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Development Strategies and Regional Income Disparities in China

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Abstract

This paper argues that the regional income gap of China is endogenously determined by its long-term economic development strategy. Development strategies can be broadly divided into two mutually exclusive groups: (i) the comparative advantage-defying (CAD) strategy, which attempts to encourage firms to deviate from the economy's existing comparative advantages in their entry into an industry or choice of technology; and (ii) the comparative advantage-following (CAF) strategy, which attempts to facilitate the firms' entry into an industry or choice of technology according to the economy's existing comparative advantages.

Since the founding of the People's Republic of China, the government has pushed a CAD strategy, i.e., 'leap forward' strategy that emphasized the development of capital-intensive heavy industries. In most provinces, however, the priority industries under this strategy were inconsistent with the comparative advantage determined by the factor endowments in those provinces. Many enterprises in the priority industries were not viable in competitive markets and required interventions in the markets by the

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Keywords: economic development strategy, regional income disparities, viability, China, economy

JEL classification: O18, O53, P20, P25

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government to support and protect them. Consequently, the CAD strategy retarded the functions of market, impeded capital accumulation and hindered technology and productivity progress in the provinces. After the reform, the provinces in the central and western regions continue to follow the CAD strategy and have poor growth performance. Therefore, it is imperative to replace the CAD strategy with a CAF strategy and restructure the existing industries in each province according to the principle of comparative advantage. This latter strategy would lead to balanced development among regions and provinces.

Acronyms

CAD comparative advantage-defying strategy

CAF comparative advantage-following strategy

FDI foreign direct investment

GDP gross domestic product

PRC People's Republic of China

SOEs state-owned enterprises

TCI technology choice index

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1 Introduction

Since the economic reforms began in 1978, China has achieved remarkable economic results. Real GDP per capita grew at an average annual rate of 8.1 per cent in the period of 1978-2001.[1] Maintaining such a high growth rate over such a long period of time with a population of more than one billion is truly a miracle in world economic history (Lin, Cai and Li 1994 and 1999).

However, as shown in Figure 1(a), the coefficients of variation of GDP per capita and per worker, and Figure 1(b), the Gini coefficients of GDP per capita and per worker, the disparities among different regions within China have increased since 1990. In 2001, of the 30 provinces in China, the three metropolitan cities (Shanghai, Beijing and Tianjin), had the highest per capita GDP in current prices: 37,382 yuan, 25,300 yuan, and 19,986 yuan, respectively; and the four coastal provinces, Zhejiang, Guangdong, Jiangsu and Fujian, had per capita GDP of 14,550 yuan, 13,612 yuan, 12,925 yuan, and 12,375 yuan, respectively. In stark contrast, the four western provinces, Guizhou, Gansu, Guangxi, and Yunnan, had per capita GDP of 2,865 yuan, 4,173 yuan, 4,679 yuan and 4,872 yuan, respectively. That is, the per capita GDP in Shanghai and Zhejiang were, respectively, 13 times and 5 times that of Guizhou.

The widening regional disparities have attracted much attention both within and beyond China. Several hypotheses have been proposed to explain the widening disparities. In their empirical study of province-level growth in 1978-89, Chen and Feng (2000) stress the importance of private enterprises to economic growth. The varying developments of private economy may contribute to regional disparities. However, the experience of shock therapy in Eastern Europe and the countries formerly in the Soviet Union show that privatization itself might not promote economic growth. The vitality of private enterprises in China has been due to their entry/adoption of labour-intensive industries/technologies, which are consistent with China's comparative advantages.

Lee (1994) and Dayal-Gulati and Husain (2000) emphasize the effects of foreign direct investment (FDI) on regional disparities. However, they do not analyse factors determining the location and industrial distribution of FDI. Young (2000) argues that regional protectionism was a key factor in the widening of regional disparities because the protection of local markets led to deviations in resource allocation away from regional comparative advantages. However, regional protectionism and market segmentation were endogenous to the regional development strategy.

Other studies (Démurger *et al.* 2001; Fleisher and Chen 1997) attribute the widening of regional disparities to the biased regional policy of the central government or to location factors. In these studies, the scholars argue that the central government's investment priority favouring the eastern region was the root cause for the lagging behind of the central and western regions and, at the same time, the unfavourable geographic

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1 The data are from NBS (2002: 14-18).

conditions limited the development of the central and western regions. However, as we will point out in the following analyses, the level of the central government's investments in the central and western regions is no less than that in the eastern region, especially in the period just prior to the reforms. If the policy bias of the central

Figure 1(a)

Coefficients of variation of GDP per capita and per worker

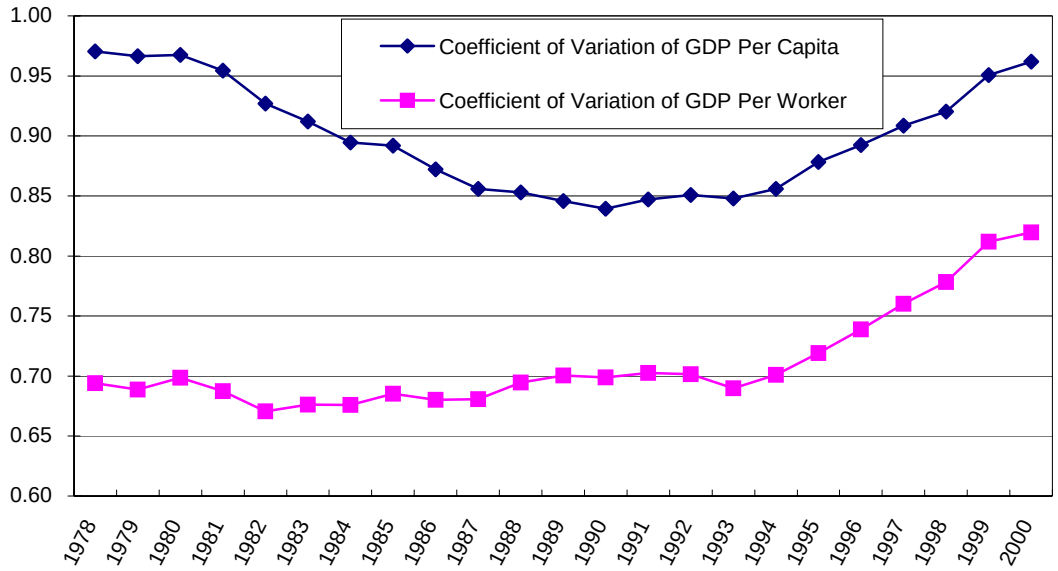
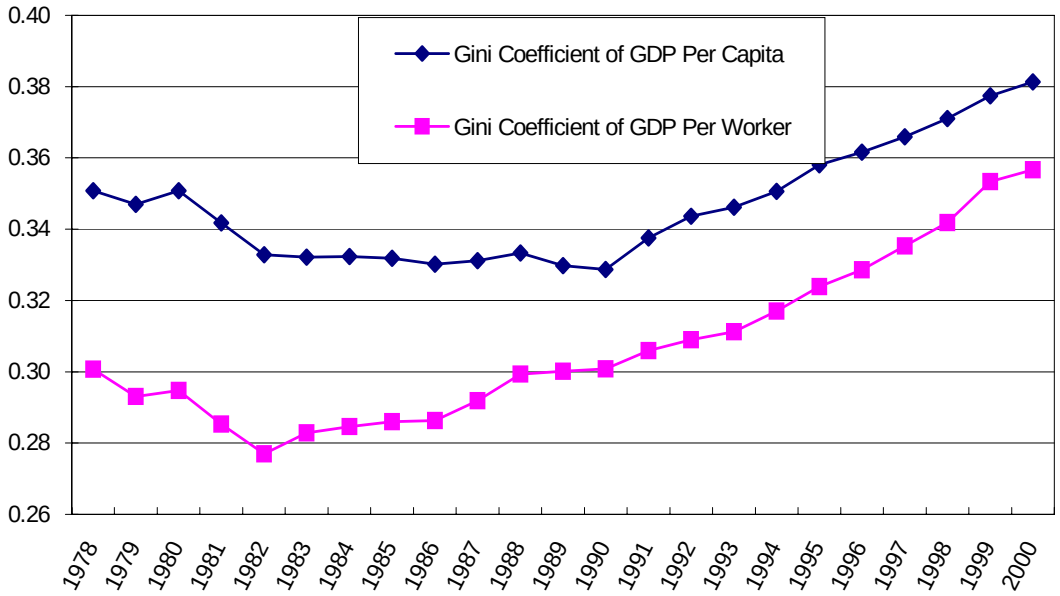


Figure 1(b)

Gini coefficients of GDP per capita and per worker



Note: The GDPs in Figures 1(a) and 1(b) are measured in 1978 prices.

Sources: NBS (1999a) and NBS (*Provincial Statistics Yearbooks*, various issues).

government's investments is the main cause for the regional disparities, it is difficult to reconcile the fact that central and western regions received large amounts of investments in the period before the reforms, but they failed to narrow the gap with the eastern region.

In this paper, we propose that a flawed development strategy is responsible for the increasing disparities in economic development among provinces in China. Since the founding of the People's Republic of China (PRC), the government has pushed a 'leap forward' strategy emphasizing the development of capital-intensive heavy industries. In most provinces, however, the priority industries under this strategy were inconsistent with the comparative advantage determined by the factor endowments in those provinces. Many enterprises in the priority industries were not viable in competitive markets and required interventions in the markets by the government to support and protect them.[2] Consequently, this leap-forward strategy retarded the functions of market, impeded capital accumulation and hindered technology and productivity progress in the provinces. The provinces in the central and western regions continue to follow the leap-forward strategy and have poor growth performance. Therefore, it is imperative to replace the comparative advantage-defying leap-forward strategy with a comparative advantage-following strategy and restructure the existing industries in each province according to the principle of comparative advantage. This latter strategy would enhance coordinated development among regions and provinces and, in effect, work more effectively to create sustainable national economic development. The regional effects of economic strategies in China are the subject of this paper.

The rest of this paper is organized as follows. Section 2 reviews regional economic development policies since the founding of the PRC in 1949, especially in the period after the reforms and liberalization. In the third section, we discuss how the leap-forward strategy has influenced regional economic development in China. The fourth section is an econometric analysis of the theories presented in this paper. Some concluding remarks are provided at the last section.

2 An overview of the evolution of China's regional development policies[3]

When the PRC was founded in 1949, the military chaos of the Japanese occupation and during the Second World War had ended and China as a nation was again ruled by a single central government. There were substantial gaps in development levels among

2 The concept of viability will be discussed in greater detail later in this paper.

3 The data in this subsection are from the NBS (1999a).

the provinces and regions at that time.[4] Data from 28 provinces[5] in 1952 show that the average per capita GDP was 134.89 yuan with a coefficient of variance[6] of 0.59 (see Figure 2). Shanghai had the highest per capita GDP of 436 yuan, while Guizhou had the lowest of 58 yuan; the former is 7.5 times the latter.

For the purpose of nation-building, the Chinese government adopted a heavy industry-oriented development strategy in its first five-year plan in 1953, focusing on the construction of 156 major projects with the assistance of the Soviet Union. Notably, due to security considerations, many of these projects were located in the northwest and southwest regions. In fact, among the 156 key projects, only one-fifth were in coastal areas.

In the second five-year plan (1958-62), the government increased its investment in the coastal areas to explore more fully the development potential of the Yangtze River delta region—with Shanghai at the helm—and of the coastal areas of northern China. The period of the third five-year plan (1966-70) included yet another strategic reallocation of China's industrial investments. As part of increased military preparedness, the central government adopted the strategy of 'third line development' and concentrated major construction projects in Sichuan, Guizhou, Shaanxi, Gansu, Shanxi, Yunnan, Hubei, and Hunan. During the fourth five-year plan, the government slowed its investment in these areas and required each province to improve industrial self-sufficiency. This change, combined with the discovery of oil in the east, prompted a resurgence of investments in

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4 China has a long history of regional disparities in economic development. The Chinese civilization originated in the Yellow River area, so since early in China's history, a high concentration of economic centres emerged along the Yellow River. During the Song Dynasty, these economic centres began to move south, and major agricultural crops changed. Manufacturing in the modern sense started with the 'importing foreign industry initiative' in the 1850s, but rather than real comprehensive industrialization, this initiative was rather selective and aimed simply to build factories in riverbank and coastal areas with good transportation conditions. At the end of the nineteenth century, most of China's industry was located in the southeast, coastal regions, with 64 per cent of all factories in China being in Shanghai, Guangzhou and Wuhan. During the ten-year period after the First World War (1928-37), China's national industries experienced rapid development and quickly boosted the growth of the national economy. In this period, the economy pursued a new trend, and heavy industries in the northeast developed quickly, giving rise to industrial centres appearing in cities like Tianjin and Qingdao. When the second Sino-Japanese war broke out in 1937, some important industrial facilities were relocated to the southwestern regions, and this movement actually helped economic development in these regions. However, generally, the southeastern areas continued to lead the other areas in economic development. From the Second World War until the founding of the PRC, regional disparities in economic development existed.

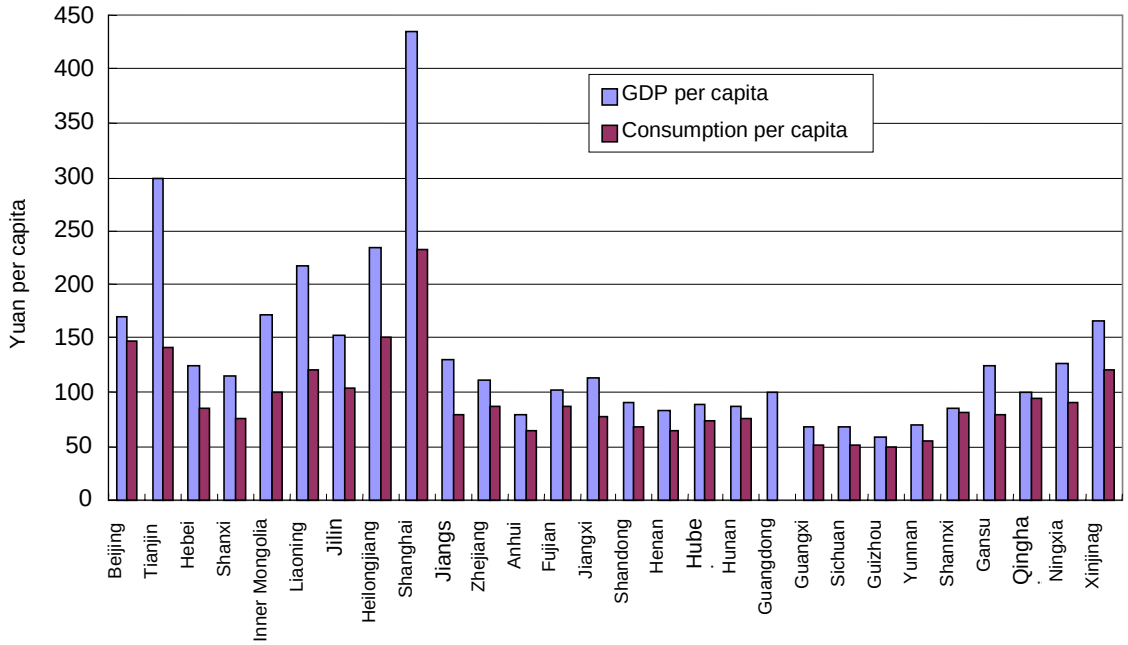
5 Data for Hainan and Xizang (Tibet) are not available; and statistics for Chongqing included in the data for Sichuan.

6 The coefficient of variance is calculated by dividing the standard variance by the mean value.

the coastal provinces. This increased coastal investment continued into the early 1970s, especially after the improvement of US-China relations.

Figure 2

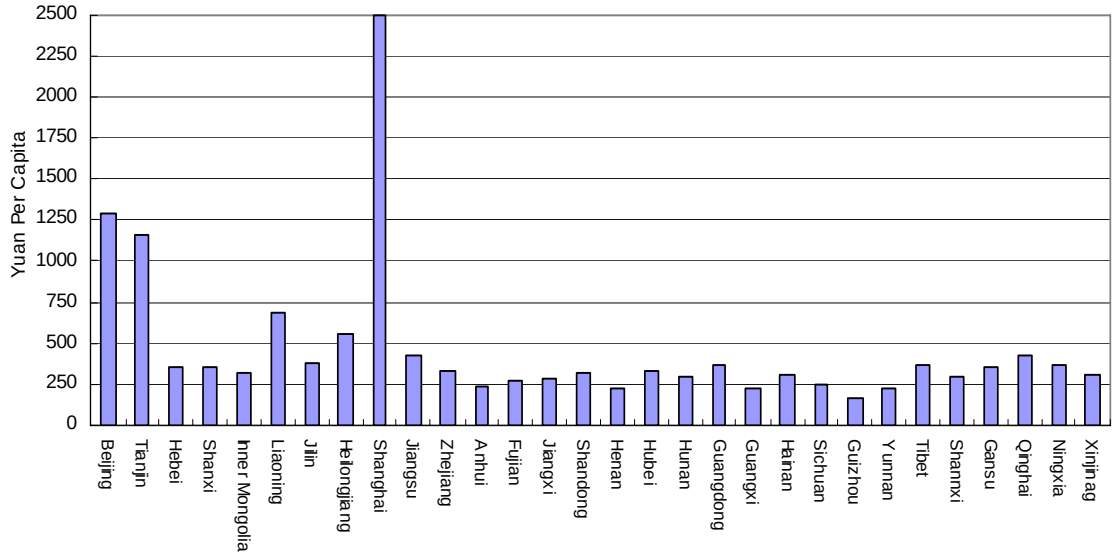
Per capita GDP and consumption expenditure in China's provinces in 1952



Source: Computed by the authors, based on data from NBS (1996b).

Figure 3

Per capita GDP in each province in 1978



Source: Computed by the authors, based on data from NBS (1996b).

According to standard neoclassical economic theories, intensive investment in the central and western areas, especially in the third-line regions, should have brought about economic development in those areas. The actual outcome, however, was very different. Before the reforms in 1978, economic development levels in the central and western areas remained behind those in the eastern areas. In 1978, Shanghai had the highest per capita GDP at 2,498 yuan, a figure 14.28 times higher than per capita GDP in Guizhou (see Figure 3). Besides the three municipalities directly under the central government (Beijing, Tianjin, and Shanghai), Liaoning had the highest per capita GDP of 680 yuan, a figure 3.89 times that of Guizhou. In 1978, the average overall provincial per capita GDP was 467.57 yuan with a variance of 0.96, much higher than the variance of 0.59 in 1952.

In the autumn of 1978, the Chinese government initiated the reform and liberalization policies. Under the leadership of Deng Xiaoping, the new policy allowed some people and some regions to get rich first.[7] The sixth and seventh five-year plans (1981-85, 1986-90) strategically declared that more concentrated development efforts would be allotted to the most promising growth regions. Thus, many areas along China's eastern coast enjoyed significant increases in investments.

An important change in fiscal policy also occurred at this time. Starting in 1980, the government began to replace the old fiscal system of 'unified revenue and expenditure' by a decentralized fiscal responsibility system, giving partial autonomy to each province for the purpose of enhancing each province's incentives to increase revenues and reduce expenditures.

By the late 1980s, the increased development investments in the coastal regions had yielded significant gains, but relative backwardness in the central and western areas became a challenge. To address this problem, the government entered the next decade emphasizing 'balanced regional economic development' in its long-term development strategies. The ninth five-year plan and long-term prospects for 2010, adopted in 1996, suggested several measures to narrow regional disparities, giving more infrastructure investments and international development agencies' loans to the central and western regions. At the end of the 1990s, the government adopted the western development strategy to promote the development of hinterland provinces. Accompanying changes in regional development policies were a reform of fiscal relations between the central and local governments in 1994, including the implementation of a tax-sharing system and the establishment of a uniform income tax for all domestic enterprises.

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7 In a conference held in March 1980 to discuss long-term plans, Deng Xiaoping pointed out that China should 'use our comparative advantages, avoid using our disadvantages and accepting the fact of economic disparities, … some people and some regions should be allowed to get rich first and in the end everyone will get rich' (Wang *et al.* 2000: 266).

3 Viability and the effects of the leap-forward strategy on regional disparities

The priority given to the development of heavy industries before the reform resulted in intensive investments in the central and western regions. However, those investments profoundly failed to bring about a corresponding increase in per capita GDP and per worker GDP in these regions. In fact, the widening of regional income disparities after the reforms also related to the above pattern of investments in the central and western regions.

In analysing the impact of development strategies on economic performance, Lin (2003: 280) formally defines the term 'viability' as follows:

> If, without any external subsidies or protections, a normally managed enterprise is expected to earn a socially acceptable profit in a free, open, and competitive market, the enterprise is viable. Otherwise, the enterprise is nonviable.

In the same paper Lin also categorizes development strategies in developing countries into two mutually exclusive groups: (i) the comparative advantage-defying (CAD) strategy, which attempts to encourage firms that ignore the existing comparative advantages of the economy in their entry/choice of industry/technology; and (ii) the comparative advantage-following (CAF) strategy, which attempts to facilitate firms' entry/choice of industry/technology according to the economy's existing comparative advantages.

The concept of viability seems to be trivial in the context of neoclassical economics because there is a belief that, if an enterprise in the long term does not expect to earn a socially acceptable profit, the enterprise will not be set up or will be driven out of the competitive market.[8] However, if a government adopts a CAD strategy, encouraging enterprises in the economy to ignore the existing comparative advantages of the economy in their entry/choice of industry/technology, these enterprises will not be viable in an open, free, competitive market (Lin 2003).

The leap-forward, heavy industry-oriented development strategy, adopted by the Chinese government since the first five-year plan, is a typical CAD strategy. The construction of heavy industries following this strategy required (i) long gestation periods, (ii) importation of foreign equipment, and (iii) large amounts of capital investment for each project. However, because China was a poor, agrarian economy at the time the leap-forward strategy was adopted, the availability of capital, foreign reserves, and investment funds were all limited. These capital-intensive enterprises that emerged from the leap-forward strategy did not conform to the capital-scarce

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8 Of course, it is not unusual that during the early period of an investment, net cash flow is negative, but the sum of discounted expected net profit over the whole investment period must be non-negative. In fact, the neoclassical economic theories presume the viability of firms.

endowment structure in China and would not have been viable in a competitive market. To establish and ensure survival of these enterprises, the Chinese government established a tripartite system, including a macro environment with distorted factor and product prices, a planned and administrative resource allocation mechanism, and a micromanagement institution characterized by the nationalization of enterprises (Lin, Cai and Li 1994).

The viability problem endogenous to the leap-forward strategy and the corresponding tripartite economic system had direct impacts on increasing regional disparities in economic development before the reforms. There are several reasons for this.

First, launching many highly capital-intensive projects in the central and western areas required large initial investments. From the statistical data alone, one may infer such an investment pattern as attempting to narrow the gap of regional development between the developed coastal region and backward hinterland region (Yang 1990). However, only a limited portion of these investments became productive capital. And even these capital investments were quite specialized for certain production purposes and had no externality on the local economies.[9]

Second, many of China's leap-forward projects required huge inputs of natural resources, raw minerals and raw products, which were produced mostly in the central and western regions. For the purpose of subsidizing those projects, the government arbitrarily depressed prices of these goods. The central and western regions were in effect subsidizing the leap-forward projects. Therefore, many construction projects in the central and western areas not only did not help economic development in these areas, but actually hampered it.

Third, although the government injected a lot of capital into the priority projects, these projects could create only limited employment opportunities for the highly educated labourforce coming mainly from the developed coastal region. The local labourforce was restricted to low productivity agriculture. Consequently, the indigenous local people's incomes remained low.

Because of the traditional system's low efficiency, China started a piecemeal gradual approach to reforming the economy at the end of 1978. The reforms first increased the autonomy of micro-agents, farmers and managers of state-owned enterprises, and then gradually the reforms extended to the resource allocation system and to the macro policy environment (Lin, Cai and Li 1994).

The gradual approach to reform enabled China to start the reforms smoothly and to have steady progress while avoiding the high costs of tumultuous social change in the reform

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9 This is because the industry and technology of those priority projects were too intensive in capital, and local economies were too scarce in capital. Therefore, it would be difficult to transfer the technology in the priority projects to the local enterprises.

process. But a gradual approach in reform also meant that different regions were not equal in grasping opportunities for regional development. Areas that were impacted the most by the leap-forward strategies faced very challenging and more numerous difficulties and required longer periods of time to accomplish the transition because the viability problems of most of their state-owned enterprises (SOEs) turned from implicit to explicit. On the other hand, those areas that were left relatively untouched by the leap-forward strategies enjoyed a much faster transition because fewer of their enterprises were burdened by viability problems.

For the purpose of subsidizing non-viable SOEs, the government continues to suppress the prices of raw materials and resource products. Suppliers of raw materials and resource products are mainly in the central and western areas. As the coastal provinces grow with the reforms, they import more of these resources from the central and western provinces. Therefore, the relatively backward central and western regions are subsidizing the growth of the relatively wealthy eastern region, causing the regional disparities to widen. Moreover, the required subsidies to the non-viable SOEs in the central and western areas have caused many problems of soft budget constraints (Lin and Tan 1999), further depressing the economic efficiency in the central and western regions.

The non-viability of many SOEs is the key issue in China's reforms (Lin, Cai and Li 1998; Lin and Tan 1999). However, the government, both at the central and local levels, continues to pay insufficient attention to this problem. In assessing the political achievements of local leaders, the central government emphasizes technological advancement and gross and net production increases. Therefore, local leaders often make decisions that disregard market signals and continue to pursue the leap-forward strategy. Fortunately, China's recent ascension to the WTO has limited the government's ability to protect/subsidize non-viable enterprises and has made all levels of government aware of the importance of following the principle of comparative advantages in developing the economy.

4 Regional disparities: an empirical analysis

4.1 A framework for empirical analysis

In order to offer deeper insights about the influence of development strategies on a region's economic development, we now present a rigorous econometric analysis. According to neoclassical growth theories (Solow 1956 and Barro 1991), an economy that has lower initial per capita income will have a higher potential growth rate due to diminishing returns in capital, leading to economic convergence.

However, neoclassical growth theories ignore the influence of economic structure, which is determined by the characteristics of development strategies, on growth. As discussed earlier, if a less developed economy adopts a comparative advantage-defying

(CAD), leap-forward strategy, its pace of economic growth will be hampered and its real growth rate prevented from reaching its full potential.

Lin (2003) constructs a technology choice index (TCI) to measure the characteristics of the development strategy in an economy. The idea behind the variable is as follows:

If an economy adopts a comparative advantage-following strategy (CAF), that is, all enterprises follow the economy's comparative advantage to choose their industries, products and technologies, the actual capital/labour ratio of the economy's manufacturing industry is endogenously determined by the capital/labour ratio of the whole economy. That is, the optimal capital intensity of the economy's manufacturing sector, K_i/L_i, can be described as a function of the economy's capital endowment, K, and labour endowment, L.

$$\left(\frac{K_i}{L_i}\right)^* = F\left(\frac{K}{L}\right). \tag{1}$$

To measure an economy's deviation from the CAF strategy, we construct the statistical indicator, TCI, the actual technology choice index of the manufacturing sector, which is defined as the actual capital/labour ratio of an economy's manufacturing industry divided by the capital/labour ratio of the whole economy. That is,

$$TCI = \frac{(K_i / L_i)}{(K / L)} \tag{2}$$

A government's choice of a development strategy will influence the economy's TCI value.

We then define the optimal technology choice index of the manufacturing sector, *TCI**. Conducting the first-order Taylor expansion of Equation (1) at $K/L=0$ and ignoring the higher order terms, we obtain Equation (3), where ω is a constant, denoting the derivative value of Equation (1) at point $K/L=0$,[10]

$$\left(\frac{K_i}{L_i}\right)^* = \omega\left(\frac{K}{L}\right). \tag{3}$$

10 $K/L=0$ means that the economy has no capital stock. Obviously, the optimal capital labor ratio in the manufacturing industry is zero. Equation (1) is a curve starting from the original point. ω is the tangent slope of this curve at the original point.

Obviously, the higher the capital/labour ratio an economy has, the higher the optimal capital/labour ratio of its manufacturing sector. That is, ω>0. Until now, we have defined the optimal technology choice index *TCI** as:

$$TCI^* = \frac{(K_i / L_i)^*}{(K / L)} = \omega \tag{4}$$

Given the endowment structure of an economy, *TCI** is the optimal *TCI*.[11] We can measure the government's deviation from the CAF strategy indirectly as follows:

$$DS = TCI - TCI^* = TCI - \omega \tag{5}$$

If a country or area follows the CAF strategy, then *DS*=0. If the government adopts a CAD strategy to promote its capital-intensive industries, we expect *DS*>0. The larger the value of DS, the stronger the CAD strategy. Furthermore, given ω, the larger the value of *TCI*, the stronger the CAD strategy.

From the above discussion, we construct the following econometric equation:

$$G_i = \alpha_0 + \alpha_1 \cdot Ln(GDPPL_{0,i}) + \alpha_2 \cdot DS_i + \psi X + u_i \tag{6}$$

In Equation (6), G_i, the dependent variable, is the average annual growth rate of per worker GDP of each province from 1978 to 2000. $Ln(GDPPL_{0,i})$ is the initial per worker GDP of each province in 1978, representing the initial level of development. According to the analysis we conducted before, if the convergence exists, α_1 is expect to be negative, and α_2, the coefficient of DS, is expected to be negative, too.

Because the optimal $TCI^* = \omega$ is not observable, we cannot calculate the value of DS_i directly. However, ω is a constant. We can therefore rearrange Equation (6) into Equation (6′), which will be used in the regression.

$$G_i = C_k' + \alpha_1 \cdot Ln(GDPPL_{0,i}) + \alpha_2 \cdot TCI_i + \psi X + u_i \tag{6′}$$

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11 In addition to factor endowments, *TCI** is expected to be affected by the stage of development of an economy and the relative abundance of natural resource in an economy. We do not consider these factors here.

In Equation (6′), $C_k' = \alpha_0 - \alpha_2 \omega$, we expect the coefficient of TCI_i, α_2, to be negative.

In Equations (6) and (6′), X denotes other explanatory variables, which we will describe in detail later.

4.2 Variables and the data resources

For the measurement of TCI_i, please refer to the work of the development strategy research group of the China Center for Economic Research (2002).[12] In fact, TCI_i reflects the characteristics of industries, products and the technology structure of each province. We have annual observations of TCI_i for each year in the period 1978-99 for each province. In order to describe the characteristics of the development strategies for the whole period, we use the arithmetical average of TCI_i for 1978-99 and denote it *TCI7899*.

In addition, we also define another indicator of development strategies, *TCI7885*, which is the arithmetical average value of TCI_i from 1978-85, in order to capture the characteristics of development strategies of each province in the initial stage of the reform.[13]

In Equation (6′), the explanatory variable X differs under different situations. According to neoclassical growth theory, the stronger the propensity to save in an economy, the higher the per worker output in the steady state. Therefore, the differences in saving propensities between economies lead to different rates of convergence. To be specific, a higher savings propensity leads to a higher income level in the steady state. Therefore, the higher the saving rate, the larger the income gap between the initial income level and the steady state income level and the fast the growth rate. Savings propensity is expressed as (SAV_i) and is expected to have a positive sign. We use Mankiw's approach (Mankiw, Romer and Weil 1992) and define the propensity to save in each province as follows:

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12 The government's heavy industry-oriented strategy can only absorb limited amounts of labour. Out of a concern for social stability, social policies always impose on firms the burden of absorbing excess labour. Therefore, firms hire more employees than are needed, and one person's work has to be assigned to three persons. This practice is not in accordance to the concept of a technology-driven leap-forward strategy that pursues priority development in capital-intensive industries. Behind the appearance of high employment is a reality of large numbers of hidden, unemployed workers.

13 The amount of labour that we use here to calculate the TCI index is larger than the real (or efficient) labor amount employed. Thus, per worker capital possession is underestimated. That is, the TCI index we get is overestimated. Nevertheless, this fact only strengthens our conclusion.

$$SAV_i = \left(\sum_{t=1978}^{2000} \frac{I_i}{GDP_i} \right),$$

where the numerator denotes fixed capital and inventory investment,[14],[15] while the denominator denotes current GDP. Both are measured in current prices.

In addition, in the neoclassical growth theory model, the greater the increases in the rates of labour, the lower the per worker income in the steady state tends to be. According to a principle similar to that of the propensity to save, we introduce the rate of labour increases in each province as an explanatory variable (denoted as $LABG_i$). This variable is expected to have a negative sign

Human capital is included as an explanatory variable in most studies of economic convergence. However, each researcher has a different definition of human capital. In this paper, we take the initial level of each province's human capital as an independent variable (denoted by $HUMK82_i$), which is defined as the proportion of individuals who had completed primary school by 1982.

Capital inflow, especially foreign direct investment (FDI), often brings with it new technology and management (Lee 1994; Dayal-Gulati and Husain 2000). Therefore, the greater the FDI inflow (denoted by FDI_i) into a province, the more advantages it has in technology progress. The measurement of FDI we use in our econometric analysis is the natural logarithm of total FDI from 1978-2000.[16] We expect the coefficient of FDI to be positive.

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14 Here we neglect the influences of government surplus and net export on savings. The relationship between these factors and productive capital is, after all, relatively weak.

15 In fact, the definition of 'savings index' here is not very satisfying. In a neoclassical framework, the savings propensity refers to voluntarily savings, and all savings become investments. The savings index in the study can also be used to represent the rate of investment. And once we take this index as the rate of investment, the policy implication from the study should be treated carefully. After all, the mechanism of voluntary savings and automatic transforming from savings to investments is totally different from the mechanism that a government uses to create a deficit budget to expand investments.

16 Strictly speaking, foreign direct investment can take various forms, including cash, technology, physical capital, etc. The definition of gross investment in national accounts is not exactly identical to the meaning of foreign direct investment. Therefore, the method in most research that uses the ratio of FDI over gross investment value to describe the impact of foreign investment upon economic growth is not very proper. In our opinion, from the perspective of technological progress, to use the absolute volume of foreign investment is a better choice than is the ratio mentioned above. Of course, in using this definition, we implicitly assume that all technological progress advantages from FDI occur at the initial stage of the investment. In fact, foreign-invested enterprises might share further information

Additionally, plenty of empirical research supports the point that China has experienced economic convergence since the reforms (Jian, Sacks and Warner 1996; Cai and Du 2000; Tsui 1991, 1993; World Bank 1995, 1997; Zhang, Liu and Yao 2001; Aziz and Christoph 2001). Stretching across a vast territory, China displays great disparities between regions in natural conditions and market capacities. In order to control these factors, we introduce two dummy variables denoting the central and western areas of China.[17]

Neoclassical growth theory ignores the structure of the economy. Realizing the disadvantageous consequences of this omission, Barro attempts to remedy this deficiency in his empirical testing of neoclassical growth theory. A variable denoting the impact on structure was introduced into the regression analysis of economic convergence in US regions. The impact variable is the sum of industrial growth rates on the national level weighted by the share of each industry in each state (Barro and Sala-i-Martin 1991, 1992). The variable reflects the neoclassical growth theory's present view on economic structure. Theoretically, Barro's understanding of the impact of structure focuses on the demand side. Although it is understandable to consider the impact of demand on economic growth, Barro's understanding of the impact of economic structure on growth violates a basic principle of economics. For instance, suppose industries grow quickly on the national level, but some provinces have comparative advantages in agriculture. Then the smaller share of industry in the agricultural provinces is not necessarily negative and unfavourable to growth. In other words, that different regions have different output structures is the result of differences in regional comparative advantages and the free movement of products and factors. Following the CAF strategy does not require each industry's growth rate in each region to be equal to the national growth rate, because the comparative advantages in each area are different and change constantly.

Certainly, in a mature market economy such as exists in the US, the patterns of industry specialization between states have conformed to the regional comparative advantages over a relatively long period of time. Therefore, Barro's understanding of the impact of structure can be regarded as the impact of demand in the short run. In other words, in the US, this variable is appropriate for describing the short-run demand impact. However, in the case of China, because of the poor match between the economic structure and the comparative advantages in each region, this variable is inappropriate. Industry has undoubtedly increased most rapidly on the national level in China since 1978. But some provinces, especially those in central or western areas, do not always have comparative advantages in industry. Therefore, specializing in the development of

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about the parent company's R&D in the future. That is to say, one-time FDI brings about continued technological progress advantages that may not initially be fully quantifiable.

17 Here, data for Sichuan includes that for Chongqing, as systematic data for Chongqing as an independent entity could not be obtained. Systematic data for Tibet and Hainan are also not available, so these two are not included.

such comparative advantage-defying heavy industry will not accelerate growth but will hinder it.

Wei (1997) adopts the impact on structure variable defined by Barro in his empirical research.[18] We use data from 1978-2000 from 29 provinces in China to calculate the impact of structure variable as defined by Barro and include it in the regression.[19] Table 1 summarizes the data set that we used in our econometric analysis.

Cheng (2002) points out that the regression results of regional convergence in China are highly sensitive to the choice of samples. To be specific, whether to regard Beijing, Tianjin and Shanghai as independent economies or integrate them into their respective surrounding provinces will lead to different conclusions. For example, Tsui (1996) includes Beijing, Tianjin and Shanghai data in provincial data, and his conclusion supports the argument for regional income divergence in China since the reforms. Other studies that support the regional convergence position are all based on methods that treat these three cities as independent economies. In this paper, we present both cases in our analysis.

The residual in Equation (6′) is assumed to be heteroscedastic, that is, $E(u) = 0, Var(u) = \sigma^2 \varsigma_i$. Under this assumption, the regressions are carried out by White's method of robustness variance-covariance matrix.

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18 In many other studies on regional economic development in China, various kinds of structure variables are included. Cheng (2002) includes an explanatory variable, the ratio of non-agricultural GDP to total GDP, to describe the influence of economic structure in the normal Barro regression. Similarly, Jian and others (Jian *et al*. 1996) use initial agricultural shares. Actually, Barro and Sala-i-Martin (1991) use the structural variable of agricultural production over total state GDP in their analysis of regional convergence of states in the US before 1929. Shen and others (Shen and Ma 2002) use a so-called industrialization index, the ratio of provincial industrial production over national total industrial production. Fang and others (Cai, Wang and Du 2001) also introduce a structural variable to describe the influence of the degree of maturity he markets: the comparative productivity of agricultural labour. The definition of this index is the proportion of agricultural production over the proportions of agricultural labour. However, they do not say whether the proportions used there were set against the national total or the provincial total.

19 Based on available data, when calculating structural variables, we divide the national economy into the primary industry, manufacturing, construction and building, trade and retailing, transportation and other tertiary industries. There are altogether six sectors.

Table 1 Dataset for empirical analysis

Province (city, section)	G_i, the average annual growth rate of per worker GDP	Ln($GDPPL_0$), initial per worker GDP	TCI7899	TCI7885	SAV, the average savings rate	LABG, the average growth rate of labour	HUMK82, the rate of primary school completion, 1982	FDI	Central areas	Western areas	Structure variable defined by Barro
Anhui	0.0730	6.4107	6.1704	10.5070	0.3815	0.0294	0.4834	12.627	1	0	0.0628
Beijing	0.0789	7.8043	2.5433	3.8859	0.4032	0.0148	0.7780	14.164	0	0	0.0886
Fujian	0.0981	6.5764	3.8099	6.4157	0.3957	0.0297	0.5525	15.024	0	0	0.0698
Gansu	0.0492	6.8381	8.8154	8.6895	0.3587	0.0366	0.4674	10.794	0	1	0.0790
Guangdong	0.1017	6.7051	3.2347	4.0162	0.2610	0.0262	0.6592	16.091	0	0	0.0736
Guangxi	0.0615	6.2556	6.2663	6.9535	0.3203	0.0267	0.6147	13.366	0	1	0.0677
Guizhou	0.0599	6.0923	7.7422	11.8262	0.1714	0.0290	0.4358	10.604	0	1	0.0658
Hebei	0.0781	6.7660	3.8184	5.2152	0.2948	0.0232	0.6365	13.606	0	0	0.0598
Henan	0.0704	6.3619	5.3099	7.7140	0.3600	0.0298	0.5702	12.996	1	0	0.0745
Heilongjiang	0.0515	7.4594	3.4011	5.1687	0.3383	0.0229	0.6781	12.818	1	0	0.0672
Hubei	0.0742	6.6726	5.0769	6.9841	0.4250	0.0205	0.6251	13.364	1	0	0.0773
Hunan	0.0655	6.4688	5.9411	8.9617	0.4197	0.0227	0.6733	13.167	1	0	0.0666
Jilin	0.0647	7.1470	4.0611	4.7230	0.4366	0.0298	0.6851	12.602	1	0	0.0667
Jiangsu	0.1062	6.7994	2.9713	4.6113	0.4708	0.0131	0.6028	15.298	1	0	0.0741
Jiangxi	0.0748	6.5419	4.6175	5.7546	0.3665	0.0248	0.5784	12.505	0	0	0.0750
Liaoning	0.0611	7.5108	3.3617	4.3924	0.3084	0.0192	0.7364	14.192	1	0	0.0659
Neimeng	0.0714	6.7902	5.1472	7.0115	0.3575	0.0223	0.6009	10.506	0	0	0.0827
Ningxia	0.0533	6.8653	3.3853	3.6154	0.1916	0.0330	0.4718	9.975	1	0	0.0719
Qinghai	0.0439	6.9790	5.2507	4.8027	0.2359	0.0272	0.4558	8.645	0	1	0.0776
Shandong	0.0836	6.6321	4.2107	6.1633	0.3703	0.0278	0.5767	14.560	0	1	0.0771
Shanxi	0.0672	6.8153	3.9497	4.9722	0.3097	0.0195	0.6874	11.924	0	0	0.0712
Shaanxi	0.0657	6.6228	4.5893	6.4586	0.2764	0.0250	0.6076	12.630	1	0	0.0794
Shanghai	0.0836	8.2704	1.7581	2.4050	0.2754	0.0077	0.7706	14.940	0	1	0.0728
Tianjin	0.0771	7.7204	1.9893	2.2888	0.2379	0.0136	0.7491	14.132	0	0	0.0893
Xinjiang	0.0827	6.6787	4.6238	6.3387	0.2755	0.0172	0.5839	10.562	0	0	0.0884
Yunnan	0.0663	6.2648	6.4853	7.4401	0.2122	0.0258	0.4269	11.808	0	1	0.0693
Zhejiang	0.1048	6.5356	2.1395	2.6067	0.4214	0.0183	0.6284	13.929	0	1	0.0650
Sichuan	0.0586	6.3922	4.3966	6.1308	0.3366	0.0194	0.6133	13.051	0	0	0.0684

Notes: (1) Hainan not included because its data for TCI are not available. In the regressions, Hainan is not included; (2) TCI7899 is the average of annual TCI for the period in 1978-99; TCI7885 is the average for the period 1978-85. *Data source*: Nominal and real GDP index from 1978 to 1998 are available in the NBS (1999b). Nominal and real GDP indices from 1999 to 2001 are available in annual books of provincial statistics. From these statistics, timeseries data for real GDP in 1978 prices can be derived. Data for employment use in G_i and Ln($GDPPL_0$) are also taken from the above-mentioned sources. Data for FDI are from China's annual statistics books. Data for the proportion of population possessing higher than rudimentary education over the total population in 1982 (which represents human capital) are available in the CASS (1985). Savings rate data for provinces are derived from the above data by dividing nominal capital formation data by nominal GDP data.

3 Results of the econometric analysis

We report the regression results in Tables 2 to 4.

Table 2 includes estimated results of the eight models. Model I uses the framework of neoclassical unconditional convergence. The result from this model does not support the unconditional convergence hypothesis. Moreover, the adjusted R^2 shows that the goodness of fit is not good. In model II and model III, we include the development strategies of each province in the initial stage of reform, TCI7885, and during the whole period of the reform, TCI7899. From the estimated results of these two models, we see that the stronger the leap-forward characteristics in the development strategies, the slower the increase in the per worker GDP. In addition, the sign of the coefficient of the initial per worker GDP has the expected negative sign.

Model IV through model VIII are based on a framework of conditional convergence. The coefficients of the development strategy variables in these models are all significantly negative. However, the initial per worker GDP has the expected negative sign but is not significant in some cases. The signs of other explanatory variables' coefficients, such as savings rates, rates of labour increases and FDI, are all as expected, however the significance of the variables is unstable. The coefficient of the human capital variable has an unexpected negative sign, and, in some cases, is highly significant. Of course, we cannot draw the general conclusion that human capital and per worker GDP are negatively related.

The eight models used to derive the results in Table 3 are the same models used in Table 2 except that we add another two dummy variables denoting central and western areas in Table 3. The inclusion of these two dummies clearly enhances the goodness of fit of all models, and the estimates for the initial per worker GDP are negative and highly significant in all models. This result indicates the existence of neoclassical convergence in China. From the regional dummies in Table 3, we can see that the growth rate of per worker GDP for provinces in the central region is significantly lower than in the provinces in the eastern region and higher than the provinces in the western regions, which reflects the influence of natural conditions and other unobservable regional characteristics on economic growth. The influence of development strategies has the expected negative sign and is statistically significant in all cases. These results indicate that the leap-forward development strategy is detrimental to an increase of per worker GDP.

Table 4 shows the results of nine models, in which the structure impact variables defined by Barro are introduced. As shown, none of the estimates for the structural impact variables are statistically significant. In sharp contrast to Barro's structure impact variables, the estimates for the development strategy variables are, as expected, negative and statistically significant in all models.

Table 2 Regression results

	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
Constant	0.0703 (0.0290) [0.0224]**	0.1807 (0.0587) [0.0050]***	0.2267 (0.0502) [0.0001]***	0.0746 (0.0478) [0.1330]	0.1281 (0.0503) [0.0188]**	0.2123 (0.0474) [0.0002]***	0.1413 (0.0497) [0.0098]***	0.2258 (0.0477) [0.0001]***
Ln($GDPPL_0$)	0.0003 (0.0042) [0.9436]	-0.0123 (0.0073) [0.1038]	-0.0171 (0.0063) [0.0113]**	-0.0039 (0.0053) [0.4712]	-0.0089 (0.0055) [0.1223]	-0.0161 (0.0082) [0.0626]*	-0.0087 (0.0052) [0.1098]	-0.0152 (0.0076) [0.0573]*
TCI7885		-0.0042 (0.0017) [0.0200]**			-0.0024 (0.0008) [0.0049]***	-0.0033 (0.0014) [0.0252]**		
TCI7899			-0.0084 (0.0020) [0.0003]***				-0.0047 (0.0012) [0.0006]***	-0.0071 (0.0021) [0.0026]***
SAVE				0.0313 (0.0244) [0.2124]	0.0395 (0.0209) [0.0732]*	0.0714 (0.0330) [0.0415]**	0.0394 (0.0203) [0.0656]*	0.0660 (0.0293) [0.0348]**
LABG				-1.2078 (0.4221) [0.0078]***	-1.0894 (0.3777) [0.0089]***	-1.1571 (0.4901) [0.0275]**	-0.8746 (0.3689) [0.0274]**	-0.7890 (0.5323) [0.1525]
HUMK82				-0.0786 (0.0269) [0.0078]***	-0.0855 (0.0249) [0.0025]***	-0.0119 (0.0506) [0.8157]	-0.0887 (0.0196) [0.0002]***	-0.0349 (0.0424) [0.4181]
FDI				0.0070 (0.0016) [0.0003]***	0.0065 (0.0015) [0.0004]***		0.0056 (0.0015) [0.0012]***	
Adjusted R^2	-0.0384	0.1214	0.4022	0.5836	0.6330	0.3271	0.6717	0.4715

Notes: (1) The figure in the parentheses under each estimate parameter is the standard deviation of the estimation; the square brackets below shows the p value of the t-test against the zero hypotheses that 'the parameter is significantly not zero. This is the same for all other OLS estimation below.

(2) As we assume that the random disturbance has heteroscedasticity, we made certain adjustments in OLS estimation. The standard deviation of the estimation reported in the table is from White's robust variance and covariance matrix. All following OLS estimations are adjusted similarly.

(3) For ease of interpretation, we denote the case where the p-value of the two-tailed t-test is less than 1% with ***; cases where the p-values are between 1% and 5% with **; and where the p-value is between 5% and 10% with *.

Table 3 Regression results (including regional dummies)

	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
Constant	0.1976 (0.0268) [0.0000]***	0.2354 (0.0316) [0.0002]***	0.2389 (0.0304) [0.0000]***	0.2100 (0.0414) [0.0001]***	0.2333 (0.0385) [0.0000]***	0.2723 (0.0285) [0.0000]***	0.2244 (0.0421) [0.0000]***	0.2609 (0.0307) [0.0000]***
$Ln(GDPPL_0)$	-0.0152 (0.0038) [0.0005]***	-0.0195 (0.0044) [0.0002]***	-0.0196 (0.0041) [0.0001]***	-0.0146 (0.0042) [0.0026]***	-0.0166 (0.0039) [0.0005]***	-0.0200 (0.0043) [0.0001]***	-0.0155 (0.0045) [0.0026]***	-0.0186 (0.0046) [0.0006]***
TCI7885		-0.0018 (0.0006) [0.0103]**			-0.0017 (0.0006) [0.0105]**	-0.0039 (0.0013) [0.0074]***		
TCI7899			-0.0035 (0.0014) [0.0179]**				-0.0029 (0.0012) [0.0263]**	-0.0028 (0.0013) [0.0350]**
SAVE				0.0104 (0.0212) [0.6292]	0.0142 (0.0178) [0.4361]	0.0161 (0.0196) [0.4212]	0.0199 (0.0209) [0.3504]	0.0218 (0.0224) [0.3428]
LABG				-1.0148 (0.3483) [0.0086]***	-0.9867 (0.3316) [0.0078]***	-0.9342 (0.3415) [0.0128]**	-0.8428 (0.3112) [0.0140]**	-0.7981 (0.3266) [0.0239]**
HUMK82				-0.0427 (0.0281) [0.1445]	-0.0577 (0.0286) [0.0581]*	-0.0328 (0.0285) [0.2643]	-0.0557 (0.0259) [0.0442]**	-0.0343 (0.0268) [0.2143]
FDI				0.0019 (0.0017) [0.2819]	0.0023 (0.0018) [0.2115]		0.0020 (0.0017) [0.2459]	
Dummy for central areas	-0.0258 (0.0040) [0.0000]***	-0.0230 (0.0040) [0.0000]***	-0.0211 (0.0043) [0.0002]***	-0.0184 (0.0055) [0.0034]***	-0.0148 (0.0056) [0.0158]**	-0.0206 (0.0041) [0.0001]***	-0.0148 (0.0058) [0.0202]**	-0.0198 (0.0045) [0.0003]***
Dummy for western areas	-0.0377 (0.0053) [0.0000]***	-0.0352 (0.0055) [0.0000]***	-0.0303 (0.0067) [0.0002]***	-0.0287 (0.0069) [0.0005]***	-0.0257 (0.0072) [0.0020]***	-0.0326 (0.0062) [0.0000]***	-0.0229 (0.0085) [0.0142]**	-0.0289 (0.0073) [0.0007]***
Adjusted R^2	0.6596	0.6794	0.7070	0.7080	0.7279	0.7239	0.7320	0.7315

Table 4 Regression results (including Barro's structure impact variable and regional dummies)

	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Constant	0.0608 (0.0354) [0.0985]*	0.1874 (0.0301) [0.0000]***	0.2262 (0.0328) [0.0000]***	0.2294 (0.0336) [0.0000]***	0.0841 (0.0464) [0.0845]*	0.2100 (0.0409) [0.0001]***	0.2413 (0.0299) [0.0000]***	0.2333 (0.0382) [0.0000]***	0.2251 (0.0413) [0.0000]***
$Ln(GDPPL_0)$	0.0077 (0.0130) [0.5575]	-0.0071 (0.0095) [0.4634]	-0.0099 (0.0093) [0.2971]	-0.0129 (0.0089) [0.1618]	-0.0108 (0.0070) [0.1369]	-0.0149 (0.0059) [0.0201]**	-0.0157 (0.0066) [0.0286]**	-0.0160 (0.0058) [0.0125]**	-0.0173 (0.0061) [0.0105]**
Barro's structure variable	-0.5622 (0.8591) [0.5188]	-0.6152 (0.5657) [0.2881]	-0.7485 (0.5319) [0.1733]	-0.4932 (0.5177) [0.3511]	0.5233 (0.4546) [0.2627]	0.0294 (0.5537) [0.9583]	-0.1507 (0.4420) [0.7367]	-0.0574 (0.5322) [0.9153]	0.1628 (0.5468) [0.7694]
TCI7885			-0.0019 (0.0006) [0.0040]***					-0.0017 (0.0006) [0.0094]***	
TCI				-0.0034 (0.0014) [0.0249]**					-0.0030 (0.0012) [0.0203]**
SAVE					0.0395 (0.0260) [0.1440]	0.0107 (0.0206) [0.6111]	0.0106 (0.0228) [0.6470]	0.0136 (0.0179) [0.4561]	0.0218 (0.0212) [0.3190]
LABG					-1.2643 (0.4260) [0.0073]***	-1.0205 (0.3467) [0.0083]***	-0.9430 (0.3583) [0.0160]**	-0.9755 (0.3054) [0.0050]***	-0.8715 (0.2983) [0.0091]***
HUMK82					-0.0815 (0.0279) [0.0081]***	-0.0433 (0.0361) [0.2450]	-0.0216 (0.0292) [0.4687]	-0.0566 (0.0349) [0.1216]	-0.0592 (0.0335) [0.0936]*
FDI					0.0070 (0.0017) [0.0004]***	0.0019 (0.0020) [0.3595]		0.0022 (0.0020) [0.2819]	0.0022 (0.0020) [0.2840]
Dummy for central areas		-0.0272 (0.0044) [0.0000]***	-0.0244 (0.0042) [0.0000]***	-0.0223 (0.0045) [0.0001]***		-0.0182 (0.0072) [0.0196]**	-0.0233 (0.0045) [0.0000]***	-0.0151 (0.0069) [0.0414]**	-0.0140 (0.0069) [0.0595]*
Dummy for western areas		-0.0372 (0.0054) [0.0000]***	-0.0344 (0.0057) [0.0000]***	-0.0301 (0.0067) [0.0002]***		-0.0286 (0.0072) [0.0008]***	-0.0341 (0.0062) [0.0000]***	-0.0259 (0.0073) [0.0023]***	-0.0223 (0.0084) [0.0163]**
Adjusted R^2	-0.0684	0.6569	0.6833	0.7017	0.5737	0.6927	0.6968	0.7129	0.7180

The regression results for the data set excluding the three municipalities are similar to those including the three municipalities. The results are not reported here but can be obtained by contacting the authors directly.

The regression results strongly support our hypothesis that if a province follows a CAD strategy, causing its TCI to deviate from ω, i.e., the optimal TCI^*, the per worker GDP growth rate in the province will be reduced significantly. Tables 4 through 6 show that the estimates for TCI7899 ranged between –0.0028 and –0.0084 and most estimates are about –0.003. If we take –0.003 as the appropriate estimate for TCI7899, this means that with a unit deviation from ω, the per worker GDP growth rate will be reduced by 0.3 per cent per year over the 1978-99 period. The fourth column in Table 1 reports the TCI7899 for each province. The exact value of ω is unknown. The second column in Table 1 shows that Jiangsu province has the highest per worker GDP growth rates among all provinces in China. If we take Jiangsu's TCI7899, which is 2.9713, as ω, we can infer the impact of the development strategy on each province's growth. For example, Guizhou's TCI7899 is 7.7422, so its DS (DS is defined in Equation 5) is 4.7709. Therefore, Guizhou's per worker GDP growth rate was reduced 1.43 per cent per year over the period in 1978-99.

5 Concluding remarks

In this paper, we study regional disparities in China's economy. It is found that a province's attempt to adopt a CAD strategy in industrial development has a significantly negative effect on the province's GDP growth. Judging from the TCI in each province, shown in Table 3, the central and western provinces tend to follow the CAD strategy more closely than do the eastern provinces. Pursuit of the wrong industrial development strategy in the central and western regions contributed to the observed widening of regional disparities after the 1978 reforms. It is imperative for each province, especially those provinces in the central and western regions, to allocate its new additional investments and restructure its existing industries according to its regional comparative advantages so that the regional disparities can be narrowed along with the dynamic growth. To shift the development of a regional economy away from its comparative advantage requires that the government protect/subsidize enterprises that are not viable due to their ambitious choices of industries, products and technologies. The accession to WTO is greatly reducing the possibility for the Chinese government to protect/subsidize any enterprises. In anticipation of the requirements of the WTO accession, the Chinese government has formally adopted the principle of comparative advantage as a guideline for the future development of the agriculture, manufacturing, and service industries and for the adjustment of the national economy in the 10th five-year plan in 2001. Regional disparities may not be eliminated totally due to the differences in natural conditions. However, in the new era after the WTO accession, the trend toward the widening of regional disparities may be mitigated.

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