CORRELATION BETWEEN CO2 EMISSIONS AND GASOLINE TO DIESEL RATIO: EVIDENCE FROM CHINA PROVINCES

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Overview

This paper utilizes 1997-2016 provincial panel data in China to verify Environmental Kuznets Curve (EKC) for Carbon Dioxide (CO2) emissions, and to explore the underlying reason of EKC hypothesis. The correlation between CO2 emissions and Gasoline to Diesel Ratio (GDR) is also been investigated. The regression result shows per capita CO2 emissions forms an inverted U-shape curve with respect to per capita Gross Domestic Product (GDP). But because the current data of per capita CO2 emissions have not shown a decreasing yet, so the hypothesis of EKC for CO2 emissions is just partially proven. Other result shows CO2 emissions has a high correlation with GDR. By panel Fully Modified Ordinary Least Squares (FMOLS) and panel Dynamic OLS (DOLS) regression, 1% GDR increase couples with 0.118186% or 0.114056% CO2 emissions decrease, respectively. This paper also demonstrate that whether the EKC holds is independent from provincial GDP per capita. So it is not the GDP, but the provincial economic structure, energy structure and their interaction, determined the provincial differences of correlation between per capita GDP and CO2 emissions.

Methods

This paper utilizes 1997-2016 panel data from 30 China provinces, with variables of provincial level per capita CO2 emissions, per capita GDP (yuan normalized to 1995 prices) and Gasoline to Diesel Ratio (GDR). The data was subjected Unit Root Test and Panel Co-integration Test. The econometric model is shown in formula (1).

$$\ln(CO2) = a \bullet \ln(PCGDP) + b \bullet (\ln PCGDP)^2 + c \bullet \ln(D/G) \qquad (1)$$

PCGDP represents the per capita GDP. G/D represents Gasoline to Diesel Ratio (GDR) and “ln” means the logarithm of the respective variables. The parameter estimation utilizes panel Fully Modified Ordinary Least Squares (FMOLS) method and panel Dynamic OLS (DOLS) method.

Results

Result of Unit Root Test is shown in Tab.1, and result of panel Pedroni co-integration test is shown in Tab.2, and estimate of long-run parameters is shown in Tab.3.

Result of Unit Root Test

Tab.1 Result of Unit Root Test

Variable	Level			1st difference		
	Intercept & trend	Intercept	None	Intercept & trend	Intercept	None
LLC test						
ln PCCE	2.95780	-0.80011	4.99719	-5.76518***	-6.18095***	-10.9650***
ln PCGDP	2.14738	-6.47103***	9.29149	-3.39264***	-3.58421***	-3.90675***
$(\ln PCGDP)^2$	-0.11924	-5.15141***	8.44186	-3.09340***	-3.90282***	-3.56155***
ln GDR	2.63121	-0.35471	-0.07902	-16.8094***	-18.5608***	-22.1776***
ADF-Fisher test						
ln PCCE	45.3058	23.9783	14.2814	109.649***	158.540***	229.143***
ln PCGDP	48.3609	51.0636	8.27696	48.5903	90.5943***	62.9540
(ln PCGDP)2	61.3441	42.9213	14.3822	45.6744	89.9462***	59.1168
ln GDR	43.4406	74.3524	56.1351	305.024***	361.043***	509.589***

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10%. Optimal lag lengths were selected automatically using the Schwarz information criteria.

Result of panel Pedroni co-integration test

Tab.2 Result of panel Pedroni co-integration test

Test	Intercept & trend	Intercept	None
Panel v-Statistic	0.942510	1.738806**	1.280907*
Panel rho-Statistic	3.491713	0.979838	0.335658
Panel PP-Statistic	-2.278606**	-2.776850***	-1.715317**
Panel ADF-Statistic	-7.466750***	-6.976971***	-3.843027***
Group rho-Statistic	4.614577	2.842682	2.563179
Group PP-Statistic	-2.994313***	-2.581444***	-1.059294
Group ADF-Statistic	-7.983388***	-7.578037***	-3.309905***

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10%. NeweyeWest automatic bandwidth with Bartlett kernel is used.

Estimate of long-run parameters

Tab.3 Estimate of long-run parameters

Province	FMOLS			DOLS		
	ln PCGDP	(ln PCGDP)^2	ln GDR	ln PCGDP	(ln PCGDP)^2	ln GDR
Beijing	8.92*[1.98]	-0.44*[-1.99]	-0.95**[-2.67]	3.03[0.31]	-0.18[-0.38]	-0.65[-0.95]
Tianjin	6.28***[2.88]	-0.29**[-2.78]	0.11[0.58]	-0.63[-0.14]	0.04[0.19]	-0.02[-0.05]
Hebei	1.80**[2.38]	-0.07*[-1.74]	-0.23***[-5.16]	1.37[1.07]	-0.04[-0.60]	-0.35**[-2.65]
Shanxi	-1.23[-1.07]	0.08[1.38]	-0.32***[-4.51]	-5.11***[-5.98]	0.30***[6.57]	-0.40***[-6.85]
Inner Mongolia	1.13[0.64]	-0.017[-0.19]	-0.04 [-0.19]	-9.47***[-4.30]	0.56***[4.72]	0.48[1.57]
Liaoning	4.01***[5.86]	-0.18***[-5.22]	-0.13**[-2.38]	1.99 [1.38]	-0.08[-1.03]	-0.0018[-0.013]
Jilin	-1.19[-1.08]	0.08[1.41]	-0.19**[-2.81]	-3.27 [-1.74]	0.19[1.85]	-0.09[-1.47]
Heilongjiang	-1.99[-1.03]	0.14[1.34]	0.07[0.40]	-1.52[-0.53]	0.10[0.66]	0.38[0.53]
Shanghai	7.61***[4.90]	-0.37***[-4.97]	-0.15 [-1.67]	10.44**[3.09]	-0.49**[-3.18]	-0.19[-0.48]
Jiangsu	2.71*[1.81]	-0.10[-1.35]	0.01[0.02]	5.74*[1.93]	-0.28 [-1.81]	0.97**[2.55]
Zhejiang	-9.14**[-2.49]	0.51**[2.72]	-2.00***[-4.72]	-12.65***[-5.95]	0.69***[6.25]	-2.59***[-9.26]
Anhui	0.79[1.25]	-0.01[-0.27]	-0.19**[-2.72]	-0.005[-0.003]	0.03[0.35]	-0.11[-0.59]
Fujian	5.57***[3.03]	-0.23**[-2.35]	-0.67**[-2.74]	7.03***[5.44]	-0.30***[-4.36]	0.0995[0.27]
Jiangxi	-1.21[-0.75]	0.10[1.10]	-0.17**[-2.13]	-1.60[-1.25]	0.13[1.83]	-0.064[-0.95]
Shandong	3.77[1.36]	-0.15[-1.09]	-0.24[-0.90]	-4.46[-1.09]	0.26[1.26]	-0.399[-0.62]
Henan	5.92***[3.99]	-0.29***[-3.61]	-0.19*[-1.97]	-3.23*[-2.19]	0.20**[2.51]	-0.30**[-2.79]
Hubei	4.999***[3.32]	-0.24***[-3.04]	-0.36[-1.18]	0.001[0.0007]	0.006[0.06]	0.86 [1.68]
Hunan	4.58[1.00]	-0.22[-0.90]	-0.28[-0.55]	-4.23[-0.99]	0.26[1.13]	1.11[1.13]
Guangdong	5.62**[2.86]	-0.26**[-2.57]	0.44***[3.01]	11.43**[2.87]	-0.54**[-2.74]	0.65**[3.31]
Guangxi	2.64*[1.99]	-0.10 [-1.4]	0.16 [0.93]	-5.59*[-2.16]	0.36**[2.49]	0.84**[3.10]
Hainan	18.15**[2.45]	-0.89**[-2.27]	0.29[0.87]	61.82[1.34]	-3.25[-1.31]	2.46[1.22]
Chongqin	1.499[0.699]	-0.07[-0.62]	-0.44**[-2.83]	2.78[0.54]	-0.15[-0.51]	-0.38[-0.98]
Sichuan	9.68***[3.09]	-0.51***[-2.94]	0.64[1.44]	22.22**[2.75]	-1.21**[-2.71]	0.51 [0.59]
Guizhou	5.44***[4.63]	-0.28***[-4.21]	0.43***[3.16]	-2.17[-1.17]	0.12[1.24]	0.14[1.05]
Yunan	12.50***[3.16]	-0.66***[-3.08]	-0.06[-0.43]	4.76[0.78]	-0.23[-0.75]	-0.06[-0.18]
Shannxi	-0.29[-0.24]	0.06[0.95]	0.15[0.97]	-2.46[-0.39]	0.18[0.50]	0.28 [0.52]
Gansu	1.29*[1.90]	-0.04 [-1.16]	-0.07**[-2.15]	-1.45[-0.73]	0.12[1.04]	-0.0005[-0.006]
Qinghai	-5.47***[-2.90]	0.31***[3.17]	-0.32***[-3.92]	-7.10[-1.23]	0.39[1.25]	-0.49*[-2.27]
Ningxia	3.97[1.29]	-0.16[-1.02]	0.01[0.06]	-8.79 [-0.40]	0.57[0.46]	0.21[0.33]
Xinjiang	-8.13***[-4.21]	0.49***[4.87]	0.16[1.12]	-4.30[-0.66]	0.28 [0.83]	0.35[0.72]
Panel	2.28***[4.75]	-0.09***[-3.60]	-0.12**[-2.50]	1.08[1.53]	-0.03[-0.75]	-0.11**[-1.97]

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10%. The values in square brackets represent the t-statistics.

Conclusions

Historical data show that the growth rate of CO2 has declined significantly. This paper hopes to verify this trend with EKC hypothesis. The purpose of studying the relationship between CO2 and Gasoline to Diesel Ratio (GDR) is to try to explain the real reason for the decrease of CO2 growth rate. The conclusions of this paper are as follows.

(i) The result of regression shows per capita CO2 emissions forms a quadratic curve with negative quadratic coefficient and a positive primary coefficient with respect to per capita GDP. It shows that the EKC hypothesis is partly true. However, although CO2 growth rate has declined, CO2 emissions has not declined yet, EKC hypothesis cannot be fully confirmed, which is similar to the conclusion of Moomaw and Unruh (1997).

(ii) There is a significant correlation between CO2 emissions and GDR. GDR has a negative impact on CO2 emissions. Because household cars in China use almost no diesel at all, while industrial and commercial transportation in China all use diesel. To some extent, GDR reflects the ratio of industrial and commercial transportation to household car use. Therefore, the result of this paper shows the change of economic structure may be an important reason for CO2 emission growth rate reduction.

(iii) Both the inverted U-shaped relationship between CO2 emissions and GDP per capita and the correlation between CO2 emissions and GDR are independent from individual province GDP per capita. This conclusion is similar to that of Dong et al. (2017).

References

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In addition to the references directly cited in this abstract, other references are not listed here.