Economic Analysis

The road to carbon neutrality

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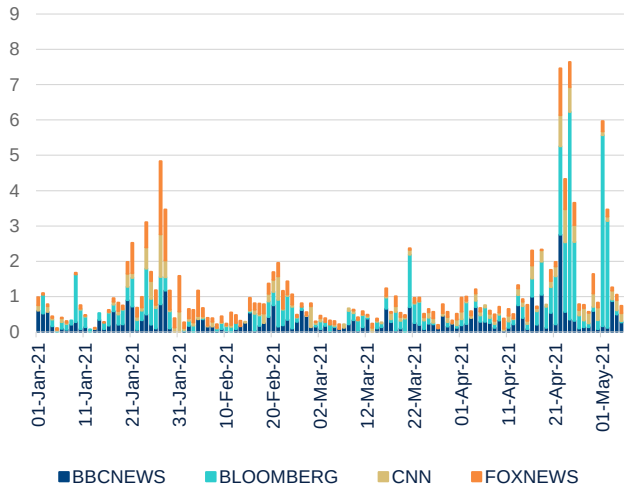
Rapidly rising climate anomalies have convinced more and more people that the only way to curb the temperature increases and their consequent economic and ecological disasters is to implement policies that aggressively eliminate carbon emissions. Figures 1 and 2 show the media report on climate since January 1, 2021. As we can see, there was intensive coverage on the Earth Day Climate Summit on April 22, 2021. At the Summit, President Biden pledged that the U.S. would cut carbon emissions by 50-52% by 2030 compared to 2005 – more ambitious than President Obama's pledge in 2015, a 25-28% reduction by 2025.

In this brief, we look into the economics behind carbon pricing and shed light on some carbon policy issues in the U.S.

Figure 1. **WORDCLOUD ON CLIMATE CHANGE**

Source: GDELT TV Explorer

Figure 2. **MEDIA COVERAGE ON CLIMATE CHANGE**



Source: GDELT TV Explorer and BBVA Research

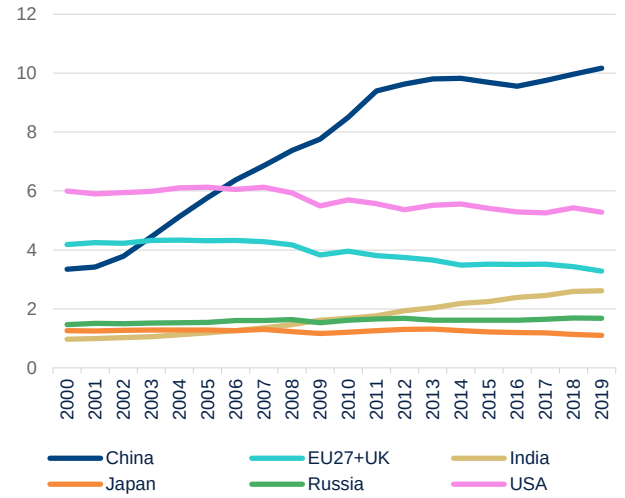
Background

The U.S., as the second largest GHG emitter and with the highest GHG emissions per capita (Figures 3 and 4), plays an important role in this global cooperation of GHG reduction and global environmental restoration.

The country's long-term goals are aligned with other major economies and GHG emitters across the world. For example, the 26 E.U. countries' target is for carbon neutrality by 2050, and China, today's largest GHG emitter, commits to achieve carbon neutrality by 2060. However, due to the unique economic structure of each country,

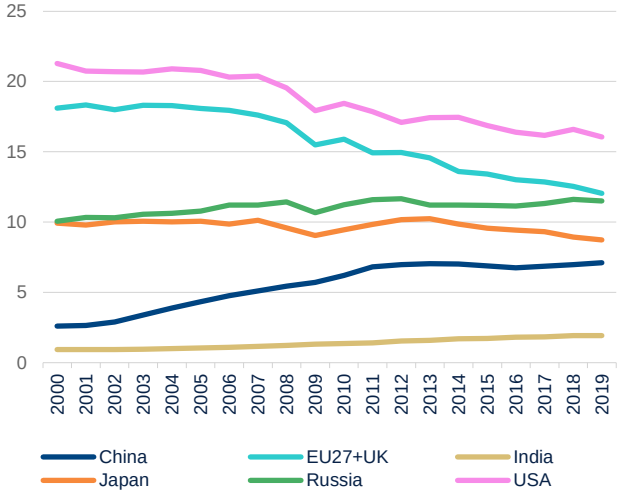
their policies can significantly vary. For example, it is unrealistic for a manufacturing-heavy country like China to massively cut GHG emissions immediately. Therefore, their commitment is to reach the peak of carbon emission by 2030 before the eventual carbon neutrality. In comparison, for advanced economies, such as the E.U. and the U.S., reductions in carbon emissions are already on the way. Their policy goals will be significantly different from China's.

Figure 3. **TOP SIX CO2 EMITTERS: TOTAL** (BILLION TON)



Source: Our World in Data and BBVA Research

Figure 4. **TOP SIX CO2 EMITTERS: PER CAPITA** (BILLION TON)



Source: Our World in Data and BBVA Research

Carbon pricing

The economics of carbon pricing is intuitive. Since today's uncontrolled human activities along with GHG emissions will lead to catastrophic climate change in the future, it is worthwhile to avoid such an economic and ecological disaster by increasing today's cost of GHG emissions. Intuitively, a carbon tax is the most straightforward way to right the wrongs. As long as we can calculate the "real" price of GHG, we can tax the emissions at such a rate. The taxes will offset GHG emissions' externalities, and industries will operate with the fair price of carbon emissions before eventually adopting green technologies.

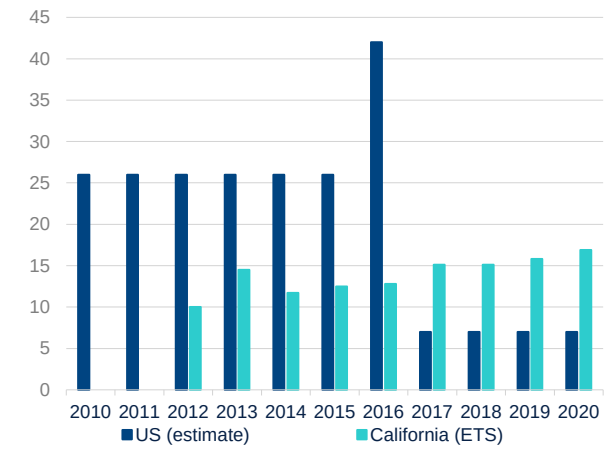
Nordhaus's Dynamic Integrated Climate-Economy model (DICE)[1] is a macroeconomic model that connects economic activities, carbon emissions, global temperature changes, and their harmful effects based on empirical evidence. The tax rate on carbon dioxide emissions will determine the equilibrium levels of temperature increase and economic growth in the model. On the one hand, high carbon prices will suppress economic activities with high GHG emissions. On the other hand, they will also lower carbon emissions and contain the costs associated with global climate change.

In equilibrium, the carbon tax policy will result in an optimal temperature increase so that today's price of curbing carbon emission is equivalent to the discounted cost of higher temperature in the future. Based on the estimation in

1: https://sites.google.com/site/williamdnordhaus/dice-rice

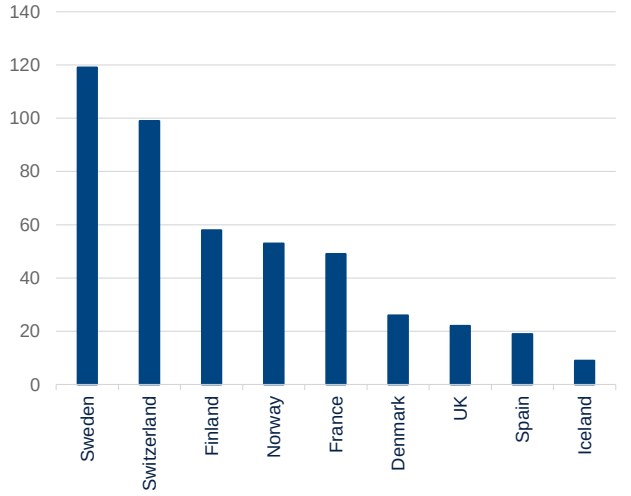
Nordhaus (2018), the overall benefits will be positive if the temperature increases no more than 3.5 degrees Celsius before 2100. However, the equilibrium temperature change can vary significantly due to different model parameterizations. For example, the UN suggests that the temperature increase should not exceed 2 degrees Celsius, and the latest results by researchers at PIK[2] support this number.

Figure 5. **CARBON PRICES (US&CA)**
USD/TON



Source: World Bank, New York Times, and BBVA Research

Figure 6. **CARBON PRICES IN EU**
USD/TON

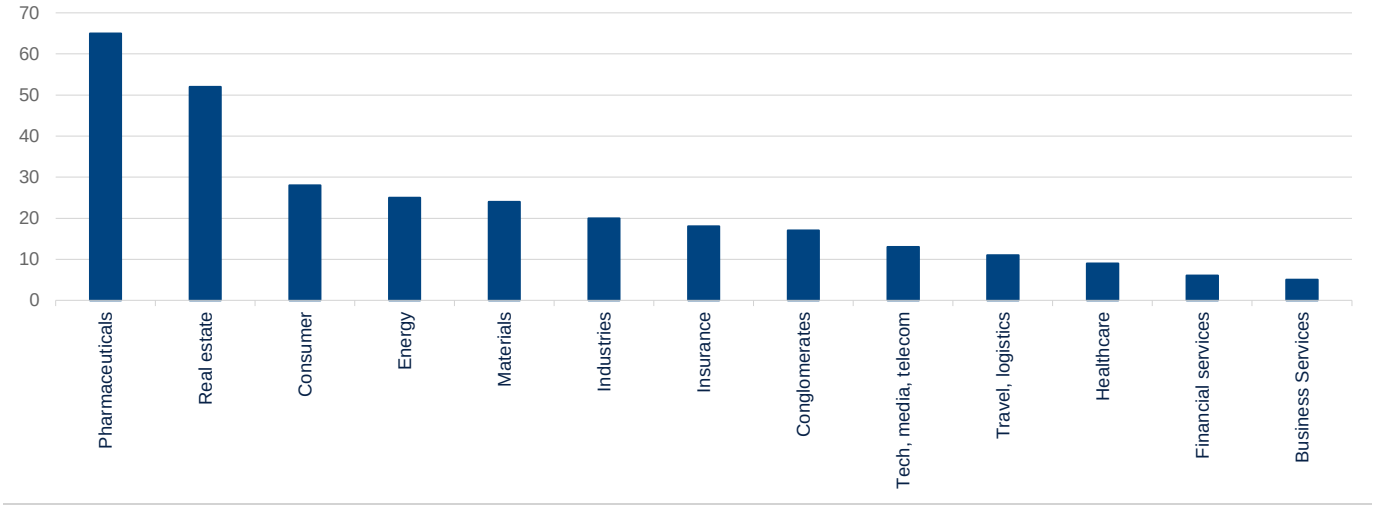


Source: World Bank and BBVA Research

Moreover, mapping temperature increase to carbon price adds another layer of uncertainty in estimating a carbon tax. The cost of carbon emissions will be high if individuals value their utilities in the future. But if society heavily discounts the future, there will be no reason to put a high tax on carbon emission. The choice of the discount rate will significantly change the estimate of the carbon price. For example, Figure 5 shows the carbon price estimates by the US government in different years and actual prices of California's Carbon Emission Trade System (ETS).[3] Figure 6 shows prices adopted by European countries. As the wide range of price dispersion shows, even though advanced economies have much in common in reducing carbon emissions, policies can still be highly diversified.

2: https://www.pik-potsdam.de/en/news/latest-news/an-economic-case-for-the-un-climate-targets-early-and-strong-climate-action-pays-off
3: Based on the excutive order from the White House in January 2021, the latest estimation under the Biden administration will take more than a year and be public in 2022.

Figure 7. **INTERNAL PRICING OF CARBON EMISSIONS BY GLOBAL INDUSTRIES** (USD/TON, MEDIAN)



Source: McKinsey & Co., Carbon Disclosure Project (2019)

The prospect of carbon pricing is further complicated by industry heterogeneities. As we can see from Figure 7, the median value of internal carbon prices varies significantly across industries. If the regulator implements a single carbon price, the industries with a low threshold, such as the healthcare industry, could potentially be damaged. Meanwhile, industries with high thresholds will have little incentive to cut their emissions.

Other carbon policy considerations

Given the complexities of carbon pricing, other approaches can be helpful supplements for policymaking. A tried-and-true approach is to implement a "cap-and-trade" scheme for GHG emissions. Instead of estimating a reasonable price to infer carbon dioxide emission reductions, the cap and trade system directly sets a cap for total emissions. The quantity of GHG emissions will dictate the price.

In 2009, the American Clean Energy and Security Act (the Waxman-Markey bill), a GHG cap-and-trade bill, failed to pass the legislator. However, it still has many merits after 12 years. Historically, cap-and-trade programs have helped the U.S. successfully reduce various pollutants, including sulfur dioxide and nitrogen oxides. It is reasonable to believe that the same system can be used to reduce GHG as well. Also, in hindsight, this bill only targeted an 83 percent reduction of GHG emissions than the 2005 benchmark. Since we have a grander ambition towards carbon neutrality, the goals and policies in the bill look relatively mild. Moreover, based on the fiscal impact analysis from the CBO, this act would be deficit-neutral for the government over the next decade. Therefore, it will not aggravate the government's debt problem.

Another dimension of policymaking is to consider the "green premium." As Bill Gates illustrated in his new book[4], the green premium is defined as the difference in costs between traditional technology and its green alternatives. Based on conventional wisdom, firms do not adopt green technologies because they are more expensive than traditional ones. However, this is not necessarily true. Gates (2021) shows that although cheap and green options are readily available in some regions and industries, firms and individuals still choose to stay with the old

4: Gates, B. (2021). *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need*. Knopf.

technologies. The reason is that there could be significant costs of human capital associated with the technologies in use. In other words, even though green options can be slightly cheaper than traditional ones, firms will need to hire new employees or train current ones at high costs. In this case, the government needs to step in and provide financial incentives for the firms to transform.

Bottom line

The Biden administration pledged that the U.S. would cut carbon emissions by 50-52% by 2030. While this ambitious goal requires tremendous efforts in policymaking, recent policy proposals from the White House show that the current administration is not short of grand visions and determination. While the estimate from the White House will not be released until 2022, it is reasonable to believe that the official carbon price will not be lower than the one estimated in the conservative setting of the DICE model. That is, 82 USD/ton.[5]

As for the policymaking, the coordination of two primary methods (carbon tax and cap and trade) should be the key to effective GHG reductions. For industries with relatively cheap green alternatives (utilities and steel), the cap and trade system will "nudge" the firms to upgrade their technologies. Their gains from carbon trades will offset extra costs from green investments. However, for sectors with little or no affordable green alternatives, such as the chemical industry, a carbon tax is more appropriate. Without a technological breakthrough, the cap and trade system for these industries will mechanically cut their supply. The sharply rising prices caused by supply shortage will have severe adverse effects on social welfare.

5: Hänsel, M. C., Drupp, M. A., Johansson, D. J., Nesje, F., Azar, C., Freeman, M. C., ... & Sterner, T. (2020). Climate economics support for the UN climate targets. Nature Climate Change, 10(8), 781-789.

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