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## **THE ANATOMY OF ELECTRICITY DEMAND: A CGE DECOMPOSITION FOR NORWAY**

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### **Abstract**

The paper derives a general equilibrium demand function for electricity by imposing a specific closure rule on a large CGE-model of the Norwegian economy, including a relatively detailed description of the appropriate long-term aspects of the energy markets. The estimated aggregate price elasticity of the Norwegian electricity demand is supported by estimates of how the various adjustments made by firms and households contribute to the aggregate response. These effects include substitution at the micro level, disproportionate changes in the activity of industries with different electricity intensities (Rybczynski effect), as well as macroeconomic income effects on total demand. *A priori*, the Rybczynski effect is likely to be particularly important in a small open economy such as the Norwegian. Moreover, the estimates of various substitution effects disentangle the empirical importance of endogenous changes in the relative prices induced by the exogenous increase in the electricity price. Specifically, the wage rate must adjust in order to restore the necessary international competitiveness.

In addition to make a precise definition of the general equilibrium demand function, the methodological contribution of the paper is to explain the decomposition scheme that allows for quantitative decomposition of the aggregate price elasticity into various theoretical effects. This scheme also serves as a useful tool to shed light into a large and complex model that might be regarded as a black box.

The analysis supports the following conclusions:

1. The aggregate general equilibrium price elasticity of electricity is estimated to -0.31.
2. The equilibrium adjustments of the private production sectors in the private Mainland economy account for 87 percent of the aggregate demand response. Whereas the demand response in the production sectors is in line with several international studies, household electricity demand is less price sensitive than in international studies.
3. The macroeconomic contraction resulting from the rise in the electricity price is too small to have but a negligible effect on the aggregate price sensitivity. The change in relative prices is the main determinant of the demand adjustments.
4. The change in the relative prices is basically due to the increase in the electricity price and the transmission of this change into other purchaser prices through the input-output structure of the economy. As a general equilibrium effect the wage rate must fall. However, the wage rate reduction is only 0.04 percent per percent increase in the reference price of electricity, which is too small to have a significant effect on relative prices.
5. Within industry factor substitution contributes most to the reduction of the electricity intensity of the aggregate production sector. This effect accounts for 0.39 percentage points of the 0.53 percent reduction in total electricity demand from private Mainland industries per percent increase in the reference price of electricity. The most important substitution effect is the reduction of the energy-labour ratio.
6. Reallocations of resources between industries with different electricity intensity in their factor composition contribute by 0.14 percentage points to the 0.53 percent reduction in

total electricity demand from private Mainland industries. This reallocation effect is basically a result of the high elasticity of output with respect to marginal costs in the export oriented electricity intensive industries.

**Acknowledgement:** Thanks to Birger Strøm for the programming. The paper has benefited from comments on an earlier version from Ådne Cappelen, Øystein Olsen and Knut Einar Rosendal.