A Stylized Applied Energy-Economy Model for France

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France, as many other countries, committed to reduce by at least 75% its greenhouse gases emissions by 2050 compared to the 1990 level. To achieve this ambitious objective, the settlement of market mechanisms based on the increase in the price of fossil fuels – whether carbon taxes or emissions trading systems –, appear inevitable. A situation with low fossil fuel prices seems indeed incompatible with a significant decrease in their utilization, and supply-demand factors are not likely to be sufficient for triggering the necessary price increase. But what should be the initial level and the time path of the tax for the consumption of fossil fuels to be reduced by a factor of four in the long run?

In France, this question has been addressed by an official commission (the Quinet commission) in 2008. According to the commission, the carbon value should start at 32€ per tonne of CO2 and grow at about 5% per year to reach around 200€ in 2050, which roughly corresponds to a 100% add-on to the price before tax. The results were based on simulations performed by large scale multi sectors models. But due to the complexity of the models, their large size and their sectoral disaggregation, it is difficult to understand some of their assumptions and conclusions. In particular, the substitution possibilities between energy and

other goods, and the implicit average rate of energy-saving technical progress cannot be easily identified.

Since those assumptions have a major impact on the carbon value necessary to achieve the emission-reduction objective, we build a simplified general equilibrium macroeconomic model, sufficiently aggregated so as to ensure that assumptions about technical progress and substitution possibilities are explicit and their influence can be easily analyzed. Using French annual historical data (1986-2008), we estimate the elasticity of substitution between fossil energy and other goods and services, and the rates of labor-saving and energy-saving technical progress. Making the hypothesis that those rates equal the average historical values estimated (respectively 1.6% and 2% a year), we simulate the impact on emissions of the carbon tax proposed in the Quinet report. We obtain that such a tax would only yield a 25% reduction in emissions. We then consider that the tax stimulates the energy-saving technical progress. Even with this mechanism, emissions would only be curbed by 40%.

The conclusion we can draw from our simulations is that a reduction of emissions by 75% is very difficult to achieve for France. Such a reduction indeed requires that energy-saving technical progress grow at a high rate that has never been reached in the past. This will not occur without an important effort which is likely to come at some cost. We wonder if existing large applied models commonly used to study environmental policy are not misleading in the sense that they under-estimate the magnitude of the effort required.