

## Input-Output approach as an instrument for estimation of potential national ecological targets

Topic: (4.6) Special Session: Input-output Approach and Impacts of Economic Policy in the Emerging Markets (2)

Author: Andrey Kolpakov

Co-Authors: Alexander Shirov

Attention to reducing the negative anthropogenic impact, especially carbon dioxide (CO<sub>2</sub>) emissions, is an important part of current vision of sustainable global economic development. International collaboration in these areas has led to the adoption of the United Nations Framework Convention on Climate Change (1992) and the Kyoto Protocol (1997), which specify the obligations of a number of countries to limit their CO<sub>2</sub> emissions. In December 2015 the Paris Agreement was adopted. According to this agreement, each party shall set and achieve nationally determined contributions to the global response to climate change.

However, many developing countries are considering the subject of CO<sub>2</sub> emissions limitations as a way to restrict their economic and technological development, as well as to maintain the leadership of developed countries in the world trade.

Currently aggregate CO<sub>2</sub> emissions generated by national production sectors (production-based CO<sub>2</sub> emissions) serve as a criterion for determining countries emissions. This methodology does not take into account the international carbon flows in the form of commodities produced in one country and consumed in another one, although up to 25-30% of worldwide CO<sub>2</sub> emissions are concentrated in such operations. And the serious question is Who shall be responsible for CO<sub>2</sub> emissions generated during the production of commodities in developing countries, which are subsequently sold to and consumed by other countries? A possible answer is the applying of consumption-based CO<sub>2</sub> emissions approach.

Consumption-based (Econs) and production-based (Eprod) CO<sub>2</sub> emissions are related through the following ratio:  $E_{cons} = E_{prod} - E_{exp} + E_{imp}$ , where  $E_{exp}$  – export-associated CO<sub>2</sub> emissions and  $E_{imp}$  – import-associated CO<sub>2</sub> emissions.

The suitability of this methodology for forming a position in negotiations of future CO<sub>2</sub> emissions limitations is obvious, as it allows to share the countries responsibility more elaborately. With this approach there are additional incentives for greater investment by developed countries in manufacturing sectors of developing ones for reducing the carbon intensity of imported goods. However, it requires more complicated calculations.

The subject of CO<sub>2</sub> emissions limitations is very important for the Russian economy in view of significant role of energy-intensive exports.

Research is devoted to estimation of Russian CO<sub>2</sub> emissions under different methods. A key objective is to analyze the possible levels of CO<sub>2</sub> emissions limits for Russia, which would not restrict its economic development in the long term.

We use Multi-regional input-output (MRIO) approach based on WIOD Database – World Input-Output Tables and Environmental Accounts. Institute of Economic Forecasting of Russian Academy of Sciences (RAS IEF) releases up-to-date input-output tables for the national economy and uses them for forming macrostructural models for forecasting the dynamics and structural characteristic of the economy in the long term. That is why WIOD data for Russia is replaced by own information in the calculations.

According to our estimates in 2013 Russian export-associated CO<sub>2</sub> emissions were 580 MtCO<sub>2</sub>, imports-associated emissions – 120 MtCO<sub>2</sub>, production-based emissions – 1740 MtCO<sub>2</sub> and consumption-based emissions – 1280 MtCO<sub>2</sub>. The largest industries exporting CO<sub>2</sub> were electric power sector (34%), metallurgy (22%), mining and quarrying (16%), transport (9%), production of coke and refined petroleum (9%) and chemical production (5%). The largest import CO<sub>2</sub> flows were associated with electric power sector (20%), agriculture (12%), metallurgy (11%), chemical

production (10%), textile manufacturing (9%), transport (9%), production of coke and refined petroleum (6%), production of transport equipment (3%) and machinery (2%).

Analyzing possible long-term emissions limitations, we use two conditional levels: "Kyoto" (100% of Russian CO<sub>2</sub> emissions in 1990) and "Paris" (75% of Russian CO<sub>2</sub> emissions in 1990) ones. We consider two scenarios of the Russian economy development: Reference ("inertial") and Accelerated Modernization (annual GDP growth rate is comparable to the world average).

We conclude that the consumption-based approach is more beneficial for Russia in terms of emissions limitations. We show that up to 2030 Russia will not reach the 1990 level of CO<sub>2</sub> emissions in any scenario. However, in Accelerated Modernization scenario Russian CO<sub>2</sub> emissions in 2030 will be very close to 1990 level. Moreover, in this scenario "Paris" level will be exceeded after the 2025. There is considerable risk that only inertial scenario will be possible for Russia if 75% limit level is used as nationally determined contributions.

This means that the condition about taking into account the absorption capacity of forests, which Russia insists on, is important for Russia to ensure sustainable long-term economic growth.