Executive summary

Economic effects of nuclear phase-out under stringent climate policy: A dynamic macroeconomic analysis

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In this paper, we analyze the economic consequences of a gradual nuclear power phase-out policy, using a fully dynamic growth model and applying it to the Swiss economy. Switzerland is an ambitious and challenging case to study, given the relatively high share of nuclear energy, the limited potential for additional hydropower and the political aim of not increasing foreign dependency. Looking at the long-run impact of policy, we are particularly interested in the induced innovation effects -- on both the sectoral and on the aggregate level -- and the structural change in the economy. We enlarge and apply a model especially designed for this purpose, the Computable Induced Technical change and Energy (CITE) model (Bretschger et al., 2011), which is a CGE model with fully endogenous growth. The original CITE model has been updated, adapted, and extended with different technologies in the electricity sector. This enables us to explicitly show the effects and requirements on the technological level and the underlying substitution potentials. Moreover, we are able to combine the effects of ambitious targets both in energy and in carbon policy; an area of broad interest for economists and policy makers.

To study the effects of nuclear phase-out, we conduct research in two directions. One is through the price mechanism, where the cost of using nuclear escalates over time due to “forgetting by not doing”, increasing security standards, and retrofitting requirements. In the optimum, this cost escalation induces a gradual nuclear phase-out. The other is to shut down nuclear through exogenous policy regulation, where the timetables of closing down the nuclear reactors are exogenously determined by authorities.

We find in our dynamic framework that the costs of ambitious carbon and energy policies are lower compared to the results of the existing literature, because there is significant induced investment and innovation. For the case of Switzerland, total welfare loss of decarbonization is as high as 1.21%; it increases to 1.58% at the maximum if nuclear phase-out takes place, which implies that the net cost of nuclear policy is maximum 0.37% in terms of welfare. Economic growth does not slow down significantly. It emerges that the trade-off between cutting carbon emissions and limiting nuclear power is moderated once the dynamics of an economy are taken into account. Phasing out nuclear at an early stage can be optimal, provided that the perceived cost escalation is high. Decarbonization policies contribute to a structural shift in favor of innovative, energy-extensive sectors. Nuclear phase-out deepens the change in economic structure in a similar direction, as a result of intensified substitution effects between non-energy and energy goods, as well as the induced energy-saving innovation. It thus implicitly induces a fast transition to a less energy dependent economy.

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