Does Fiscal Policy influence per capita CO_2 emission?

A cross country empirical analysis

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GGKP Annual Conference 2014-2015
"Fiscal Policies and the Green Economy Transition:
Generating Knowledge – Creating Impact"
January 29-30, 2015

Background

- Provision of subsidies to domestic players with various motives, e.g., countering domestic distortions; granting 'infant-industry' protection; facilitating innovation; supporting national champions; ensuring redistribution etc.
- Implications of all forms of subsidies on environment.

1. Input subsidies – rise in demand due to substitution of other non-subsidized inputs - consequent change in input usage patterns lead to growth of the sectors benefiting from input subsidies, leading to overproduction and in turn overexploitation of resources.
2. Output subsidies - higher price per unit of output produced, may lead to over-use of inputs, over-exploitation of resources, over-production and consequent environmental degradation.

Objective and Structure of Current Analysis

- Objective:
- Analyzing the influence of subsidies on per capita CO_2 emissions for 131 countries over 1980-2010.
- Non-availability of long time series data on other GHGs for a large number of countries has restricted us to consider only per capita CO_2 emissions as an indicator of climate change.
- Structure:

1. Brief literature survey on the implications of subsidies on climate change concerns
2. Discussion on selection of the empirical model and data sources
3. Cross-country empirical results
4. Policy Conclusions

Evidence from Literature: Subsidies and Climate Change Concerns

- Reduction in per unit cost through subsidies, motivating over-production, overexploitation of natural resources and/ or increased uses of energy products leading to deepening of climate change concerns.
- Subsidy-led adverse environmental impacts in several resource-intensive sectors, e.g., primary sector (e.g. agriculture, fisheries), transport, energy and water sector etc.
- Fertilizer subsidies and climate change concerns
- Electricity subsidy and cultivation of water-intensive crops, leading to groundwater overexploitation on one hand and large scale leaching of nitrates and pesticides into aquifers on the other.
- Fuel subsidies to fishing trawlers and other vessels for capturing marine fisheries and overuse of mineral fuels, harmful discharge in seas and over-fishing.
- Energy-related subsidies and their implications for developed (Victor, 2009) emerging economies and developing countries.

Influence of Other Socio-economic and Economic factors on Climate Change

- A non-linear relationship between per capita GDP level of a country and its CO_2 emissions, i.e., *Environmental Kuznets Curve Hypothesis* (EKCH).
- As manufacturing sector is one of the major contributors of GHGs, the share of the manufacturing sector in GDP has been considered as one of the control variables.
- The effect of the other two sectors, namely, agriculture and services are also used as control variables in the regression analysis.
- Level of urbanization (proxied through percentage of urban population in total population) has been included in the model as a control variable as growth divergence may bear interesting climate change repercussions.
- Therefore, PCGDP, $PCGDP^2$, Share of agricultural, manufacturing and services, and urbanization have been included as control variables in the current analysis.
- Government support type and level of development has been included as additional control variables in the analysis.

The Data Availability Question

- While budgetary subsidies play a crucial role in influencing the climate change concerns, the role of implicit subsidies (e.g., income foregone) are no less important.
- As compared to budgetary subsidies which are generally reported in Government Budgets, implicit subsidies are difficult to identify but their magnitude could often be comparable to the budgetary subsidy by many times and create strong *composition effects*.
- Evidence of perverse incentives of subsidies:
- Adoption of weaker environmental standards on pollution abatement
- While estimated values of sector-specific input subsidies is available for select countries for certain years, one major challenge is however to obtain actual / estimated data on implicit subsidies at country level on a regular basis
- Present analysis analyzes the nexus between government budgetary subsidies and climate change concerns as reflected through per capita CO_2 emissions

Regression Model

- $$\log(CO_{2it}) = a + \beta_1 \log(SUB_{it}) + \beta_2 \log(SUB_{i(t-1)}) + \beta_3 \log(CO_{2i(t-1)}) + \beta_4 \log(PCGDP_{it}) + \beta_5 \log(PCGDP_{it})^2 + \beta_6 \log(AGRIGDP_{it}) + \beta_7 \log(MFGGDP_{it}) + \beta_8 \log(SERVGDP_{it}) + \beta_9 \log(TAXREV_{it}) + \beta_{10} \log(URB_{it}) + C_{it} + GOV_{it} + T_t + \varepsilon_{it}$$

Empirical Model: Underlying motivations

- Independent variables of the proposed empirical model in line with the existing empirical literature, especially in terms of measuring the aforesaid three effects.

1. Higher volume of output might be associated with higher emission of pollutants owing to additional energy use, exploitation of natural resources etc. Hence $PCGDP_{it}$ considered as proxy of *scale effect*.
2. As per EKCH predictions in the early stages of development a country moves from primary to secondary (i.e. manufacturing) sector, leading to increase in emissions level. Since manufacturing sector is one of the major contributors of GHGs, $MFGGDP_{it}$ considered as proxy of *composition effect*.
3. EKCH also notes that further development may be associated with greater sustainability with rise in contribution of relatively less polluting services sector, higher citizen demand for cleaner environment, adoption of better environmental governance through stricter enforcement of sustainable practices etc. Therefore, $PCGDP^2_{it}$, $SERVGDP_{it}$ and URB_{it} included as proxies of *technique effect*.

Data Source

- Data on budgetary subsidies from Government Finance Statistics (GFS).
- Three types of government reporting have been observed in the GFS data for which the required data on subsidy is available.

1. *General Government* (GG) includes all the Central Government (CG) transfers plus budgetary expenses of all the Central Ministries / Departments and the same for the State Governments (SG) (including provincial or regional) and Local Governments.
2. *Central Government* (CG) transfers on the other hand represent the consolidated transfers of the Central Government (including transfers of Central Ministries / departments).
3. *Budgetary Central Government* (BCG) covers "Any central government entity that is fully covered by the central government budget" (IMF, 2005).

- GFS generally reports the budgetary statistics for countries adopting cash-based accounting method, but for several countries accrual-based accounting (non-cash) method has been reported.

Data Source (Contd.)

- The present analysis considers the data on subsidies as percentage of GDP of respective countries and the process scale out the size of the economy (as measured by their respective GDP).
- The data on annual Per Capita CO_2 emission (in tonne), i.e., the dependent variable included in the empirical analysis, is obtained from World Development Indicators database of the World Bank.
- For the other control variables, the data on per capita GDP, share of agriculture, manufacturing and services sectors in GDP, level of urbanization and tax revenue (as percentage of GDP) have been taken from World Development Indicators (WDI) database.
- The dummy variables have been generated from the obtained data series as per the defined specifications.

Broad features of the data series ..

Interpreting the Empirical Results

1. Government subsidies adversely influence Per Capita CO_2 emissions. The relationship is found to be robust both for the current and past values of subsidies.
- Models 3 and 4 reveals that the coefficient of *lsub(-1)* is found to be higher vis-à-vis the corresponding coefficients for *lsub*, which demonstrates the importance of the lagged effects of budgetary subsidies on per capita CO_2 emissions.
2. The coefficient of *lpcco$_2$(-1)* has been found to be positive and significant, implying that a country's historical high level of CO_2 emissions is expected to influence the current level of emissions.
3. For one percentage point increase in *lpcgdp*, *lpcco$_2$* emission generally increases by a higher proportion.
- Higher order terms of income (*lpcgdp^2*) are associated with a negative sign in all the estimated models.

Interpreting the Empirical Results …

4. Contribution of manufacturing sector in GDP is found to be positively influencing the dependent variable, while the reverse is noted in case of primary and service sectors.
   - In other words, growth in composition of manufacturing sector in an economy results in growth of CO_2 emissions, while the rise in primary and service sectors contribute in curbing the same.
   - The PCGDP and economic composition results provide a strong support to the existence of the EKCH phenomenon.
5. The result signifies the negative repercussions of urbanization on CO_2 emissions.
6. A negative relationship between TAXREV and $PCCO_2$ is noted, which implies that higher the tax revenue (as % of GDP) lower the per capita CO_2 emission.
7. The cash and government dummies are found to be significant, implying the importance of the underlying accounting method and level of government data reporting practices in influencing the subsidy-climate change nexus.

Interpreting the Stability Analysis Results

- In Models 5 and 6, the difference in share of subsidies in GDP and its difference with the past year's value has been considered as an independent variable and the estimated coefficient is found to be positive and significant.
- Implication: rising difference between past and present values of subsidies positively influence CO_2 emissions.
- As the estimated result of a regression model could be specific to functional form, to check the robustness, Model 9 is estimated where first differences of all continuous variables are taken.
- Neither the sign nor the significance level of key policy variables changes in this model.
- In addition, by splicing the sample countries into two groups, namely LIC & LMIC and UMIC & HIC as per the relevant income definitions, the robustness of the proposed relationship has been checked through Models 7 and 8.
- The coefficient of *lsub* is found to be positive in both models, but the coefficient for the lower income countries are found to be larger vis-à-vis the same for their higher income counterparts.
- Implication: provision of subsidies in the lower income countries may potentially lead to greater CO_2 emissions given the possibility of natural resource base erosion.

Analysing the Three Effects

	Lower Income Countries (LIC and LMIC)	Higher Income Countries (UMIC and HIC)
Scale Effect	Weaker	Stronger
Composition Effect	Stronger	Weaker
Technique Effect	Weaker	Stronger

Conclusion

- Divergence in values of the estimated coefficients across LIC-LMIC and UMIC-HIC groups indicates how subsidies influence climate change concerns across different countries differently depending on the relative strengths of the *scale*, *composition* and the *technique* effects.
- For UMIC-HIC, while the presence of a stronger *technique effect* might conceal part of the adverse effect of budgetary devolutions, adverse *scale* and *composition effects* are clearly witnessed for these economies.
- Developing countries also need to urgently pay heed to the adverse influence of budgetary subsidies on per capita CO_2 emissions, as the presence of a weaker *technique effect* but *stronger composition effect* is apparent.
- Need for an early conclusion of the UNFCCC forums negotiations to secure GHGs reduction commitments by both group of countries.

Areas of future research ..

Thank You!!

Comments are Welcome