THE AGGREGATE EFFECTS OF THE STRUCTURE OF INFORMATION IN LOW-CARBON TRANSITION POLICIES: AN EMPIRICAL APPLICATION

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Overview

This paper analyses the impacts on growth of a low-carbon policy in the power sector depending on different structures of information available to agents - *i.e.*, whether agents anticipate or not the future evolutions of energy policies and prices. We develop an empirical hybrid modelling that combines a General Equilibrium model with the optimization model of the power system developed by the French electricity Transmission System Operator. The results show that the effects of the low-carbon energy transition on decarbonation, growth and the non-environmental well-being of households (especially if non ricardian) depend significantly on the structure of information. The role of investment in durable goods and physical capital is important in our model to explain these differences in GDP and welfare between the two information structures. *Ceteris paribus*, an imperfect informational structure results in our model in a slower decarbonization of the economy and a higher economic growth.

Methods

We draw and expand on the previous literature by developing a hybrid model (called HyGEM) that combines a dynamic empirical GE model with the partial equilibrium model for the power generation sector developed by the French electricity Transmission System Operator (Rte). The evolution of the power sector (wholesale electricity prices, electricity system costs, subsidies, wholesale market revenues) is linked to the dynamic GE model via a two-way soft link. Energy enters the dynamic GE model via households' energy services as in Henriet *et al.* (2014) and also as a factor of production as in Hassler *et al.* (2012). We take account of energy efficiency in electric equipment and in fuel equipment. We distinguish between Ricardian and non-Ricardian households. Energy services produced by households add durable goods as a channel of propagation of energy shocks in the economy as in Dhawan et Jeske (2008) and Henriet *et al.* (2014). We also carefully apply an estimation of the elasticities of substitution à la Klump et de La Grandville (2000) that are key to the dynamics of an economy augmented by an energy module such as the inter-energy elasticity of substitution. As in Chan (2020), two informational structures are then considered and their consequences on the simulation of the model are analyzed: whether agents anticipate or do not anticipate the evolution of energy prices and low-carbon transition policies.

Results

Our results suggest, on French data, that whether or not the agents anticipate future energy efficiency efforts, carbon tax and oil price in the long run significantly alters the aggregate dynamics of the economy and the non-environmental welfare of agents (defined here as the welfare gains from increased consumption of non-durables goods and energy services). In both informational structures, the dynamics of fiscal revenues are quantitatively close. Accordingly, a switch to a more electrified energy-mix may not result, all things being equal, to a significant loss of revenues for government, thanks partly to the possibilities of substitution. However, whether or not agents perfectly anticipate the future entails a significant impact on their non-environmental welfare, and especially so for non-Ricardian households. The role of durable goods seems important in explaining these differences in GDP and welfare between the perfect and imperfect information structures. Also, the effects of an unanticipated carbon tax differ whether the household is Ricardian or not. We discuss these results in the light of the current literature. Ceteris paribus, an imperfect informational structure results in our model in a slower decarbonization of the economy and a higher economic growth.

Conclusions

The paper builds on a hybrid model that combines a dynamic GE model and an optimization problem for the power generation sector to study the aggregate effects of the electricity transition in the long run in France under different information structures. The results show that low-carbon public policies (public subsidies to the power generation

sector, constraints on the power mix, carbon taxation and policies promoting energy efficiency efforts) have a significantly different impact on the aggregate dynamics if they are announced in advance or not. When they are not announced in advance, agents do not overreact to energy shocks. The effects of unanticipated of energy shocks are more beneficial to the growth of the economy than of anticipated shocks but with a lower decarbonization. Moreover, the main transmission channel of the low-carbon transition in our model is the demand for energy through the relative price of energy and the relative efficiency of energies, rather than through increased investment in the decarbonization of the power mix. Also, the durables goods play a central role to explaining the differences in GDP and non-environmental welfare between the two information structures.

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