DID CARBON EMISSIONS BEHAVE DIFFERENTLY IN THE 2020 RECESSION THAN IN PAST RECESSIONS?

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Overview

The 2020 COVID-19 driven recession saw a sharp drop in carbon dioxide emissions as transportation and some other energy uses were curtailed. This was an unusual recession – past recessions were driven primarily by changes in investment and central bank policies etc., while this one was driven by a pandemic. Was the behaviour of carbon emissions in this recession different to that in past recessions? If so, what does that teach us about the relationship between carbon emissions and economic activity?

Methods

We use time series models estimated on monthly U.S. GDP (Brave et al., 2019) and monthly carbon emissions data to explore how emissions fall in recessions and rise in booms. Previous studies have discussed the possibility of asymmetric effects when measuring the impacts of GDP growth on carbon dioxide emission. We build on the literature on an asymmetric response of emissions to falls and rises in GDP (Sheldon, 2017). Following this approach, we assess whether there is an asymmetric effect for emission-income elasticity during recessions and booms,

$$\Delta lnC_t = \alpha_0 + \beta_1 D_{recession} \Delta lnG_t + \beta_2 D_{no\_recession} \Delta lnG_t + \epsilon_t \quad (1)$$

Where $\Delta \ln C_t$, $\Delta \ln G_t$ denote the first difference of carbon emission and GDP changes (in logarithm term). Recession dummy $D_{recession}$ equals one when one month is during recession and 0 otherwise; non-recession dummy equals 1 when it is not in a recession and 0 when it is a recession. ϵ_t is an error term.

We compare the COVID-19 pandemic recession with past recessions in the United States since 1973 individually. Since past recessions are associated with different sources, two types of recessions might offset each other, it is necessary to identify individual recessions with econometric method.

$$\Delta lnC_t = \alpha_0 + \tau T_{recession\ identification} + \gamma \Delta lnG_t + \sum_{i=0}^{7} \rho_i T_{recession\ identification=i} \Delta lnG_t + \epsilon_t \quad (2)$$

Recession identification term ($T_{recession\ identification}$) and subscript i distinguish each financial recession recognized by National Bureau of Economic Research (NBER[1]) in the U.S. history. Seven recessions are identified between 1973 and 2020: 1973-1975 recession (November 1973- March 1975); 1980 recession (January 1980- July 1980); 1981-1982 recession (July 1981- December 1982); 1990-1991 recession (July 1990- March 1991); 2001 recession (March 2001- November 2001); 2007-2009 recession (December 2007- June 2009) and 2020 recession (February 2020 -December 2020[2]).

We use the U.S. data as long monthly time series are available, start from January 1973 and end until December 2020. Emissions and energy-related data are seasonally adjusted using X13-ARIMA-SEATS

[1] Business Cycle Dating by NBER, https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions

[2] Due to data availability, we only identify the COVID-19 recession as February-December 2020.

program.

Results

We distinguish recession and non-recession periods by including the interaction term between recession dummy and GDP growth rate. Comparing recessions individually, we find along with the 2020-recession (coefficient of the interaction term is 1.56 at 1% significance level), during 1973-1975 recession (3.31 at 5% significance level), 1980 recession (2.19 at 10% significance level) and1990 recession (3.74 at 5% significance level), the emission-income elasticity under asymmetric effect is significant.

This makes us interested because during these past three periods, oil supply shocks are also erupted In the U.S. But unlike past three oil crises, oil shock during 2020 recession is mostly associated with a negative demand shock. While for the rest recessions where no significant asymmetry compared with booms are seen, the financial crises are primarily affected by banking policies. For instance, the great recession (December 2007-June 2009) is normally considered to be related to subprime mortgage crisis and early 2000s recession is relevant to stock market bubble and the 9/11 terrorist attack (Roberts 2009).

Kilian (Kilian 2009) also argued that not all shocks on oil price are alike by distinguishing shocks to the crude oil into supply and demand perspectives. Therefore, it makes sense to make the hypothesis that sources of recessions are important in affecting the carbon emission elasticity of income. If a recession is associated with oil crisis, it is likely to have significant asymmetric effect on carbon emissions between recessions and booms. By contrast, recessions related to investment and central bank policies did not show significant this asymmetric effect.

Conclusions

Asymmetric effects are found on CO_2 emission during recessions compared to booms, emissions drop faster during recessions. When distinguishing recessions as past recessions and the 2020 COVID-19 recession, the asymmetric effect during 2020 recession is significant compared to the aggregated effect from past recessions.

Offsetting impact on the asymmetry of emissions from economic changes is detected by further identifying previous recessions individually. Past recessions in the U.S. history are associated with different sources. We find that along with the 2020 recession, during 1973-1975 recession, 1980 recession and 1990 recession, asymmetric effects on emission compared with booms are significant. Apart from 2020 recession, the other three recessions are related with oil supply shocks. The 2020 recession is associated with negative demand shock for oil use. Recessions associated with oil crises have asymmetric effect on emissions during the recession periods compared to booms. While no significant asymmetric effects are found for those recessions mainly associated with investment or banking crises.

References

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