Carbon Intensity, Productivity, and Growth
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Abstract
Over the past several decades real GDP per capita in the US has strongly increased while CO2 emissions per capita have seen a secular decline, thus sharply reducing the carbon emission intensity of output. We identify an emission intensity shock as the innovation which explains the maximum share of variation in the ratio of CO2 emissions and real GDP at the horizon of 20 years. While the shock is associated with a persistent decline of emissions per unit of output, per capita CO2 emissions quickly revert back to their initial level. The reason is that output and its components strongly increase in response to the emission intensity shock, providing evidence of a rebound effect in aggregate US carbon emissions. The emission intensity shock triggers a substitution of fossil fuels with electricity that is mainly generated from nuclear energy. A separately identified TFP news shock is highly correlated with the emission intensity shock, and both explain similarly large fractions of GDP at longer horizons. A TFP news shock orthogonalized to the emission intensity shock only explains small fractions of GDP and its components, suggesting that innovations to the energy mix of the US economy have been a key driver of growth in recent decades. While the emission intensity shock explains the bulk of variation of emissions per unit of output, it only explains modest shares of emissions per capita. The remaining variation is driven by shocks related to the demand for oil at business cycle, and to the supply of oil at lower frequencies.