

## REGIONAL GROWTH AND INCOME INEQUALITY IN CHINA AFTER 1978: A SPATIAL ECONOMETRIC APPROACH\*

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*Based on Kaldorian approach to economic growth and development, this study aims at providing an alternative perspective and explanation of the pattern of regional growth and income inequality in China. Using spatial econometric techniques, it empirically demonstrates that the Chinese regional economic growth has been demand-led and that regional dependence among the Chinese provinces is weak. In order to rebound the current trend of increasing regional income inequality, the present study suggests the rehabilitation of active roles played by local governments in developing regional economies and progressive income distribution policy to support effective demand.*

JEL Classification: O18, O53, R58

Keywords: Spatial Econometrics, Income Inequality in China, Demand-led Growth, Spatial Autocorrelation

### I. INTRODUCTION

The rapid growth of the Chinese economy has been accompanied by widening disparity of regional incomes among Chinese regions. In fact,

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*Received for publication: Oct. 14, 2008. Revision accepted: June 3, 2009.*

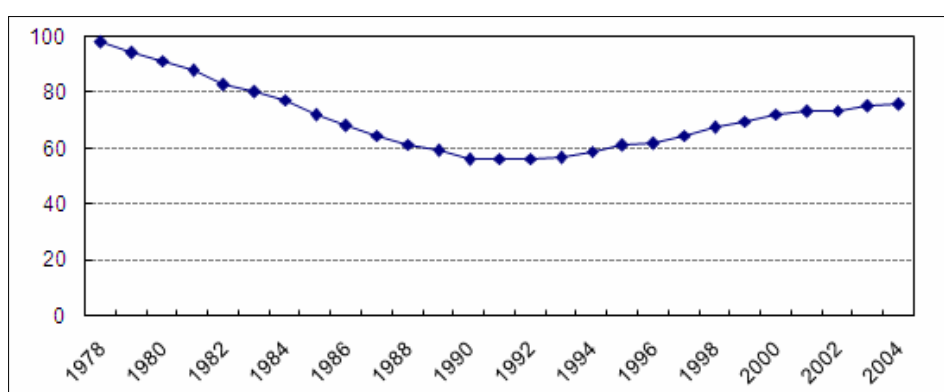
\* This work was supported by the Korea Research Foundation Grant funded by the Korean Government (MOEHRD, Basic Research Promotion Fund) (KRF-2007-411-J03301).

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Figure 1 below shows that the regional income inequality measured by coefficient of variation for 29 regions and municipalities<sup>1</sup> in China had been reduced over the 1980s, but the trend rebounded after 1990.<sup>2</sup> The increasing trend of (regional) income inequality in China deserves much attention as being an indispensable condition for a sustainable economic growth in the future.

**[Figure1]** Regional Income Inequality in China for 1978-2004



We suggest that the pattern of regional income inequality in China over time be explained mainly by indentifying the sources of regional growth in the Chinese regions. With a simple algebraic manipulation of GDP per capita ( $GDP/Pop$ , where  $Pop$  denotes population), it can be shown that the growth of GDP per capita is the sum of the growth of productivity and participation rate of labor force. Explaining income inequality, that is, GDP per capita, with regional growth may be justified by the following two stylized facts in empirical senses: first, the disparity in participation rate among Chinese regions is ignorable (Yu, 2004); second, there is big empirical literature demonstrating the co-movement of disparity in per capita income and labor productivity in Chinese regions (see the literature survey in the next section), both of which together imply that GDP per capita may well be explained by the growth of GDP alone without

<sup>1</sup> The coefficient of variation is calculated for real regional per capita GDP. Out of 31 Chinese regions and municipalities, Tibet is excluded because of data unavailability, while Chongqing, which was a part of Sichuan until March 14, 1997, is merged into Sichuan province data.

<sup>2</sup> This trend is confirmed by major empirical researches such as Yu and Wei (2003), among others.

demographic factors. In other words, the factors and sources that explain vicissitude of regional economic growth differences could account well for that of regional income disparities.

We adopt Kaldorian approach to economic growth and development to provide an alternative perspective and explanation of the pattern of regional growth and income inequality in China. In details, utilizing special econometric techniques, we empirically demonstrate that the Chinese regional economic growth was demand-driven. The fact that Chinese regional economic development was driven by the demand side suggests that the regional economic policy that would be carried out effectively by local governments should pay further attention to income distribution to provide enough effective demand, as well as industrial policies in the supply side. This study also finds that, contrary to the cases of EU and US economies, regional dependence is weak among the Chinese provinces. From a policy perspective, it suggests that the weak spatial autocorrelation among Chinese regions may imply the importance of regional policies conducted by local governments in China.

The study is organized as follows. Section II critically reviews the literature on the sources of Chinese regional income inequality and show that the majority of conventional approaches suffer from the lack of theoretical rigorousness, calling for an alternative. Section III is devoted to the discussion of Kaldor's laws as an alternative to the conventional approach along with their implications and suggests test specifications. In Section IV, we discuss empirical methodology adopted for this study and present empirical results. Section V focuses on the relationship between regional income inequality and regional policies that were carried out effectively by the Chinese local governments. Section VI summarizes the major findings and concludes by discussing further policy implications that are drawn from the empirical findings.

## II. LITERATURE REVIEW AND AN ALTERNATIVE

The growing empirical literature on regional economic growth in China could be classified into three groups. The first group of studies is engaged in the regional growth accounting practices (e.g., Ezaki and Sun, 1999; Fleisher and Chen, 1997; Liu and Yoon, 2000; and Wu, 2000) that

estimate regional total factor productivity (TFP) by either the national income accounts or econometric models, and argue that the regional disparities of technical progress which is measured by TFP explain the different economic performances across Chinese provinces. However, it does not go without criticisms. First, in a methodological perspective, the notion of TFP is not so convincing in practice unless the relationship between factor shares (or income distribution) and technological progress is clarified at the empirical level (Felipe and McCombie, 2003). Second, in the TFP literature, it is hard to find any explanation of the different TFP itself among regions. This may mean that the technological progress is presumed to be exogenously given.

The second group of studies, which has taken center stage in empirical research on regional economic growth, discusses the sources of regional income inequality in China in the context of “convergence debates”. Building on the (augmented) Solow model and following pioneering empirical application of Barro and Sala-I-Martin (1991, 1992) and Mankiw et al. (1992), they regress the growth rates of regional per capita GDP over the sample period on the initial level of regional per capita GDP plus variables that could affect the steady-state rate of growth such as investment and human capital (e.g., Chen and Fleisher, 1996; Gundlach, 1997; and Yao and Weeks, 2003), in which the models are estimated either by cross section or panel data to incorporate regional heterogeneity. These empirical studies find the tendency for per capita production to (conditionally) converge across China’s regions. The convergence of regional income across the Chinese provinces may imply that the regional inequality would be explained by the disparity of steady-state growth rate among them, which are in turn determined by conditional factors. Although the econometric techniques used for these studies may be so advanced and sophisticated as in the convergence literature in general, it is hard to believe that technical progress is exogenous and even across all regions and economies.<sup>3</sup> As is well known, the (augmented) Solow model focuses on the transitional growth

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<sup>3</sup> The notion of exogenous technical progress lays the foundation of the growth accounting exercises in which, to use conventional terms, a shift of the production function due to technical progress can be distinguishable from a movement along a production function induced by changes in production factors.

dynamics of one economy or one region toward its steady-state income path. However, it is by the assumption of the same steady-state growth rates and income levels across economies or regions that empirical studies on the regional economic growth have transferred the convergence within an economy or a region to the convergence across economies or regions. Furthermore, this is the case even for the panel data analysis in which regional heterogeneity is considered.

The last group of research may be called an ad-hoc regression approach in which regional per capita (log) income level is regressed on a vector of variables. The specification of the regression equation in this type of study is not derived from some growth theory. Instead, the explanatory variables are selected in an ad-hoc manner. These equations usually include the variables which are popular in growth literature such as the initial level of GDP and others depending on the research interests. For example, Bao et al. (2002) incorporate some geographic variables into their regression equation and finds that geographic effects on the regional GDP growth are significant, while Yu and Wei (2003) find strong associations between the growth of regional per capita GDP and geographical location, FDI, and (negatively) share of state-owned enterprises (SOEs) (see also, Fleisher and Chen, 1997; Chen and Feng, 2000; Demurger, 2001; Lin and Liu, 2000; and Ying, 2003, for numerous factors). Although they have found “statistically” significant explanatory variables, its ad-hoc manner of variable selection makes it hard to interpret the econometric results. In a viewpoint of robustness of the approach, Levine and Renelt (1992) demonstrate that those empirical results are extremely sensitive to minor alternations in the explanatory variables.

In addition to the shortcomings of the previous studies above, one can find a common ground on which the previous approaches are based: they are exclusively supply-oriented approaches in which the roles of demand side are ignored. In contrast, Kaldorian tradition, which is one tradition of the demand-oriented approaches,<sup>4</sup> has questioned the very presumption of exogeneity of factors of production and technical progress. In this

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<sup>4</sup> For a comprehensive discussion on various traditions of demand-oriented approach and associated issues, see McCombie & Thirlwall (1994) and Setterfield (2002).

viewpoint, supply of factors of production and technological progress are driven by demand, instead of being determined exogenously by the outside economy. This does not mean that the supply conditions do not matter. On the contrary, what the demand-side approach attempts to do is to make the supposedly exogenous factors in the supply side be endogenous to demand. Formulating the effect of demand factors at work in economic growth, Kaldor put forward a series of laws for economic growth (Kaldor, 1957; 1966; 1967; 1968). Since then, his followers have intensively developed more accurate theoretical underpinnings and extensively accumulated empirical results supporting them. They are especially relevant to regional economic development as the mechanisms that were identified have important implications for the appropriate role of public policies in stimulating the economic growth of lagging regions.

Although numerous studies have empirically tested Kaldor's laws, only a few have been carried out at a regional level with regional data within an economy. McCombie and de Ridder (1984) and McCombie (1985) were the first two studies testing Verdoorn's law (Kaldor's second law) with regional data for the United States. They found substantial increasing returns to scale in the United States. However, these studies do not take into account spatial effects which might lead to biased estimates and inefficient tests when OLS is applied. In contrast, Bernat (1996) is the first and only study which uses US states' data in a spatial econometric perspective. He found substantial spatial dependence between the continental 48 states as well as evidence for Kaldor's laws. In terms of spatial econometrics, Fingleton and McCombie (1998) test Verdoorn's law in the EU regions and finds evidence for increasing returns to scale in the region. Pons-Novell and Viladecans-Marsal (1999) apply spatial econometric models to all Kaldor's laws in the European regions, finding supportive evidences. To our knowledge, there are only two case studies for China testing Kaldor's hypotheses. Using a panel data set that consists of Chinese provinces, Hansen and Zhang (1996) and Jeon (2006) find the evidences that all three of Kaldor's laws hold good in China. However, these two studies are at a national level, and do not take into account the regional or spatial dependences.

### III. KALDOR'S ECONOMIC GROWTH LAW

The first law often called “the engine of growth hypothesis” maintains that the growth of GDP is positively associated with the growth of the manufacturing sector of the economy. Formally,

$$q_{GDP} = a_1 + a_2 q_m, \quad a_2 > 0 \quad (1)$$

where  $q_{GDP}$  and  $q_m$  are the growth of GDP and of manufacturing, respectively, and  $a_i (i=1, 2)$  are regression coefficients. Note that the strong association between GDP growth and expansion of manufacturing is not simply because the manufacturing sector takes an increasingly bigger proportion in an economy as economic development proceeds, which might be called a “share effect.” To avoid this share effect, an alternative specification is suggested as:

$$q_{GDP} = a_3 + a_4 (q_m - q_{nm}) \quad (2)$$

where,  $q_{nm}$  indicates the rate of growth of non-manufacturing output. A positive sign of the coefficient of growth of manufacturing implies that a rapid growth of GDP is associated with excess rate of growth of manufacturing over growth rate of GDP. Alternatively, we may examine the role of manufacturing industry in an equation that incorporates all industries as the regressors. That is,

$$q_{GDP} = a_5 + a_6 q_{primary} + a_7 q_m + a_8 q_{tertiary} . \quad (3)$$

This study will utilize equation (1) through (3) as test specifications for the first law.

If the differences of the rates of economic growth between regions are by and large accounted for their differences of productivity in the economies, there should be some identifiable mechanisms through which fast growing manufacturing sectors produce higher productivity of an economy as a whole. Kaldor and his followers have suggested two

transmission channels, which consist of the next two laws.

The second law that have been referred to as “Verdoorn’s Law” states that in the manufacturing sector, the growth of productivity is positively associated with the growth of production, which is specified as

$$p_m = b_1 + b_2 q_m \quad (4)$$

where  $p_m$  is the growth rate of labor productivity in manufacturing, and  $b_i$  ( $i=1, 2$ ) are regression coefficients. To avoid a possibility of a spurious correlation emerging from definitional identity for the labor productivity  $p_m = q_m - e_m$ , another specification is preferred.

$$e_m = c_1 + c_2 q_m \quad (5)$$

where  $e_m$  is the growth of labor employment in manufacturing, and  $c_1 = -b_1$  and  $c_2 = 1 - b_2$ . In equation (5),  $c_2$  less than unity is interpreted as the existence of substantial dynamic increasing returns to scale.<sup>5</sup> In general, the sufficient condition for there to be increasing returns to scale is  $c_2 = 1 - b_2 < 1$ . The sources of increasing returns to scale are explained in two ways. First, it is suggested that, in contrast to the notion of the exogenous technological progress, the Verdoorn’s Law is seen as a technical progress function that is combined with investment and the increase in capital stock (Bairam, 1987; Dixon & Thirlwall, 1975; and McCombie, 1982). Second, the technical progress relies much more on dynamic, rather than static, relations between output and productivity brought about by induced technical progress, learning by doing, external economies in production, etc. (McCombie & Thirlwall, 1994, p.174; and Young, 1928).

<sup>5</sup> Many authors testing the Verdoorn’s law argue that a variable for capital stock should be included in order to capture the contribution of capital accumulation to productivity growth (*inter alias*, Bairam, 1987; Leon-Ledesma, 2000; McCombie & De Ridder, 1984; and Wolfe, 1968), the rationale for which is the belief that faster capital accumulation may have positive effects on the labor productivity. However, to include the capital variable in the specification for a test of Verdoorn’s law is not consistent with the implicit criticism of the notion of technological progress. For the derivation of the Verdoorn’s law in this vein instead of from a conventional aggregate production function, see Dixon & Thirlwall (1975) and Targetti (1992).



It is extremely important to note that the growth of output plays the key role as the ultimate driving force leading to fast growth of productivity, that is, the causality runs from demand to productivity, but not the other way round. This is because, first, according to the notion of dual economy which can be applicable even to advanced economies, there cannot be a supply-side constraint such as labor shortage (Cornwall, 1976; and Kaldor, 1975). Second, the exogeneity of technological progress and productivity are not reconcilable with the notion of dynamic increasing returns which is obviously pervasive in manufacturing. Therefore, the correct specification for the measurement of returns to scale should be equation (5) that has been derived in such a way to incorporate mainly the dynamic aspects of increasing returns while not relying on any type of an alleged aggregate production function.

Kaldor's third law maintains that the growth of productivity of an economy as a whole is positively connected with the growth of output in the manufacturing sector through the labor transfers to the manufacturing sector from the other sectors including agriculture and service. Extending and generalizing the notion of dualism, demand-led growth approaches have identified two main channels through which the positive effects of labor transfers to the manufacturing sector on the overall productivity are supposed to work (Cripps and Tarling, 1973; and Kaldor, 1968; Thirlwall, 1983). First, the productivity of the manufacturing will increase as it absorbs more of labors to produce more of goods; as the production of manufacturing increases, as seen above, it is likely to result in a higher productivity through the Verdoorn effect. Second, the productivity outside the manufacturing will also increase because evicting the surplus labor prevailing in them will improve the productivity of the remainder of the labor forces.

In practice, it is hard to test directly the relationship between labor transfer and growth of productivity of the economy because it is very difficult to measure the productivity growth in many activities outside manufacturing. Following Thirlwall's specification, we estimate the following equation:

$$q_{GDP} = d_5 + d_6 e_m + d_7 e_{nm}, \quad d_6 > 0, \quad d_7 < 0 \quad (6)$$

where  $e_m$  and  $e_{nm}$  are the growth rates of employment in manufacturing and that of outside manufacturing, respectively, and  $q_{GDP}$  and  $p_{GDP}$  denote the growth rate of output and productivity, respectively, of an economy.<sup>6</sup> Equation (6) suggests that growth of output of an economy is associated positively with growth of employment in manufacturing and negatively with growth of employment in non-manufacturing.

## VI. EMPIRICAL STUDIES

### 4.1. Data and Methodology

The target time period of this study is between 1979 when the packet of reform and open policies was launched and 2004. In origin, Kaldorian regularities in economic growth were discussed in the context of cross-country. Because of this, much care of appropriate data set and technique to be utilized is to be taken when we apply them to a single economy. One of the most important constraints that should be considered is the fact that the regularities are discussed in terms of long-run perspective in which cyclical effects are removed. For the purpose of the present study, an averaged regional cross-section data set which is built by averaging each variable for the sample period, is preferred to other data sets in that the use of averaged data over the sample period could wipe out the cyclical effects and better reveal the long-term relationships between variables under consideration. The observations represent 29 Chinese provinces and municipalities (see footnote 1).

According to the development of spatial econometrics, the presence of spatial autocorrelation could have important adverse consequences to the standard parameter estimations by OLS and their inferences (Anselin, 1988; and Anselin and Griffith, 1988, among others). Spatial autocorrelation in the econometric models can take two forms: spatial lag

<sup>6</sup> Cripps and Tarling (1973) had suggested, instead,  $p_{GDP} = d_8 + d_9 q_m + d_{10} e_{nm}$ ,  $d_9 > 0$ ,  $d_{10} < 0$ , where  $p_{GDP}$  denotes the growth rate of output. McCombie (1982), however, demonstrates that it derives from the definitional identity for the growth rate of overall productivity, implying that the coefficients in this equation may be merely proportion parameters for manufacturing and non-manufacturing output out of total GDP, but not behavioral implication.

model and spatial error model (see Appendix for details of these two forms). Note that, in contrast to the structural dependence in the spatial lag model, the spatial error autocorrelation may result from a nuisance such as a mismatch between economic boundaries and administrative boundaries based on which data are collected and organized. In other words, the existence of spatial autocorrelation in error terms may not have significant implications as much as the spatial lag dependence with regard to regional policy implications.

In the rest of this section, we estimate the specifications for Kaldor's laws with a first-order contiguity spatial weight matrix.<sup>7</sup> To consider the possible spatial autocorrelation, we first estimate the models by OLS and calculate Moran's I statistics to test spatial dependence. Although Moran's I test is probably the most popular test for a spatial autocorrelation, it does not provide any additional information about the form of spatial dependence, spatial lag, or spatial error. To distinguish between the two patterns of spatial dependence, we utilize Lagrange multiplier tests, using LM (error) for a spatial error model and LM (lag) for spatial lag model (Anselin, 1988). When Moran's I is significant and a form of spatial dependence is identified, we re-estimate the spatial econometric model by maximum likelihood (ML) principle. Finally, likelihood ratio (LR) is used to test the spatial autoregressive coefficient for either spatial lag or spatial error. In addition, we report some diagnostic test results such as Jarque-Bera normality test and (spatial) Breusch-Pagan heteroscedasticity test. The former is especially important in the sense that the maximum likelihood estimation of the spatial econometric models is based on the assumption of normal error terms.

## 4.2. Empirical Results

Table 1 reports the estimations of the specifications for Kaldor's first law which posits that industry is the engine of economic growth. When

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<sup>7</sup> There is no obvious criterion for the best weight matrix. Although the study reports only the estimation results drawn with contiguity weight matrix, we experimented with squared and simple distance inverse weight matrices as well as distance band weight matrices with various critical bands. But, the experiments show very similar patterns to those reported here, except for the case of an extremely large distance band weight matrix. However, this case is not usual in economic terms.

equation (1) is estimated by OLS in the second column, the nulls of normality and homoscedasticity are not rejected at the conventional significant level. However, Moran's I test indicates the possibility of spatial dependence. The consequent LM tests, which identify the type of spatial autocorrelation, indicate a spatial error model, implying inefficiency of OLS estimation. In the next column with the heading of S-error, a spatial error model is estimated by means of ML principle. It shows the improvement of estimation efficiency in terms of AIC and LIK, both of which, in contrast to the value of R-squared, are comparable to those for OLS. The LR test for the coefficient of spatial error verifies the allusion hinted by OLS estimation of spatial autocorrelation in the form of spatial error, while the LM (lag) test at the bottom of the table shows that there is no possibility for this spatial error model to suffer from spatial autocorrelation in the form of spatial lag, implying that it is not necessary to consider a spatial lag model. The estimated coefficient of 0.692 means that the growth rate of GDP for a region with a growth rate of the secondary industry higher by 1 percentage point than its overall average across regions has grown faster by 0.692 percentage points than the average growth rate of GDP across regions in China, which may imply the significant role of the secondary industry in the growth of regional GDP. Note also that the absence of spatial lag autocorrelation points out the absence of spatial dependence of the regional economic growth.

Taking into account the possibility of a spurious relation between the two variables, equation (2) and (3) are also estimated. When equation (2) is estimated by OLS, there is no abnormality in terms of normality and homoscedasticity as well as spatial autocorrelation. The estimation result shows that regional economic growth measured by the growth rate of regional GDP is associated positively, if only moderately, with the difference between the growth rate of secondary industrial output and that of non-secondary output ( $p$ -value=0.088). That is, if one region's secondary industry grows faster than the other industries and the difference is higher than the average difference across regions by 1 percentage point, that region's GDP grows faster by 0.144 percentage points than the average GDP growth rate across regions, which may be taken as evidence for Kaldor's first law. When equation (3), in which the

**[Table 1]** Kaldor's First Law

Equation	(1)		(2)	(3)		
	OLS	S-Error	OLS	OLS	S-Error	S-Lag
constant	3.215 (0.000)	2.986 (0.000)	10.099 (0.000)	-0.122 (0.845)	0.043 (0.934)	-0.062 (0.950)
q_primary	-	-	-	0.097 (0.156)	0.069 (0.260)	0.095 (0.161)
q_m	0.662 (0.000)	0.692 (0.000)	-	0.397 (0.000)	0.469 (0.000)	0.397 (0.000)
q_tertiary	-	-	-	0.422 (0.000)	0.366 (0.000)	0.423 (0.000)
(q_m)-(q_nm)	-	-	0.144 (0.088)	-	-	-
Lambda (error)	-	0.550 (0.002)	-	-	0.533 (0.003)	-
LR (error)	-	5.862 (0.015)	-	-	3.606 (0.058)	-
Rho (lag)	-	-	-	-	-	-0.006 (0.940)
LR (lag)	-	-	-	-	-	0.006 (0.938)
AIC	57.812	51.949	106.112	28.765	25.158	30.759
LIK	-26.906	-23.975	-51.056	-10.382	-8.579	-10.379
Jarque-Bera	0.681 (0.711)	-	1.412 (0.494)	2.241 (0.326)	-	-
Breusch-Pagan	2.871 (0.090)	2.305 (0.129)	0.010 (0.919)	0.086 (0.993)	0.533 (0.912)	0.081 (0.994)
Moran's I	3.024 (0.002)	-	0.949 (0.342)	2.222 (0.026)	-	-
LM (error)	5.827 (0.016)	-	0.374 (0.541)	2.013 (0.156)	-	2.356 (0.125)
LM (lag)	1.070 (0.301)	0.493 (0.482)	0.566 (0.452)	0.007 (0.936)	0.980 (0.322)	-

regional GDP growth rate is regressed on all three industrial output growth rates, is estimated by OLS, Moran's I test implies spatial autocorrelation, but two LM tests do not. In order to consider any possibility, we estimate both spatial lag and spatial error models. In the two spatial models, no evidence for spatial dependence is found, as LR tests for the spatial autocorrelation coefficients do not reject the null. Furthermore, the values of AIC and LIK for the spatial lag model turned out even worse than those for OLS estimation. Looking at the coefficients,

all three of the estimated equations indicate that the coefficient for primary industry is not significant, while those for secondary and tertiary industry are highly significant.

From these empirical findings, we can draw two conclusions. First, the overall results imply that the secondary industry has played a significant role in regional economic development in the regions of China. Although the coefficient for tertiary industry in equation (3) is significant, the causality should run from growth of the regional GDP to growth of tertiary industry, since the latter is induced by the growing demand for services as the regional economies grow. Second, we find very weak spatial dependence of the growth of regional GDP among the Chinese regions. This may show characteristics of autarky in the Chinese regions, which may in turn reflect the important role of local governments in regional development.

Using equation (5), Table 2 reports the estimation of Kaldor's second law (or Verdoorn's law) in which the growth rate of secondary employment is regressed on the growth rate of secondary industrial output. We first estimate equation (5) by OLS and then conduct the normality and homoscedasticity tests. As is shown in Table 2, no abnormality is found. Furthermore, the tests for spatial dependence find no symptom of spatial autocorrelation. Therefore, the OLS estimation results could be taken without a reference to spatial econometric models.

**[Table 2]** Verdoorn's Law

	OLS
constant	-3.632 (0.022864)
q_m	0.678 (0.000)
R-sqr.	0.452
AIC	110.811
LIK	-53.405
Jarque-Bera	4.133 (0.127)
Breusch-Pagan	0.609 (0.435)
Moran's I	-0.132 (0.895)
LM (error)	0.182 (0.670)
LM (lag)	0.751 (0.386)

The estimated coefficient has the right sign and is highly significant. And, the implied Verdoorn's coefficient of 0.322 ( $=1-0.678$ ) means increasing returns to scale in the secondary industry of the Chinese regions. That is, regarding regional economic growth in China, a region with growth of output in secondary industry higher by 1 percentage point than the average enjoyed greater productivity growth by 0.322 percentage points, relative to other regions.

This finding may well imply the leading role that secondary industry has played in regional development. Furthermore, it should be noted that, as was noted in the theoretical discussions, the productivity growth is demand-driven in the sense that increase in demand for industrial goods leads to faster growth of output, which in turn results in higher productivity. As is discussed further in the following, it is worth noting the absence of regional dependence in productivity growth across the Chinese regions.

[Table 3] Kaldor's Third Law

Dependent	q
	OLS
constant	10.080 (0.000)
e_m	0.349 (0.005)
e-nm	-0.610 (0.044)
R-sqr.	0.366
AIC	98.071
LIK	-46.035
Jarque-Bera	0.594 (0.743)
Breusch-Pagan	2.834 (0.242)
Moran's I	-0.587 (0.557)
LM (error)	0.810 (0.368)
LM (lag)	0.231 (0.631)

Finally, Table 3 estimates equation (6) for Kaldor's third law by OLS. It does not reject the null hypothesis of normality and homoskedasticity as Jarque-Bera and Breusch-Pagan tests indicate. Furthermore, there is no symptom of spatial autocorrelation: Moran's I test indicates no spatial autocorrelation and the consequent LM tests indicate neither spatial lag

model nor spatial error model. Therefore, we can take the OLS estimate as being a valid estimation results. It shows that the growth rate of the regional GDP is correlated positively with the growth rate of industrial employment and negatively with that of non-industrial employment, which is also predicted by the third law. It suggests that labor transfer from non-secondary to secondary industry has been an important source of labor productivity growth in the Chinese regions.

## V. SPATIAL AUTOCORRELATION AND LOCAL GOVERNMENTS IN CHINA

In order to understand the implications of spatial autocorrelation in terms of regional growth and inequality, it is important to articulate the relationship among the empirical findings of spatial independence, the role of local governments, and regional economic growth and income inequality. One of the most significant findings in the present study is the absence of spatial autocorrelations for the dependent variables in the various models. This is verified further by examining spatial autocorrelations of all variables involved. Table 4 reports the test results for spatial autocorrelation by Moran's I and Geary's C. It shows that all variables involved in the previous models are not spatially dependent across the Chinese regions, except for the growth rate of employment in secondary industry.

[Table 4] Spatial Autocorrelations

Variables	Moran's I Test		Geary's C Test	
	I	p-value	C	p-value
q_GDP	0.086	0.318	0.872	0.341
q_m	0.106	0.248	0.806	0.147
q_nm	-0.074	0.753	1.201	0.133
q_m - q_nm	-0.069	0.788	1.135	0.313
e_primary	-0.067	0.800	0.913	0.518
e_m	0.265	0.014	0.698	0.024
e_nm	0.074	0.368	0.868	0.325
p_GDP	0.091	0.301	0.861	0.299
p_m	-0.213	0.148	1.250	0.062



This finding of spatial independence among Chinese regions may have conceivable implications for the importance of roles that Chinese local governments have played in the regional development and economic growth processes, and, as a consequence, regional income inequality among regions. As is well known, the rapid expansion of industrial output in China during the reform period was mainly due to the meteoric growth of rural industry represented by so called township-village enterprises (TVEs). It is crucial to realize that the Chinese local governments actually run the business of TVEs from their establishment to their management (Oi, 1999; and Unger, 2002). Although most of the previous studies have treated them as being a private sector, they were actually collective firms owned by the local public and managed by public offices. They did not work like a private enterprise responding sensitively to their own profit opportunity. For example, the major source of capital for TVEs was local branches of state-owned banks which loaned them upon the request of local government offices, and the local governments' decision was made by public needs in the regions such as employment and regional economic development, but not by private profit motivations. It has also been noticed by many field studies that local governments even acted as a long-run regional planner, establishing a long-term development plan and adjusting long-run industrial structures through rationing financial resources, which is much similar to the role played by the Ministry of International Trade and Industry (MITI) in Japan during its economic development. Furthermore, the Chinese local governments supported industrial development in their areas by providing massive infrastructure, which might not have been built if tasks had been left to the private sector or market processes.

As a consequence, between 1978 and the mid-1990s, it was TVEs that were the most dynamic part of the Chinese economy. On the one hand, TVEs value-added, which accounted for less than 6% of GDP in 1978, increased to 26% of GDP in 1996, notwithstanding the fact that GDP itself was growing very rapidly during this period. On the other hand, the employment of TVEs grew from 28.27 million in 1978 to reach 135.08 million in 1996. After a sharp drop between 1997 and 1998, it resumed absorbing labor and reached its peak of 138.66 million in 2004.

Considering the fact that the agricultural employment declined very rapidly, from 70.5% of total employment in 1978 to 50.5% in 1996, one would plausibly infer that the transfer of labor from primary to secondary industry and its productivity benefits were created within Chinese regions.

What is more, the local governments have protected regional industries in their jurisdiction by building various effective trade barriers and practicing discriminatory policy in favor of local firms and, at the same time, against firms from other regions. Our empirical finding of spatial independence among the Chinese regions should be considered to be another way to confirm the argument for the existence of strong regional protectionism and (regionally) fragmented markets in Chinese that have been found and intensively documented by many China economists (e.g. Young 2000; Poncet 2003, 2005; Boyreau-Debray and Wei, 2003, Huang 1996, 2003: and World Bank 1994, among others, for evidence of regional fragmentation in China. Note also the directive issued by China's State Council in April 2001 to outlaw regional blockades in market activities). In general, the absence of spatial autocorrelation should imply no or very weak spillover effect among the regions under question in any way.

Therefore, recalling the importance of secondary industry in regional economic growth, the fact that regional economic development in the Chinese provinces has owed much to the active role of local governments in promoting local secondary industry, may account for a big part of the pattern of regional economic growth and income inequality. Indeed, the latter coincides with local policy patterns: that is, the growing regional income inequality after 1990 may be due to the retreat of local governments from regional economic development. Recall that at the first stage of reform during the 1980s when Chinese local governments were responsible for their region's economic development, they were able to promote local economic growth by stimulating regional industries which played a key role in the economic development during this period of time. In other words, the active roles of local governments in economic development consequently resulted in reduction of disparity of regional income in the 1980s. In contrast, after 1992 when strong market based policies represented by privatization and local governments'

abandonment of industrial policy were pursued, the regional income inequality started getting worse until the present.

## VI. CONCLUSIONS

According to the empirical evidence above, the process of economic development in the Chinese regions between 1979 and 2004 can be best described as follows. The expansion of secondary industry has played a key role in the growth of regional GDP in two ways. First, it was the secondary industry that achieved appreciable increasing returns to scale which are assumed to be spread over the entire economy in the Chinese regions. The second reason for the secondary industry's key role in the overall economic growth in the Chinese regions is explained by labor reallocation between industries. When surplus labor forces are assumed, transferences of surplus labor into secondary industry with higher productivity might well result in higher overall productivity of an economy as a whole, since the growth of industrial output is a net increment in resources, but not just a reallocation of resources from one use to another in the sense that they would otherwise have been *de facto* unused (Thirlwall, 1983; and Targetti, 1992). In the Chinese context, the most important reallocation of labor forces from agriculture to secondary industry took place within rural areas, but not among them.

In addition to the regional policies conducted by local government to boost local secondary industry, it is worth recalling the fact that the regional economic growth in China was demand-led. During the 1980s, the Chinese local governments were able to promote local industry under the circumstances of growing income levels which had resulted in greater purchasing power for Chinese households. This may be evidenced by the fact that the TVEs were producing manufactured goods: increases in demand for manufactured goods pulled the production of industry which in turn raised its productivity via Verdoorn's Law, the gains of which should spread over the entire economy; on the other hand, the lift of manufacturing production induced by the increase in demand for manufactured goods set off labor transfer from agriculture to manufacturing, increasing labor productivity of the overall economy.

This consideration of demand-side sheds new light on the importance

of income distribution policy. In the Chinese case, the increase in income of households, the source of effective demand during the 1980s, was supported mainly by government policies. For example, the sustained household consumption in the early period of reform could be explained as follows. First, the reform period has witnessed a sustained increase in prices of agricultural goods. Indeed, in the beginning of the reform in 1979, the average of prices for the quota and above increased by 22.1% and thereafter by 1989, prices of agricultural products grew on an annual average of 8.9%. Furthermore, reflecting the effect of the decision by the state to shift the intersectoral terms of trade in favor of agriculture in 1979, the agricultural terms of trade, as compared to industrial products, improved from 1:1 in 1978 to 1:1.71 in 1989, which might have increased rural household income leading to consumption demand. The second source of the increase in rural incomes was the considerable spurt of agricultural outputs, which was again the direct result of government efforts in improving farm technologies including high-yielding modern varieties, constructing irrigation systems and providing more chemical fertilizer. Third, as seen above, the rapid growth of TVEs in rural areas, which was initiated and managed by the local governments, provides rural households with another source of income by working in industry for a higher wage than that of agriculture workers.

To sum, in order to reduce growing regional income inequality in China, the present study suggests rehabilitation of the active roles played by local governments in developing regional economies and progressive income distribution policy to support effective demand.

**[Appendix 1] Spatial Models**

The first form of the spatial autocorrelation is called spatial lag model and formulated as in equation (8):

$$y = \rho Wy + X\beta + \varepsilon \quad (8)$$

where  $y$  is a vector of  $n$  observations (regions) on the dependent variable,  $W$  is a  $n \times n$  spatial weight matrix,  $X$  is a vector of explanatory variables,  $\beta$  is a coefficient vector,  $\rho$  is the spatial autoregressive coefficient, and  $\varepsilon$  is a vector of error terms which conform to the standard assumption of white noise. Note that the spatial dependence in this model is similar to having a lagged dependent variable as an explanatory variable. If model (8) is correct, but it is to be estimated without the spatial autoregressive term, the estimated vector of coefficient  $\beta$  should be biased and all inferences based on the omitted variable model are invalid. It is important to understand that the spatial autoregressive coefficient  $\rho$  captures the magnitude of effect that dependent variables of neighboring regions make on the dependent variable of one region. In other words, it measures the degree of the substantive dependence of one region's dependent variable upon the dependent variable of the surrounding regions, which may derive from a variety of spill-over effects such as technology diffusion and transfers of factors of production. Therefore, the existence of the spatial lag dependence indicates a structural spatial dependence among regions (Rey and Montouri, 1999).

The second form of spatial autocorrelation is the spatial error model and expressed as equation (9):

$$\begin{aligned} y &= X\beta + \varepsilon \\ \varepsilon &= \lambda W\varepsilon + \xi \end{aligned} \quad (9)$$

where  $\lambda$  is the autoregressive parameter and  $\xi$  is a vector of white noise error terms. Compared with model (8), model (9) indicates that spatial dependence is embodied in the error terms. If the spatial

autocorrelation in model (9) is ignored and estimated by OLS, the OLS coefficient of  $\beta$  may still be unbiased, but the parameter estimation is inefficient and the associated inferences may be misleading.

**[Appendix 2] Real GDP Per Capita in Chinese Regions, 1978-2004**  
(Price in 1978=100)

Regions	Real GDP Per Capita (Yuan)						Average Growth Rate (%)	
	1978	1985	1990	1995	2000	2004	1978-1990	1991-2004
Beijing	1,290	1,974	2,044	3,006	4,823	8,403	3.9	10.6
Tianjin	1,160	1,734	1,791	2,946	5,245	9,754	3.7	12.9
Hebei	364	580	743	1,341	2,253	3,710	6.1	12.2
Shanghai	2,498	2,956	2,632	4,501	8,871	14,609	0.4	13.0
Fujian	273	551	758	1,673	2,916	4,383	8.9	13.4
Shandong	316	765	979	1,840	3,044	5,299	9.9	12.8
Guangdong	369	709	995	1,995	3,090	4,725	8.6	11.8
Liaoning	680	1,106	1,261	1,867	3,100	4,613	5.3	9.7
Jiangsu	430	855	998	1,920	3,113	5,516	7.3	13.0
Zhejiang	331	783	921	1,981	3,270	5,872	8.9	14.1
Hainan	314	525	618	1,082	1,509	2,128	5.8	9.2
Guangxi	225	338	458	769	1,047	1,746	6.1	10.0
Inner Mongolia	317	635	737	1,037	1,632	3,090	7.3	10.8
Jilin	381	657	801	1,180	1,844	2,833	6.4	9.4
Hubei	332	645	771	1,105	1,939	2,794	7.3	9.6
Shanxi	365	687	752	1,001	1,468	2,591	6.2	9.2
Heilongjiang	564	790	922	1,361	2,146	3,436	4.2	9.8
Anhui	244	543	592	965	1,437	2,156	7.7	9.7
Jiangxi	276	466	535	844	1,327	2,204	5.7	10.6
Hunan	286	465	558	797	1,294	2,042	5.7	9.7
Henan	232	494	585	1,105	1,828	3,000	8.0	12.4
Qinghai	428	638	743	896	1,233	2,033	4.7	7.5
Xinjiang	313	660	910	1,265	1,877	2,808	9.3	8.4
Shaanxi	291	486	608	731	1,154	1,956	6.3	8.7
Sichuan	262	437	531	803	1,259	2,023	6.1	10.0
Yunnan	226	395	610	836	1,227	1,765	8.6	7.9
Guizhou	175	328	392	502	706	1,109	6.9	7.7
Gansu	348	497	553	645	1,057	1,631	3.9	8.0
Ningxia	370	585	676	909	1,302	2,102	5.2	8.4

Source: All China Data Online, China Data Center at the University of Michigan (<http://chinadataonline.org/>).

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