Interfuel Substitution:
Evidence from the Markov Switching Minflex Laurent Demand System with BEKK Errors

by

Apostolos Serletis and Libo Xu

Executive summary

In this paper, we take the econometric approach to the demand for energy and interfuel substitution. This approach allows estimation in a demand systems context, assuming a flexible functional form for the underlying aggregator function, and the computation of the relevant Morishima elasticities of substitution. We also pay explicit attention to theoretical regularity by treating the curvature property of the aggregator function as a maintained hypothesis.

We use the flexible minflex Laurent demand system. This model is based on the Laurent series expansion, which is a generalization of the Taylor series expansion, possessing a better-behaved remainder term, to approximate the unknown aggregator function. We follow recent advances in the literature and relax the homoskedasticity assumption, instead assuming that the covariance matrix of the errors of the minflex Laurent demand system is time varying, thus improving the flexibility of the demand system to capture important features of the data. Moreover, we advance the methodology, by relaxing the assumption of constant parameters in the aggregator function, and thus the resulting demand system, using the Markov regime switching approach.

We use a century of price and quantity data for three major energy goods --- crude oil, natural gas, and coal --- to investigate interfuel substitution in the United States. The evidence indicates that the Morishima elasticities of substitution among the three energy goods are always positive, suggesting substitutability. However, they exhibit large swings across two regimes, generally being higher in the high demand volatility regime before the 1950s and very low in the low demand volatility after the 1950s. This suggests that interfuel substitution is higher when fuel demand is uncertain. This is the first paper in the literature that identifies this mechanism.

Our results also inform policymakers that price interventions for substitutability purposes and environmental policies (such as, for example, emissions reductions) are regime dependent. Moreover, given the low interfuel substitution since the 1950s, such policies are not very effective.

Keywords: Minflex Laurent flexible form; Markov regime switching; GARCH; BEKK.