The political economy of emissions reduction in China
Are incentives for low carbon growth compatible?

Cai Fang and Du Yang

There is growing, unassailable evidence of severe existing and potential consequences of global climate change and of the relationship between human economic activities and global warming (for example, Stern 2007). The Kyoto Protocol and the Bali climate conference road-map proposed either compulsory or moral requirements for action from all economies—including China, which has the largest population size, the fastest growth rate and the second-largest gross domestic product (GDP) in purchasing power parity (PPP) terms. As research (Thomas 2007) estimates, assuming the ratio of carbon dioxide emissions to GDP remains at the 2001 level, total global emissions will reach as high as 25 billion metric tonnes by 2018. While this will represent an increase in global carbon dioxide emissions of 69 per cent, emissions in China will increase to 9 billion tonnes—a growth of 218 per cent, exceeding all other countries in terms of total emissions.¹

It seems to be the case that China's emissions reduction efforts are motivated by international pressure, which the central government passes on to local governments and enterprises. If, however, external pressure is the sole motivating factor for the government to take the issue seriously—and it is not induced endogenously by China's economic growth per se—China will face great difficulty reducing emissions because there will be a lack of incentives to carry out emissions reduction strategies. That is, the following questions should be answered before we can be confident about the realisation of the strategic goal. First, does the central government have persistent volition to carry out the policy, in financial and administrative terms? Second, are local...
governments willing to sacrifice short-term growth for sustainable long-term development? Third, can an enterprise’s behaviour in dealing with emissions reduction incentives be compatible with the government’s intentions? As has been widely observed, China’s rapid economic growth during the transitional phase was stimulated largely by local governments pursuing GDP growth and the resulting enhancement of fiscal revenue. To guarantee an effective implementation of the strategy, any slow-down of economic growth supposedly caused by emissions reduction must be compensated.2

Those policy advocates for China’s emissions reduction who emphasise the issues of obligation and responsibility but pay no attention to issues relating to capability and incentive, are irrelevant in policy decisions and incomplete in theoretical consistency. The argument of this chapter is that the relative bargaining power and effectiveness of policy advocacy are determined by the dominant priorities and the particular stage of development. While conditions mature, incentives, behaviour and priorities change. The environmental Kuznets curve (EKC), which depicts the relationship between per capita income and environmental quality, is a reflection of such political and economic logic (Deacon 2005). While the EKC is indicative of a simplified correlation of environmental appearance with environmental requirements associated with per capita income, there can be deeper implications behind it. In the case of China, the government’s behaviour, characterised so far by its developmental state, which consists of strong development impulses from the central and local governments, responds more sensitively to the demands from potential changes in growth patterns than to the demands from income increases.

In this chapter, we discuss the continuing fundamental changes in China’s development stage and the implications for growth patterns. Taking sulphur dioxide emissions as an example, we estimate a Chinese EKC and try to reveal incentive mechanisms and policy focuses for implementing emissions reduction strategies from the empirical findings. The following questions are expected to be answered: 1) can the orientation of growth policy be changed as a result of interaction between central and local governments; 2) are emissions reductions and low carbon growth financially feasible; and 3) can incentives be compatible between the central government, local governments, enterprises and the general population in implementing a strategy of emissions reduction?

Development stage and growth patterns

China’s environmental problems are the result of its economic growth pattern, characterised by a reliance on labour and capital inputs rather than on productivity enhancement, although this growth pattern suits a particular
development stage. The Chinese stimulation of economic growth is unique in combining central and local governments to form a developmental state, which characterises the outstanding government function in economic development. Consequently, while individual enterprises inherently tend to respond to growth pattern changes—which emissions reduction is the result of—regulations and other government reactions are much more important in guaranteeing the realisation of the strategy. The impending new development stage will help the government shift its policy orientation by making the relevant regulations incentive-compatible among stakeholders.

The political economy of emissions reduction relates to the different reactions of all relevant parties. First, for the central government, decision-making has to do with the recognition of the importance of emissions reduction as required by the change in the development stage. Second, for local governments, incentives to shift growth patterns from input driven to productivity driven and a willingness to sacrifice short-term growth in GDP and fiscal revenue for sustainable growth are more relevant in response to the central government’s mandate. Third, for enterprises, which are supposed to care more about profitability than externality, immanent irritants requiring transition from inputs-based to productivity-based expansion are generated by modification of the production factor endowment. Finally, for people, stronger demands for environmental quality come ultimately from the transition from a livelihood dominated by subsistence pressures to comprehensive human development that alters in accordance with development stages. In the final analysis, an environmental strategy can be implemented effectively only by combining the quartet of capacity, responsibility, obligation and incentive.

In his prominent paper on the relationship between economic growth and income inequality, Kuznets (1955) postulates that in the economic growth process, income inequality first increases then declines after reaching a turning point. Environmental economists later applied this inverted U-shape curve to depict a similar relationship between economic growth and environmental quality (Grossman and Krueger 1995). The EKC can also be a useful framework with which to examine whether the Chinese economy possesses inherent momentum to transform its growth pattern to a more environmentally friendly one and, in particular, to understand the political economy behind the transformation.

In more concrete terms, we investigate the ways in which the changes in development stages impact on environmental policy decisions from two aspects. First, the change in development stage requires transformation of growth patterns. The economic growth pattern can be referred to in ways in which factors of production are allocated at micro and macro levels and it can usually be classified by what kinds of sources the economic growth is based on. Thanks
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to the earlier than expected completion of demographic transition, the entire period of reform and opening-up in China has been characterised by adequate labour force supply and a high savings rate. This demographic dividend resulting from a productive population structure has been realised through marketised resource allocation mechanisms and participation in the global economy. The favourable population factor has provided China’s economic growth with a window of opportunity and, therefore, the phenomenon of diminishing return to capital has been deterred (Cai and Wang 2005). In the meantime, economic growth in transitional China has relied heavily on inputs of production factors rather than on productivity improvement. After a short rise in total factor productivity (TFP) and its contribution to growth in the early stages of reform, China’s TFP performance has been unsatisfactory since the 1990s (for example, Zheng and Hu 2004; Kuijs and Wang 2005). This was a major attribution of the growth pattern characterised by heavy pollution, high depletion and low efficiency (Kaneko and Managi 2004).

Similar stories were told about the early experiences of the ‘Four Tigers’ when they created the disputable ‘East Asian miracle’. At the time, Krugman (1994) noted that the economic growth in East Asia was fuelled merely by inputs of labour and capital, and the growth of TFP and its share of economic growth were insignificant. Krugman believed the miracle was doubtful; his judgement was based on the neoclassical theory of growth, which assumes diminishing returns to capital due to limited supplies of labour, which was not true in those economies. The facts subsequently showed that once the dual-economy feature of an unlimited labour supply disappeared, those economies had to transform their economic growth patterns from inputs driven to TFP driven—and have since sustained their growth (Bhagwati 1996). After three decades of extraordinary economic growth, fuelled largely by demographic dividends, and as the population ages rapidly and the reservoir of surplus labour in rural areas runs dry, China’s labour supply and demand scenario has changed fundamentally since 2004. With the approach of a Lewis turning point, conditions under which economic growth becomes increasingly reliant on productivity improvement rather than on expansion of inputs are maturing (Cai 2008).

In addition, the increase in per capita income induces people’s desire for security and quality of life, and their calls for a better environment. A decade ago, the World Bank (1997) estimated that in 1995, financial losses resulting from air and water pollution were worth US$54 billion, accounting for 8 per cent of China’s total GDP. Since then—namely, during the period from 1995 to 2006—the real per capita income of urban households increased by 131
per cent, and the real per capita income of rural households increased by 74.8 per cent. As a result of a much faster rate of income growth for the upper group, the richest 20 per cent earned 4.6 times more than the poorest 20 per cent. Per capita income level is the decisive factor in both of the widely used approaches to estimating losses caused by environmental damage—namely, the human-cost and the willingness-to-pay approaches. The upper income group, especially, has stronger bargaining power to have an impact on policy decisions about environmental issues. Therefore, the outstanding performance of income enhancement for Chinese residents must play a role in increasing calls for environmental improvement. Frequent environmental incidents in recent years have shown how quickly and enthusiastically citizens and the press can respond to environmental disasters (Hayward 2005).

The concerns of Chinese residents, scholars, policymakers and, to a lesser extent, enterprises about environmental quality have been translated into the central documents and protocols of the eleventh Five-Year Plan. The documents make repeated calls for transformation of growth patterns and the eleventh Five-Year Plan stipulates restrictive criteria for emissions reductions. As a response partly to those regulations and partly to the increase in prices of raw materials and wages, Chinese manufacturing enterprises successfully improved the efficiency of their usage of intermediate inputs and labour productivity (Kim and Kuijs 2007).

**China’s environmental Kuznets curve**

An effective way of understanding the relationship between economic development and emissions in China is to depict the EKC. As we have mentioned already, economic development and demand for environmental quality as a result of improved living conditions can be represented by per capita GDP. When discussing EKC therefore, we employ provincial panel data to explore the relationship between emissions and per capita GDP and observe when the Kuznets turning point appears. The two main emissions are those of carbon dioxide and sulphur dioxide; however, this chapter describes only the EKC of sulphur dioxide because the data for carbon dioxide emissions are not yet available officially.

Sulphur dioxide is one of the main air pollutants produced by the combustion of sulphur compounds and is of significant environmental concern. Since coal and petroleum, which are the main sources of energy in China, often contain sulphur compounds, their combustion generates sulphur dioxide. In 2005, total sulphur dioxide emissions in China were 25.49 million metric tonnes—the highest in the world. In the eleventh Five-Year Plan, limiting sulphur dioxide
emissions is one of the main goals for environmental protection. The plan requires a 10 per cent reduction in sulphur dioxide emissions by 2010—that is, total emissions of sulphur dioxide should not exceed 22.95 metric tonnes.

Data for our empirical analysis were collected from the *China Statistical Yearbook* (NBS, various issues). The variables we chose included sulphur dioxide emissions, per capita GDP, industrialisation levels and population by province from 1991 to 2006. Due to incomplete data for Tibet and Chongqing, we excluded these two provinces from the data sets. Table 10.1 displays the summary of statistics of the variables. Average sulphur dioxide emissions for all observations were 14.02 metric tonnes per 1,000 people; they reached 19.37 metric tonnes per 1,000 people in 2006. Grouping the averages of sulphur dioxide emission levels in the period 1991–2006 by region, we found slightly more emissions generated in the coastal areas than in the central and western areas, but the eastern provinces emitted much less sulphur dioxide (15.2 metric tonnes per 1,000 people) than their central and western counterparts (21.6 metric tonnes per 1,000 people) in 2006 alone. In addition, it is worth noting that the disparities of per capita GDP in 2006 were greater than the time series average.

### Table 10.1 Summary statistics of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean in 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All provinces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO2 emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(metric tonnes/1,000 people)</td>
<td>14.02 (8.74)</td>
<td>1.48</td>
<td>57.95</td>
<td>19.37 (12.53)</td>
</tr>
<tr>
<td>Per capita income (1990 yuan)</td>
<td>4,954 (4,407)</td>
<td>860</td>
<td>34,200</td>
<td>9,743 (7,069)</td>
</tr>
<tr>
<td>Population (million)</td>
<td>41.2 (25.3)</td>
<td>45.4</td>
<td>97.2</td>
<td>43.5 (26.6)</td>
</tr>
<tr>
<td><strong>Coastal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO2 emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(metric tonnes/1,000 people)</td>
<td>14.29 (7.33)</td>
<td>14.8</td>
<td>33.19</td>
<td>15.23 (6.79)</td>
</tr>
<tr>
<td>Per capita income (1990=100)</td>
<td>8,516 (5,727)</td>
<td>1,794</td>
<td>34,200</td>
<td>1,712 (766.4)</td>
</tr>
<tr>
<td>Population (million)</td>
<td>39.85 (28.6)</td>
<td>67.4</td>
<td>93.1</td>
<td>44.3 (32.9)</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO2 emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(metric tonnes/1,000 people)</td>
<td>13.88 (9.41)</td>
<td>3.55</td>
<td>57.95</td>
<td>21.55 (14.37)</td>
</tr>
<tr>
<td>Per capita income (1990=100)</td>
<td>3,080 (1,499)</td>
<td>860</td>
<td>8,518</td>
<td>5,861 (1,497)</td>
</tr>
<tr>
<td>Population (million)</td>
<td>42.0 (23.4)</td>
<td>45.4</td>
<td>97.2</td>
<td>43.0 (23.7)</td>
</tr>
</tbody>
</table>

**Note:** We define Beijing, Tianjin, Liaoning, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong and Hainan as coastal areas, and the remaining provinces as central and western areas.

We now describe the time trend and regional characteristics in detail. Figure 10.1 shows the changes in China’s per capita sulphur dioxide emissions as a whole over time. While there has been a general trend of increases in sulphur dioxide emissions in the past decade, emissions have accelerated since 2002. With rising public attention paid to environmental protection and improved capacity for implementation, the amount of sulphur dioxide limitation has increased more rapidly than emissions. In general, the growing pattern of sulphur dioxide generation can be characterised by a higher rate of removal and bigger increases in emissions in terms of absolute magnitude. This implies that, with enormous economic growth, current efforts of removal and recovery cannot adequately counter emissions.

Figure 10.2 shows the changes in regional emissions of sulphur dioxide over time; the proportion of emissions generated in the central and western provinces of the total enhances over time. The ratio of emissions in 19 interior provinces to that in 10 coastal provinces was 1.57 in 1991, but it increased to 2 in 2006. Given the increasing disparities in economic development between eastern provinces and central and western provinces in the same period, the

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**Figure 10.1** Emissions and removals per capita of sulphur dioxide in China, 1991–2006

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efficiency gains of emissions reduction in coastal areas are much higher in real terms, whereas those in the interior provinces are dissatisfied. This rejects any attempt to take emissions in China as a homogenous issue and suggests a methodology that treats the two distinct regions differently while trying to do any meaningful analysis.

The scattered observations in terms of sulphur dioxide emissions at certain times shown in Figure 10.3 further reveal the great heterogeneity between the coastal and interior regions. The horizontal axis represents the levels of per capita GDP in 1990 prices and the vertical axis the levels of per capita sulphur dioxide emissions. At a relatively low level of per capita income for coastal and interior regions, there was no significant difference in emissions between the two regions. As each of the economies grow, the levels of emissions grow, with an even larger divergence in emissions than in economic growth, implying that if there is a sign of EKC, it must be the case that the eastern provinces alone present the path of increase first and then decline in emissions.

To see whether an EKC in terms of a sulphur dioxide emissions pattern exists, we run a regression to examine the relationship between regional economic development and sulphur dioxide emissions based on the following empirical model.

\[
S_{i,t} = \alpha + \beta_1 y_{i,t} + \beta_2 y_{i,t}^2 + \beta_3 m_{i,t} + u_i + v_t + \varepsilon_{i,t}
\]

in which \( S_{i,t} \) is per capita sulphur dioxide emissions of province \( i \) in year \( t \), \( y_{i,t} \) and \( y_{i,t}^2 \) are per capita GDP at the 1990 constant price and its square term of province \( i \) in year \( t \), and \( m_{i,t} \) is the level of industrialisation of province \( i \) in year \( t \) measured by the ratio of value added in the industrial sector to total GDP. \( u_i \) is the province dummy reflecting the persistent provincial difference, such as different patterns of energy consumption, regulation of energy use and environmental protection, preferences for energy consumption and so on. \( v_t \) is the year dummy to control the factors that change with time, apart from economic development, such as commodity and energy prices, technology for sulphur dioxide removal and the like. \( \varepsilon_{i,t} \) represents randomly disturbing factors apart from time and region. As in other studies on the EKC, the purpose of this estimation is to look at the significance and sign of \( \beta_1 \) and \( \beta_2 \) to decide if they present an inverted-U shape.

Table 10.2 presents the regression results. The three columns list regression results for all 29 provinces, for coastal provinces and for central and western provinces, respectively. The fitness to model varies among regions: that for the model of coastal areas has the highest overall \( R^2 \) in three equations, while
Figure 10.2  **Regional composition of sulphur dioxide emissions, 1991–2006**

![Graph showing regional composition of sulphur dioxide emissions from 1991 to 2006. The graph displays two categories: Coastal and Other. The emissions are shown in thousands of metric tonnes.


Figure 10.3  **Sulphur dioxide emissions against per capita GDP by province, 1991–2006**

![Graph showing sulphur dioxide emissions against per capita GDP for coastal and other regions from 1991 to 2006. The emissions are shown in metric tonnes per 10,000 people, and the GDP is in 1990 prices.

that for other areas is low. The model for coastal areas explains 58 per cent of variations of sulphur dioxide emissions, while that for others explains only 5 per cent.

What concerns us are the signs of the square term of per capita GDP in all three equations, because the negative signs indicate the existence of an EKC, though the coefficients are statistically insignificant for the regression for central and western provinces. For this reason, we can infer that the presence of an inverted-U shape for the pooled sample exists only because the general pattern of sulphur dioxide emissions in coastal areas shows a predictable Kuznets turning point. Based on the regression results in the first column, we can plot a graph that depicts the changing pattern of sulphur dioxide emissions in China as a whole, denoted by 29 provinces (Figure 10.4). Looking at Figures 10.3 and 10.4, the plots of observations for the central and western areas scatter far left of the turning point, while those for the coastal areas stand around the turning point. The huge heterogeneity identifies a need to distinguish between the two regions when observing the EKC in China.

We now use information from the second column in Table 10.2 to predict the EKC for coastal areas, and show the outcomes in Figure 10.5. According to the parameters estimated from the current sample, the turning point appears when per capita GDP reaches RMB18,963 at the 1990 constant price. Beyond this point, emissions are supposed to decrease. With this pattern, provinces that surpassed the turning point in 2007 included Beijing, Tianjin, Shanghai and Zhejiang, while Guangdong and Jiangsu were very close to the point in terms of per capita GDP. In other words, in the current circumstances, many provinces in eastern China have already had the capacity and incentives to reduce their sulphur dioxide emissions—namely, to afford low carbon growth.

On the other hand, with accelerating economic growth, the central and western provinces continue their patterns of emissions. In the third column of Table 10.2, we see that coefficients of per capita GDP and its square term are statistically insignificant. If we use a different specification without inclusion of the square term, as shown in the last column of Table 10.2, we see a significant and positive coefficient for the variable of per capita income, which implies that the central and western regions stay at a phase of increasing emissions. As is expected, Figure 10.6 shows that, though diverging, most of the provinces in the region are scrambling in line with monotonously increasing sulphur dioxide emissions. In comparison with the predicted EKC of the eastern provinces, the picture here does not show any sign of an EKC.
<table>
<thead>
<tr>
<th></th>
<th>All provinces</th>
<th>Coastal areas</th>
<th>Interior areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita in 1990 price</td>
<td>.0033</td>
<td>.010</td>
<td>.031</td>
</tr>
<tr>
<td></td>
<td>(1.38)</td>
<td>(3.10)</td>
<td>(1.54)</td>
</tr>
<tr>
<td>Square term of GDP per capita</td>
<td>-2.09e–07</td>
<td>-2.68e–07</td>
<td>-1.21e–07</td>
</tr>
<tr>
<td></td>
<td>(3.35)</td>
<td>(4.06)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>Ratio of secondary industry in GDP</td>
<td>3.77</td>
<td>3.93</td>
<td>4.41</td>
</tr>
<tr>
<td></td>
<td>(6.26)</td>
<td>(5.99)</td>
<td>(4.63)</td>
</tr>
<tr>
<td>Fixed effect, provinces</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fixed effect, years</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant</td>
<td>-44.1</td>
<td>-75.5</td>
<td>-104</td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td>(2.23)</td>
<td>(2.60)</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within</td>
<td>0.47</td>
<td>0.48</td>
<td>0.53</td>
</tr>
<tr>
<td>between</td>
<td>0.06</td>
<td>0.61</td>
<td>0.002</td>
</tr>
<tr>
<td>overall</td>
<td>0.15</td>
<td>0.58</td>
<td>0.051</td>
</tr>
<tr>
<td>No. of observations</td>
<td>464</td>
<td>160</td>
<td>304</td>
</tr>
</tbody>
</table>

**Note:** t value is in parenthesis.

Figure 10.4  **Environmental Kuznets curve: 29 provinces**
Figure 10.5  Environmental Kuznets curve: coastal provinces

Figure 10.6  Environmental Kuznets curve: central and western China
Conclusion and policy implications

Exemplified by sulphur dioxide emissions, the Chinese EKC shows the existence of a relationship between income increases and environmental improvement. There are, however, issues to be considered apart from the general conclusion.

First, while one can expect a future turning point from increases to decline in emissions for China as a whole, most Chinese provinces are still far from reaching that point. The central and western provinces in particular still have a strong desire for economic growth at the cost of the environment in order to catch up with their eastern counterparts. If the previously outlined path is followed, China will have to suffer further environmental degradation before reaching its spontaneous turning point, because the experiences of a spatial transfer of industries show (and the EKC implies) that the latecomers in economic growth tend to receive the transferred industries from their advanced counterparts in accordance not only with their comparative advantage but with their acceptance of environmental degradation—that is, there will be a tendency for the central and western regions to welcome polluting industries transferring from eastern regions. Given the strong desire for growth in the less-developed provinces and the large income gap between Chinese provinces, single incentives such as per capita income are not sufficient to lead those regions to the Kuznets turning point. Genuine changes must rely on the introduction of incentives and regulations based on the need for transformation of growth patterns.

From the regression results, one can see a great heterogeneity of sulphur dioxide emissions among regions, which suggests distinct policy packages for different regions in terms of emissions reduction. For most coastal provinces, which either passed through or are moving towards the Kuznets turning point, the inertial path and intrinsic forces can lead them to reduce emissions spontaneously. As far as the central and western provinces are concerned, it is hard to predict when they will enter the Kuznets turning intervals since the emissions in these areas are accelerating. In this regard, it is essential to enforce regulations to limit their emissions behaviour as total emissions in China are already the highest in the world.

Although we estimated a reasonably fitted EKC and its visible turning point for the eastern regions, observations differ substantially. Even for those observations whose positions are on the right interval of the turning point, they stand at different plots, implying significant heterogeneity among the eastern provinces. In general, the emissions in the east remain high and their decline will be slow.

Studies show that while a general relationship between per capita income and environmental quality has been observed, there are huge differentials
across pollutants. Greenhouse gas emissions, while concomitant with those such as sulphur dioxide that are directly harmful to people’s health, usually do not follow exactly the same path as other pollutants. As a greenhouse gas with no smell and no immediate harm to health, carbon dioxide emissions have not shown a significant path as the EKC suggests. For instance, the previous empirical studies rarely found an EKC between income levels and carbon dioxide emission patterns. If there are rare cases, they show that the turning point indicating carbon dioxide emissions tending to decline comes much later and requires several times higher income levels than do other pollutants (Webber and Allen 2004).

It is believed widely that because of China’s enormous population size, the dominance of manufacturing in its industrial structure and the low efficiency of energy usage, in international rankings, China is positioned high in terms of per capita emissions and low in terms of per GDP emissions. Starting with this feature, there is a tendency for China to converge with rest of the world—that is, its per capita emissions have been found to increase over time, reflecting the development emissions effect, and the per GDP emissions decline, reflecting the progress of technology and improvements in efficiency (Figure 10.7). As is expected, the overall performance of carbon dioxide has not been as good as that of sulphur dioxide.¹

Even though the EKC is not a sufficient notion for revealing the complete determinants of the rise or fall of emissions, it is useful to justify the existence of the relationship between levels of development and pollution, because it shows that governments, enterprises and people are willing and able to respond positively to changing environmental requirements derived from changes in developmental stages and therefore growth patterns. The predictable EKC and turning point disclose the governmental cognition, determination and policy measures in respect of the environmental issues, and the incentive compatibility between stakeholders—although they by no means imply that the chronic environmental problems can be solved xenogenetically when the time comes. Activities conducted by governments at all levels, such as education and the provision of information, play a role in shortening the time of solving the problem (Deacon and Norman 2004).

Our empirical results show that there is high heterogeneity in sulphur dioxide emissions across provinces, which is also true for the emissions pattern of carbon dioxide; therefore, the policies regarding emissions should be specified regionally. In China’s case, given the strong motivations of the central and western provinces to catch up with their eastern counterparts, one of the challenging tasks for the central government is to design a well-functioning
mechanism to provide incentives that will translate the implications drawn from changing growth patterns into changes in the function and behaviour of local governments to spur regional economic development. Such policy measures include those that improve transfers between central and local governments and among regions, provide physical and financial incentives for less-developed regions to choose sustainability rather than exploitation of growth potential and to implement emissions reduction policies with incentive compatibility between agents.

The effectiveness of emissions reduction policy lies in the endogenous demands for change in growth patterns and requirements for a better environment. Only when economic development moves to the stage at which economic growth becomes productivity driven can the policy package aimed
at significantly reducing greenhouse gas emissions be incentive-compatible with the development motivations of local governments and the behaviour of enterprises. By estimating the EKC, this chapter examined the need for the Chinese economy to implement emissions reduction strategies. The results show that it is not enough to wait for the turning point to come; instead, policy implementation should be strengthened further in order to make incentives compatible between the central and local governments, enterprises and people in a joint effort to reduce emissions and improve the environment.

Notes

1 The figures for China's carbon dioxide emissions are disputable. Apart from official Chinese denial of the figures estimated and published by Western scholars, there is a problem of emissions transfer—that is, in the past two decades, an increasing amount of the polluted, energy-consuming and emission-producing products have been manufactured in China, but consumption has taken place mainly outside China.

2 In his discussion at a workshop, Assar Lindbeck (2008) raised the issue of government incentives for emissions reduction as a sacrifice of growth. His concern was that the central government’s imposition of emissions duty on local governments could result in strong resistance from the latter and countermeasures against it, leading to policy failure.

3 Auffhammer and Carson (2008) forecast a likely scenario of a dramatic increase in carbon dioxide emissions in China in the future. As a consequence, China is expected to take the lead in global greenhouse gas emissions.

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