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A Comparison of Product Diffusion and Distributed Lag Models for Estimation Wood/Non-wood Substitution in the US Window Market

Jeff Moffett. 1993

Executive Summary

Wood product markets are subject to substitution by lower cost non-wood materials. Alternative materials such as aluminum and vinyl are generally more fossil fuel intensive and have different environmental impacts from renewable wood resources. Increased attention to environmental impacts has drawn increased attention to substitution of wood by non-wood products.

This study surveys the available research on explanations for substitution related to economic and technological change, then models substitution within a particular end-product market. The question of whether substitution can be explained by prices of technological change almost independent of prices is an important factor in analyzing the impacts of policies on the environment.

This report uses as a case study the United States residential window market, where wood and aluminum windows have been competing for the past five decades. Prior to World War II, wood windows dominated the window market. Since then aluminum windows have increased market share. By 1982, wood windows held only 26 percent of the market. Throughout much of this period, not only were wood windows more expensive than aluminum windows, but the price differential steadily increased.

Substitution models based on distributed lags of relative prices appear to provide more accurate and detailed information on market share changes than models that rely on arbitrary technological innovation formulations. While the short-run own-price and cross-price market share elasticities may be low, the long-run elasticities suggest that direct substitution between competitive products, such as wood and aluminum windows, can exceed 1.0. The case study shows a 1.7 percent change in wood window market share in the long-run for every one percent change in relative price. This high long-run price elasticity of substitution may have significant implications for carbon mitigation analysis and other environmental policy issues.

The primary differences between wood and non-wood alternatives used in residential and light commercial construction are the energy requirements involved and carbon emissions related to fossil fuel consumption in production. When all of the aspects of extraction, transportation, processing and production were considered, wood products were found to require less energy in manufacture (CORRIM, 1976). The exact amounts differed for each end-product.

Several studies have examined the environmental impacts arising from the production of wood, plastics, aluminum, steel and concrete. Each of these industries has substantial extraction impacts. The manufacturing of steel, aluminum and plastics was judged to create more significant problems than sawn-wood and cement (Alexander and Greber, 1991). Furthermore, wood has the unique attribute of being a renewable resource which can be managed over many rotations.

The most significant effect of forest management on the level of carbon dioxide in the atmosphere will come from the substitution of wood materials for more energy-intensive materials. New approaches to forest production and more intensive forest management practices requiring forest investment would be necessary to increase the production of higher-quality logs needed in order to increase the substitution of wood for non-wood products. While shortages of wood products due to forest preservation constraints may reduce wood demand and forest investment on one hand, carbon taxes on fossil fuels could have the impact

of increasing demand and forest investment resulting in the substitution of wood for non-wood products on the other. In effect, environmental policies need to consider substitution issues which are likely to show a strong advantage for the use of renewable resources.

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