China's Provincial Growth Dynamics

Jahangir Aziz and Christoph Duenwald

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Abstract

China's rapid overall growth since 1978 masks significant differences in relative economic performance across its provinces. This paper finds that, while per capita income of poor provinces are catching up with those in the rich, the relative income distribution appears to be stratifying into a bimodal distribution—the coastal provinces gravitating toward one mode, and the remaining provinces toward the other—with economic structure and policies playing important roles in the growth dynamics.

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I. INTRODUCTION[2]

China's economic performance since the onset of economic reforms in 1978 has been remarkable; the per capita real GDP growth has averaged 8¼ percent and social indicators have improved markedly. However, the rapid pace of growth of the national economy masks substantial differences in the growth rate and level of per capita incomes across different provinces in China. The issue of uneven regional development has recently moved to the top of the policy agenda in order to share more broadly the benefits of economic reforms.

This paper seeks to provide answers to the following three questions:

- Are the relatively poor provinces in China catching up with the rich?
- If they are, what are the characteristics of the catch up process?
- On current trends, what will the provincial income distribution look like in the future?

In the empirical growth literature, these questions have been broadly classified as those relating to the study of *convergence* of income levels among economic units—countries or provinces within a particular country. However, the term convergence has been used to mean several different phenomena in the literature. In this chapter, convergence will be defined as the phenomenon of income levels in poorer provinces catching up in relative terms with those in the rich.

The subject of income disparities within China has, of late, been the focus of several studies. Generally speaking, three main results emerge from these studies:

- If one looks at only per capita incomes of provinces, then in the post–1978 period there is little evidence that the initially poorer provinces have, on average, grown at a faster pace than their richer counterparts.[3] However, if per capita incomes of provinces are adjusted for differences in economic structure, economic policies, demographics, and geography, then there is evidence that, on average, the initially poorer provinces have indeed grown faster than those that were initially richer.[4]

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[2]Throughout this paper, references to China are to the Mainland and the term "provinces" refers to the set of 28 provinces, autonomous regions and municipalities listed in Table1.

[3]In the growth literature, the phenomenon of initially poorer economies—measured in terms of their per capita incomes—growing faster than those that are initially richer is referred to as *absolute (or unconditional) beta-convergence*.

[4]This phenomenon is referred to as *conditional beta-convergence.*

- Forces of *conditional convergence* were stronger in the pre-1990 era—the early reform period, and weaker in the 1990s.

- The dispersion in relative incomes of the provinces fell in the early reform period and rose in the 1990s.[5]

However, virtually all these studies provide only a partial view of the convergence process. They tend to focus exclusively on the average (in the case of unconditional and conditional beta-convergence) and standard deviation (in the case of sigma-convergence) of the relative income distribution of provinces, and based on the behavior of these two statistics, draw inferences about whether relative income levels of China's provinces are converging or not. Although these two statistics provide valuable insights into the convergence process, as shown in many studies—theoretical and empirical—inferences based solely on the behavior of the two statistics are incomplete. In particular, the answer to the question of whether or not the poor provinces are catching up with the rich, depends on how the shape of the entire provincial relative income distribution has changed over time, and not simply on the behavior of two statistics—the average and the dispersion—of the distribution.

The approach taken in this chapter is to exploit more fully the information contained in the shape of the relative income distribution and the way in which it has changed over time. To do this, in the spirit of Quah (1997), kernel estimates of the relative income distribution of China's provinces are computed and their intertemporal properties characterized. The results from this exercise suggest the following:

- Per capita incomes of the initially poor provinces are catching up with those in the initially richer provinces.

- However, this overall tendency masks significant differences across provinces. On the one hand, the coastal provinces are growing at a relatively faster pace than the rest, including the initially richer provinces. On the other hand, many of the initially poorer provinces, after improving their relative rankings in the 1980s, have been falling behind in the 1990s. The initially richer provinces have been losing their standing in the relative income ladder quite rapidly.

- As a result, the relative income distribution seems to be stratifying into a bimodal distribution; the coastal provinces gravitating towards one mode, and the remaining provinces toward the other.

- Economic structure and policies, in particular, the concentration of state-owned enterprises (SOEs) and the openness of the province to external trade, have been significant factors in these distributional dynamics.

[5]The decline in the dispersion of relative income across a set of economies is referred to as *sigma-convergence.*

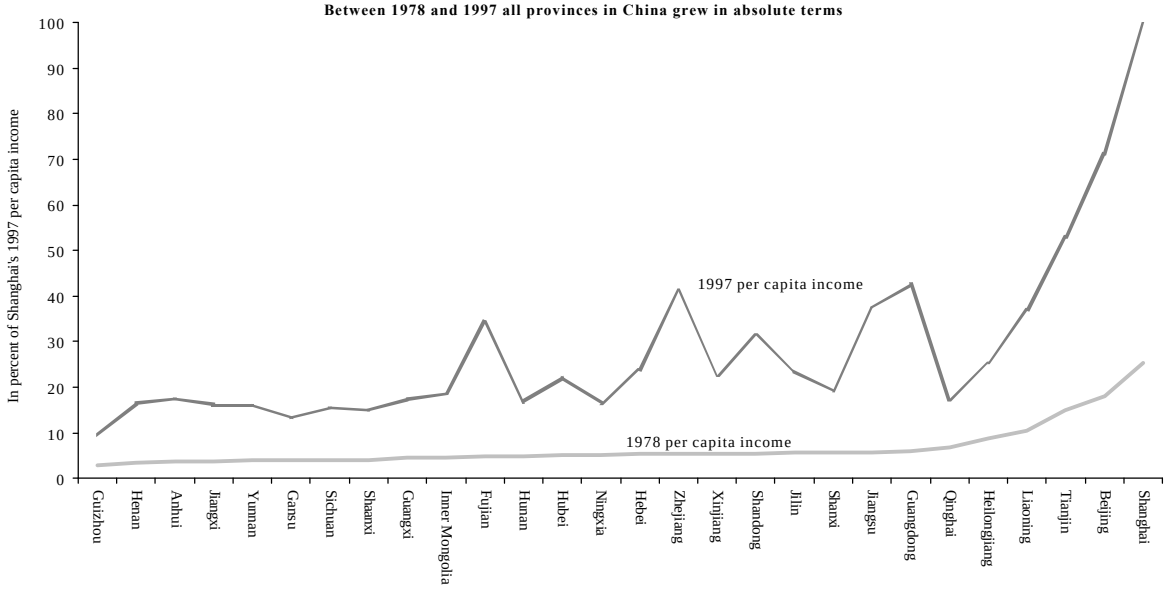
The chapter is organized as follows: Section B summarizes the existing empirical evidence on convergence among China's provinces. This is followed by the main section of the chapter, where kernel estimates of the relative income distribution and their intertemporal changes are discussed and inferences reported. Section D concludes with a discussion of some of the implications of these results.

II. CONVERGENCE: EVIDENCE FROM RECENT STUDIES

A. Economic Performance of China's Provinces

Chart 1. China: Provincial Income Distribution, 1978-97

Between 1978 and 1997 all provinces in China grew in absolute terms



Economic performance has varied substantially across China's provinces.[6] Between 1978 and 1997, per capita incomes grew in all Chinese provinces in absolute terms, and both initially rich and initially poor provinces experienced a significant increase in living standards (Chart 1). However, the extent of improvement in living standards differed substantially among the provinces. While real GDP per capita has grown by at least 5 percent on average during the reform period, some provinces—notably those along the coast—have grown at more than twice that rate.[7] Indeed, the variation in economic performance has displayed

[6]This section draws on Husain (1998), Jian *et al.* (1996), and Dayal-Gulati and Husain (2000).

[7]Some observers believe that China's GDP growth rates are overstated by as much as 2 percentage points. This issue is not relevant to the present study, which focuses on relative provincial GDP levels and growth rates, under the assumption that there is no systematic tendency for growth in certain provinces to be overstated more than in others.

some distinct geographical patterns. Coastal provinces have tended to outperform the central provinces, which in turn surpassed the western provinces. For example, coastal provinces like Guangdong, Fujian, and Zhejiang each grew at an average annual rate of around 12 percent in real per capita terms during 1978–97, while central provinces like Hubei, Henan, and Jiangxi grew by about 9 percent. Western provinces like Gansu, Qinghai, and Ningxia grew by between 5 and 7 percent.

Significant variation in relative economic performance over time is also a feature of the provincial data (Table 1 in the appendix). Shanghai and Guizhou were China's richest and poorest provinces, respectively, in both 1978 and in 1997. However, there were considerable changes in rankings (in terms of level of real per capita GDP) among the other provinces between those two years. For instance, the coastal province of Zhejiang moved from rank 15 in 1978 to 5 in 1997, while the western province of Qinghai dropped from its rank 6 to 20 over the same period. More broadly, in 1978, the most affluent provinces tended to be in the northeast, but by 1989 some of the coastal provinces had joined the northeastern region as the most affluent in the country. By 1997, the coastal provinces were clearly the most affluent (apart from the metropolitan areas of Shanghai, Beijing, and Tianjin), followed by the northeastern region.

B. Convergence and Growth Regressions

One of the key predictions of the neoclassical growth model is the convergence hypothesis, i.e., the tendency of poor countries/regions to catch up with richer countries/regions.[8] In the literature, the most common approach to studying such a phenomenon is to conduct a beta-convergence exercise, which amounts to verifying whether the neoclassical (standard Solow or augmented endogenous growth) model is a good description of a country's development experience.[9] In this context, as noted, a distinction between absolute and conditional beta-convergence is typically made. If economies vary in their saving rates and initial capital stocks, then the neoclassical model predicts conditional convergence, a situation in which per capita incomes converge, conditional on each economy's steady state. [10] That is, among economies that are similar in preferences, technologies, savings rates and other structural characteristics, the lower the initial levels of output per capita the higher the growth rates.

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[8]More precisely, and as argued by Barro and Sala-i-Martin (1995), the neoclassical model leads to *conditional* rather than *absolute* convergence (defined in footnotes 2 and 3).

[9]Examples include Mankiw, Romer, and Weil (1992), Cashin and Sahay (1996), and Dayal-Gulati and Husain (2000).

[10]Convergence in this case arises from the assumption of diminishing returns to capital. Since the rate of return on capital is lower in economies with more capital per worker, there are incentives for capital to flow from rich to poor economies, boosting growth in the latter relative to the former, and thus causing convergence.

The methodology to test the hypothesis of beta-convergence commonly involves regressing per capita output growth during a given time interval on a constant, initial per capita income, and a set of conditioning variables. Empirical studies differ in terms of the conditioning variables included, but investment ratios, educational characteristics, population growth, and dummy variables for coastal effects have typically been used. The conditional convergence hypothesis predicts a statistically significant negative coefficient on initial income (holding the conditioning variables constant).

In the case of China, several studies have shown that, in general, the relative dispersion of provincial per capita incomes fell in the 1980s, but rose subsequently. This observation suggests that the evolution of China's regional income dynamics can be roughly divided into two time periods: 1978–89 and 1990–97, with the former period characterized by convergence and the latter by divergence, as measured by sigma-convergence.

Table 2. China: Selected Tests of Convergence Hypothesis for China's Provinces

Study	Convergence
Jian, Sachs, and Warner (1996)	
1978-93	absolute
1978-85	no
1985-93	no
1990-93	no
Chen and Fleisher (1996)	
1978-93	conditional
Raiser and Nunnenkamp (1997)	
1978-85	conditional
1985-92	conditional
1978-92	conditional
Li, Liu, and Rebelo (1998)	
1978-95	absolute
1978-95	conditional
Dayal-Gulati and Husain (2000)	
1978-82	conditional
1983-87	conditional
1988-92	no
1993-97	no

A number of studies have also tested the beta-convergence hypothesis using Chinese provincial data. A selected survey of these studies is shown in Table 2, and their main findings are the following:

- Jian *et al.* (1996) find that China's regional disparities narrowed between 1978 and 1990, but that subsequently, the coastal and interior regions of China began to diverge, reflecting in part the special privileges given to the coastal regions. They explain the divergence in regional incomes by an increase in the variance between the coastal provinces and the interior provinces, rather than by an increase in the variance within either the coast or the interior. They conclud that, China is on a dual track, with a prosperous and fast growing coastal region and a poor interior growing at a lower rate.

- Chen and Fleisher (1996), using an augmented Solow growth model, find evidence that convergence was conditional on coastal location. Their result suggests that convergence is occurring within the coastal and inland regions but not between these regions.

- Raiser and Nunnenkamp (1997) find evidence in support of conditional income convergence among China's provinces; however, they also show that the rate of convergence in the 1985–92 period is markedly slower than that for 1978–85.

- Li *et al.* (1998), using the augmented Solow-Swan model, find support for the conditional convergence hypothesis, and estimate the convergence rate to be relatively high at 4¾ percent per annum.[11] However, they also note an increase in income inequality after 1990, and point out that, while economic reforms in China have facilitated convergence of each province toward its steady state, reforms have also widened the gap between the steady states of different provinces. The authors also present evidence in support of unconditional convergence during the sample period, so that regional economies converge even though they have dissimilar steady states.

- Dayal-Gulati and Husain (2000) show that regions are converging, but to different steady state levels of income. They find the pattern of FDI flows, as well as structural characteristics of the regions—including total investment, the concentration of SOEs, and bank loan-deposit ratios—are important factors determining growth and convergence.

Using a representative set of conditioning variables used in the above studies, similar beta-convergence exercises were performed for the period 1978–97, and the sub-periods 1978–89 and 1990–97. The results—summarized in Table 3—generally confirm those from the earlier studies.

Table 3. China: Provincial Growth Regressions, 1978-97

Dependent Variable: Growth Rate of Real Per Capita GDP

	Coefficients					
	1978-97		1978-89		1990-97	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Independent variable						
Initial per capita income (in log)	-1.24	-3.57 **	-2.49 ***	-5.62 ***	2.77 *	-1.56
Population growth		-0.52		-2.01		0.3
Domestic investment-to-GDP		0.027		0.07 *		0.02
Foreign direct investment-to-GDP		0.14		0.27 ***		0.05
Government revenue-to-expenditure		-0.001		0.003		-0.004
M2-to-GDP		-0.007		-0.001		-0.014
Share of SOEs in industrial output		-0.045 ***		-0.02		-0.09 ***
Coastal dummy		1.83 ***		1.3 *		1.97 ***
Adjusted R^2	0.03	0.79	0.09	0.61	0.02	0.84
Standard error of regression	3.03	0.8	1.48	0.97	2.48	1.01

Sources: Chinese authorities; and staff estimates.
Notes: * implies statistical significance at 10 percent level; ** implies statistical significance at 5 percent level;
*** implies significance at 1 percent level.

III. DYNAMICS OF CONVERGENCE

The results from the previous section, while useful, do not provide a complete picture about the shape of the relative income distribution or how it has evolved over the years. To do so, the *kernels* of the actual relative provincial incomes in different time periods are estimated so that their shapes and intertemporal dynamics can be studied. A *kernel estimator* of a set of observations—in this case the relative rankings of the provincial per capita

[11] In comparison, estimates of the rate of convergence for other economies center around 2 percent. See Mankiw, Romer, Weil (1992), for example.

income—is an estimated distribution function from which the observations are likely to have been drawn (for details, see Silverman (1986)). Mathematically, *the kernel estimator f(x) is defined as*

$$f(x) = \frac{1}{Nh} \sum_{j=1}^{N} K\left(\frac{x - X_j}{h}\right)$$

where,

X_j = data

N = number of data points

h = window width/smoothing parameter[12]

K = kernel/weighting function (assumed to be the normal distribution in this paper)

A. Provincial Income Distribution

The three panels in Chart 2 display the kernels of the provincial relative incomes in 1978, 1989, and 1997. In each panel, the kernel was estimated in the three steps.

- In the first step, in each year, the real per capita income of each of China's 28 provinces was rescaled as a fraction of Shanghai's per capita income,[13] [14] such that the range of the distribution is restricted to lie between 0 and 1. Since by construction, Shanghai's relative income is always 1, it was also excluded from the sample.

- In the second step, for a suitably large number of points spanning the interval [0,1],[15] the relative frequency, i.e., the unconditional probability, with which each of these values could have occurred, was estimated. The probability of each point was computed as the weighted average of the distance of that point from the given relative incomes of all the 27 provinces, with the weights drawn from a normal or Gaussian distribution centered at that point.

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[12]The window width was chosen following the suggestion in Silverman (1986) to be given by $0.9AN^{-1/5}$, where A=min(standard deviation, interquartile range/1.34).

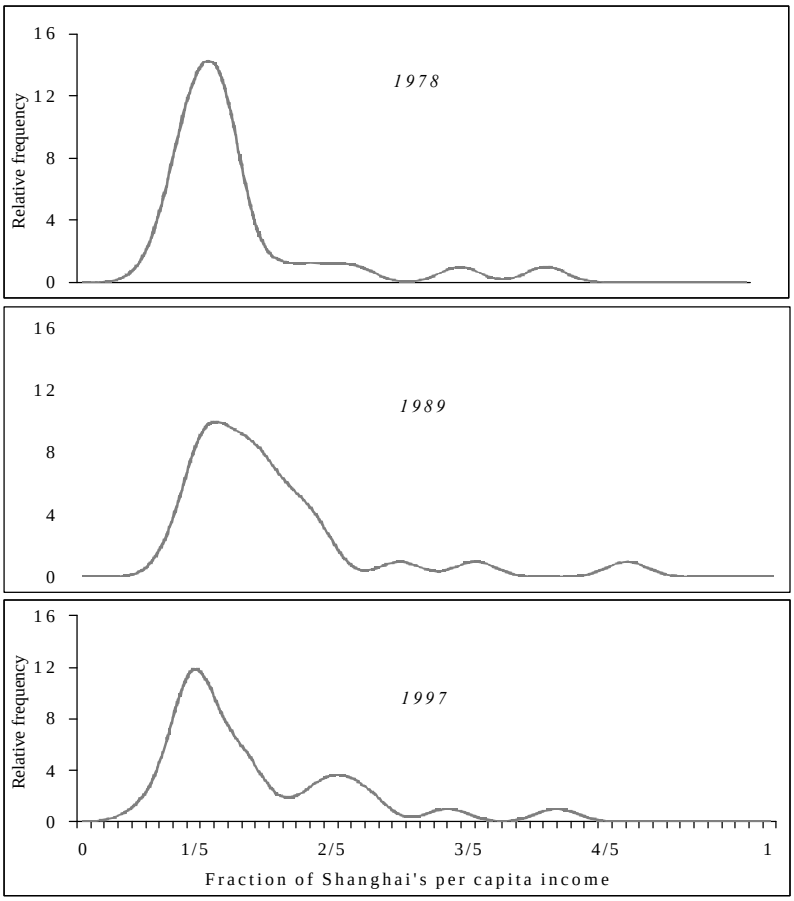
[13]The choice of Shanghai as the numeraire is arbitrary and has little impact on the analysis.

[14]Note that Hainan and Tibet Autonomous Region were excluded from the sample since data on per capita income are not available before 1985. Data for Chongqing, which became a municipality in 1997, were included in the data for Sichuan.

[15]For these exercises, the interval [0,1] was divided into equally spaced 50 sub-intervals.

- In the third step, the relative frequencies of these points were filtered for noise using the procedure in Silverman (1986). The collection of the filtered relative frequencies formed the kernel of the relative provincial incomes in that year. The area of the distribution was normalized to 100.

Chart 2. China: Relative Income Distribution Across Provinces, 1978-97
(Gaussian kernels of provincial relative income distribution)



One interpretation of the kernel estimators is that, based on the actual growth experience of China's provinces, they tell us how likely it is that per capita income, on average, was a certain fraction of Shanghai's per capita income in a particular year. For example, in the first panel of Chart 2, in 1978 the unconditional probability that a province's per capita income was 1/5 of Shanghai's was 14 percent. This probability declined to 10 percent in 1989 and then rose to 12 percent in 1997 (the second and third panels).

An examination of the provincial income distributions over the period 1978–97 reveals the following stylized facts:[16]

- Most of the mass of the income distributions for all three periods remained below 2/5 of Shanghai's per capita income, indicating that throughout the last two decades of reform, on average, provincial per capita income was most likely to have been less than 40 percent of Shanghai's per capita income.

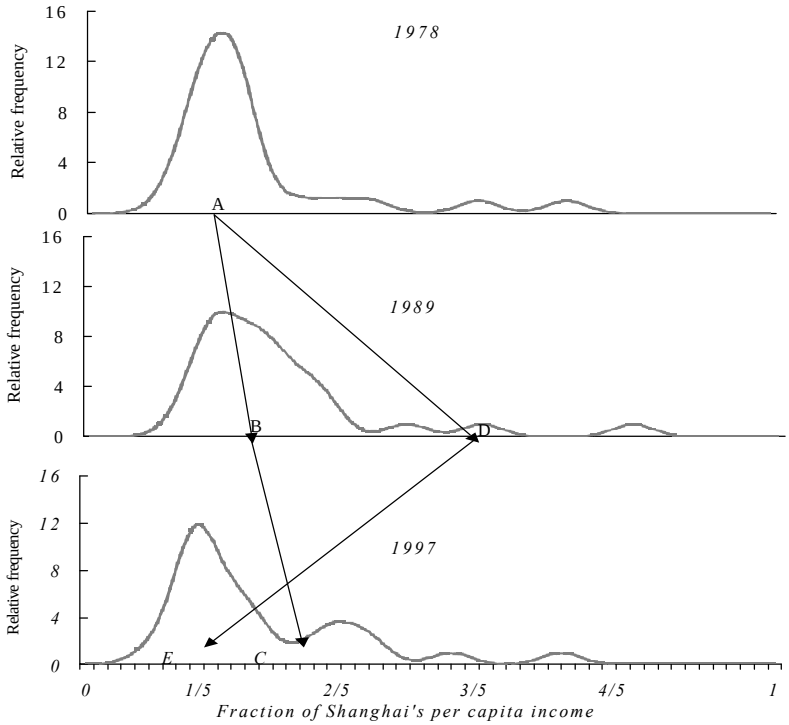
[16]In the remainder of this chapter the terms *kernel* and *distribution* will be used interchangeably. In the charts, the income distribution is referred to as the Gaussian kernel since the weights used were drawn from a Gaussian distribution. Weights drawn from a Epanechnikov distribution, which is the other frequently used weighting method, did not seem to make any material difference to the shape of the estimated kernels.

- In the early reform period, there was some decline in the mass of provinces in the first quintile of the distribution, partially offset by an increase in the second quintile.

- In the late reform period, the shift to the second quintile was reversed, as the proportion of provinces in the first quintile rose.

These stylized facts are consistent with some of the results of the convergence exercises. It shows that there was tendency in the early reform period for unconditional beta-convergence, which disappears in the later reform period. It is also consistent with a decrease in the standard deviation of the provincial relative incomes in the 1980s, i.e., sigma-convergence, followed by a rising trend in the 1990s.

Chart 3. Examples of Distribution-Preserving Movements
(Gaussian kernels of provincial relative income distribution)



However, the relative income distributions tell us little about whether the poor provinces became richer or poorer in relative terms in the early and late reform periods. Chart 3 provides various examples of movements of provinces over time that preserve the overall shape of the distributions in Chart 2, but reflect dramatically different growth dynamics. In particular, it is possible that a province at point A in 1978 (at 1/5 of Shanghai's per capita income), moved to point B in 1989 and then to point C in 1997. Alternatively, point A could have moved to point D in 1989, and then fallen back to point E in 1997. These examples suggest that an answer to the question requires carefully tracking the positions of each province in the relative income distributions in 1978, 1989, and 1997.

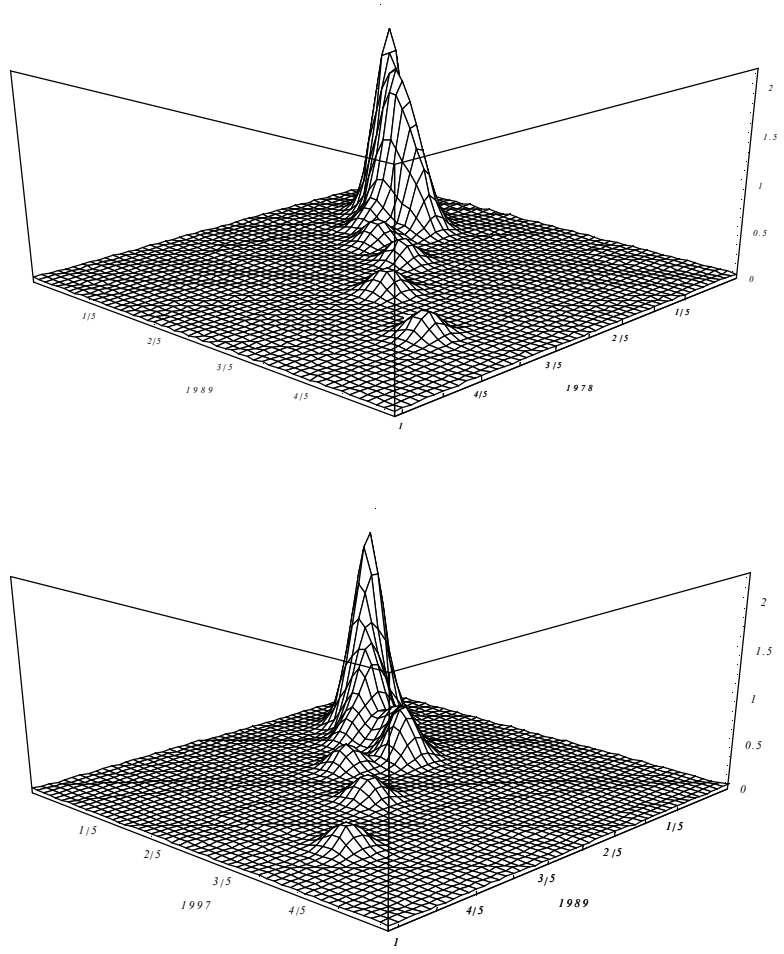
B. Growth Dynamics in China's Provinces

This section focuses on the intradistribution dynamics among the Chinese provinces, displayed in Charts 4 and 5. In each panel, the kernel of the joint distribution of relative incomes in the initial and terminal years is shown. The horizontal axes measure the relative incomes in the initial and terminal years, while the vertical axis measures the frequency. The height of the distribution shows the frequency with which a particular growth experience occurred between the two time periods. Points of the distribution that lie along the north-south diagonal represent unchanged relative incomes, while points to the right (left) of the diagonal represent a rise (decline) in relative incomes between the two periods plotted.

In the first panel of Chart 4, the kernel shows that the dominant experience among China's provinces was that relative incomes were between 1/5 and 2/5 of Shanghai's income in 1978 and remained in that interval in 1989; for a small number of provinces relative income was

Chart 4. China: Distribution Dynamics in the Early and Late Reform Periods

Gaussian kernel of the joint distribution of provincial relative income.
The area under the entire distribution is normalized to be 100.
The horizontal axes measure provincial per capita income as a fraction of Shanghai's per capita income, while the vertical axis measures the relative frequency, in percent.
A movement to the right of the north-south diagonal indicates improvement in relative income ranking, while a movement to the left suggests a worsening in the relative income ranking between the initial and terminal years.



higher in 1978, but remained around the same levels eleven years later. Put differently, based on China's actual provincial growth experience during 1978–89, the probability that a province in the [1/5–2/5] interval in 1978 remained in that interval at the end of the period was fairly high, while that of reaching, say 3/5 and above of Shanghai's income, was virtually zero.

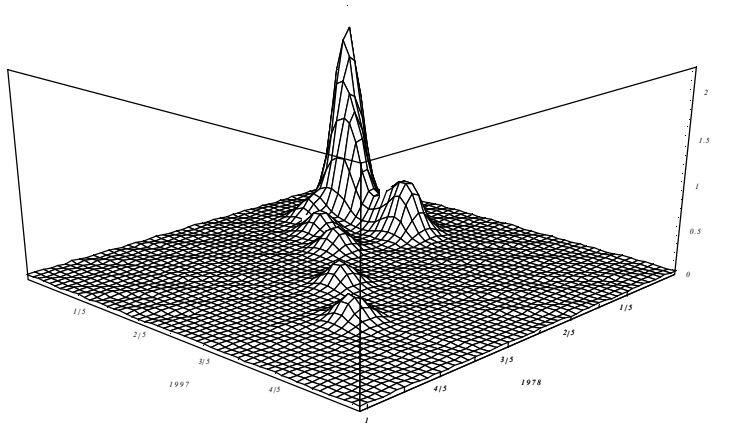
This picture of apparent immobility is, however, not entirely correct. Along the north-south diagonal of the panel, the entire distribution is skewed to the right. This implies that although most provinces remained in the second quintile between 1978 and 1989, many shifted closer to the upper end of the interval during the period. The same was true for those in the fourth quintile in 1978; they moved up into the fifth quintile in 1989. Consequently, in the early reform period, not only was there considerable intra-distributional mobility across provinces, but the poor provinces did in fact become richer in relative terms.

This trend seems to be have been somewhat reversed in the later reform period. The kernel of the joint-distribution between 1989 and 1997 shows a distinct left skew along the north-south diagonal at both the lower and upper ends of the range. This implies that while the provinces in the second quintile shifted toward the lower end of the interval, so did those in the upper quintiles. More interestingly, however, a set of provinces in the second quintile in 1989, broke out of that range to move into the third and fourth quintiles. Some of the relatively better-off provinces whose relative position worsened were Heilongjiang, Liaoning, Qinghai, Tianjin, and Beijing, while provinces like Guizhou, Yunnan, Gansu, and Shaanxi, which were already relatively poor, became poorer. The provinces that gained most in relative terms were the ones in the coastal region—Guandong, Jiangsu, Zhejiang, and Fujian. Thus, while the coastal provinces gained in rank, some of the relatively rich provinces and many of the low-income provinces fell behind.

What do the intradistribution dynamics for the entire period 1978–97 look like? Chart 5 shows the kernel of the joint relative income distribution between 1978 and 1997. The distribution has two distinct features; while a predominant part of the distribution is shifted to the left of the north-south diagonal, there is a significant mass skewed to the right. It would seem as if the coastal provinces are gravitating rightward and forming their own cluster, while

Chart 5. China: Distribution Dynamics During 1978-97

Gaussian kernel of the joint distribution of provincial relative income.
The area under the entire distribution is normalized to be 100.
The horizontal axes measure provincial per capita income as a fraction of Shanghai's per capita income,
while the vertical axis measures the relative frequency, in percent.
A movement to the right of the north-south diagonal indicates improvement in relative income ranking, while
a movement to the left suggests a worsening in the relative income ranking between the initial and terminal years.



the remaining regions—both the relatively rich and poor—are gravitating to the left to form a separate cluster. In other words, there is an emerging tendency for the distribution to be stratified into a bimodal distribution.[17]

These results provide somewhat firmer ground to answer the questions raised in the introduction.

- The relatively poor provinces are catching up with the rich, but this is occurring in a somewhat complex manner. Some of the coastal provinces, which were relatively poor at the beginning of the reform period, have been growing at a considerably faster pace than the erstwhile rich provinces of the rust belt, especially in the 1990s. As a result, the gap between the coastal provinces and the initially rich is closing in relative terms. On the other hand, the other initially poor provinces are falling behind in relative terms, such that the dispersion among these initially poor and rich provinces is also declining—the provinces seem to be clustering toward two separate relative income clubs.

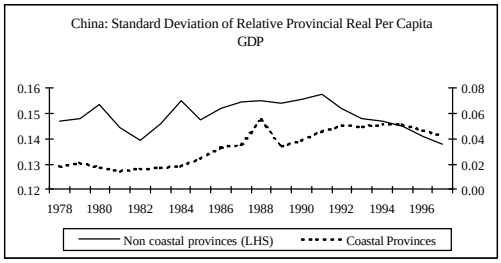
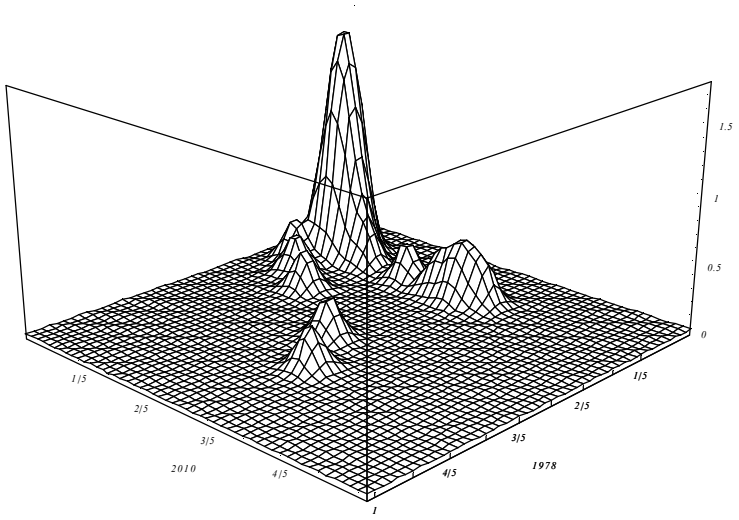


Chart 6. China: Projected Distribution Dynamics On Current Trends

Gaussian kernel of the joint distribution of provincial relative income.
The area under the entire distribution is normalized to be 100.
The horizontal axes measure provincial per capita income as a fraction of Shanghai's per capita income,
while the vertical axis measures the relative frequency, in percent.

- Furthermore, there has been considerable mobility in relative rankings. This raises a whole new set of questions that are explored in the next section. If labor and capital were relatively immobile in China, as suggested by conventional wisdom, what explains the intra-distribution churning? Is it the



[17]Quah (1997) termed this bimodality "twin peaks" in the context of cross-country growth experience. In that study, the twin peaks lay along the north-south diagonal implying little mobility in relative rankings. In the case of China's provincial growth, the emergent twin peaks would lie across the north-south diagonal, implying significant mobility in rankings. This is a specific example of what Baumol (1986) termed " club convergence".

structure of these economies or is it due to different policies adopted by these provinces? The next section provides partial answers to these questions.

- To answer the question about the future shape of the regional income distribution, the relative income rankings based on the relative growth differentials among the provinces in the 1990s were projected to 2010. Chart 6 shows the kernel of the joint distribution of relative incomes in 1978 and that projected for 2010. As can be observed, the stratification into two peaks becomes more pronounced, underscoring the earlier conclusion about emerging club convergence.

C. Explaining Provincial Growth Dynamics

The analysis so far has not made a distinction of the kind between conditional and unconditional beta-convergence. Recall that the distinction was based on the notion that different provinces could be converging to different steady states, depending on the specific features of the economic structure and economic policies, and thus, converging at different rates. This section focuses on the question whether the growth dynamics and inferences made in the previous section, which were based only on the growth experiences of the provinces and thus unconditional in nature, are affected by economic structure and policies.

The methodology used to was the following:

- First, for each province "conditioned" growth rates for the periods 1979–89 and 1990–97 were constructed using the fraction of the growth rate explained by the variables—population growth rate; foreign direct investment-to-GDP ratio; domestic investment-to-GDP ratio; government revenue-to-expenditure ratio; M2-to-GDP ratio; share of SOEs in industrial production; and the coastal dummy—in the regression equations 4 and 6 in Table 3.[18]

- Second, residual growth rates were computed by subtracting the conditioned growth rates from the realized growth rates. Using these residual growth rates, conditioned relative incomes for 1989 and 1997 were computed.

- Third, based on the actual relative incomes in 1978, and the conditioned relative incomes in 1989 and 1997, kernels of the conditioned joint distribution of relative incomes between 1978–89, 1989–97, and 1978–97 were computed. These are depicted in Charts 7 and 8.

[18]Except for population growth, all the other variables were chosen on the basis of results in Dayal-Gulati and Husain (2000).

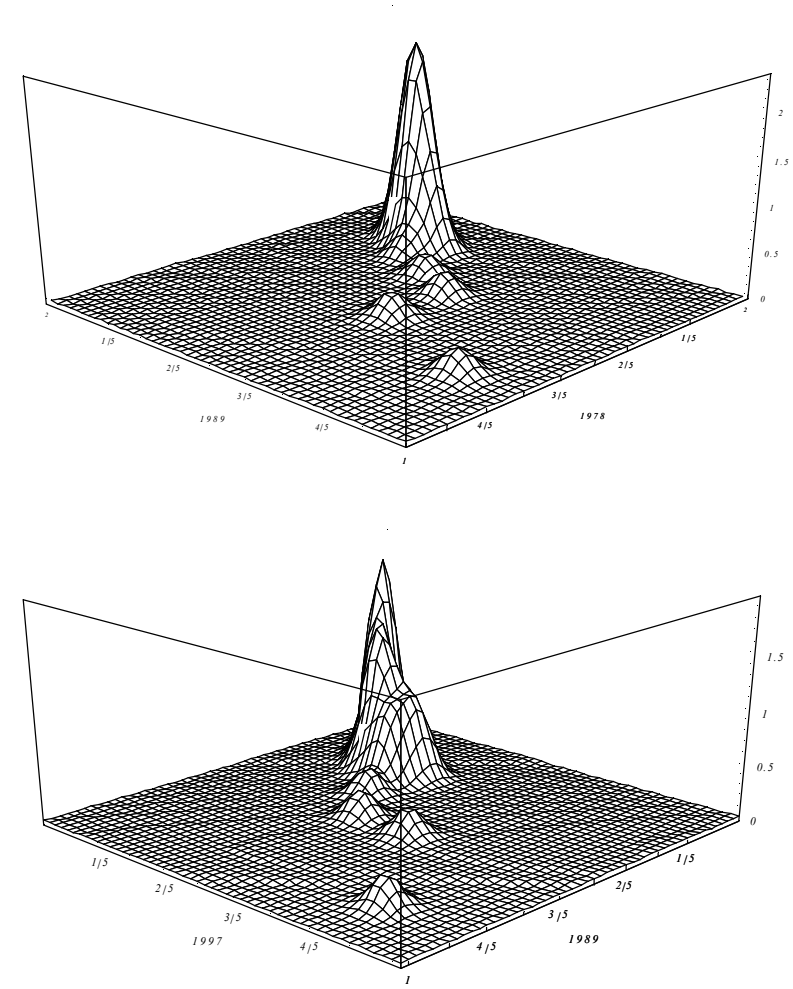
The noticeable feature of the conditioned distributions for 1978–89, 1989–97, and 1978–97 (Charts 7 and 8), is that they are all skewed to the right of the north-south diagonal. Comparing the conditioned joint distributions with the unconditioned ones (Charts 4 and 5), the following inferences can be drawn:

- For the period 1978–89, the skew in the unconditioned joint distribution is not very different from that in the conditioned distribution; thus, economic structure and policies had little influence on inter-regional convergence.

- However, for the period 1989–97, the conditioned distribution shows a more marked skew toward the right of the north-south diagonal than that in the unconditioned distribution. This underscores the strong presence of convergence forces after the influence of policies and economic structure has been filtered. Importantly, the coastal regions no longer show the previous strong shift to higher rankings. The absence of the marked shift was largely due to the strong explanatory power of the coastal dummy in the growth regression for the later reform period. As noted previously, the coastal dummy plays the role of a proxy for the external openness of the provinces, albeit a very weak one. This suggests that external trade was a strong factor behind the growth of the coastal provinces in the 1990s.

Chart 7. China: Conditioned Distribution Dynamics During the Early and Late Reform Periods

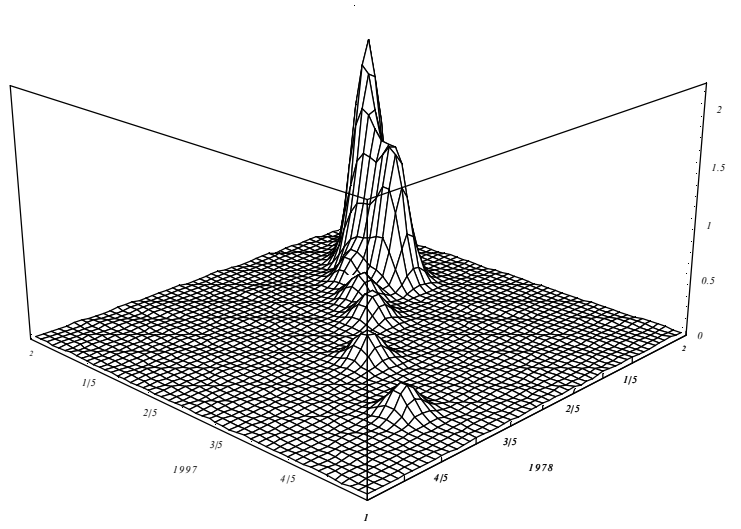
Gaussian kernel of the joint distribution of provincial relative income.
The area under the entire distribution is normalized to be 100.
The horizontal axes measure provincial per capita income as a fraction of Shanghai's per capita income,
while the vertical axis measures the relative frequency, in percent.



- For the period as a whole, the conditioned distribution shows an almost uniform tendency toward convergence. In contrast, the unconditioned distribution showed more complex dynamics, with an emerging tendency towards twin-peakedness. Consequently, it would appear that economic structure and policies of the provinces have played an important role in increasing stratification among China's provinces.[19]

Chart 8. China: Conditioned Distribution Dynamics During 1978-97

Gaussian kernel of the joint distribution of provincial relative income.
The area under the entire distribution is normalized to be 100.
The horizontal axes measure provincial per capita income as a fraction of Shanghai's per capita income, while the vertical axis measures the relative frequency, in percent.



The variation in economic performance across provinces has been a function of the timing, sequencing, and targeting of economic reforms and the associated structural shifts. Whereas China's pre–1978 development strategy emphasized balance and equity, this gave way to the pursuit in the 1980s of the objective of rapid growth based on gradual and incremental reforms.[20] This new strategy shifted the focus of state investment from the interior to the coastal regions and granted the latter preferential treatment. Beginning in 1980, the coastal region was opened up to foreign investment through the creation of special economic zones and open cities. Combined with this region's other advantages, such as a relatively high level of human capital and geographical location, this resulted in a sharp pickup in growth along China's southern coast. The resulting narrowing gap between southern coastal provinces and eastern coastal provinces served to reduce regional disparities during the 1980s. As the government's pro-coastal policy orientation strengthened further in the late 1980s, the interior provinces became increasingly cut-off and income disparities started to rise, causing the government to adjust its policies during the Eighth Five-Year Plan (1991–95), and to increase support to the less developed regions in the central and western parts of China (Ninth Five-Year Plan (1996–

[19]The major factors, however, are mainly structural since the coefficients of the structural variables in regressions 4 and 6 in Table 3 are statistically significant while those on the policy variables are not.

[20]During the Sixth Five-Year Plan (1981–85), a pro-coastal policy program was adopted, and this orientation became even more pronounced in the Seventh Five-Year Plan (1986–90).The idea was that reforms should be conducted on an experimental basis in certain regions first. If such experiments were successful, their influence would eventually spread to other regions (see Wang and Hu (1999)).

2000)). More recently, the government has redoubled its efforts to reduce regional disparities.

The northeastern provinces, including Liaoning and Heilongjiang, were initially the most affluent provinces,[21] reflecting large-scale investment in the industrial sector under central planning. As a result, on the eve of reforms, provinces with relatively large industrial sectors were the most affluent. However, the associated high concentration of SOEs in the eastern provinces subsequently became a drag on growth, with most of these provinces recording relatively low growth rates.

Apart from the selective opening up in the 1980s, the other major area of reform in the post–1978 period was in the agricultural sector. A shift in agricultural production from the commune system to the household responsibility system led to a rapid increase in agricultural productivity, benefiting per capita incomes in those provinces where agriculture was a relatively high share of provincial GDP (certain central and western provinces).[22] In addition, rural areas benefited from the emergence of township and village enterprises (TVEs), which operated outside of the central plan and absorbed excess labor from agriculture. These reforms—which took place for the most part between 1979 and 1985—resulted in relatively strong per capita income growth in those provinces where agriculture was the dominant sector and where there was a high concentration of TVEs, contributing to a reduction in regional income inequalities during the 1980s.

IV. Concluding Remarks

Conventional convergence studies, which use regression techniques to determine the existence of convergence, do not provide a complete answer to the question of whether poor provinces in China are catching up with richer provinces. A better approach is to examine the entire distribution of relative provincial incomes, as this sheds light on the intertemporal dynamics that lie behind China's development and growth experience. The distributional dynamics suggest that China's poor provinces are catching up with the rich. The catch-up, however, is occurring in a complex manner, with the gap between the coastal provinces and the initially rich provinces closing in relative terms. Moreover, the initially poor provinces, as well as the previously richer provinces, are both falling behind in relative terms (the latter at a faster pace). Thus, provinces in China appear to be clustering toward relative income clubs of their own, which is causing the distribution of relative incomes to become stratified into a bimodal distribution. An extrapolation of current growth trends to 2010 reveals an even more pronounced bimodal stratification. Finally, this chapter finds

[21]Excluding the even more affluent but largely metropolitan areas of Shanghai, Beijing, and Tianjin.

[22]The household responsibility system allowed peasant households to operate their own plots and to have greater freedom to choose which crops to plant.

that economic structure and policies have played an important role in bringing about increasing stratification among China's provinces.

China's prospective entry into the WTO could accelerate the process of stratification. The coastal provinces and, to a lesser extent, those provinces' immediate hinterland, could benefit from the expected growth in international trade. On the other hand, the relatively poor provinces, particularly those dependent on agriculture, could see a further slowdown in the growth of per capita incomes as prices for agricultural products fall. Moreover, the provinces with a heavy concentration of SOEs may see their former affluence erode even further as pressures mount to restructure the state enterprises.

As mentioned earlier, the Ninth Five-Year Plan (1996–2000) addressed regional disparities, and, since then, the Chinese authorities have intensified their efforts to narrow the income gaps among China's provinces. Indeed, developing the central and western region is a cornerstone of the Tenth Five-Year Plan (2001–05), and a "Develop the West" initiative has recently been launched. Under this plan, efforts are focused on infrastructural investment, technological upgrading, and training and education,[23] while emphasis is also being given to projects that protect and restore the environment. In addition, efforts are being made to equalize preferential tax policies between coastal and inland areas. With regard to the fiscal system more generally, while discretionary fiscal transfers have been used in the past to help offset large social safety net needs in poorer regions, concerns about regional disparities may necessitate a review of the entire system of intergovernmental fiscal relations at some point in the future.

[23]About two-thirds of the expenditure under the fiscal stimulus packages in 1998 and 1999 has been targeted at the central and western provinces.

V. REFERENCES

Barro, Robert and Xavier Sala-i-Martin, 1995, *Economic Growth*, McGraw-Hill, New York.

Baumol, William, 1986, "Productivity Growth, Convergence, and Welfare," *American Economic Review*, 76 (December), 1072-1085.

Cashin, Paul and Ratna Sahay, 1996, "Internal Migration, Center-State Grants, and Economic Growth in the States of India," *International Monetary Fund Staff Papers*, Vol. 43, No.1.

Chen, Jian and Belton M. Fleisher, 1996, "Regional Income Inequality and Economic Growth in China," *Journal of Comparative Economics,* 22, pp. 141-164.

Dayal-Gulati, A. and Aasim M. Husain, 2000, "Centripetal Forces in China's Economic Take-off," *IMF Working Paper* 00/86.

Durlauf, Steven N., and Danny T. Quah, 1998, "The New Empirics of Economic Growth", *Centre for Economic Performance Working Paper* No. 384, January.

Husain, Aasim M., 1998, "Economic Performance and Business Cycles in China's Provinces and Regions," in People's Republic of China—Selected Issues, International Monetary Fund, SM/98/184.

Jian, Tianlun, Jeffrey D. Sachs, and Andrew M. Warner, 1996, "Trends in Regional Inequality in China," *NBER Working Paper No. 5412* (Cambridge, Massachusetts: National Bureau of Economic Research, January).

Li, Hong, Zinan Liu, and Ivonia Rebelo, 1998, "Testing the Neoclassical Theory of Economic Growth: Evidence from Chinese Provinces," *Economics of Planning*, 31:117-132.

Mankiw, N.G., David Romer, and David Weil, 1992, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*, 107, 2 (May), pp. 407-437.

Quah, Danny, 1993, "Galton's Fallacy and Tests of the Convergence Hypothesis", *The Scandinavian Journal of Economics*, 95 (4), pp. 427-443, December.

Quah, Danny, 1997, "Empirics for Growth and Distribution: Polarization, Stratification, and Convergence Clubs", *Journal of Economic Growth*, 2 (1), pp. 27-59, March.

Raiser, Martin and Peter Nunnenkamp, 1997, "Die andere Seite Chinas—Strukturprobleme, Reformdefizite und verzögerte Aufholprozesse im chinesischen Binnenland," *Kiel Working Papers*, No. 794, Kiel Institute of World Economics.

Silverman, Bernard W., 1986, *Density Estimation for Statistics and Data Analysis*, Chapman and Hall, New York.

Wang, Shaoguang and Hu Angang, 1999, "The Political Economy of Uneven Development—The Case of China," M.E. Sharpe, Inc., New York.

VI. APPENDIX

Table 1. China: Real Per Capita GDP by Province Relative to Shanghai, 1978-97

	Province	1978		Province	1989		Province	1997
1	Shanghai	1.00	1	Shanghai	1.00	1	Shanghai	1.00
2	Beijing	0.70	2	Beijing	0.79	2	Beijing	0.69
3	Tianjin	0.57	3	Tianjin	0.57	3	Tianjin	0.53
4	Liaoning	0.41	4	Liaoning	0.46	4	Guangdong	0.41
5	Heilongjiang	0.35	5	Guangdong	0.35	5	Zhejiang	0.41
6	Qinghai	0.29	6	Heilongjiang	0.33	6	Jiangsu	0.37
7	Guangdong	0.23	7	Zhejiang	0.32	7	Liaoning	0.36
8	Jilin	0.22	8	Jiangsu	0.32	8	Fujian	0.35
9	Shanxi	0.22	9	Shandong	0.28	9	Shandong	0.31
10	Jiangsu	0.22	10	Xinjiang	0.28	10	Heilongjiang	0.25
11	Hebei	0.21	11	Jilin	0.27	11	Hebei	0.24
12	Shandong	0.21	12	Fujian	0.27	12	Jilin	0.23
13	Xinjiang	0.21	13	Qinghai	0.25	13	Hubei	0.22
14	Ningxia	0.21	14	Hubei	0.24	14	Xinjiang	0.22
15	Zhejiang	0.20	15	Shanxi	0.23	15	Shanxi	0.19
16	Hubei	0.19	16	Hebei	0.23	16	Inner Mongolia	0.18
17	Hunan	0.19	17	Ningxia	0.23	17	Anhui	0.17
18	Fujian	0.18	18	Inner Mongolia	0.22	18	Guangxi	0.17
19	Inner Mongolia	0.18	19	Shaanxi	0.20	19	Hunan	0.16
20	Guangxi	0.18	20	Yunnan	0.19	20	Qinghai	0.16
21	Gansu	0.16	21	Hunan	0.19	21	Henan	0.16
22	Yunnan	0.16	22	Anhui	0.18	22	Ningxia	0.16
23	Shaanxi	0.16	23	Henan	0.17	23	Jiangxi	0.16
24	Sichuan	0.15	24	Sichuan	0.17	24	Yunnan	0.15
25	Anhui	0.15	25	Gansu	0.17	25	Sichuan	0.15
26	Jiangxi	0.15	26	Jiangxi	0.17	26	Shaanxi	0.14
27	Henan	0.14	27	Guangxi	0.16	27	Gansu	0.13
28	Guizhou	0.11	28	Guizhou	0.13	28	Guizhou	0.09

Source: National Bureau of Statistics.
Note: Hainan and Tibet Autonomous Region were excluded since data on per capita income are not available before 1985. Data for Chongqing, which became a municipality in 1997, are included in the data for Sichuan.