ECONOMIC GROWTH AND AIR POLLUTION IN THE PERSIAN GULF OIL EXPORTING STATES

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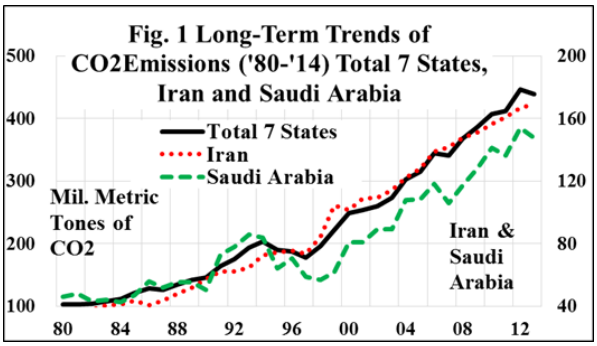
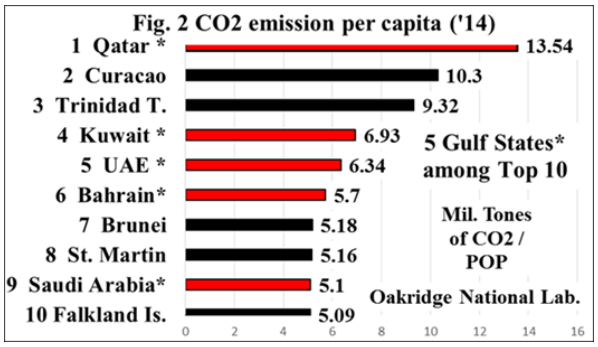
Overview

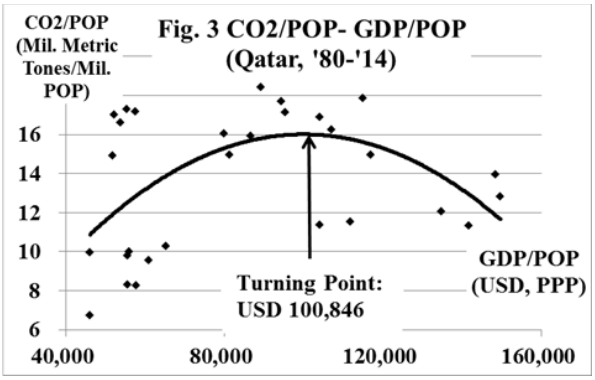
This study examines the relation between economic growth (as measured by GDP per capita) and air pollution (as measured by CO_2 emission per capita) in the Persian (Arabian) Gulf's oil-exporting states based on the Environmental Kuznets Curve hypothesis (EKC hypothesis) using regression analysis.





Furthermore, in world rankings of per capita CO_2 emissions, five of the Gulf states mentioned above come in among the top 10. Fig. 2 shows the world ranking of every state in the world in terms of CO_2 emissions per capita: Qatar comes in first, and Kuwait is fourth. Therefore, the impact of the seven Gulf states cannot be omitted during analysis.

Second, with the Paris Agreement coming into force in 2016, theoretical as well as empirical studies on climate changes are expected: indeed, the seven Gulf states have signed the agreement in 2016 and Saudi Arabia and the UAE have already ratified it.



Though important economic players in natural resources, finance, and infrastructure, the Gulf states have not been examined enough in terms of environmental economics, especially by using the EKC hypothesis to the best of author's knowledge. This study, then, considers economic growth and air pollution in the Gulf states through a regression analysis by showing factors behind the verified results.

Therefore, this study will contribute to the further development of academic studies on energy and environmental economics as well as environmental policy-making and corporate strategy-planning by exploring an important but hitherto academically unapproached frontier

Methods

In the EKC hypothesis, emission levels increase up to a certain level of economic growth, calculated by per capita GDP, and then start to decrease as measure per capita. Fig. 3 visualizes this relation for Qatar in the period from 1980 to 2014.

Target: 7 Persian (Arabian) Gulf States - Bahrain, Iran, Kuwait, Oman, Qatar, Saudi Arabia and the UAE (excluding Iraq for data restriction).

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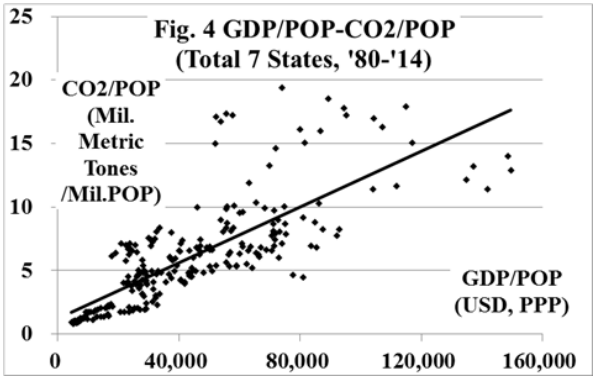
Pollutant: CO_2 emissions in all sectors and origins (oil, solid, transport etc.)
Periods: 35 years (1980-2014) from the initial period of the state founding to present through the Lehman Crisis.
Data sources: CO_2 - Carbon Dioxide Information Analysis Center, Oakridge National Laboratory (http://cdiac.ornl.gov/trends/emis/tre_coun.html. Last access: 2017. 5.26)
Population and GDP per capita (Purchasing Power Parity) - IMF World Economic Outlook Database October 2015 (http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/ weoselgr.aspx. Last access: 2016.7.4) .
Mathematical model: regression analysis.
Objective variable - logged per capita CO_2 emissions
Explanatory variables - logged per capita GDP and its squire.

$$\ln\left(\frac{EMS}{POP}\right) = \alpha + \beta_1\left(\frac{GDP}{POP}\right) + \beta_2\left(\frac{GDP}{POP}\right)^2 + e$$

P value - less than 5 % ($p < 0.05$), α - intercept, e - standard errors.
For the inverted U-shaped curve, the model must be satisfied with the two terms: $\beta_1 > 0$ and $\beta_2 < 0$.
In addition, the income standards of each tuning point can be calculated by $\left(\frac{-\beta_1}{2\beta_2}\right)$.

Results

First, during the 35-year period, the EKC hypothesis does not hold well in meeting with the "strict" criteria of 5 % significance. Instead, a linear relation dominates in the four states of Iran, Kuwait, Oman, and Saudi Arabia, and the aggregated 7 states so that growth is associated with increasing emissions as the Fig. 4 shows.



Under a 'loosened' criteria that the first and second terms are significant while the constant term is not, 5% significance is also found in Iran, Kuwait, Qatar and the aggregated 7 states. And the turning points (USD, PPP) in each case are as follows. Iran: 23,843 (theoretical level to be attained), Kuwait: 64,462, Qatar: 10,846, and the 'states: 169,815 (theoretical level be attained).

However, the linear relation is also found at the same time. It might be, then, appropriate to treat the validity of the EKC hypothesis of the four cases as a spurious correlation.

If the case in Iran is valid with the "loosened" criteria, the factors underlying the case should be considered. The limited successful result in Iran, however, does not derive from the series of UN economic sanctions against the nuclear weapons program (starting in 2006 and ended in 2015). Indeed, the extended analysis with a dummy valuable to the regression shows that null hypothesis is not rejected (sanctions: 1980-2005 = 0, 2006-2014 = 1).

$$\ln\left(\frac{EMS}{POP}\text{Iran}\right) = \underset{(p=0.319)}{-0.169} + \underset{(4.164E-06)}{2.038E-04}\left(\frac{GDP}{POP}\right) - \underset{(6.644E-02)}{0.078}\left(\frac{GDP}{POP}\right)^2 - \underset{(0.528)}{0.078(\text{sanctions})} + 0.104$$

$$(\text{Adj.}R^2 = 0.957, F = 6.891E-22)$$

Second, the factors underlying the rejection of the EKC hypothesis include the trends of CO_2. increase tends to be delayed compared with those of other emissions. The institutional challenges and social custom to fostering interactive actions by economic agents for emission reduction are also important factors here. The underdeveloped waste management. CO_2 emissions in the solid wastes have accounted for 55.2 % of total CO_2 emissions on average in the seven Gulf states during the 35-year period while it is 11.8% in Japan, for example. Development-oriented policies and energy subsidies have hindered the promotion of emission reductions in the Gulf states.

Conclusions

The weak support for the EKC hypothesis suggests opportunities for the US, the EU, and developed Asian countries to boost their international presence by assisting Gulf states in decoupling economic growth from CO_2 emissions in the energy and environment sectors through the introduction of energy-efficient and environment-friendly technologies and consultations. Therefore, cooperation with the governments, businesses and citizens would enable oil exporters to attain balanced and sustainable economic, environmental and social growth contribute not only to gaining economic benefits but also prestigious positions for the developed countries in the international community.