported in some format in cross-country studies: openness correlates with high growth[14]. Here, a one percent increase in the scale of exports, is associated with a higher two-year growth rate by 2.5 percentage points.

If the growth rate of exports is used as an explanatory variable, its estimated coefficient is 0.046 and significant at the ten 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 foreign direct investment. Ideally, we would like to use the stock of foreign direct investment. But the data are not available at the city level, so we use the flow data[15]. Similarly with the export variables, the FDI variable can enter the regression in one of two ways: in absolute scale (in US dollars), or as a percentage of total fixed capital investment.

If the two measures of FDI are entered the regression separately, only the absolute scale of FDI is significant. A one percent increase in the size of FDI is associated with 1.3 percentage points higher growth rate for the two-year period. This lends some support to the notion of an externality effect of FDI.

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[14] See Edwards (1989) and papers cited therein.

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

An extra growth by 1.3 percentage points is not a negligible number, 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 1b 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 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 contributes more to cross-city differences in industrial output than does the exports. Furthermore, the scale effect of foreign investment is significant, and is supportive of the hypothesis of spillover of technological or managerial knowhow across firms within cities.

Other reform policies

One often-mentioned aspect of the Chinese reforms is the vitality of China's non-state sector[16]. Here, we will quantify the contribution of the non-state sector to overall industrial growth,

[16] In the Chinese context, non-state sector is not exactly the same thing as a private sector. The majority of non-state firms are what are called collectively owned enterprises. They are community based firms, but the relevant local governments often have powers to appoint or dismiss managers. Among the collectively owned firms, the township and village enterprises (TVEs) have been developing particularly fast.

and will do so in connection with examining the open door policy.

The first regression in Table 2 includes as an explanatory variable the ratio of non-state firms' output to total output. Here the non-state firms are defined as private firms, township and village enterprises (TVEs) and foreign-owned or managed firms. Urban collective firms are excluded because no data are available. We find this ratio to be positive and significant at the one percent level. A one percent rise in the output share of the non-state firms is associated with a 0.19 percent higher growth rate.

If we decompose the non-state 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 one percent increase in the output share of TVEs is associated with 0.22 percent higher growth rate. Cities with one 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 circumvent 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 for an explanation, one may note that private firms in China are typically family-based small business (with less than 8 employees) and are newly started during the

reform years. The 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 are financially less necessary to enforce strictly 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 initiatives 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 size of rural areas under their jurisdictions. For example, the city government of Shanghai has a jurisdiction of ten surrounding small counties, while the city governments in Sichuan control more and larger counties. To the extend 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). In other words, we cannot find a positive effect of price liberalization on industrial growth as measured by the initial share of free market. The growth in the share of free market, when included as an explanatory variable, is positive and statistically significant. But the magnitude of the contribution to the overall city growth is modest: A one percent higher in the growth of the free market is associated with a 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, as Special Economic Zones (SEZ)[17]. In a 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-year of low tax rate (7.5%). After the initial five years, foreign firms then pay a 15% tax rate. In comparison, outside the SEZs, the tax rate is 33% for foreign firms and 55% for domestic state-owned

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[17] Shekou, the part of Shenzhen close to Hong Kong, was announced to be an industrial export zone in January 1979.

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, as a "special area open to foreign investment" and, in 1988, as the largest special economic zone.

In May 1984, the Beijing government announced that fourteen cities spread along the entire Pacific coast were granted the "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 well-educated labor force. With the new status, they can offer essentially all the preferential policies towards foreign investment as a SEZ except for the income tax rate. Typically, foreign owned/managed firms need to pay tax at a rate of 24%, somewhere between the rates in a SEZ and elsewhere in the country. But the manufacturing firms are taxed at a concessionary 15% rate[11].

Starting from 1981, the central government (and provincial governments) have designated 72 cites to be "comprehensive reform experimenting" cities. Governments of these cities have gained more authority in managing firms inside the city boundaries, have

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[11] Started from mid-1980s and accelerated from 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 its preferential policies even broader in scope than a SEZ. I have not attempted to formally incorporate these developments in the statistical work of this paper. For a survey of these development, see IMF (1993).

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 a 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, and those with SEZ and COAST in Table 4. The coefficients for the RFM and SEZ dummies are not significant. This indicates that at least during 1988-90, there is no systematic difference in the growth performance for cities with or without those 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 are due to their ability to attract foreign investment.

To summarize, cities with a larger share of non-state sector tend to grow faster. The contribution of the non-state 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.

Human capital

Recent growth theories have stressed the importance of human capital on growth (Romer, 1986; and Lucas, 1988). This section examines the contribution of human capital to Chinese growth, and 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 labor force offers a more direct measure of average skill/education level of the labor force than primary and secondary school enrollment, since there is a time lag between school enrollment and entry into labor force. School

enrollment is often used as a measure of average human capital level in cross-country studies because the more direct measure is not available[19].

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 in Table 5. Unfortunately, neither the scale or intensity measures of human capital is statistically significant when included alone in the regression, and some even have negative coefficient. When the growth of the number of scientific personnel is included in the regression alone, it is positive and significant at the ten percent level. A one percent increase in the growth rate of scientists is associated with 0.06 percent increase in the industrial growth rate. However, when the scales of exports and foreign direct investment are included in the same regression, the growth of scientists loses its statistical significance (at the ten percent level). The scale of FDI is positive and significant at the ten percent level.

To summarize, the scale or average level of human capital does not appear to contribute to the cross-city difference in industrial growth rates during 1988-90. The contribution of the open door

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

policy (in particular, that of the foreign investment) identified in earlier subsections is not altered.

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 taking out 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% and 203%, respectively, while Jingzhou and Yunchen were growing at -36% and -29%. I will delete all the observations that are outside a two standard deviation band from the mean. This criteria deletes eight super-growing cities and 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 in beginning-of-the-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 trade/output ratio and reform dummies. The scale of FDI remains to have a significant and

positive effect on industrial growth.

Section 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 omitted data is Haikou, because it is the only city that is reported to have 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% over 1980-90.

Shenzhen is omitted in all regressions because there is 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 ten-year growth rate over 1980-90 is a phenomenal 545%, twice as high as the second highest growth rate in the sample[20], and more than six standard deviations (0.61) above the mean (155%). As a special economic zone, the city is known to have been extremely outward-oriented. Had it been included in the

[20] The second highest growing city in the sample is Guiling, with the ten year growth rate reaching 267%.

sample, it would undoubtedly have reinforced any finding of a positive contribution of exports or foreign investment to the city growth.

We would like to replicate all the key regressions as in the other sample. Unfortunately, the data on FDI and the ownership composition of the industrial output are not available for 1980. The corresponding data for 1990 are used as a substitute. 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 non-foreign 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.

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 new FDIs always go to cities that grow rapidly. By the end of the sample, fast-growing cities may have more FDIs. Hence, this can produce a correlation between FDI and growth. For whatever they are worth, regressions similar to the 1988-90 sample have been run.

Initial size of the industrial sector

From Table 6, one may notice a somewhat surprising result. The coefficient on the level of 1980 output is negative and statistically significant, suggesting a tendency of convergence in growth rates in Chinese cities. A one percent higher in the 1980 output tends to be associated with a reduction in the ten-year total growth rate by 24 percentage points (or 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 a phenomenal growth.

The negative coefficient suggests that the 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 the pre-reform China was extremely inefficient, burdened with obsolete technology, inadequate management and poor worker discipline. Furthermore, in selecting cities to experiment with

reform measures particular in the early 1980s, Chinese government is 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 the initial size and the subsequent growth.

Exports and FDI: Scale vs. intensity effects

The first set of results is in Table 6a. As expected, the growth rate of the non-agricultural population has a positive impact on the growth rates. The coefficient on the 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 five percent level. A one percent higher in the scale of exports of a city is associated with 16 percentage points higher ten-year growth rate.

If the ratio of exports to output is included in the regression, a much larger estimate is obtained. A one percent higher in this ratio is associated with 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 five percent level.

A one percent increase in the absolute scale of FDI is associated with a rise in the ten-year growth rate by 4.8 percentage points. There is a positive intensity effect as well. A one percent increase in the FDI to 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, only the scale of exports is significant at the five level. Unlike the 1988-90 sample, the contribution of the exports appears more important than FDI for the decade. Furthermore, the scale effect of exports suggest that the contribution of exports is also through some positive spillover.

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 non-state 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 7, the estimated coefficient on the non-state sector is positive and statistically significant: A one percent increase in the share of the non-state sector in total output is associated with an increase of 1.3 percent in the ten-year growth rate.

If we decompose the non-state sector into private individual

firms, town and village enterprises (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 one percent higher in the share of TVEs is associated with 1.36 percent higher growth rate. A one percent higher in the share of foreign invested/managed firms is associated with 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.

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

Thirdly, dummies for "coastal open cities," COAST, and for "comprehensive reform experimenting cities," RFM are added as regressors. The SEZ 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 fourteen coastal open cities do grow faster than the national average. However, when the scales of exports and FDI 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 have enjoyed is largely due to their above-the-average export performance. [In comparison, during the last two years of the 1980s, the extra growth is more

likely explained by the above-the-average FDI presence in these cities.)

Human capital

As a measure of human capital, the number of broadly defined "scientific and technical personnel" and the ratio of them to population are included separately in the regressions[21]. As can be seen from Table 10, neither measure is positive, contrary to what the human-capital strand of the new growth theory would have suggested (one of the estimate is even negative and significant). However, when the growth of the scientific personnel is used as a regressor, it turns out to be positive and significant. Notice because there are only seventeen cities that have data on the number of scientists in 1980, these estimates should be treated with caution.

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 are positively associated with higher industrial growth across the cities. In

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

comparison, in the late 1980s, the cross-city growth difference is 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 infusion of new capital.

Cities with a larger share of non-state sector grow faster. The contribution of the non-state sector 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 benefits of an export expansion or a foreign investment boom in one city may spill over to the 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 the paper. Even though the open door policy may substantially raise the overall Chinese growth, it may not be picked up by the coefficient estimates for city-level foreign investment or export variables[22].

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[22] One channel through which cross-city spillover takes place is labor (and manager) movement across cities. This channel is so far only marginally operative. The inter-city job mobility has changed from virtually zero in the pre-reform years to a small

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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 social safety net continue to impede labor mobility across cities (Davis, 1992).

Another channel through which spillover takes place is the downstream and upstream production linkages for firms located in different cities. This channel is likely to be active and increasingly important, although I only have anecdotal evidence to support this claim.

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Appendix C Definition of variables in the regressions

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

Y - gross value of industrial output

POPNA - non-agricultural population

EXP - purchase for exports in RMB yuan

FDI - Foreign direct investment in US dollar

IV - total fixed capital investment by all ownership types

RYIND - share of individual/private firms in total industrial output

RYTVE - share of township or village owned firms in total industrial output

RYFOR - share of foreign owned/managed firms in total industrial output

RNS - share of private, 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 fourteen coastal open cities.

RFM - dummy for 72 "comprehensive reform experimenting cities".

Table 1a: Exports, Foreign Investment and Industrial Growth (1988-1990)

	(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					
RExp80		.685##				
		.422				
GExp			.046#			
			.027			
LFDI88				.013#		
				.008		
RFDI88					.289	
					.192	
GFDI88						.008##
						.005
#Obs	347	347	342	.142	341	124
SEE	.19	.19	.19	.13	.18	.13
Adj.R2	.18	.20	.21	.07	.19	.06

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, #, ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 1b: Exports, Foreign Investment and Industrial Growth (1988-1990)

	(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
#Obs	142	123	123
SEE	.13	.12	.12
Adj.R2	.07	.15	.09

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 2: Non-State Sector and Industrial Growth (1988-1990)

	(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
#Obs	330	138	120	330	138	120
SEE	.16	.12	.12	.16	.12	.11
Adj.R2	.25	.13	.12	.26	.19	.21

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 3: Reform Experiments and Industrial Growth (1988-90)

	(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
#Obs	346	142	123	347	142	123
SEE	.19	.13	.12	.19	.13	.12
Adj.R2	.18	.06	.14	.17	.07	.15

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 4: Coastal Areas and Industrial Growth (1988-90)

	(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
#Obs	347	142	123	347	142	123
SEE	.19	.13	.12	.19	.12	.12
Adj.R2	.17	.06	.16	.18	.14	.14

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 5: Human Capital and Industrial Growth (1988-90)

	(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
#Obs	346	346	346	142
SEE	.19	.19	.19	.13
Adj.R2	.17	.18	.19	.07

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 6a: Exports, Foreign Investment and Industrial Growth (1980-90)

	(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
#Obs	43	43	43	38	38
SEE	.32	.32	.33	.32	.31
Adj.R2	.17	.17	.12	.20	.23

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 6b: Exports, Foreign Investment and Industrial Growth (1980-90)

	(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
#Obs	38	38
SEE	.31	.31
Adj.R2	.23	.25

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) *, # and ## denote significance at the 5%, 10% and 15% levels respectively.

3) All regressions have an intercept which is not reported.

Table 7: Non-state Sector and Industrial Growth (1980-90)

	(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
LExp80		.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
#Obs	43	38	43	38	43	38
SEE	.28	.29	.29	.29	.27	.27
Adj.R2	.36	.36	.34	.35	.41	.43

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) * and # denote significance at the 5% and 10% levels respectively.

3) All regressions have an intercept which is not reported.

Table 8: Reform Experiments and Industrial Growth (1980-90)

	(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
LFD190		.044	.021		.028	.009
		.031	.028		.027	.022
RMKT90	-.623	-.636	-.445			
	.597	.528	.577			
RFM				-.089	-.079	-.084
				.117	.160	.151
#Obs	41	36	36	43	38	38
SEE	.34	.31	.30	.33	.32	.31
Adj.R2	.10	.27	.30	.11	.22	.24

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) * and # denote significance at the 5% and 10% levels respectively.

3) All regressions have an intercept which is not reported.

Table 9: Coastal Areas and Industrial Growth (1980-90)

	(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
#Obs	43	38	38
SEE	.33	.32	.31
Adj.R2	.14	.21	.23

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) * and # denote significance at the 5% and 10% levels respectively.

3) All regressions have an intercept which is not reported.

Table 10: Human Capital and Industrial Growth (1980-90)

	(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
#Obs	17	15	17	14	14	14
SEE	.43	.38	.38	.38	.38	.41
Adj.R2	.16	.41	.35	.35	.36	.27

Notes

1) Below coefficient estimates are heteroskedasticity-consistent standard errors.

2) * and # denote significance at the 5% and 10% levels respectively.

3) All regressions have an intercept which is not reported.