CARBON PRICING EFFICACY: CROSS COUNTRY EVIDENCE

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Overview

Analysis of the effectiveness of climate policies is essential for formulating climate change mitigation strategies. Economic theory is clear that putting a price signal on emissions will tend to reduce emissions. This has also been established in some individual case studies. However, there is a remarkable lack of cross-country studies on the effectiveness of carbon pricing in reducing emissions. In this paper we estimate the contribution of carbon pricing schemes to reducing carbon dioxide (CO_2) emissions, using data for over two decades for 143 countries. A quarter of these countries have had carbon prices. We employ econometric techniques that control for other potential determinants of emissions growth, including other policies. We focus on emissions from fossil fuel combustion, which account for approximately 80% of CO_2 emissions and have been the main target of carbon prices (IEA 2017). We also analyse sectoral effects.

Methods

We seek to explain factors affecting CO_2 emissions from fossil fuel use across countries. Emissions data are from the International Energy Agency (IEA 2019), covering 143 countries that account for approximately 96% of the global population.

Our analysis uses several variables describing the existence, strength, and extent of carbon pricing (OECD 2016; ESMAP (Energy Sector Mangement Assistance Program) 2018; World Bank and Ecofys 2018). This includes continuous measures and also a binary measure.

We use three modelling approaches that are suitable for our analysis of policy effects on carbon dioxide emissions. In addition to policy variables, we also include initial economic structure variables related to the Kaya Identity, initial levels of emissions to control for possible convergence effects (Barro 2015; Csereklyei and Stern 2015; Best and Burke 2017), and prior-period growth in emissions to control for potential momentum effects. The three modelling approaches are:

- Cross-sectional growth rate regressions
- Fixed-effects panel estimations
- Difference-in-differences estimations

Results

We find negative and significant coefficients for carbon pricing in explaining the subsequent CO_2 emissions growth rate. A one-euro increase in the effective carbon rate per tonne of CO_2 emissions is associated with a slowdown of 0.2 percentage points in annual emissions growth, significant at the 1% level. The effective carbon tax variable, which is one of the two additive components of the effective carbon price rate, has a similar impact. There is also a negative and significant coefficient for the other component of the effective carbon rate, the ETS rate. These results are consistent with the emissions-reducing effect of a carbon price being stronger for higher carbon prices, as theory would suggest.

Other carbon pricing variables also have negative effects on emissions. The carbon pricing score from the Energy Sector Management Assistance Program (ESMAP) of the World Bank (2018) has a negative association with subsequent emissions growth, significant at the 5% level. A carbon pricing variable that equals one for countries with a carbon price at the beginning of the growth period in 2012, zero for countries that did not have a carbon price from 2012–2016, and the fraction of years for countries introducing a carbon price during 2012–2016, also has a negative and significant coefficient at the 1% level.

Conclusions

The results of our analysis provide empirical support to the theoretical contention that carbon pricing helps to reduce emissions. We quantify the size of the effect of carbon pricing on the subsequent emissions growth rate. We find that there are substantial effects of carbon pricing on subsequent emissions growth. Our analysis uses cross-country panel data with an extensive list of policy and other controls. We use continuous policy variables, an advance on many studies of renewable energy uptake that only use binary variables. We assess a global sample of countries. Our analysis covers over two decades of carbon pricing experience. Our suggestive results are useful as the first study of this type.

References

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