Policy solutions

CAONingcheng
Cnch181207@163.com
MSc in Applied Economics

An executive summary

This paper brings a new solution for China to meet environmental protection and economic development at the same time based on the target of sustainable trade. We first focus on the relationship between annual average concentrations of major pollutants (PM2.5) in Beijing and its GDP. Besides we suggest that if China wants to increase its environmental score above average, China's government can tax on carbon intensive products in carbon tax to those first tier cities with high energy consumption. Moreover we conclude that although lump-sum carbon emission tax slows down the growth rate of GDP, the impact is very tiny and China will still have a relative high GDP growth rate compared with other countries. And it will be an efficient way to reduce the demand of limited fossil fuel.

Identification and explanation of the issue

By STI Paper, although Asian countries have generally retreated trade sustainability, improvements in the economic pillars have been offset significantly by declines in the social and environmental pillars. In contrast, China, especially Beijing, really did a fabulous job in environment. Since Beijing's air pollution has decreased markedly while keeping a high speed of economic growth.

In detail, on one hand, different from 2013, the annual average concentrations of major pollutants in Beijing decreased significantly in 2018, with SO_2 and PM2.5, decreasing by 77.8% and 42.7% respectively; on the other hand, GDP of Beijing was rising from 2013 to 2018 with growth rate of it became a little bit slower around 7% which is still a large number compared with other countries.

But China's environmental score is still below average. Since China does care about global environment and is willing to make effort on it, finding new ways for first tier cities with high energy consumption to strengthen economic stability and keep trade sustainable without hurting environment becomes vital.

Implementation Plan

As a big export country, China's export of cheap goods produced at the expense of its environment and resources has become the main way for developed countries to transfer carbon emission. While carbon tariff, a special tariff on carbon dioxide emissions on exports of countries that do not levy carbon or energy taxes at home and have substantial energy subsidies, proposed by western countries has a negative impact on China's economic and trade interests, and are likely to be used as a new means of trade protection.

My solution is that to avoid carbon tariffs and enhance China's environmental sustainability, China's government should tax on carbon intensive products in carbon tax to modern cities as a small scale M-form experiment because well-developed cities have high level demand of living environment and ability to implement tax reform. By this way, it will not only promote domestic enterprises to save energy and reduce carbon emissions, but also obtain carbon tax revenue and promote the realization of sustainable development.

Since different natural resources cause different levels of carbon emission, according to the suggestion of China's Ministry of Finance and Planning Institute of Ministry of Environmental Protection, 10 RMB per ton of carbon dioxide emissions would be levied in 2012. By 2020, specifically coal, oil and natural gas are levied carbon taxes of 11, 17 and 12 RMB per ton (in total 50 RMB per ton)

So we assume that from 2012 to 2017, this three carbon taxes including Coal Carbon Emission Tax, Petroleum Carbon Emission Tax and Natural Gas Carbon Emission Tax would all increase at a fixed speed till 2020. We mainly focus on finding out how carbon taxes can influence GDP. We select 9 representative cities and provinces of China.

Table 1

Time	Coal CET (RMB/t)	Petroleum CET (RMB/t)	Natural CET (RMB/t)
2012	2.2	3.4	2.4
2013	3.3	5.1	3.6
2014	4.4	6.8	4.8
2015	5.5	8.5	6
2016	6.6	10.2	7.2
2017	7.7	11.9	8.4
2018	8.8	13.6	9.6
2019	9.9	15.3	10.8
2020	11	17	12

Table 2

time		Raw Coal TD (standard coal:10k tons)	crude oil TD (standard coal:10k tons)	Natural Gas TD (standard coal:10k tons)	GDP (RMB100 million)
2012	Beijing	2270	1533	92.1	17879.4
2013		2019	1481	98.8	19800.81
2014		1737	1538	113.7	21330.83
2015		1165	1584	146.9	23014.59
2016		848	1578	162.3	25669.13
2012	Tianjin	5298	1619	32.6	12893.9
2013		5279	1542	37.8	14442

2014		5027	1615	45.5	15726.9
2015		4539	1732	64	16538.2
2016		4230	1778	74.5	17885.4
2012	Shanghai	5703	3260	64.4	20181.7
2013		5681	3396	72.9	21818.2
2014		4896	3292	72.4	23567.7
2015		4728	3460	77.4	25123.5
2016		4626	3633	79	27466.2
2012	Zhejiang	14374	2751	48.1	34665.3
2013		14161	2814	56.7	37756.6
2014		13824	2781	78.2	40173
2015		13826	2970	80.3	42886.5
2016		13948	2909	87.8	46485
2012	Henan	25240	1693	73.9	29599.3
2013		25058	1951	79.8	32191.3
2014		24250	1978	76.9	34938.2
2015		23720	2100	78.8	37002.2
2016		23227	2159	92.8	40160
2012	Guangdong	17634	5481	116.5	57067.9
2013		17107	5178	124	62474.8
2014		17014	5320	133.8	67809.9
2015		16587	5619	145.2	72812.6
2016		16135	5942	167.8	79512.1
2012	Chongqing	6750	637	71	11409.6
2013		5794	706	72.2	12783.3
2014		6096	704	82.1	14262.6
2015		6047	793	88.4	15717.3
2016		5674	864	89.3	17558.8
2012	Sichuan	11872	1961	153	23872.8
2013		11679	2395	148.3	26392.1
2014		11045	2724	165.2	28536.7
2015		9289	3029	171	30053.1
2016		8869	3137	181.6	32680.5
2012	Shaanxi	15774	1199	66	14453.7
2013		17248	1177	70.3	16205.5
2014		18375	1213	74.3	17689.9
2015		18374	1114	82.7	18021.9
2016		19671	862	98.2	19165.4

Critical evaluation of the solution

- **The relationship between carbon taxes and GDP**

Benchmark

$\Delta \widehat{\ln gdp}$ = -0.049111 + 3.36E-05Δraw-coal-TD
(0.042498) (7.96E-06)
+ 0.000716Δcrude-oil-TD + 0.005155Δnatural-gas-TD
(0.000101) (0.001502)

N = 29, R^2 = 0.702775

There is no serial correlation and OLS is valid because DW = 1.985892. P-value of regressors are all smaller than 0.001.

Experimental group

$\Delta \widehat{\ln gdp}$ = -0.109226 + 1.12E-05coal-CET*Δraw-coal-TD
(0.050811) (3.68E-06)
+ 0.000175petroleum-CET*Δcrude-oil-TD + 0.001439natural-CET*Δnatural-gas-TD
(2.95E-05) (0.000508)

N = 29, R^2 = 0.622533

There is no serial correlation and OLS is valid because DW = 2.233493. P-value of independent variables are all smaller than 0.001.

The real influence of lump sum carbon tax to the growth rate of GDP is the difference in difference. Holding others constant, because of the carbon emission tax, the explaining power of these three total demands of natural resources to the growth rate of GDP all decrease. In other words, holding other factors fixed, if China's government taxes on carbon intensive products in carbon tax to those modern cities with high energy-consumption, it will reduce the speed of economic development by a little bit while the total influence is still positive.

To be more specific, when there is a CET, if Δcrude-oil-TD changes by 1 unit, the growth rate of GDP will increase by 0.0175% not 0.0716%; when Δnatural-gas-TD changes by 1 unit, the growth rate of GDP will increase by 0.1439% rather than 0.5155%. It shows that if those cities are charged by carbon tax, the growth rate of GDP in modern cities will depend less on demand of fossil fuel and the economy will grow in more sustainable environment way.

The reasons are that implementing carbon emission tax, firstly, makes all firms' production costs become larger, then those enterprises with low productivity and high energy consumption will shut down and withdraw from the market; secondly, forces companies to pay more attention on raising productivity and conserving of natural resources and the whole society's technology level might increase; thirdly, reduces supply of high resources consuming and environmentally unfriendly products which are the main goods China export to other countries.

In detail, based on General Equilibrium Theory, taxation shifts the total supply curve to the left. Initially, the market demand curve remains unchanged, the equilibrium market price will go up, and the equilibrium market volume will go down. If the change of producer surplus is positive, then firms can use the profit to offset the pressure of taxation. Later, as people realized the

general increase in the price of fossil products, they would consciously reduce the consumption of fossil energy and increase the consumption of clean energy as its substitutes. In this way, we can protect our limited natural resources and strength trade sustainable.

- **Drawbacks of the model**

Usually for self-developed strong economies, they depend less on other's financial investment. At the same time, they are attractive to investors. Because environment, especially carbon emission, is only a part of the sustainable trade and there are still too many factors that can affect trade and we should include more independent variables and enlarge our sample capacity.

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