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# *Insight: The Relationship Between Environmental Protection & Economics Growth in China*

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***Abstract:*** Stepping ahead into the 21st century, one alarming challenge put upon human society is to balance a healthy relationship between protecting mother earth and achieving economic growth. Back in 2017, China, one of the world's leading superpowers, proposed its answer to the problem with the Dual Control policy package. This passage serves as an explanation of the Chinese Dual Control and as an evaluation of its true effectiveness after 5 years of implementation timespan. The research team considered short-run economic impacts as well as long-run effects of the Dual Control and eventually reached an overall appraisal concerning its rationality. The team then constructed an analytics hierarchy process (AHP) model to consolidate the prior evaluations. Specifically, the research team divided the current status into the economic part and the environmental part. For each part, the team compiled historical statistics and relatable indexes to eventually form the Environmental-Economic Index (EEI). Based on the modeling results, the team also suggested original policy recommendations to further improve the situation. Examples include the woodland preservation policy package, the build-operate-transfer model, and the feasible emission trading system currently in use by several global nations.

***Keywords:*** Dual Control, Environmental Protection, Economic Growth, Analytic Hierarchy Process Model, Environmental Economic Index

## 1. Introduction

Ever since the start of the industrial revolution, pollution has started to gradually increase in severity, posing a greater challenge to the world on an annual basis. The industrial revolution certainly enabled greater productivity, but it also caused great harm to the environment. In the present day, pollution and climate change are becoming increasingly serious problems. China has long been the biggest carbon-emitting nation worldwide (30% of total global emissions) [1], and this percentage has grown steadily in the past 10 years. Therefore, reducing emissions is a necessary practice.

In order to counter the fierce environmental crisis, China introduced a "Dual Control" (DC for short) policy series, which aims to lower total energy consumption (kWh) and energy consumption intensity (kWh/GDP). At the same time, the growth of industrial production may be potentially

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impeded by these measures, as the Chinese industrial growth rate has decreased consistently since the implementation of DC. During the 13th Five-Year Plan period, the country not only put forward the energy intensity target of reducing energy consumption per unit of GDP by 15% compared with 2015, but also set the target upper limit of total energy consumption of 5 billion tons of standard coal [2].

There are also remarkable results during the 14th Five-Year Plan period. China continued to control both the total and intensity of energy consumption and reducing energy consumption per unit of GDP by around 3% was listed as the main development target for 2021 in the government work report [2].

## 2. Current Policies: China's Dual Control of Energy Consumption

### 2.1. Short Run

#### 2.1.1. Reduced Industrial Output

The straightforward consequences of these policies are pronounced. First, industrial product outputs have dropped sharply as processed steel production in Inner Mongolia dropped from 25% in 2019 Q1 to 4.4% in 2021 Q3. Overall, DC has a negative effect on China's real GDP of -0.4% -0.6% [3]. The decreased output and increased production costs have caused drastic unemployment & firm shutdowns. The rate of operation for traditional blast-furnace metal firms has decreased continually, from around 65% in Jan.2019 to a mere 52% in Sep.2021. Over the same period, the survival rate for midstream businesses also dropped fiercely from over 70% to around 60% [4].

#### 2.1.2. Inflationary Pressure

Second, the drastic and sudden decrease in industrial outputs has caused alarming costpush inflation for downstream industries as raw material prices soared. For example, China's electrolysis aluminum price increased by over 20% in less than a month [4]. More importantly, the difference between China's PPI and CPI (price scissors) has increased dramatically as PPI growth rate topped at 9.5% while CPI growth rate decreased to 1.9%. This difference can be depicted as an overall leftward shift of the short-run aggregate supply curve resulting in higher unemployment & product price level. Also, with increased investment into renewable energies, the aggregate demand (AD) curve may shift rightward and create more inflationary pressures.

#### 2.1.3. Harmed Midstream Industries

Another problem is that the cost burden of midstream industries brought by the price increase from upstream can't be fully transferred to downstream industries. Down-stream markets are closer to the general public and are closer to perfectly competitive status. Therefore, midstream businesses cannot raise their prices (they may lose market shares if they do so) which increases the burdens placed on them. According to Lai, a security analyst from Kaiyuan Securities, the reduced profits accelerated the worsening of price scissors.

#### 2.1.4. Distorted Price Mechanism

Apart from the supply side, the demand side also faces difficulties. The contracted electric supply has greatly inflated electricity prices [5], which hurts the consumer surplus in the electricity market while causing serious demand-supply imbalances. This issue was further amplified by the fact that electricity is an absolute necessity and has a relatively inelastic price elasticity of demand. The

DOI: 10.54254/2754-1169/3/2022804

distorted price mechanism can be best demonstrated by an extreme example—the mass-influenced power outage in Heilongjiang province in November 2021.

#### 2.1.5. Improved Upstream Revenues

However, increasing raw material prices have improved upstream industries' revenues. Since raw industrial products like metals and concrete are highly inelastic supplies, the increase in price will not cause a proportional decrease in quantity, therefore raw material processors will actually benefit from DC. The improved upstream profits can be reflected by a surge in stock prices for the upstream industries as shown in Figure 1.

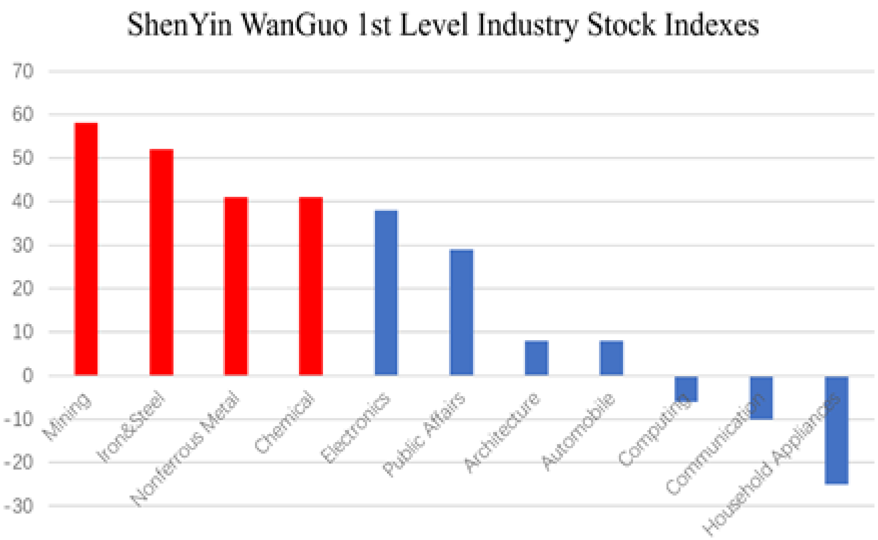


Figure 1: Surge in stock prices for upstream industry [4]. (Authors revised the origin figure).

### 2.2. Long Run

#### 2.2.1. Increased Renewable Energy Usage and Market Expansion

From 2005 to 2020, China's renewable energy usage rate has doubled from 7.4% to 15.9% [6]. In comparison, the nation's energy intensity (halved from 2000's 1 to 2020's 0.57) and aggregate energy consumption (less than 0.1 billion tons of coal) have also been controlled effectively. These efforts may close the domestic negative production externality gap and amend the over-allocation of resources (coal and other materials) gradually.

What's more, DC has intermediately created new industries and investment opportunities for the public, including the electric automobile industry with its market share tripling in 20 years (CAD), the "green infrastructure" construction (wind farms, solar panels, charging poles, etc.). Increased investment will likely increase aggregate expenditures. Investment in renewable industries reached ¥12.4 billion in 2019, which was larger than that of 2016, 2017 and 2018 combined [7].

#### 2.2.2. Going Green Becomes Popular

Second, green businesses are the most benefited stakeholders in the DC context. Chinese existing subsidies toward renewable firms and blockades towards competitive traditional businesses are likely to promote the former firms in a sustainable way. Currently, China already grants a ¥0.02/kWh subsidy to green energy producers [3], which will likely support green production industries until it ultimately outperforms traditional methods to match DC's standards. Authorized organizations have projected that by the end of 2030, around.

#### 2.2.3. Improved Efficiency

Lastly, recent reports have exemplified that renewable energy production procedures can reach an energy usage efficiency of 76%-79% [4] which is nearly 2 times the traditional number (40%). Therefore, promoting renewable energy production is likely to increase workers' efficiency and productivity in the long term. In other words, these efforts will likely stretch the production possibilities and therefore boost the full-employment output. The enhanced productivity can be depicted as outward shifts of long-run aggregate supply (LRAS), shown in Figure 2.

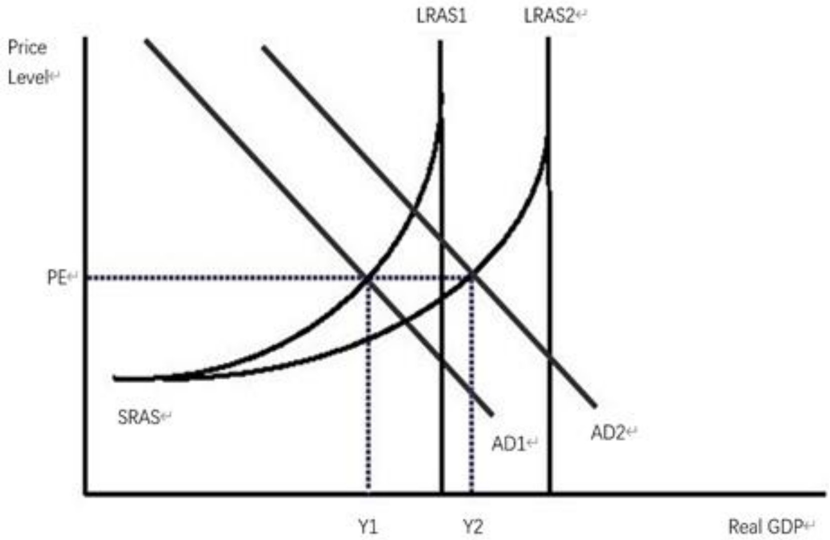


Figure 2： Increasing output and efficiency in the long run (slide to doc) [8].

## 3. The Economic-Environmental Index

Current DC policy benchmarks mainly focus on the environmental side of the policy, with little reference to the economic situation. Simultaneously, the environmental index in the current benchmark, carbon emission intensity, failed to fully address the actual environmental situation. Therefore, this essay promotes another index that can consider both the environmental and economic performances.

For such an index, we set the overall equation as

$$\frac{Economic \quad index}{Environmental \quad index} \tag{1}$$

where an increase in the index value indicates, a deteriorated overall performance of the policy. The decrease in the value indicates good overall performance. However, apart from a general index formula, detailed indexes need to be made to cover the full dimensions of the economy and the environment.

### 3.1. Considered Indexes & The AHP Method

Firstly, the policy is associated with supply-side suffering, specifically for industrial production in the short run. Therefore, the established indexes are the Gross Domestic Product per Capita Growth

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and the Industrial Production Index (IPI). On the environmental side, industrial production's harm to the environment focuses primarily on air, water, and land. In the Air Index (AI) specifically, factors that need to be considered include the Carbon Emission Intensity (CEI), Air Quality Index (AQI), Sulfur Dioxide Index (SDI), and the Nitrogen Oxide Index (NOI). For the Water Index (WI), there is the Water Quality Index (WQI) and the Heavy Metal Content (HMC). The Land Index (LI) consists of the Soil Pollution Index (SPI) solely. Here, all the index indicates the growth rate to help normalize the data so that there will not be further weight added to the index value apart from the calculated weight.

With these indexes, we still need to construct a mathematical model to connect each of the indexes. We choose to develop the Analytic Hierarchy Process (AHP) to determine weights for the indexes. The decision tree of the AHP model in our case is shown in Figure 3.

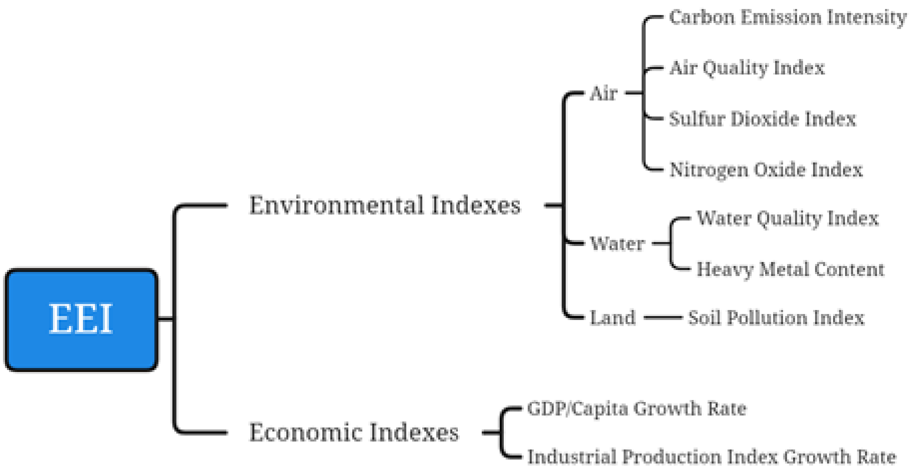


Figure 3： AHP Model Decision Tree.

First, to carry out the AHP model, we need to build a comparison matrix with a nine-point scale for the comparison and weight calculation in the economic indicator. The matrix should be the size of $n \times n$, where $n$ is the number of indexes being considered. Here is the comparison matrix built between the GDP per capita growth and Industrial Production Index (IPI) growth. The comparison matrix is shown in the following:

$$\begin{pmatrix} 1 & 3 \\ \frac{1}{3} & 1 \end{pmatrix} \tag{2}$$

Then, to calculate the weight of each of the indexes, we need to calculate the eigenvalue, $\lambda$, for each of the indexes, and the maximum eigenvalue, $\lambda_{max}$. As the matrix is symmetrical, with the row and column having the same order of the same group of indexes, the total eigenvalue of a row is the eigenvalue of the index representing that row. The eigenvalue of this matrix is shown as the following:

$$\begin{pmatrix} 1.176 \\ 0.824 \end{pmatrix} \tag{3}$$

With the two eigenvalues, we can calculate the maximum eigenvalue, which is 2 in this case. Thus, the weight of the indexes is calculated as the following:

$$\begin{pmatrix} 0.588 \\ 0.412 \end{pmatrix} \tag{4}$$

DOI: 10.54254/2754-1169/3/2022804

For this model to be working, two values must be tested. The first value is the maximum eigenvalue, $\lambda_{max}$, which should be as close to $n$ in the size of the comparison matrix $n \times n$. In this case, our eigenvalue is 2, and our $n$ is 2. The exact same numbers prove the high accuracy of our model. The second value is the Consistency Ratio (CR) value, which measures how the comparisons match each other. Simply speaking, these checks when the importance of A is greater than the importance of B and the importance of B is greater than the importance of C, whether or not the importance of A is greater than C. However, the CR value is not as simple as this. If the importance of A relative to B is 3 and the importance of B relative to C is 5, then if the importance of A is 2, the CR value will also show an unacceptable value. The CR value is calculated as the following, with the help of the consistency index (CI) and the Radom Consistency Index (RI) (RI is a constant which a given $n$ will give a RI value):

$$CI = \frac{\lambda_{max}}{n-1} \tag{5}$$

$$RI = 0 \tag{6}$$

$$CR = \frac{CI}{RI} = null \tag{7}$$

The CI value needs to be lower than 0.1. Here, we have a zero value, further implicating the accuracy of our model. For the other weight calculations, the same process is repeated. The results are shown as the following:

For the weight between Air Index, Water Index, and Land Index:

$$\begin{pmatrix} 1 & 2 & 5 \\ \frac{1}{2} & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & 1 \end{pmatrix} \tag{8}$$

$$\lambda_{max} \tag{9}$$

$$\begin{pmatrix} 1.744 \\ 0.927 \\ 0.329 \end{pmatrix} \div 3.004 = \begin{pmatrix} 0.581 \\ 0.309 \\ 0.110 \end{pmatrix} \tag{10}$$

$$CI = 0.002 \tag{11}$$

$$RI = 0.52 \tag{12}$$

$$CR = 0.004 < 0 \tag{13}$$

For the comparison within the Air Index and between the Air Quality Index, Carbon Emission Intensity, Sulfur Dioxide Index, and Nitrogen Oxide Index:

$$\begin{pmatrix} 1 & \frac{1}{4} & \frac{1}{2} & \frac{1}{2} \\ 4 & 1 & 3 & 3 \\ 2 & \frac{1}{3} & 1 & \frac{1}{2} \\ 2 & \frac{1}{3} & 2 & 1 \end{pmatrix} \tag{14}$$

$$\lambda_{max} \tag{15}$$

$$\begin{pmatrix} 0.418 \\ 2.028 \\ 0.650 \\ 0.904 \end{pmatrix} \div 4.082 = \begin{pmatrix} 0.105 \\ 0.507 \\ 0.163 \\ 0.226 \end{pmatrix} \tag{16}$$

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$$CI = 0.027 \tag{17}$$
$$RI = 0.89 \tag{18}$$
$$CR = 0.031 < 0.1 \tag{19}$$

For the calculation of the weight of the indexes within Water Index, Water Quality Index and Heavy Meatal Content:

$$\begin{pmatrix} 1 & 3 \\ \frac{1}{3} & 1 \end{pmatrix} \tag{20}$$
$$\lambda_{max} \tag{21}$$
$$\begin{pmatrix} 1.5 \\ 0.5 \end{pmatrix} \div 2 = \begin{pmatrix} 0.75 \\ 0.25 \end{pmatrix} \tag{22}$$
$$CI = 0 \tag{23}$$
$$RI = 0 \tag{24}$$
$$CR = null < 0 \tag{25}$$

Then, we calculated weights of the AHP Environment-Economic Index Model:

$$Economic\ \ Index = 68.824\% \times GDP + 41.196\% \times IPI \tag{26}$$
$$Environmental\ \ Index = -(58.126\% \times AI + 30.915\% \times WI + 10.915\% \times LI) \tag{27}$$
$$AI = 10.462\% \times AQI + 50.963\% \times CEI + 16.250\% \times SDI + 22.596\% \times NOI \tag{28}$$
$$WI = 75\% \times WQI + 25\% \times HMC \tag{29}$$

Thus, the Environmental-Economic Index is calculated as the following:

$$EEI = \frac{EnconomicIndex}{EnvironmentalIndex} = (68.824\% \times GDP + 41.196\% \times IPI)/\ \ (-[58.126\% \times (10.462\% \times AQI + 50.963\% \times CEI + 16.250\% \times SDI + 22.596\% \times NOI) + 30.915\% \times (75\% \times WQI + 25\% \times HMC) + 10.915\% \times LI]) \tag{30}$$

The negative sign here helps indicate that a decrease in the environmental index is favorable.

### 3.2. Policymaking Significance & Current Analysis

With the benchmark, we developed conditions when the policy needs to be changed. The following application is suggested.

Table 1: Benchmarks and the Relative Policy Changes.

| Conditions | Policy Change | Benchmark |
|---|---|---|
| 1 | Increase Restrictions | When the index increases its value or decreases its value by ≤5% |
| 2 | Loosen Restrictions | When the index decreases its value by ≥15% and ≤30% |
| 3 | Mission Completed | Carbon Neutrality met |
| 4 | Pause Restrictions | Significant decrease (>30%) in the value of the index |
| 5 | Abandon Restrictions | Gradually (≤ 5%) decrease of the value over time after the mission completed |

We simulated our model with real-time data from 2015, when the DC policy started, and to 2019 to prove the applicability of our model as well as to test if the DC policy has been working well. The data is from ChinaPower Project, Ministry of Ecology and Environment of the People's Republic of China, Ministry of Ecology and Environment of the People's Republic of China and Statista [9-12].

DOI: 10.54254/2754-1169/3/2022804

The years 2020 and 2021 are not considered to exclude influence from the pandemic. Every data is normalized to prevent biased comparisons. In 2015, the index value was 1.204548, while in 2019, that figure was 0.6047. This indicated a good policy performance of the current DC policy. The average annual decrease rate is 9.7%. Under this circumstance, the policy should remain unchanged according to our benchmark.

## 4. Overall Evaluation of DC

In the short run, traditional midstream producers are the biggest losers; upstream businesses suffer from unemployment but were partially compensated by an increase in revenue; consumers are influenced but only to a small extent since only a minority of demand was hurt. Yet in the long run, those businesses are projected to recover as they will be reformed into the green production method. According to Zhongshang statistics, China's total number of renewable businesses sustained a 3% increase in the past 5 years and is projected to have a larger growth rate in the future [7].

In terms of Dual Control's primary purpose—lowering energy consumption intensity and aggregate energy usage—numbers are exhibiting optimistic trends. On the other hand, the implementation of DC has positive outcomes in the long run while only displaying drawbacks in a temporal & inconsistent manner as in Figure 4.

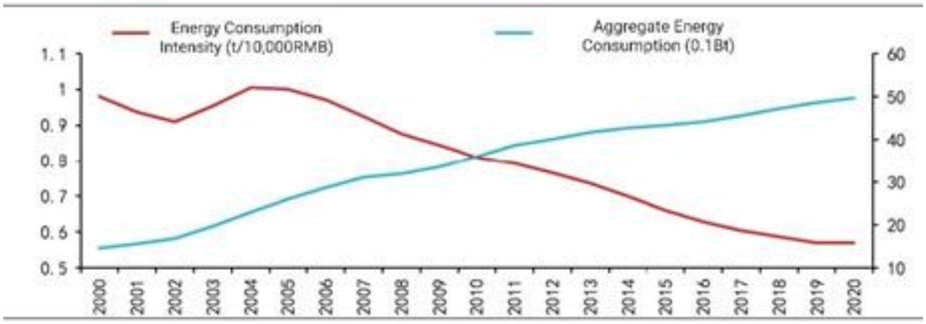


Figure 4： DC's primary purposes are exhibiting optimistic trends [4]. (Authors revised the origin figure).

The central cause of the environment-growth paradox at present is that traditional energy cuts are too aggressive for China's developing society to adapt. The reason why developed nations face a smaller conflict than developing nations like China is that developed nations have already abandoned the outdated production methodologies decades ago. Yet domestically, more than 75% of Chinese industrial process relies on coal/oil energy [13] and 44% of China's real GDP belongs to the secondary sector [3]. Therefore, limiting the crucial coal energy has larger effects on Chinese industries than supposed.

## 5. Economic Dilemma Between Environment and Growth

It is quite evident that addressing the climate issues slows industrial production growth. From 2015, when the DC policy was introduced, to 2019, the annual GDP growth rate decreased from 6.8% to 5.8%. The annual growth rate of Added Value of Industrial Output also fell from 5.9% to 4.8% [14]. The regression indicated a slower growth of industrial production and the overall economic performance. Even though it was reasonable to attribute this decrease to the China-United States Trade War in 2019, the gradual decrease throughout the five years still suggested a problem.

However, the short-run suffering in the economic performance does not necessarily imply a competing relationship between protecting the climate and developing the economy. Under the pressure of the DC policy, the growth of the renewable energy industry and other innovative

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industries was promoted. It was forecast that the out-put of the renewable energy industry will increase to ¥110 billion in 2025, almost doubled the value in 2021 [15]. The output of the green industry was even forecast to be ¥11,000 billion [16]. Together these two industries will account for 7.5% of the forecast GDP in 2025. The future of the industries related to renewable energy and green production was bright.

Simultaneously, new business ideas such as the circular business model where the companies used each other's production waste to produce in a community, which minimized waste and the use of raw materials, are proposed [17]. These together can increase investment and help boost the economy. Therefore, the economy must correct itself from the short-run suffering and seek more opportunities and economic growth in the long run. Figure 5 is the aggregate supply and demand graph use to explain the relationships between environmental protection and economic development.

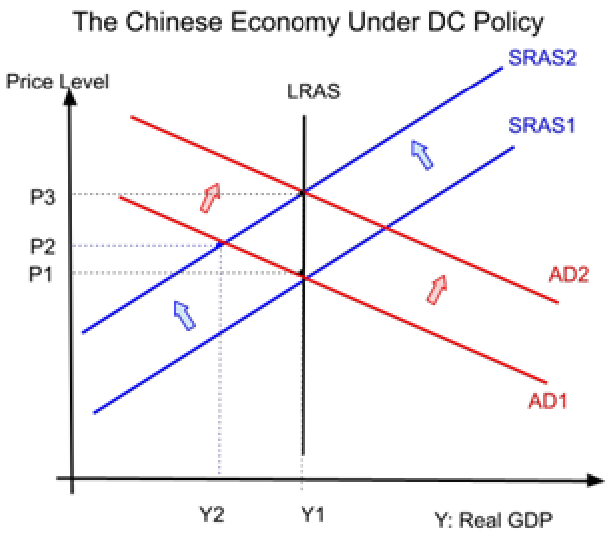


Figure 5： Relationships between environmental protection and economic development.

On the other hand, if the environment is not protected, long-run consequences caused by the negative externalities of the current production may include an inward shift of the production possibility and the long-run aggregate supply, which is unfavorable for the global economy. Thus, a protection that suffers the short-term economic growth may actually benefit the long-run growth.

Therefore, the principles to follow to balance the environment and economy in the short run are: (a) focus on alternative methods to control pollution and remove energy cuts; (b) grasp the need of struggling traditional firms to meet the green standards and construct circular business model.

## 6. Recommended Policies

### 6.1. Woodland Preservation

Woodlands and forests have long played a critical role in carbon control. Forest carbon-sinking strategies were proved to be statistically competent on carbon absorption (the China Southern land biosphere alone is responsible for 31.5% of national carbon sinks every year) and is continually underestimated by policymakers and the public [18].

To better utilize this power of nature, the Chinese government should introduce a "Woodland Red-Line" as they once introduced a "Farmland Red-Line". This means that the government should implement a rigid lowest minimum for national wood-land areas and stipulate that this red-line value should increase by a percentage every year. The initial red-line value could be calculated by taking ratios of the aggregate carbon emission and the volume of $CO_2$ absorbable by a unit area of woodland.

DOI: 10.54254/2754-1169/3/2022804

The strictness of this redline and its yearly growth rate can also be determined in virtue of the environmental-economics index mentioned above. During the preservation of this redline, the government can also encourage private investment in plantations by providing subsidies and low-interest loans.

Woodland preservation has many inherent advantages. First, it can partially loosen the pressure on energy cuts and restore short-run production. One major reason why individual producers suffer in the short term is because of severe energy cuts. By planting more trees and utilizing forest carbon sinks, the government can undo certain energy-cutting or production-limiting policies, which created extra production space for firms and can balance both short-run economic growth and environmental protection.

Moreover, apart from the supply side, woodland preservation also has positive impacts on the demand side. It promotes private investment alongside government spending. By creating a woodland-trading system, the government could inform that firms who cannot meet the environmental standards must plant certain areas of woodland as a penalty. Other firms can also purchase woodland and trade them with the former businesses in need, which pulls private investment and boosts domestic aggregate demand.

However, woodland redline preservation does need tremendous initial investment. Between 1998 and 2014, China has already spent $100 billion exclusively on plantations (RTA). This number will only continue to grow and not to decline, given that China still needs to plant more trees every year. Also, woodlands are not appearing overnight. Although this policy is not going to take too long, it may not have immediate results either.

## 6.2. Build-Operate-Transfer

Another often overlooked strategy to cope with environmental-economic paradoxes is the Build-Operate-Transfer (BOT). Private entities receive concessions from the government to invest in and build renewable energy plants. The entities may operate the plant for a period and sell the clean energy to traditional firms struggling to meet the standards. During the investment process, the government needs to provide political support by means of subsidies, reduced taxes, eased financing, and so on. Ultimately, when individual entities' green energy sales cover their initial investment, they can transfer the energy plant entirely to polluting firms or to the government itself, forming a circular flow of capital as in Figure 6.

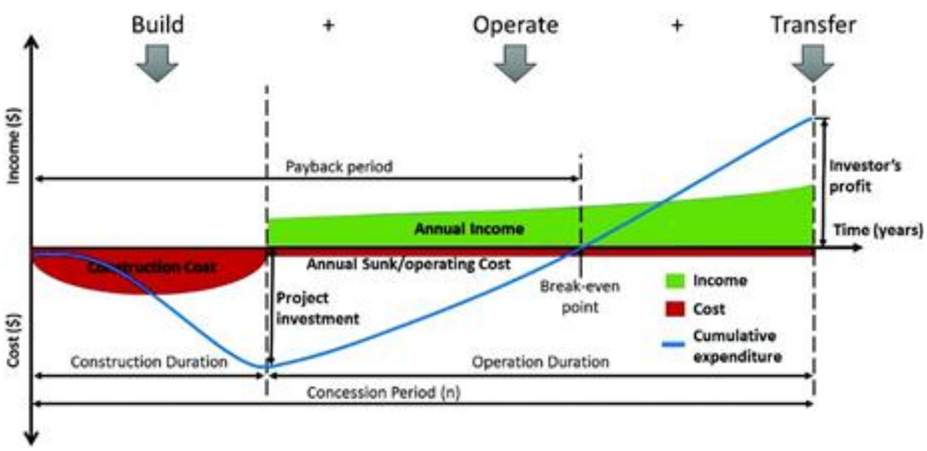


Figure 6: The circular flow of capital [19].

One obvious advantage of BOT is that it promotes production and demand of both private and public sectors. Private sector investments include the construction of energy plants, maintaining and upgrading the plants, and forming partnerships with polluting firms, who will also invest to meet the

DOI: 10.54254/2754-1169/3/2022804

rigid regulations. Therefore, in the short run, BOT shifts both AD and AS rightwards, addressing the unemployment crisis and possibly inflationary pressure. Moreover, since renewable energy production is thrusted, BOT is likely to positively impact the environment as well.

BOT is also beneficial for the recovery of fiscal deficits and public savings. By utilizing private investments on renew- able projects, governments can save considerable spending and those savings can be further reused in other fields. BOT projects avoid governmental crowdouts of private investment, since private investment itself is contributing to the nation’s green endeavors. Figure 7 indicates Private investments reduce government spending and fix fiscal deficit.

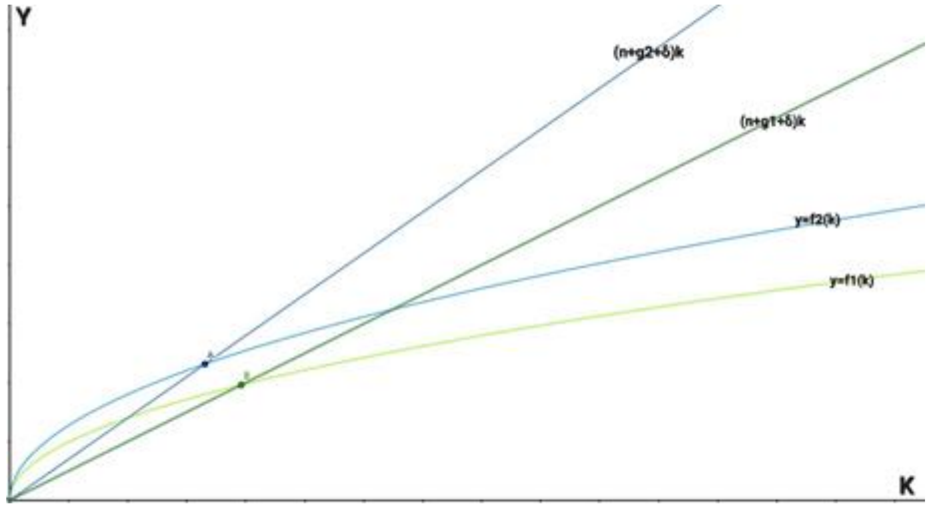


Figure 7： Private investments reduce government spending and fix fiscal deficits. Y: Real GDP, X: Capital Accumulation, A: Equilibrium 2, B: Equilibrium 1.

Another crucial advantage of BOT is its sustainability. Since energy plants are consistent long-term capital, the increased technology accumulation and productive efficiency (previously mentioned that green methods are 2-times more efficient than traditional ones) will likely result in an overall boost in economic growth. This can be depicted as an upward shift of the production function in the Solow growth model and a corresponding increase in the slope of the equilibrium growth path, resulting in faster economic growth.

Nevertheless, BOT may bring over transaction costs and a higher chance of resource misallocation. Individual entities have to form multiple partnerships with third parties (polluting client firms, construction businesses, government, banks, etc.) to support their gigantic projects, which will likely increase their fixed costs. Also, the location, size, and construction of energy plants should be carefully analyzed. They need to be close to polluting industries and really aid in their production. If the plants are not located properly and cannot reach any polluting firms, it is possible for the entire plant to be left wasted. Therefore, the government and individuals also have a heavier pressure on advertising.

### 6.3. Emission Trading System

Constructing an emission trading system is a classic example of monetizing polluting firms’ negative externalities [20]. Every firm is given a carbon-emission limit initially with which firms can trade. Firms who manage to complete the production within the limit can sell their extra permits to firms who need more permits to produce. The traded value is therefore a bonus for green firms and a penalty for polluting firms. The government can supervise the permits market by controlling the total number of limits-similar to central banks controlling money quantity.

DOI: 10.54254/2754-1169/3/2022804

One obvious advantage of carbon trading is the internalization of externalities. Firms who contaminate the environment have to pay for their frauds, which will also intermediately raise their product price and weaken their presence on the demand side. Others who can produce within the standard receive bonuses for their obligations. In the short run, this strategy can internalize the externality gap by shifting polluting firms' supply leftwards while moving green firms' supply rightwards, in which they meet at the socially optimal quantity. In the long run, emission trading can form an incentive for polluting firms to develop their production process and lower their emissions, in order to decrease financial burdens as in Figure 8.

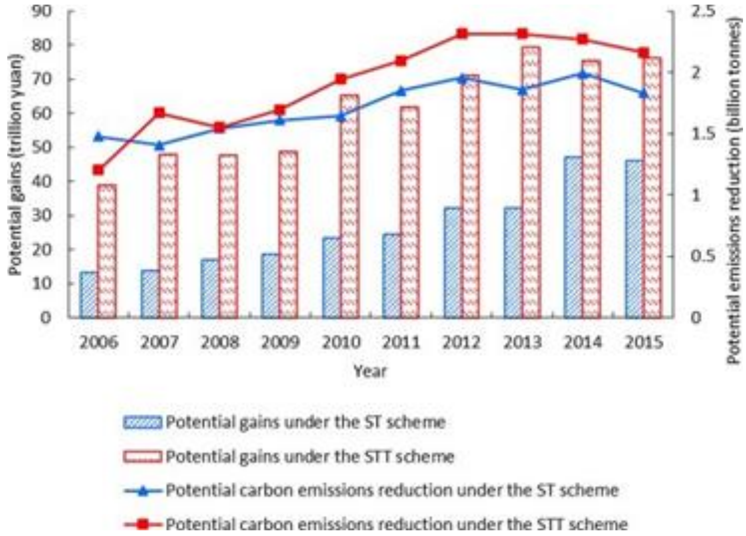


Figure 8： Effect of Emission Trading System [21].

This effect is further accelerated via the promotion of green finance. In the stock market, a business's financial performance has a critical directory impact on investors' choices. The carbon trading system emphasizes the comparative advantage financially of green firms, which will "guide more investors towards green businesses" [4] and help green firms become stronger relative to traditional ones, from which the general public's capital is drifting out. Green finance also promotes interactions among businesses and creates new investment opportunities.

However, carbon trading systems need meticulous designs and operating precision to be truly effective. First, the government needs to carefully control the total number of permits in a system. Over or under a certain value will both cause allocative inefficiency of carbon trading (e.g. if there are too many permits at a time, the polluting firms will always have sufficient permits for production and therefore will not have the incentive to reform). The price of permits also needs to be regulated. If the price is too low, large polluting firms can continue to produce while carrying this small burden, impairing the efficiency of environmental control.

Therefore, while constructing a trading system, the government needs to supervise the market carefully. The key principle is to make the financial burdens on polluting firms pronounced. Upshifting permit prices and tightening permit numbers might be a utilizable strategy. Nevertheless, the government can always refer to the environmental-economic index mentioned above as a benchmark for policy strictness.

## 7. Conclusion

In conclusion, environmental protection and economic growth conflict to a smaller extent than previously thought. Admittedly there are trade-offs in the short run, but in the long run, the benefit of going green certainly stands out. China's Dual Control policy worked because both the growth rate of aggregate energy usage and the rate of energy intensity dropped since 2015, and are projected to decline further in the following decades.

Nevertheless, to mitigate the short-run economic drag, the government should find alternative carbon-sinking ways to loosen energy cuts and commercialize emission-related objects, which helps in maximizing domestic investment and inter-business communications. Based on these principles, some obtainable policies for the Chinese government are forest carbon sinks, BOT infrastructure as a part of public-private partnership, and emission trading systems.

To present the government with a clearer outlook of China's general status quo, the environmental-economic index was introduced as a benchmark for policy strictness. Several reflective indexes from both environmental and economic viewpoints were chosen to form an all-around index for each field. Taking the ratio of these two indexes, the conflict between environmental protection and economic growth can be explicitly shown, which will contribute to the decision-making of policy designers.

## 8. Author's contributions

Yijhan Hsieh: developed the Analytic Hierarchy Process to calculate the Environmental Economic Index and the policy benchmarks, and analyzed the Economic Dilemma Between Environment and Growth.

Houxian Li: helped Proofreading and Graphics.

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