Effects of Intraregional Disparities on Regional Development in China:

Inequality Decomposition and Panel-Data Analysis

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ABSTRACT

This paper analyzes the development and effects of intra-provincial regional disparities in China between 1989 and 2001. A decomposition analysis shows that intra-provincial disparities contribute significantly to total regional inequality. In the second part of the paper, the impact of the observed intra-provincial disparities on regional economic development is addressed. Using provincial panel data on industrial growth, capital and employment, the impact of inequality on industrial growth is estimated as affecting technical efficiency and level of technology. The results show a significant positive effect of intra-provincial disparities on provincial industrial growth, with causality from inequality to growth. Moreover, it appears that the inequality-growth relationship is not a linear one, but rather that the impact of extreme changes in inequality is stronger and more significant than a moderate increase in inequality. These outcomes are robust to alternative model specifications and control variables.

Keywords: Inequality, Decomposition, Growth, Panel Data, China

JEL-Codes: O11, O15, O40, O53, R11

June 23, 2004

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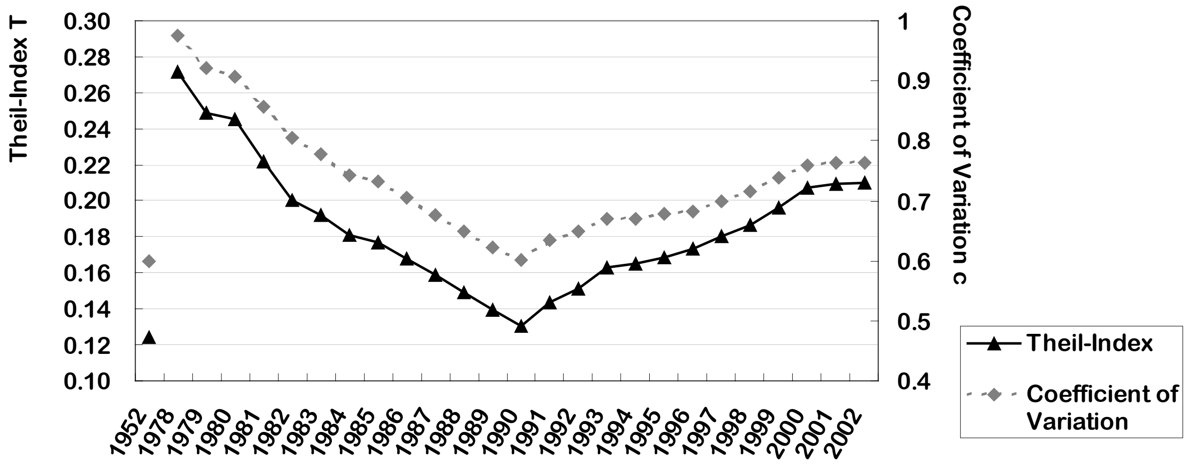
I. Introduction

Income disparities in transitional China are a multi-faceted, multi-dimensional phenomenon. They appear between geographical regions, between rural and urban areas, between industries, between ownership forms, and even between people who share all these characteristics. They can be measured, for example, on the national, macro-regional, provincial, prefectural, and household level. It is broadly acknowledged that income disparities for all measures in transitional China decreased in the early era of reform (1978 – mid 1980s), but steadily increased afterwards (see figure 1).

Figure 1 Trend of Inequality in China, 1978 – 2002



Note: Regional income disparities measured on the provincial level.
Source: Data from NBS 1999a; NBS CSY 1999 – 2003, own calculations.

Frequent public and political statements and reports denouncing income disparities in China suggest that the problem already has reached a critical stage. Accordingly, voluminous research on the topic finds alarming levels of disparities. Among all forms of inequality in China, urban-rural disparities are reported to be the biggest contributor; regional disparities are identified to be responsible for a smaller but growing portion of inequality.[1]

No matter how well analyzed *inter*regional disparities in China are, our current knowledge on the extent and effects of *intra*regional inequality is extremely limited. Selective measurement is provided in studies by Khan et al. (1993), Khan and Riskin (2001), Tsui (1993, 1998a, 1998b), Hermann-Pillath, Kirchner and Pan (2002), Gustafsson and Li (2002), Akita (2000, 2001, 2003) and Song, Chu and Chao (2000). The common understanding is that intraregional disparities make a large proportion of total regional disparities. Khan et al. (1993: 66), for example, argue that "a careful analysis of regional differences in sources of inequality could be of much help in devising policies for improving income distribution." Therefore, the first objective of this paper is to provide a systematic measurement of the regional component of intraregional disparities in China over time and geographic space.

But how serious are the observed disparities? Only measurement exercises are not able to give a reasonable answer to that question. On the one hand, a difference in expected incomes – or the incentive to achieve a significantly different income from other people – is one of the most powerful driving forces of a market-coordination based economy. On the other hand, excessive inequality is supposed to have detrimental impacts on incentives, growth, and development. To answer this second question, the last part of the paper applies a simple growth model incorporating inequality to panel data on the industrial development of the Chinese provinces.

II. Intra-Provincial Inequalities in China

II. 1. Background and Previous Studies

Although voluminous literature on interregional inequalities in China exists, analyses of the pattern of intraregional disparities are - as mentioned above – in short supply. The main reason for this could be the high level of aggregation used in most studies about the subject, which focus on disparities between macro-regions using province level data.

Hermann-Pillath, Kirchert and Pan (2002) analyze how the choice of different levels of aggregation is in the context of analyzing regional inequality in China. Using prefecture level data on economic development for 1993 and 1998, they find the common three-belt approach overly aggregated and inconsistent considering the internal economic structure of the belts. They recommend using provinces as appropriate units for understanding growth and development dynamics. However, they also note the strong disparities between prefectures as well as the continuing importance of the rural-urban gap.[2] On the other hand, Knight and Song (1993) as well as Peng (1999) argue that counties should be the appropriate unit of analysis, "because every county behaves like a little kingdom.".[3] By using cities as basic units for inequality decomposition, but provinces as basic units for analysis the growth impacts of disparities, this paper tries to combine both arguments.

Only a few studies go so far as to disaggregate the data and venture into the analysis of regional disparities or economic development on a sub-provincial level. In the following paragraphs, some major studies that nevertheless did so are introduced and discussed. In general, these studies attempt to measure disparities between regions in China either as regional differences in growth or by calculating direct inequality measures. As data, either regionally aggregated data (for cities or counties) or household income survey data has been used.

Wei (1993) and later Wei and Wu (2001) use city-level data to analyze the growth impact of foreign trade and investment on regional economies. While the first study suffers from a short time period and a very limited sample, the latter is able to establish a strong negative correlation between economic openness and urban-rural disparities.[4] From their results, less intra-provincial inequality should be expected in the coastal areas, with highest disparities in the Northwestern regions.

The data set analyzed in Wei and Wu (2001)[5] is very similar to that used here. However, this paper is able to utilize more actual data, up to 2001. Moreover, Wei and Wu (2001, pp. 9, 25) focus on large cities (prefecture- and province-level) that also administer adjacent rural counties, and include data on rural areas; while I restrict my analysis to the urban data so as to obtain a more consistent sample. Occasionally however, I also include county level cities. These different data boundaries are reasonable considering the differing objectives of these papers: urban-rural comparison on the one hand and cross-provincial comparison over time on the other. In this paper, I assume cities to be the economic gravity centers of their regions, thus representing the surrounding regional economies as well. Including adjacent rural counties would create new sources of differences between cities depending on the relative importance of those rural areas in the city economy, because the strong rural-urban bias would be introduced into the data.

Khan et al. (1993) and Khan and Riskin (2001) use data from the 1988 and 1995 Household Sample Survey,[6] respectively, to calculate rural and urban Gini ratios for Chinese provinces. Their results show that the variability of intraregional inequality is greater for 1995 than for 1988, and inequality levels increased in almost all of the regions, often very drastically. In both papers, it is repeatedly stressed that no simple source can be identified to explain the pattern of regional inequality.[7] For example, surprisingly, neither rural and urban inequality nor rural and urban incomes appeared to be significantly rank-correlated.[8] Therefore, differences in the composition of regional incomes by income source are analyzed, and similar income components are found to cause the interregional inequality to diverge as those observed to affect the national average: the wage income share in rural regions, and (disequalizing) subsidies in urban areas.

Gustafsson and Li (2002) utilize the same household survey data sets to directly address the question: how much income inequality can be measured within and across rural counties? Their explicit approach of decomposing and comparing the regional components of inequality come very close to the objective which this paper pursues. The authors conclude that most of income inequality in rural China has been spatial; however, inter-province and – especially – inter-belt disparities were more important than disparities between rural counties within provinces.[9]

Akita (2000; 2001; 2003) applies an analogical decomposition approach, calling it a nested decomposition analysis, for the cases of Indonesia and China. For China, he decomposes sub-provincial data for 1997, and reports that almost two-thirds of the overall inequality is due to within-province disparities. Similar results have also been reported by Tsui (1993) for county and city data in 1982, and Tsui (1998a, 1998b) for rural household survey data for the provinces Sichuan and Guangdong (1985 – 1990), where he finds only a very tiny share of overall inequality to be explained inter-provincially.[10]

Finally, Song, Chu and Cao (2000) examine economic disparities between and within regions in China using city-level data from 1985 (106 cities, Survey of Income and Expenditure of Urban Households) and 1991 (477 cities, China Urban Statistics Yearbook 1992). The results lead Song, Chu and Cao (2000, pp. 259, 252f.) to conclude that - within the widening regional inequality - large but similar intraregional disparities within the eastern, central and western regions exist. However, several serious limitations of their analysis invalidate their conclusions.[11]

Compared with the papers mentioned above, the first contribution of this study is to describe the development of different components of inequality – in absolute as well as in relative terms – over time, using a broadly consistent data set on the city level. The decomposition methodology applied is similar to that of Akita (2000, 2001, 2003) or Gustafsson and Li (2002), and the data used is roughly comparable with that used by Wei and Wu (2001). However, the approach is extended to include the sectoral division of city level data as well, and spans over a longer and more recent time period.

II. 2. Measurement Issues and Data

II. 2.1. The choice of an inequality measure

Various indicators can be used in the analysis of income disparities.[12] Although there is no consensus in the literature on which inequality measure is the most preferable, appropriate indicators could be chosen considering two main evaluation criteria:

- consistency with distributional and welfare axioms;
- practicability considerations.

(i) The most common way to judge the applicability of inequality measures is by comparing their behavior with some *axioms* theoretically derived as preferable properties of such measures. The main issue addressed by this approach is the reasonability of the ordering criterion; which is necessary for any meaningful inequality comparison (see Fields and Fei 1978: 315).

Several systems of axioms have been proposed, differing widely in the number and strength of their required axioms. Usually they include:[13]

- anonymity (no personal characteristics other than the income determine the ordering principle),
- scale independence or income homogeneity (multiplying all incomes with the same positive scalar does not change inequality),

- population independence or population homogeneity (replicating each income an integral number of times does not change inequality),
- the transfer principle or Pigou-Dalton condition (transfers from a richer to a poorer person do reduce the measured inequality).

Surprisingly, only a few measures can satisfy the commonly accepted axioms. These include the coefficient of variation, the Gini coefficient, the Atkinson class of measures, and finally the generalized entropy family of measures, with the Theil index as the most prominent example.[14]

(ii) Given an inequality measure fulfils the above stated axiomatic general conditions, a final choice of the appropriate measure can be made considering the practicability of each measure in the specific context. This relates not only to problems like data availability and complexity of calculation, but also to additional properties that an inequality measure can offer, and depends mainly on the specific purpose for which the measure is calculated. In this paper, the importance of sub-provincial regional inequality shall be assessed; therefore an important property of an appropriate inequality measure would be its decomposability.[15]

In the context of decomposability, two types of decomposition are addressed: decomposition by subgroups (e.g. regions, population subgroups, etc.) and by income source (e.g. income from wages, property, subsidies, etc.).[16] In this paper, decomposition into subgroup components is intended. For this purpose, a desirable measure requires two decomposition properties:[17]
- subgroup consistency (which means the positive responsiveness of the overall inequality measure to changes in the inequality levels of constituent groups, see Sen 1997, p. 157) as a minimum requirement; and
- additive decomposability (overall inequality is the sum of all between-groups and within-groups inequality) as an additional restriction.

These two properties together are only satisfied by the Theil index and the MLD index.[18] Therefore, one of these measures will be applied in the following decomposition analysis.

The Gini coefficient is not decomposable in the sense of subgroup consistency; a decomposition of the index will produce an additional interaction term as long as the subgroups are overlapping,[19] as is the case with regional incomes. However, given the wide popularity and the otherwise favorable properties of the Gini index, it will be supplied as a measure for total inequality and cross-regional inequality comparisons.

II. 2.2. Data Sources and Selection

In this study, inter- and intraregional disparities are reviewed by analyzing a sample of 215 cities over a 13 year period from 1989 to 2001. The data used in this article is mainly taken from "Fifty Years of Cities in New China" published by the National Bureau of Statistics of China (1999b), a collection of historic data on the city level, mainly based on data from the various issues of the Urban Statistical Yearbooks. The time series data reported in this source cover the period from 1990 till 1998. I also used the Urban Statistics Yearbooks for additional data (volumes 1990, 2000, 2001 and 2002) and for the crosschecking and verification purposes (various issues).

Generally, the number of cities in China increases over time. While for 1991, there were only data for 479 cities reported in the Urban Statistics Yearbook, this number had risen to 662 cities in 2001.[20] This increase is mainly due to the upgrading of many county-seat towns into county-seat cities.[21] Given the broad and varying coverage of cities within these publications, I had to limit the sample to a consistent set of cities to ensure comparability. Therefore, only cities for which all necessary information was available across the entire period were included. Exceptions were only made in cases where formerly independent cities merged or where simply name changes occurred, as far as these changes became obvious from the data sources. This data selection reduces the total number of observations to only 215 (compared with 662 available observations in 2001).

Nevertheless, even with this cautious and prudent data selection, minor inconsistencies may occur, since some of the time series for identical locations do show relatively high volatility, especially the case of population data, and may point to significant changes in the size of jurisdictions or the inner-provincial organization of administration, regardless of identity in names.

The main data taken from these sources includes:
- population data: year-end population (nianmo zong renkou); and annual average population (nian pingyue renkou, only for 1989; all other values calculated as average between two consecutive years);
- income data: GDP (guonei shengchan zongzhi) and values/percentages for secondary, tertiary sector;
- employment data: year-end total employment (nianmo quanbu congye renyuansu), and percentages for secondary and tertiary sectors.[22]

For decomposition purposes, provinces are grouped into three macro-regions following the common classification:[23]
- Coastal: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, Hainan;
- Central: Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan;
- Western: Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

Of these, Beijing, Tianjin, Shanghai and the province Qinghai are excluded from the analysis due to non-available data for the sub-provincial level, and Chongqing and Tibet due to missing data.

II. 3. Methodology

For the above described data set, I calculated Gini coefficients and Theil Indices, decomposing the latter into three regional components of inequality: inequality between macro-regions, inequality within macro-regions between provinces, and inequality within provinces. The following section presents the definition of applied measures.

II. 3.1 Overall Inequality Measures:

For measuring aggregate inequality, two measures will be applied: the Gini coefficient and the generalized entropy measure in form of the Theil index.

Following Sen (1997), the Gini index G is often defined as:[24]

$$(1) \qquad G = \frac{1}{2n^2 \mu_y} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|$$

with

G = Gini coefficient, n = number of individuals,

μ_y = average income (mean), y_i = income of person i , y_j = income of person j

This formula, however, is designed for individual data. Because the data under consideration here is grouped and, moreover, the partition is not equal, the following formula will be used for calculating the Gini for grouped data:[25]

$$(2) \qquad G = \sum_{i=1}^{n-1} \left(\frac{N_i}{N} \right) * \left(\frac{Y_{i+1}}{Y} \right) - \sum_{i=1}^{n-1} \left(\frac{N_{i+1}}{N} \right) * \left(\frac{Y_i}{Y} \right)$$

with

n = number of groups, N_i = cumulative population,

N = total population, Y_i = cumulative income , and Y = total income.

The generalized entropy class of inequality measures as second indicator is defined as:[26]

$$(3) \qquad I_\alpha = \frac{1}{\alpha(1-\alpha)} \frac{1}{n} \sum_{i=1}^{n} \left[1 - \left(\frac{y_i}{\mu_y} \right) \right]$$

for all $0 < \alpha < 1$; and with $\alpha = 1$ as the Theil Index T:

$$(4) \qquad T = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\mu_y} \ln \left(\frac{y_i}{\mu_y} \right)$$

For grouped data, a typical way of writing the Theil-Index T is:[27]

$$(5) \qquad T = \sum_i \sum_j \left(\frac{Y_{ij}}{Y} \right) \ln \left(\frac{Y_{ij} / Y}{n_{ij} / N} \right)$$

with

Y_{ij} = total income of the i-j group,
n_{ij} = absolute frequency of population in the i-j group; and

$Y = \sum_i \sum_j Y_{ij}$ as total income over all groups, and $N = \sum_i \sum_j n_{ij}$ as total population.

This Theil index compares the relative income share of each group (Y_{ij}/Y) with its relative share in the total population (n_{ij}/N).

Both indicators will take values between zero and one for perfect equality or concentration of income respectively. Since both indicators satisfy the distributional axioms described above, their results should not differ with regard to the ordering alternative distributions from the same data set. They differ, however, in the weight they attach to a specific income in this distribution, and therefore in their cardinal measurement of inequality. For the Theil index, sensitivity for transfers in different income classes is defined by the parameter $\alpha = 1$; which implies a relative overweighting of lower income groups. In inequality analysis, this statistical property is often regarded as positive, since similar income transfers are considered to matter more for personal utility in the lower end of the distribution. The sensitivity of the Gini coefficient depends on the relative position of the individual in comparison to other individuals (so-called irrelevant alternatives). Therefore, if more people are in the lower end of the income distribution – as is usually the case – these lower incomes will get a stronger weight.

Another possible difference between the indicators is their sensitivity on differing sample sizes. Khan and Riskin (2001, p. 163) claim that the Theil index is very sensitive to the sample size. To reduce the problems arising from this property, the number of observations has been held constant over time; however, obvisously, a direct comparison between groups is complicated.

II. 3.2 Decomposition Analysis

a) Basic Concept

The Theil index defined above can easily be decomposed into within and between group components for different groups of income receivers, or – as in this case – regions. The common formula for this decomposition is

$$(6) \qquad T = T_B + T_W = \left[\sum_i \left(\frac{Y_i}{Y}\right) \ln\left(\frac{Y_i / Y}{n_i / N}\right)\right] + \left[\sum_i \left(\frac{Y_i}{Y}\right) T_i\right]$$

with

$Y_i = \sum_j Y_{ij}$ as the total income of the i[th] group, $n_i = \sum_j n_{ij}$ as the absolute frequency of population in i[th] group, and $T_i = \sum_j \left(\frac{Y_{ij}}{Y_i}\right) \ln\left(\frac{Y_{ij} / Y_i}{n_{ij} / n_i}\right)$ as the Theil-Index for the i[th] group.

In this paper, I go one step further by decomposing the within group inequality. Two ways of decomposing the Theil index for intraregional inequality will be applied; one could call them vertical and horizontal decomposition, depending on whether groups are defined exclusively according to different administrative levels (national, belts, provinces, cities), or whether groups within the same administrative level are defined according to additional characteristics (e.g. a sectoral division).

b) Vertical Decomposition of Intraregional Inequality

First, intercity inequality will be decomposed vertically, distinguishing between three subsequent levels of disaggregation:
- macro-regions (the coastal, central and western regions);
- provinces and province level municipalities as subgroups of these macro-regions; and
- cities as basic units of which the provinces are composed.

Such nested inequality decomposition into three components exceeds the common decomposition analysis using Theil indices into inequality between and within provinces.[28] It therefore shows disparities below the aggregated provincial level, and at the same time allows a comparison of the importance of each inequality component within the big picture.

For this purpose, the Theil index describing total inequality is redefined as:

$$(7) \qquad T = \sum_h \sum_i \sum_j \left(\frac{Y_{hij}}{Y}\right) \ln\left(\frac{Y_{hij} / Y}{n_{hij} / N}\right)$$

with

Y_{hij} and n_{hij} as total income (GDP) and absolute population of city j in province i in macro-region h, $Y = \sum_h \sum_i \sum_j Y_{hij}$ = total income of cities, and $N = \sum_h \sum_i \sum_j n_{hij}$ = total population of all cities.

Since each lower-level grouping is only a further division of the previous groups, this expression is equal to the direct calculation of total inequality using the smallest available division (which is the city level), as Theil-Index over all cities k (k = i*j*k = 215):

(8) $$T = \sum_k \left[\frac{Y_k}{Y} \log\left(\frac{Y_k / Y}{n_k / N} \right) \right]$$

with Y_k = total income in city k; and n_k = absolute population in city k.

Overall inequality then can be decomposed into its regional components as follows:

(9) $$T = T_B + T_P + T_C = \left[\sum_h \left(\frac{Y_h}{Y} \right) \ln\left(\frac{Y_h / Y}{n_h / N} \right) \right] + \left[\sum_h \left(\frac{Y_h}{Y} \right) T_h \right] + \left[\sum_h \sum_i \left(\frac{Y_{hi}}{Y} \right) T_{hi} \right] ,$$

with

T_B = Component of the Theil-Index for inequality between macro-regions,

T_P = Component of the Theil-Index for inequality between provinces in macro-regions,

T_C = Component of the Theil-Index for inequality between cities within provinces,

$T_h = \sum_i \left(\frac{Y_{hi}}{Y_h} \right) \ln\left(\frac{Y_{hi} / Y_h}{n_{hi} / n_h} \right)$ = Inequality between the provinces within each macro-region,

$T_{hi} = \sum_j \left(\frac{Y_{hij}}{Y_{hi}} \right) \ln\left(\frac{Y_{hij} / Y_{hi}}{n_{hij} / n_{hi}} \right)$ = Inequality between cities within province i in region h,

$Y_h = \sum_i \sum_j Y_{hij}$ = total income of region h, $n_h = \sum_i \sum_j n_{hij}$ = total population of region h,

$Y_{hi} = \sum_j Y_{hij}$ = total income of province i in macro-region h,

$n_{hi} = \sum_j n_{hij}$ = total population of province i in macro-region h, and Y_{hij} and n_{hij} as above.

c) Horizontal Decomposition of Intraregional Inequality

In the second step, I address more specifically the nature of disparities within provinces. Therefore, I am going to ask whether it is appropriate to focus the analysis on regional differences between sub-units (in this case: cities) of a province, or whether the real break within provinces rather exists between alternative groups, e. g. urban and rural areas, or different sectors of the local economy. To do so, I will decompose intra-provincial income disparities into income differences between sectors and income differences between cities (or more exactly; between sectors on the provincial level, and within sectors but between cities).

Applying the tripartition into the primary, secondary and tertiary sectors,[29] this classification embraces not only the division between rural (represented mainly by the primary sector) and urban economic activities, but also differences between economic sectors per se. However, this division of urban-rural by sectors is not common in the literature, which usually defines rural and urban activities by geographic areas. Nevertheless, in contemporary China, the so-called *rural* vicinities of large coastal cities might easily appear to be much more urban in the common sense than minor cities in, e.g., the hinterland of the western province of Sichuan; making the previous distinction between rural and urban areas misleading. Moreover, since the data used in this study focuses on urban areas specifically, I prefer the division along economic activities rather than according to an arbitrary rural-urban classification.

Since the derivation of the decomposition formula is similar to the previous case, only the final version is presented below. It is identical down to the provincial level, but redefines the intra-provincial inequality as sum of inter-sectoral inequality T_S and intra-sectoral but inter-city inequality T_{SC}. For this purpose, the new smallest unit of disaggregation becomes the sector within each city (which also leads to a change in the subscript). Another difference is that because population data is not available according to this sectoral division, employment data is used instead. Finally, since this level of disaggregation was not available for all years consistently over all cities in the sample, the time span reduces to the period from 1990 to 1997, and the total number of cities in the sample to 212.

Thus the second decomposition formula becomes:

(10) $$T = T_B + T_P + T_S + T_{SC}$$
$$= \left[\sum_h \left(\frac{Y_h}{Y}\right) \ln\left(\frac{Y_h/Y}{m_h/M}\right)\right] + \left[\sum_h \left(\frac{Y_h}{Y}\right) T_h\right] + \left[\sum_h \sum_u \left(\frac{Y_{hu}}{Y}\right) T_{hu}\right] + \left[\sum_h \sum_u \sum_v \left(\frac{Y_{huv}}{Y}\right) T_{huv}\right]$$

with

T_B = Component of the Theil-Index for inequality in GDP per employee between macro-regions,
T_P = Component of the Theil-Index for inequality between provinces in macro-regions,
T_S = Component of the Theil-Index for inequality between sectors within provinces,
T_{SC} = Component of the Theil-Index for inequality between city sectors within provinces,

$T_h = \sum_u \left(\frac{Y_{hu}}{Y_h}\right) \ln\left(\frac{Y_{hu}/Y_h}{m_{hu}/m_h}\right)$ = 'GDP per employee'-inequality between u provinces within region h,

$T_{hu} = \sum_v \left(\frac{Y_{huv}}{Y_{hu}}\right) \ln\left(\frac{Y_{huv}/Y_{hu}}{m_{huv}/m_{hu}}\right)$ = Inequality between v sectors within province u in region h,

$T_{huv} = \sum_w \left(\frac{Y_{huvw}}{Y_{huv}}\right) \ln\left(\frac{Y_{huvw}/Y_{huv}}{m_{huvw}/m_{huv}}\right)$ = Inequality between w cities within sector v,

$M = \sum_h m_h = \sum_h \sum_u m_{hu} = \sum_h \sum_u \sum_v m_{huv} = \sum_h \sum_u \sum_v \sum_w m_{huvw}$ = total employment in all cities,

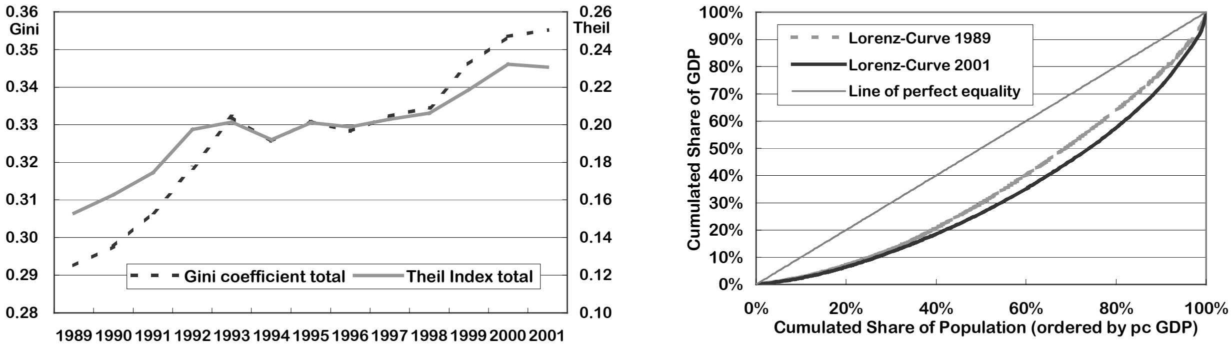
m_{hu}, Y_{hu} as total employment and income in province u in region h,
m_{huv}, Y_{huv} as sectoral employment and income in sector v in province u in region h,
m_{huvw}, Y_{huvw} as sectoral employment and income in city w and sector v in province u in region h,
m_h = total employment in region h; and Y_h and Y defined as before.

II. 4. Decomposition Results and Interpretation

a) Overall Inequality

As a first result, the following graph shows the development of total inequality for the specific sample on the city level as described by Gini coefficient and Theil index. As expected, a steady increase over the analyzed time span is observed by both measures. However, during the middle of the 1990s, they remain relatively constant; a characteristic that was not detected by the province level data in figure 1.

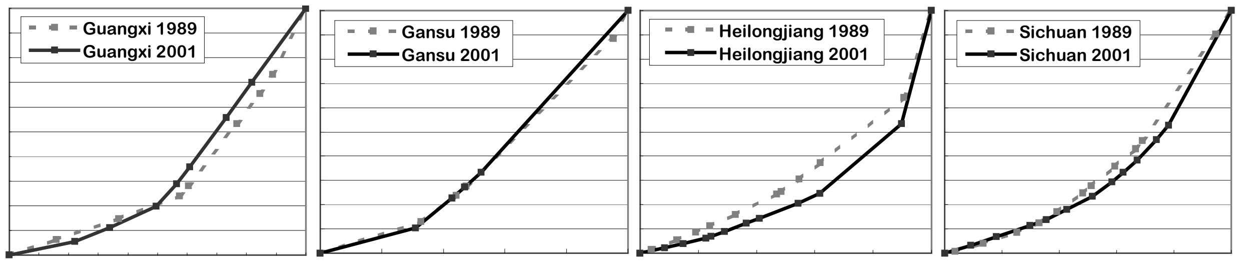
Figure 2 Overall Income Disparities on the City Level



To get a better impression of how to interpret these changes in inequality, the second graph visualizes the distributive changes in the form of two Lorenz-curves. The second curve, describing income distribution in 2001, lies constantly below the curve of 1989; corresponding to a generally more unequal distribution of regional incomes. However, the distance to the original curve is especially large in the right part of the diagram, which shows the income share of richer regions. Therefore, we can conclude that income distribution did worsen especially at the upper end of the distribution. On this very high level of aggregation, regional income disparities in China appear as a problem of extreme wealth rather than of extreme poverty.

This fact might lead to the conclusion that the current focus on poverty reduction in development economics might not be the appropriate measure for China. Should China concentrate more on linking the extreme rich cities with the rest of the country, instead of financing poverty reduction programs? The graph, however, depicts only a national average. Consequently, when looking at the local level, a much more diverse picture evolves, as depicted in figure 3. Here, the Lorenz curves for two richer and larger (Heilongjiang, Sichuan) and two smaller and poorer provinces (Guangxi, Gansu) are graphed.

Figure 3 Provincial Lorenz Curves



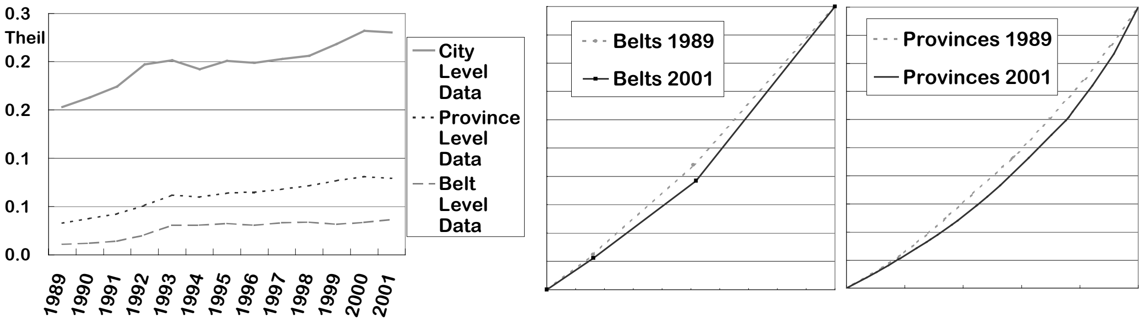
The picture shows that, while in the richer provinces disparities clearly did widen in the upper part of income distribution, the opposite was true in the poorer provinces; in both Gansu and Guangxi disparities in richer incomes were actually even reduced, as the intersecting Lorenz curves depict. The increased inequality in the poorer income groups in poorer provinces points to the development of poverty pockets in these provinces. Naturally, the increase in these poor and densely populated areas is outmatched when aggregated with the rich and large provinces. Thus, the above stated an interpretation has to be regarded with caution.[30] Both, a better integration of extremely rich cities with the rest of their province, as well as the fight against poverty in backward poverty locks are important policy measures that have to be taken seriously.

The facts unraveled above do clearly show the importance of incorporating lower level aggregation into the analysis. However, considering these results, what additional insight has been achieved on the aggregate level by using city level data instead of province-level or even macro-level data? To show the differences in results, figure 4 compares Theil indices that result from using cities as basic unit with those derived from provincial or belt-level aggregation.

Besides representing much lower absolute values of inequality – already due to the exclusion of inequality within sub-units and smaller sample size – the higher-level aggregation hides much of the fluctuations in the data. To take one example, the local minimum in 1994 can hardly be identified using aggregated data. One possible explanation might be a surprising one: As in the beginning of reforms, when rapid growth was accompanied by decreasing inequalities, so might the economic boom following Deng Xiaoping's 1992 Southern Journey have had inequality reducing effects, possibly due to a smoother dispersion of growth from until-then isolated growth poles. If periods with accelerated liberalization and less state intervention turn out to reduce regional disparities in China, aren't these disparities then maybe rather policy induced than a result of the transformation process?

Another way of analyzing the differences is by comparing the corresponding Lorenz-curves, which also are presented below. As before, they show the 2001 curve consistently below the 1989 base line, indicating a higher level of inequality throughout all income levels. However, the stronger increase in the upper end of the income distribution is almost not noticeable.

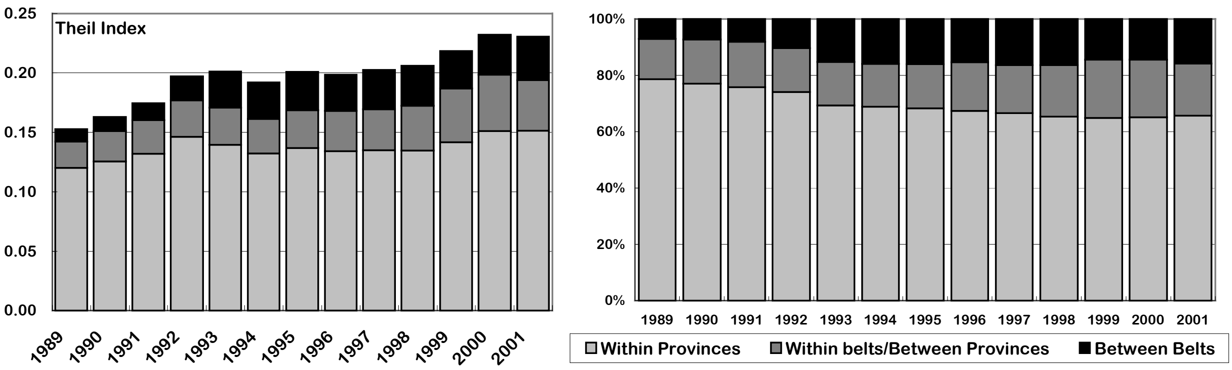
Figure 4 Disparities on Different Levels of Aggregation



b) Vertical Inequality Decomposition

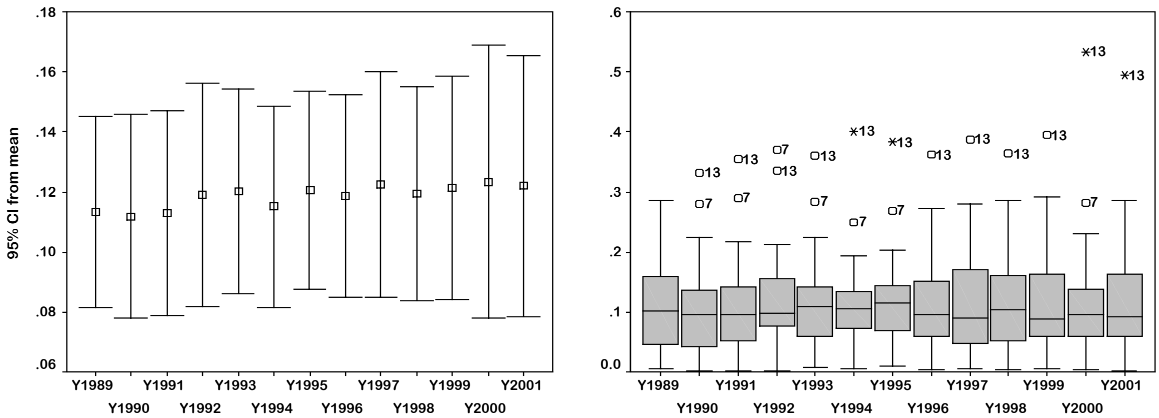
As a next step, overall inequality shall be decomposed into its regional components, applying the methodology described above. The results are graphed in figure 5. This figure shows that the largest share in regional inequality – almost 60 percent - can be attributed to intra-provincial disparities. However, although the absolute value of disparities on the lower level still increased throughout the 1990s, its relative importance declined. Nevertheless, in the last two years its share has stabilized on a high level. Interestingly, except for a steep increase in the beginning of the 1990s, a rise in the relative importance of inter-belt disparities – as often reported - is not supported by the data.

Figure 5 Vertical Decomposition of Theil Index



Given the immense importance of intra-provincial disparities, how much do they vary across China? Or, on the other hand, are they a common phenomenon? In the following, the decomposition results derived above are analyzed further to answer these questions. Therefore, the main measures for location and dispersion of the provincial data on intraregional inequality – mean, standard deviation, etc. - are calculated (left graph). They reveal a steady increase in the average value as well as in the spread of intra-regional disparities between provinces throughout the 1990s.

Figure 6 Measures of Central Tendency and Dispersion of Intra-Provincial Disparities



Note: 13 = Heilongjiang; 7 = Guangdong

To visualize the results, the error bar and boxplot diagrams are shown in the above figure. The first graph depicts the range of the 95 percent confidence interval for the mean of intraprovincial Theil indices. In this diagram, the rising and dispersing trend of intraregional inequalities is apparent. The second graph presents the median and interquartile range. These are not sensitive to extreme values, thus allowing the identification of outliers and extrema.[31] Thus it becomes obvious that much of the increase in the means and variations of intraregional disparities between provinces is due to outliers and extreme cases in the upper part of the distribution; notably Heilongjiang and Guangdong. This reconfirms one of the earlier results of the analysis: Disparities in China are mainly a problem of differences in the incomes of the rich, rather than a result of extreme poverty. However, the different sources of intra-provincial disparities, as identified before, become not apparent from the graph.

Combining the results of the previous analysis, a rather surprising result appears: Although intraregional inequality in China seems to be on the rise when measured by the mean (a result that many studies on the subject share), the rising trend in inequality largely disappears when outliers are accounted for (e.g. by using measures that are insensitive to outliers like the median). Thus, apart from some very prominent examples, intraregional disparities seem to be rather stable over time. As a first result, the claim of strongly rising inequality in recent years cannot be verified generally.

Nevertheless, a widening spread between relatively equal and relatively unequal provinces is identified by both kinds of measures. Moreover, the extreme increase in inequality in some rich provinces can partly be contrasted with the development in poorer provinces. As seen by comparing provincial Lorenz curves, the trend in these provinces is driven by different forces. While in the richer provinces, the uneven growth of a few economic centers disequalizes the income distribution in its upper part, poorer provinces experienced the development of some poverty locks while generally becoming more equal in their richer regions. Considering the development of disparities over time, one might suspect that disintegrating policy measures are an important factor in causing intraregional disparities in the richer provinces, while disparities in poorer provinces – usually unnoticed in the aggregated data – might rather be influenced by geographic backwardness.

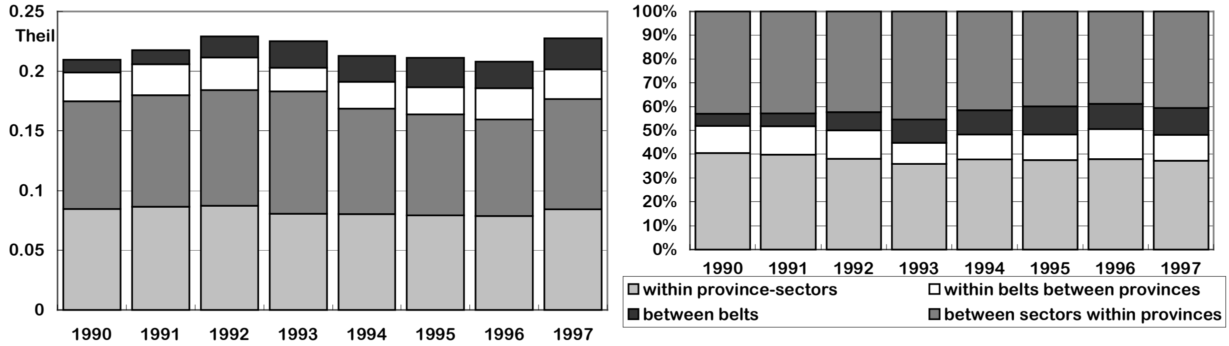
c) Horizontal Inequality Decomposition

Until now, the analysis entirely focused on *unpacking* the aggregated regional data into smaller regional divisions. However, it has been argued that within provinces, characteristics other than location are more important in determining incomes. Especially the division of economic activities into rural and urban is commonly regarded as an important factor. Given these arguments, is it really appropriate to compare sub-provincial jurisdictions to explain intraregional disparities?

To reply to this possible objection, another way of decomposing a less aggregated set of income data is applied. Taking the primary, secondary and tertiary sectors of each city in the sample as the basic units, the contribution of sectoral and locational characteristics in determining intra-provincial disparities are separated. As explained earlier, the sectoral division used here is expected to address not only economic activities, but also to be a proxy for the rural-urban divide within one region. Due to data availability, the time span analyzed is much shorter now and covers only the years 1990 – 1997.

Since the data set used now differs in level of aggregation, sample size and definition of the population variable (year-end employment instead of average population), the following figure shows the new results of the overall inequality measurement and its decomposition. Note that the overall Theil index now is divided into four components: between macro-regions, within macro-regions but between provinces, within provinces but between sectors, and within provincial sectors but between city sectors.

Figure 7 Horizontal Decomposition of Theil Index



From the second graph, the percentage of contribution of each component to overall sector-regional inequality can be seen. Although up to 1993, the importance of sectoral components (upper part of the bar) increased steadily – mainly at the cost of inter-city disparities –, the trend reversed since then. On average, inter-sectoral and inter-city components explain roughly one half of intra-provincial disparities. It thus can be concluded that both sources – locational characteristics as well as the different source of local incomes, can explain each a significant proportion of intra-provincial disparities. Therefore, the further analysis of factors affecting intraregional disparities needs to pay attention to both the regional dimension and the material scope of intraregional incomes.

Despite the obvious importance of intra-regional disparities, to my knowledge no single study exists that addresses the effects of that inequality on the regional economic development in China, especially on regional growth.

To fill this gap, the remainder of this paper analyzes whether the diverging growth path of provincial economies is partly explained by their differences in intra-provincial disparities, applying empirical methods to test this hypothesis.

III. The Impact of Intraprovincial Disparities on Provincial Industrial Growth

III. 1. Theoretical and Empirical Background of the Inequality-Growth Relationship

For a long time, economists regarded inequality as having a positive impact on growth.[32] On the one hand, differences in the expected return to any economic effort were considered incentive-enhancing. Mirrlees (1971) formalized this intuitively simple idea for the problem of optimal redistribution in a moral hazard context. His model assumes skill differences to be driving forces for individual productivity differences without any redistribution. In this case, the optimum inequality level depends on the distribution of skills within the population; with higher inequality being incentive- and thus growth-enhancing in a population with relatively dispersed skills. However, the model also shows the welfare-reducing effect of high inequality in societies with relatively less dispersed skills.[33]

On the other hand, inequalities in wealth were argued to have a stimulating effect on accumulation. This might either be due to rising marginal propensities to save with higher incomes, due to indivisibilities for large-scale investments or because of control and governance deficiencies associated with dispersed shareholdings of large companies.

Although all of the described arguments remain valid, more recent research introduced new transmission mechanisms between inequality and the growth rate, mitigating or even reversing the overall effect of inequality on growth. Thorbecke and Charumlind (2002) summarize four main channels that primarily concern the political economy.[34] First, income inequality not only stimulates incentives for productive efforts, but also raises incentives to engage in rent-seeking activities. Secondly, social tensions and political instability as result of excessive inequality increase uncertainty and discourage investment. Thirdly, high inequality is conducive to efficiency-reducing redistribution, since the median voter is likely to be relatively poor. Fourthly, the existence of a large, prosperous middle class can reduce fertility and population growth. Beyond this, some studies argue that capital market imperfections aggravate the negative effects of inequality on growth.[35]

Galor (2000) seeks to unify the competing arguments by proposing a changing relationship accompanying the development process. In his model inequality can enhance growth in the early stages of development, when capital accumulation is still regarded to be the most important source of growth. Subsequently, with increasing importance of human capital accumulation in later stages of development, unequal distribution of incomes will actually turn to limit economic growth.

Empirics have not been able to offer unequivocal evidence for one of the two competing arguments. According to Fields (2001: p. 203), it "… remains an open question which way this effect actually runs." While many studies report that initial income inequality has a negative impact on subsequent growth,[36] more recent research questions the established results and proposes a positive sign of the relationship.[37] Fishlow (1996) is not able to corroborate any significant relationship between initial inequality and future growth once specific regional cases are accounted for. Alternatively, the results of Barro (1999) as well as Savvides and Stengos (2000) suggest the nature of the relationship to be to be conditioned by the level of economic development, especially the per capita income level of a region.

For the Chinese case, many studies examine determinants of provincial growth,[38] but only very few consider the role of income disparities in this context. One exception is Ravallion (1998), who uses the example of rural China to show what disguising effects the regional aggregation of household level data may have when growth regressions are used to test for effects of inequality on growth. He is able to establish a significant negative link between initial wealth inequality in the county of residence and individual consumption growth when using farm-household data. However, in a simple regional growth model, this effect becomes insignificant.[39] Having reported this result, I also ought to acknowledge that the main criticism of Ravallion's paper – the fact that the use of household level data is by far superior to regionally aggregated data, and the induced aggregation bias is rather large – applies to this paper in the same manner.

Some other papers plainly note that the initial income position of a province is not significantly related with its subsequent growth.[40] Lu (2002) estimates the impact of initial per capita income and its growth on rural-urban consumption disparities, but is not able to find a significant relationship. However, he identifies the effectiveness of economic growth to raise local per capita consumption expenditure as the most important mechanism to reduce disparities. Nevertheless, he focuses on a causal direction from growth to inequality. Apart from these empirical studies, Renard (2002) states the opinion that regional disparities in the special Chinese case will continue to reduce both equity and efficiency; mainly via the channels of regional economic fragmentation and social instability.

III. 2. A Model for Testing the Inequality-Growth Relationship

The growth of an economy is influenced by a variety of factors, of which inequality might obviously not be the most important one. Therefore, one should not expect a meaningful result from the short-form regression of growth on inequality; an approach often found in the literature. Rather, inequality might be seen as a factor indirectly influencing the working of other, more important determinants of growth. Obvious candidates proposed by growth theory here are capital and labor inputs.[41] For example, considering the simple growth model:

(11) $DY = f(DK, DL)$

with DY = growth rate of output, DK = growth rate of capital stock, and DL = growth rate of labor; and applying the theoretical explanations described above, it seems feasible to expect inequality to have an impact on how capital is accumulated; in a more unequal economy, capital investment could be expected to be larger in scale, probably resulting in more capital-intensive as well as high-technology investment. Alternatively, considering the political-economy aspects of the relationship, inequality can be considered to suppress the productivity of labor, therefore reducing the effective labor input from each additional unit of measured labor, and resulting in a negative relationship between inequality and investment. Taking the model above, inequality would thus significantly influence either differences in the technological level available in these economies or their technical efficiency, both until then unexplained parts in the residual term.

To analyze these mechanisms empirically, I apply a very simple growth accounting framework with capital, labor and inequality as explanatory variables. Thus, following equation (11), the basic regression model is

$$(12)\ \Delta GIOV_{it} = \alpha_1 + \alpha_2 \Delta CAPI_{it} + \alpha_3 \Delta EMPI_{it} + \alpha_4 INEQ_{it} + \varepsilon$$

with

ΔGIOV = relative change in Gross Industrial Output Value as measure of growth;
ΔCAPI = relative change in the average capital stock in the industrial sector as measure of investment,
ΔEMPI = relative change in average industrial employment as measure of differences in labor input, and
INEQ as one of the four indicators of intraprovincial inequality representing alternative hypotheses on the relationship between inequality and growth and explicitly described below.

The subscripts i and t indicating the value of a variable in province i at time t. To efficiently utilize the information embodied in the panel data, both the simple pooled regression as well as the panel-specific fixed-effect model are applied. Additionally, lagged values of the variables are tested to account for possible lags in the transmission process.

Specifically, I propose four different hypothesis on the relationship between inequality and growth:

- a linear association between levels of inequality and growth;
- a (negative) quadratic association between levels of inequality and growth;
- a linear association between relative changes in inequality and growth; and
- a quadratic association between relative changes in inequality and growth.

What is the rationale behind the hypothesized relationships? To start with, I address the relationship between the levels of inequality and growth. Levels of intraprovincial inequalities are measured by the provincial Theil indices derived from city data in the first part of the paper. Two alternative specifications for the relationship of inequality and growth are addressed: First, I follow the traditional way and test for a linear statistical association, either positive or negative, which would confirm or reject some of the arguments above.

By supplementing the pooled data regression with testing a fixed-effects model, I am able to control for province-specific but time-invariant aspects of provincial growth. This methodology can cure some often criticized shortcomings of cross-section analysis;[42] namely incomparability of cross-regional data due to specific characteristics of the regional economies. In statistical terms, the fixed-effects model assumes an individual effect (differing across cross-section but constant across time) that is correlated with the explanatory variables; thus statistical inference is conditional on the regional division applied.[43] However, one has to be careful not to rely overly on the fixed-effects specification, since measurement error in or endogeneity of the explanatory variables can render "the cure .. worse than the disease".[44] As Bruno, Ravallion and Squire (1995, p. 20) note, inequality measures are rather "noisy" variables; thus they may well be expected to cause the problems mentioned before.

Second, I alternatively assume the relationship between inequality and growth to be vary for different levels of inequality. From the theoretical background, it seems to be reasonable to assume that while decent inequality has a positive impact on economic performance, extremely equal or extremely unequal societies might suffer; either due to the lacking incentive structure or due to social instability. A similar mechanism could also be derived from the above-cited paper of Mirrlees (1971). Thus, in a society with extremely low disparities, the inequality growth relationship should be positive, while being negative in extremely unequal societies. Consequently, no significant relationship might be expected in regions with moderate inequality. Graphically, this relationship would take an inverted U-shaped form,[45] probably well described by a quadratic function with negative algebraic sign. Therefore, a quadratic regression of inequality on growth is tested and compared to the previous specification.

In a third step, the results for *levels* of intraprovincial inequality are compared with the impacts of *changes* in inequality on growth. Widely varying outcomes between countries in cross-section studies on the relationship between growth and inequality suggest that the country specific or situational factors may strongly influence the impact of a given level of inequality in different regions on economic outcomes. For example, it has been – although disputably - argued that even lower levels of inequality in China would have the same detrimental effects as in, e.g., Latin American countries, because of the strong tradition of a relatively equal Chinese society during the last 50 years. On the other hand, if there exists a strictly increasing or decreasing relationship between inequality and economic development, than changes in inequality should have a similar impact regardless of region- or situation-specific factors.

Therefore, relative changes in intraprovincial inequality are included as explanatory variable into the growth regression. These changes, as a flow variable, surely rather influence the behavior of economic agents (e.g. their motivation to work, or their willingness to invest) rather than their overall state (e.g. their ability to invest).

Fourth, the squared version of the change in intraprovincial inequality measure is regressed on provincial growth, expecting a negative sign of the coefficient. Similarly to its level variant, this variable gives higher weight to extreme changes in inequality, assuming both negative and positive extremity of the income distribution as detrimental to growth.

Finally, I slightly alter the model specification by allowing for lagged values of the growth rates of GIOV and CAPI, as well as by including a time trend. These modifications are considered to be proxies for other omitted variables or misspecifications, and to test the robustness of the model in general and with regard to the inequality variables in particular.

III. 3. Provincial Industrial Data and Data Problems

The data used in the regressions are panel data on the growth of industrial output, investment and employment growth for 25 provinces (as above) and the time period 1989 – 2001. In analyzing the relationship between inequality and growth, the use of sub-national level disaggregation has obvious advantages versus the common cross-country regressions. It especially increases the comparability between sections.[46] It also has been noted that the Chinese case is especially well suited to substitute for cross-country analyses, because it is a large country with a relatively large number of intra-national observations.[47]

Specifically, the variables are taken from a compilation of historical Chinese industrial statistics (NBS 2000) and various issues of the China Industrial Economy Statistical Yearbook (NBS CIESY), and are defined as follows: Output is measured as industrial *gross industrial output value* (GIOV) of each province. This measure has the disadvantage that it double-counts intermediate products used in later stages of production,[48] and is therefore biased for provinces with highly vertical integrated industrial structure. However, it is the only indicator available over a reasonably long time period, and commonly used in studies analyzing earlier time periods of China's transition.[49] The capital stock is calculated as sum of the annual averages of *fixed assets* and *circulating funds* (current assets) in the industrial sector. Employment is defined as *average annual industrial employment*. Growth rates of all variables are calculated as relative change of a variable to its value in the previous year.

It has to be noted that several statistical redefinitions compromise the consistency of the sample over time. The most important are: The redefinition of Gross Output Value reporting in 1995;[50] a major change in the data set, when the scope of enterprises that are required to report in 1998,[51] and a redefinition of employment statistics in also in 1998. To address possible problems arising from this, I also estimated sub-samples of the panel for shorter time periods. However, especially in the case of the fixed-effects model, unobserved bias might be introduced due to the inevitable attrition caused by the adjustments of the statistical reporting.[52] Running the regressions for sub-samples replicated main results for period prior to 1995 and 1998, but produced insignificant results for the inequality variable for later sub-samples. So, while the impact of definition changes for the total sample appears to be minor, there could be evidence for a break in the real behavior of variables towards the end of the sampling period. However, especially by using a fixed-effects specification of the panel data model, the available time period is to short to make such a claim statistically convincing.

III. 4. Estimation Results and Interpretation

As described in the previous section, the hypotheses about a statistical relationship between intraregional inequality and provincial growth in China are tested using a simple growth model applied to a panel of 25 Chinese provinces over the period 1989 – 2001.

To address the impact of inequality on growth, four alternative variables are alternately included in the above test regression:

- THEIL (as provincial Theil indices) to test for a relationship between intraprovincial inequality level and growth;
- SQTHEIL (as the squared provincial Theil indices) to test for the alternatively assumed negatively quadratic relationship describing a U-shaped inequality-growth relationship;
- DTHEIL (as relative change in the provincial Theil index) to specifically examine the impact of changes in intraprovincial inequality on the provincial growth performance; and
- SQDTHEIL (as the square of the variable DTHEIL), which is essentially identical with DTHEIL, but assigns higher weights to larger changes in inequality, as well as not distinguishing between positive and negative changes.

Each regression is estimated both with pooled data as well as under the assumption of fixed-effects between provinces. Moreover, a lagged version of the inequality variable is likewise tested to control for the possible (and even probable) time lag of growth effects. Finally, alternative specifications of the model and control variables are included to test the stability of the results.

Specification tests on the residuals from a simple OLS-regression reveal groupwise heteroskedasticity (adjusted Bartlett test) and heteroskedasticity over time (White's test). Therefore, the model is specified using estimated residual variances as cross-section weights, and estimate White heteroskedasticity consistent covariances.

The following tables report the main regression results.

Model 1 in the first table is the plain growth model without any inequality variable. It is reported here as a comparison for any following model. Already in this very simple formulation, the model is able to explain more than half of the variation in provincial industrial output growth.

Table 1: Regression Results 1

Model	*1*	*2a*	*2b*	*3a*	*3b*	*4a*	*4b*	*5a*	*5b*
Hypothesis	**No (baseline)**	***Linear* relationship between inequality *level* and growth**				***Quadratic* relationship between inequality *level* and growth**			
Functional form		**Linear in levels**		Linear in Level, 1 lag		**Quadratic in levels**		Quadratic in levels, 1 lag	
Model specifications	**Common Intercept**	Common intercept	**Fixed Effects**	Common intercept	Fixed Effects	Common intercept	**Fixed Effects**	Common intercept	Fixed Effects
Intercept	**0.13*****	0.12***	**Province specific**	0.12***	Province specific	0.13***	**Province specific**	0.12***	Province specific
ΔCAPI	**0.17*****	0.18***	**0.17*****	0.18***	0.17***	0.18***	**0.17*****	0.18***	0.17***
ΔEMPI	**0.90*****	0.90***	**0.92*****	0.89***	0.91***	0.90***	**0.92*****	0.89***	0.91***
THEIL		0.07	**0.45****	0.08	0.45*				
SQTHEIL						0.21	**1.17****	0.20	1.05
R^2 (adjusted)	**0.514 (0.511)**	0.517 (0.512)	**0.535 (0.493)**	0.509 (0.504)	0.531 (0.485)	0.517 (0.513)	**0.535 (0.493)**	0.509 (0.504)	0.533 (0.487)
F-statistic	**170.15*****	114.36***	**12.65*****	102.16***	11.42***	114.56***	**12.66*****	102.34***	11.52***
Observations (section/panel)	**13/325**	13/325	**13/325**	12/300	12/300	13/325	**13/325**	12/300	12/300
D-W stat	**1.86**	1.87	**1.94**	1.70	1.75	1.87	**1.94**	1.71	1.75

Dependent Variable ΔGIOV.
Estimated with GLS (cross-section weights), White Heteroskedasticity-Consistent Standard Errors & Covariance.
***,**,* indicate significance at the 1, 5 and 10 percent level respectively.

As a first extension of the basic specification, model 2 tests the impact of differences in the level of intraprovincial inequality on growth. Although the positive effect of inequality is small and insignificant for the panel as a whole (model 2a), it turns out to be relatively large and significant at the 5 percent level if time-invariant province-specific characteristics are accounted for by a fixed-effect specification (2b). However, although the new model increases the overall explanatory power of the model somehow, the inclusion of 24 new intercepts and a new variable reduces the adjusted R^2 markedly.

These results do not change significantly if a quadratic functional form for inequality is chosen instead of the linear form (see model 4). Moreover, since the coefficient of the quadratic function is positive, it gives no support to the proposed inverted U-shaped form the inequality-growth relationship. The data also provides no support for to a lag in the transmission mechanism, thus leaving the question of causality mainly unanswered.

Table 2 addresses the third hypothesis stated above: is there a direct relationship between changes in inequalities and growth?

Table 2: Regression Results 2

Model	*6a*	*6b*	*7a*	*7b*	*8a*	*8b*	*9a*	*9b*
Hypothesis	***Linear* relationship between inequality *change* and growth**				***Quadratic* relationship between inequality *change* and growth**			
Functional form	Linear in levels		**Linear in Level, one lag**		**Quadratic in levels**		Quadratic in levels, one lag	
Model specifications	Common intercept	Fixed Effects	**Common intercept**	Fixed Effects	**Common intercept**	Fixed Effects	Common intercept	Fixed Effects
Intercept	0.13***	Province specific	**0.14*** **	Province specific	**0.12*** **	Province specific	0.14***	Province specific
ΔCAPI	0.17***	0.16***	**0.16*** **	0.15***	**0.17*** **	0.16***	0.17***	0.15***
ΔEMPI	0.88***	0.87***	**0.97*** **	0.97***	**0.86*** **	0.86***	0.96***	0.96***
DTHEIL	0.03	0.03	**0.03** **	0.04**				
SQDTHEIL					**0.02*** **	0.03***	0.001	0.002
R^2 *(adjusted)*	0.510 (0.505)	0.521 (0.474)	**0.589 (0.585)**	0.602 (0.559)	**0.532 (0.528)**	0.547 (0.502)	0.578 (0.573)	0.591 (0.546)
F-statistic	102.72***	10.98***	**129.64*** **	13.86***	**112.27*** **	12.19***	123.51***	13.20
Observations (section/panel)	12/300	12/300	**11/275**	11.275	**12/300**	12/300	11/275	11/275
Durbin-Watson	1.72	1.76	**1.94**	2.00	**1.69**	1.74	1.92	1.98

Dependent Variable ΔGIOV.
Estimated with GLS (cross-section weights), White Heteroskedasticity-Consistent Standard Errors & Covariance.
***,**,* indicate significance at the 1, 5 and 10 percent level respectively.

The observed relationship is again clearly positive, but more significant and with more explanatory power than in the case of levels. The R^2 is raised by more than 7 percentage points in model 7a. As expected, a fixed-effects specification does not further increase the explanatory power and significance of the inequality variable in this model. This means that different form the *level* of intraprovincial disparities, the effects of *changes* in inequality are similar across all provinces, and not contingent to province-specific characteristics; a finding that contradicts the results reported in Barro (1999) and Savvides/Stengos (2000).

If a linear functional form is assumed, then changes in inequality affect growth significantly only after a 1 period time lag. This result would promote theories that propose the effectiveness of investment as a transmission mechanism between inequality and growth, rather than motivational and incentive aspects of the labor input. Moreover, it suggests the causality indeed being directed from inequality changes to growth.

On the other hand, if inequality changes are assumed to enter the relationship in a quadratic form, the impact on growth is even more significant. Since the coefficient has a positive sign, the result points to an interesting pattern in the transmission process from inequality changes to growth impacts: larger changes have a much stronger effect on growth than smaller changes. This seems to contradict intuition, because moderate variations in inequality are usually believed to be more incentive-enhancing than larger, abrupt changes, which are generally associated with uncertainty and social instability. In the current context, inequality changes might have to pass a certain threshold to cause any growth impact. However, this result might well be a specific of a transitional society such as China and not applicable to a more traditional development process.

Given the significant results for both specifications 7a and 8a, which model should be chosen as better fitting the data? I tend to argue that both are plausible descriptions of the 'true' relationship between inequality changes and growth, but each focusing on a very different aspect. Model 7a describes how relative changes in inequality, positive or negative, affect growth positively or negatively. In contrast, model 8a rather describes the responsiveness of growth on changes in inequality; its significantly positive results suggest that a large change in inequality, positive and negative, has a disproportionately stronger impact on growth than smaller changes. Thus, the two specifications represent two in principle different models, trying to answer different specific questions. This also becomes apparent if the different lag structure of both models is considered. Consequently, the inclusion and exclusion of variables in each specification also differs. Although their outcome is not directly comparable, both specifications describe a particular aspect of the inequality growth nexus.

Having derived the model 7a, 8a, 2b and 4b as reasonable specifications, as a next step several control variables are included to test for the robustness of the model in general and of the inequality variables in particular. The alternately included variables are: (I) $\Delta GIOV_{t-1}$, describing the lagged value of the growth rate of industrial output and accounting for a possible autoregressive tendency in industrial output growth or approximating any omitted variable; (II) $\Delta CAPI_{t-1}$, representing the growth of the capital stock in the previous period due to the fact that the output effect of investment may be lagged and spans over more than one period; and (III) a time trend variable, which describes any factor affecting growth that is constant across cross-sections but depending on time.

All additional variables are, as reported in the table, statistically significant and improve explanatory power of the model, but do not fundamentally alter the previous regression results. Especially the inequality variable remains significantly positively related with growth. Therefore, the established relationship can be considered relatively robust to changes in the model specification.

Table 3: Regression Results 3

Original Model	*7a ($DTHEIL_{t-1}$)*			*8a (SQDTHEIL, common intercept)*			*2b (THEIL, fixed eff.)*		*4b (SQTHEIL, fixed eff.)*	
Extension	I	II	III	I	II	III	I	II	I	II
Intercept	0.13***	0.12***	0.18***	0.11***	0.10***	0.07***	Province-specific		Province-specific	
ΔCAPI	0.11**	0.13***	0.11*	0.14***	0.15***	0.24***	0.13**	0.14***	0.13**	0.14***
ΔEMPI	0.94***	0.95***	0.96***	0.83***	0.84***	0.92***	0.88***	0.89***	0.88***	0.89***
INEQ	**0.03***	**0.03****	**0.04****	**0.02*****	**0.02*****	**0.02*****	**0.43***	**0.51****	**1.16***	**1.38****
$\Delta GIOV_{t-1}$	0.15***			0.13***			0.12***		0.11***	
$\Delta CAPI_{t-1}$		0.13***			0.12***			0.12***		0.13***
TREND			-0.003*			0.005***				
R^2 (adjusted)	0.610 (0.604)	0.615 (0.609)	0.591 (0.585)	0.545 (0.539)	0.548 (0.542)	0.554 (0.548)	0.538 (0.491)	0.548 (0.501)	0.539 (0.491)	0.548 (0.502)
F-statistic	105.37***	107.91***	97.48***	88.40***	89.42***	91.78***	11.28***	11.73***	11.30***	11.74***
Durbin-Watson	2.10	1.90	1.92	1.81	1.67	1.81	1.88	1.76	1.88	1.76

Dependent Variable ΔGIOV.
Estimated with GLS (cross-section weights), White Heteroskedasticity-Consistent Standard Errors & Covariance.
***,**,* indicate significance at the 1, 5 and 10 percent level respectively.

IV. Possible Shortcomings and Extensions of the Analysis

The analysis in the previous sections was able to show the development of intraprovincial income disparities in China, and to establish a statistically significant positive relationship between intraprovincial disparities and provincial industrial growth for various hypothesized functional forms. Moreover, the results of the regression analyses have been shown to be robust to changes in the model specifications. Still, several reasonable objections to the analyses could be raised. The following section therefore discusses some of the possible shortcomings and extensions.

First, objections might be raised regarding the inequality measures used in the regression. Because the Theil index is sensitive to differences in the sample size, the comparison between provinces might be distorted. Moreover, figure 3 revealed that not only the extent of disparities differs between provinces, but also the structure of these disparities. This problem, however, should disappear when fixed-effect estimation is used. Since all results for fixed-effects models were consistent with the common intercept specification, the differing sample sizes seem to have no impact on the outcome.

Second, a bias might be introduced into the analysis if the industrial structure between provinces differs strongly, and this different industrial structure causes provincial industrial growth rates to diverge. To, A disaggregation of industrial growth into sectors could account for such a bias.

Another problem might arise from the exclusion of rural inequality, because this study considered inequality between cities on the one hand, but growth in the industrial sector on the other. Although the industrial sector is often associated with urban areas, it has been argued for the Chinese case that especially differences in rural industrialization did cause rural provincial incomes to diverge.[53] Thus, excluding rural inequality from the analysis but including rural industries might provide a incomplete picture of the inequality growth relationship. One of the core problems in this respect is the availability of more reliable data over longer periods for cities compared with cities. Another argument is that the bias may appear less serious if cities can be regarded as growth poles for their adjacent rural areas. It may be not plausible to assume the spatial pattern of interregional income distribution for rural areas to differ markedly from that of the related urban centers.[54]

Beside this, one might criticize that the analysis was too short in explaining the actual transmission mechanism between inequality and growth. Although I assumed inequality to affect the efficiency of the factor inputs in the theoretical background, this issue was not addressed again in the empirical analysis. Thus, another extension of the model would be to explicitly relate income disparities and factor productivities.

Finally, the use of a very simplified form of growth model might be objected. It might indeed be useful to test the relationship in an extended growth model, possibly with a panel covering a longer time period than this paper. Alternatively, in the same framework, the question of whether inequality influences convergence between region might be an interesting aspect and extension.

V. Conclusion

This paper analyzed the development and effects of intraprovincial disparities in China between 1989 and 2001. Using city level data a set of more than 200 cities in 25 provinces, a Theil index decomposition method was applied to show the contribution of intraprovincial disparities to overall regional disparities. The results reveal that intraregional disparities contribute significantly to total inequality, and that the relative importance of these disparities has even increased in recent years. Moreover, it was demonstrated that intraregional disparities in China markedly differ between provinces. Thus, intraprovincial disparities – compared with a sectoral or rural-urban division – should not be ignored.

In the second part of the paper, I assessed the importance of intraregional disparities in China by estimating their impact on provincial industrial growth. The Chinese case is of special interest here: as a large country with administrative units of sizes comparable to independent countries, it allows the application of panel data methods without having to deal with the problems inherent in cross-country analysis.

The results show a significant positive effect of intra-provincial disparities on provincial industrial growth across a range of possible model specifications and robust to the inclusion of control variables. This is true for the level of intra-provincial inequality if province-specific but time-invariant effects in the panel are accounted for, but also for any change in inequality in general. This result is consistent with the view that reforms in China accelerated growth by improving incentives for economic activities. It also shows that, at least during the time period under consideration here, income inequalities have not reached a critical level yet to induce serious growth-reducing instability and uncertainty. However, this relationship somehow weakened towards the end of the observation period.

On the other hand, the empirical results also suggest that the inequality-growth relationship might not be a linear one; the impact of extreme changes in inequality appears to be stronger and more significant than a moderate increase in inequality. So far, the Chinese government has been rather reluctant to engage in some more radical reform steps, notably concerning enterprise reforms.[55] The results reported here cast a critical light on the growth impact of this reform strategy.

Endnotes:

[1] See World Bank 1997, p. 15.

[2] Compare Hermann-Pillath; Kirchert and Pan 2002, p. 53.

[3] Peng 1999, p. 247.

[4] Wei/Wu 2001, p. 19.

[5] For about 100 cities over the period 1988 – 1993, taken from NSB USY (various years from 1985 to 1995) and NSB 1999b.

[6] For details on the survey in 1988 see Eichen and Zhang 1993, for 1995 Khan and Riskin 2001.

[7] See Khan et al. 1993, pp. 56, 58; Khan and Riskin 2001, pp. 48f..

[8] See Khan et al. 1993, pp. 52f..

[9] See Gustafsson/Li 2002, pp. 197f..

[10] See Tsui 1998a, p. 794.

[11] The very different nature, size and source of their samples (1985: data on household income and expenditure for 106 cities, Survey of Income and Expenditure of Urban Households; 1991: per capita income and per capita GDP for 477 cities, China Urban Statistics Yearbook 1992) make the comparison between the two years rather difficult. How much the source of data can matter in Chinese statistics has been demonstrated for example by Scharping (2001, p. 324) for the case of population statistics. Moreover, in analyzing the determinants of regional per capita income differences, the study applies a growth accounting framework on the city level (Song, Chu and Chao 2000, pp. 256ff.); however, without considering any regional aspects (except a coastal province dummy). Therefore, contrary to their claims, their analysis does achieve very little in describing or even explaining intraregional disparities in different regions over time.

[12] For an overview and some examples, see Champernowne 1974, p. 791; Fields 2001, p. 30; and Sen 1997, pp. 24ff..

[13] See Cowell 2000, pp. 97ff.; and Fields 2001, pp. 15ff..

[14] Strictly speaking, the coefficient of variation can be regarded as the square root of the generalized entropy measure for $\alpha = 2$ (see the exact formula of the generalized entropy family of measures below); and generalized entropy measures with $\alpha < 1$ can be regarded as monotonic transformation of the Atkinson measure. In all cases, α can be interpreted as „inequality aversion“ parameter, with lower values of α being more sensitive to changes in the incomes of poorer subgroups. $\alpha = 2$ than represents „transfer neutrality“, while generalized entropy measures with $\alpha > 2$ would be especially sensitive to transfers on the upper end of distribution. See Sen 1997, pp. 140f..

[15] Compare Sen 1997, pp. 149ff., esp. p. 156.

[16] See Cowell 2000, p. 123.

[17] See Cowell 2000, pp. 124f..

18 See Cowell 2000, p. 125.

19 See Cowell 2000, pp. 125 – 127.

20 See Urban Statistical Yearbook (1990, 2002).

21 See Song, Chu and Chao 2000, p. 250.

22 The definition of employment statistics, however, changed significantly over time.

23 This division, called „three economic belts“ (*sanda jingji didai*), was officially the first time adopted in the Seventh Five-Year Plan (1986 – 1990), see Fan 1997, p. 623.

24 There exists, however, a large number of possible definitions of the Gini coefficient. For an overview, see Xu 2004.

25 See Hettige Don 1998, p. 91. Note that this formula – as well as other formulas used later - assumes equal incomes within each subgroup (in this case: city), and therefore disregards inequality within the subgroups, thus systematically underestimating total inequality. Note also that this computation requires data to be ordered by per capita income.

26 Compare Shorrocks 1980, p. 622; definition of variables as before.

27 Compare for example Ikemoto 1991, p. 167; or Hettige Don 2000, p. 218.

28 So far, a similar approach has been applied to the Chinese case only by Akita (2000, 2001, 2003) and Gustafsson and Li (2002).

29 The sectors are defined as follows: Primary sector: agriculture, forestry, animal husbandry and fishery; Secondary sector: mining and quarrying, manufacturing, production and supply of electricity, water and gas, and construction; Tertiary sector; all economic activities not included in primary or secondary industry.

30 Two more methodological caveats have to be mentioned. First, the data used here nevertheless is aggregated, thus not showing the individual income distribution. Moreover, it focuses on urban areas exclusively, thus, it cannot reflect for rural poverty.

31 Outliers are defined as cases with values between 1.5 and 3 box length from the lower or upper edge of the box (which represents the interquartile range). Values with more than 3 box length difference are called extremes.

32 See Aghion/Caroli/Garcia-Penalosa 1999, p. 1615.

33 See Mirrlees 1971, esp. p. 207

34 See Thorbecke/Charumilind 2002, p. 1480; even more (but partly less convincing) aspects are presented by Fields 2001, pp. 201 – 202.

35 See Galor/Zeira 1993; Bénabou 1996; Aghion/Bolton 1997; and Aghion/Howitt 1998, pp. 280 ff..

36 See for example Alesina/Rodrik 1992, 1994; Clarke 1995; Deininger/Sqire 1998; Persson/Tabellini 1992, 1994; Bénabou 1996; Often the link is establish via the indirect path of social instability; see for example Alesina/Perotti 1996, or the overview in Bénabou 1996, pp. 14f..

[37] See Forbes 2000; Li/Zou 1998.

[38] To mention just a few examples: Aziz/Duenwald 2001; Bao et al. 2002; Chen, B./Feng 2000; Chen, J./Fleisher 1996; Dayal-Gulati/Husain 2000; Ezaki/Sun 1999; Renard 2002; Sandberg 2002; and Yao/Weeks 2000.

[39] See Ravallion (1998), pp. 76, 77.

[40] See for example Demurger 2001, p. 98.

[41] The most important factor driving economic growth is, undisputedly, technological progress. However, to avoid the measurement problems adherent to technology or human capital, as well as to restrict the number of variables to be included in the model, I do not include technological progress explicitly in the model. Interregional differences in technological progress therefore should show up in the residual term and – in case of fixed-effect panel data regression – in the region-specific intercept.

[42] For a discussion on the problems of cross-sectional data in empirical research on growth see Srinivasan 1995, pp. 57ff.; and Srinivasan/Bhagwati 1999, pp. 34ff.

[43] See Johnston/DiNardo 1997, pp. 390f.; Baltagi 2001, p. 12; Alternatively, a random effect specification (which assumes non-correlation between individual effects and explanatory variables) would be appropriate if one chooses a random set of individual from a large population; see Baltagi (2001), p. 15.

[44] See Johnston/DiNardo 1997, p. 399.

[45] It should be noted that the relationship proposed here is different from those reported by Kuznets (1955), who argues inequality being dependent on growth in form of an inverted U-shape, and Barro (1999)who assumes different inequality-growth mechanisms for high and low per capita income levels.

[46] See Balisacan/Fuwa 2003, pp. 53f..

[47] See Wei/Wu 2001, p. 5.

[48] See OECD, p. 29; Gross output value statistics are collected on a factory level; thus they exclude double counts of intermediate products within the same factory, but include double counts of inputs between factories.

[49] See for example Lee 2000, Tsui 1993, Hare/West 1999.

[50] See CSY 2003, pp. 521f..

[51] See Holz/Lin 2001 for a more detailed description and analysis. It resulted in a significant reduction of included enterprises, but had only limited impact on the variables under consideration here.

[52] See Baltagi 2001, p. 9; Johnston/DiNardo 1997, pp. 402.

[53] See Chan/Chan 2000, p. 36.

[54] It has to be noted in this context, however, that Khan et al. (1993, pp. 52f.) did not find evidence for a rank-correlation of rural and urban provincial incomes.

[55] See for example OECD 2000, pp. 103ff.; Qian 2000, pp. 25ff..

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