

## Executive Summary

Sectoral Interfuel Substitution in Canada: An Application of NQ Flexible Functional Forms

by

Ali Jadidzadeh and Apostolos Serletis

We examine interfuel substitution possibilities in energy demand within the residential, commercial, and industrial sectors in Canada as a whole and six of its provinces --- Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. We focus on electricity, natural gas, and light fuel oil, ignoring energy forms with low shares in total energy expenditure. Our objective is to provide updated empirical work using methodological improvements of the past twenty years, and improve our understanding of how changing energy prices and incomes will influence interfuel substitution and the demand for energy in the future.

We use annual data and recent state-of-the art advances in microeconometrics. In particular, we use duality theory and the demand systems approach based on neoclassical consumer and firm theories which allows us to estimate the demand for electricity, natural gas, and light fuel oil in a systems framework. Moreover, we are motivated by the widespread practice of ignoring the theoretical regularity conditions of neoclassical microeconomic theory and use flexible functional forms that allow the imposition of global curvature without losing their flexibility properties. In particular, in the case of the commercial and industrial sectors we use the normalized quadratic (NQ) cost function, introduced by Diewert and Wales (1987), and in the case of the residential sector we use the NQ expenditure function, introduced by Diewert and Wales (1988).

We produce inference about the demand for energy in terms of expenditure elasticities, own- and cross-price elasticities, Allen own- and cross-price elasticities of substitution, and the asymmetrical Morishima elasticities of substitution, which is consistent with neoclassical microeconomic theory. The expenditure elasticities reveal that in general the energy forms are normal goods, except for light fuel oil which is an inferior good in some of the provinces and sectors. We find that the interfuel Morishima elasticities of substitution (the correct measures of substitution when there are more than two goods) are in general positive and statistically significant. Moreover, our results indicate limited substitutability between electricity and natural gas, but strong substitutability between light fuel oil and each of electricity and natural gas in most cases.

Overall, our results highlight the fact that the substitution between different forms of energy has been quite restricted and suggest that fossil fuels will continue to maintain their major role as a source of energy in the near future. This suggest that such daunting tasks as curbing carbon emissions and preventing climate change require a more active and focused energy policy.