Forest Policy and Economics 81 (2017) 83–87

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Elasticity of import demand for wood pellets by the European Union☆

Lili Sun *, Kurt Niquidet

Forest Industry, Trade and Economics Research, Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada, 506 West Burnside Road, Victoria, BC V8Z 1M5, Canada

ARTICLE INFO

Article history:
Received 19 October 2015
Received in revised form 31 January 2017
Accepted 5 February 2017
Available online 12 February 2017

Keywords:
Import demand
Bioenergy
Elasticity
Wood pellets
Trade

ABSTRACT

Import demand for wood pellets by the European Union (EU) was investigated using a source-differentiated non-linear Almost Ideal Demand System (AIDS) model with monthly data from 2009 to 2015. Our research provides the first complete set of expenditure, price and cross-price elasticities for this rapidly expanding forest product market. Expenditure elasticities reveal that wood pellets from the United States have the most to gain from an expansion in EU expenditures, followed by Canada, while Russia has the least to gain. We attribute this result to differences in the quality, reliability and sustainability of wood pellet supply between the countries. The degree of substitution among the major suppliers was also assessed through cross-price elasticities.

1. Introduction

The development of a global wood pellet market can be traced back to Northern Europe during the early 1990s with the introduction of biofuels in district heating (Ericsson and Nilsson, 2004). Sweden introduced a tax on carbon dioxide, but emissions from renewable sources such as wood are exempt. This policy resulted in a rapid expansion of demand for wood pellets as a fuel. As these markets developed in Sweden, many other countries recognized that wood pellets provided a viable alternative to fossil fuels, which could help reach future policy goals. The use of bioenergy for electricity production and residential and district heating has been growing rapidly in Europe at an annual rate of 25% because of aggressive policies in the European Union (EU) (Magelli et al., 2009). The EU requires member states to implement National Biomass Action Plans that set out measures to promote biomass use for heating, electricity and transport, as well as to provide investments in cross-cutting measures affecting biomass supply, financing and research. The national plans have resulted in a great deal of activity using biomass to co-fire coal power generation plants. However, many countries do not have sufficient domestic feedstock to meet renewable energy production targets and the European Commission (2013) estimates that 200–260 million m^3 of wood will need to be imported in order to meet the EU 20-20-20 target. With such large expected increases in demand, questions have arisen regarding the sustainability of foreign supply sources and the potential impact on pellet and other wood products prices (Lamers et al., 2015; Johnston and van Kooten, 2016).

Despite the rapid growth of the wood pellet market and the heavy reliance of the EU on wood pellet imports, no empirical econometric research has been done on the import demand for wood pellets. Wood pellet import demand elasticities are essential if one is to conduct policy analysis. For instance, elasticities are required if one is to estimate the trade volume, welfare and customs revenue changes if a trade agreement or a trade barrier is introduced. Moreover, since the EU wood pellet market is heavily supported by various EU policies that promote renewable energy such as biomass, understanding import expenditure elasticities will be necessary to comprehend the implications of changes to policies that have the effect of increasing or decreasing expenditure on imports. Finally, uncovering the effect of prices on imports and the composition of imports as relative prices change will help our understanding of longer-term market development.

The objective of this paper is to investigate the import demands for wood pellets in the EU using a source-differentiated Almost Ideal Demand System (AIDS) model. The model provides estimates of EU wood pellet import price elasticities, expenditure elasticities and substitution elasticities by country of origin. The AIDS model has been broadly applied, especially for agricultural products, but less so for forest products. For example, to our knowledge, thus far the AIDS model has been applied to wood products in four instances. Luo et al. (2015) investigate the impact of trade intervention in the bedroom wood-furniture market; Niquidet and Tang (2013) study the import demand for Canadian logs and lumber in China and Japan; Wan et al. (2010) investigate the import demand for US wood beds; and Arabatzis and Klonaris (2009) use the AIDS model to explore Greek wood products imports.

In the next section we provide a brief overview of recent trends in the EU import of wood pellets. In Section 3, we introduce the AIDS

☆ This article is part of a special feature entitled: "Forest sector trade" published at the journal Forest Policy and Economics 81C, 2017.

* Corresponding author.
E-mail address: lili.sun@canada.ca (L. Sun).

http://dx.doi.org/10.1016/j.forpol.2017.02.001
1389-9341/

model and explain its applicability to EU wood pellet imports. Empirical results are then presented and discussed, followed with our conclusions pertaining to policy developments in the EU and future modelling of the wood pellet trade.

2. Wood pellet market

Global production of pellets was approximately 21.6 million tonnes in 2013. The top five pellet producing countries were the US (5.0 million tonnes), Canada (2.4 million tonnes), Germany (2.2 million tonnes), Sweden (1.4 million tonnes) and Latvia (1.1 million tonnes), yielding over 50% of the world's wood pellets (FAO, 2015). In 2013, the EU produced 11 million tonnes and consumed 17 million tonnes. The 6 million tonnes of pellets imported by the EU come mainly from the United States, Canada and Russia, and were largely used in industrial power generation.

Fig. 1 shows EU imports from 2009 to 2015 and the market shares of major exporting countries (right-hand axis). EU wood pellet imports have grown dramatically over the years from 1.7 million tonnes in 2009 to 7 million tonnes in 2015, with the largest imports coming from North America (62% of all imports in 2009 and 79% in 2015). Canada was the largest exporter to the EU until 2012, when the US took over top spot. There has been a recent boom in wood pellet mill development in the US, especially in the southeast where there is a vast biomass resource (Goetzl, 2015). In 2015, the US held 59% of the wood pellet import market share while Canada represented 20%. Some of these mills are owned and operated by European electrical utility companies, such as Drax, in an effort to secure their supply of pellets to meet mandated emissions targets. The top EU markets for US pellet exporters were the UK (30% of EU imports), the Netherlands (24%), and Belgium (16%).

The second largest region for wood pellet imports by the EU was Eastern Europe, primarily Russia. Russia's market share of the EU market dropped from 16% in 2009 to 11% in 2015. Finally, EU wood pellet imports from the rest of the world have remained relatively stable and include imports from the southern hemisphere including Brazil, South Africa, New Zealand and Australia.

3. The theoretical model (Almost Ideal Demand System)

The Almost Ideal Demand System (AIDS), originally introduced by Deaton and Muellbauer (1980), was selected as the empirical model for wood pellet import demand analysis of the EU because it can readily provide price elasticity of import demand, expenditure elasticity and cross-price elasticities. The AIDS model has been widely used in applied demand analysis and one of its key applications is to model commodity trade flows (e.g., Winters, 1984; Alston et al., 1990; Yang and Koo, 1994; Chang and Nguyen, 2002; Taljaard et al., 2004; Niquidet and Tang, 2013). Its popularity is due to several advantages (Deaton and Muellbauer, 1980; Alston and Chalfant, 1993; Eales and Unnevehr, 1994). First, the AIDS is consistent with consumer theory because it is derived explicitly from a consumer cost minimization problem. Secondly, its flexible functional form provides an approximation to any demand system, consequently limiting specification biases. Thirdly, the theoretical properties of homogeneity and symmetry can be tested and imposed through linear restrictions on the parameters. Fourthly, it overcomes the limitations of a single equation approach and examines how consumers make decisions among bundles of goods to maximize their use under budget constraints. Finally, it is compatible with aggregation over consumers and can model consumer behaviour with both aggregated (macroeconomic) or disaggregated (household survey) data.

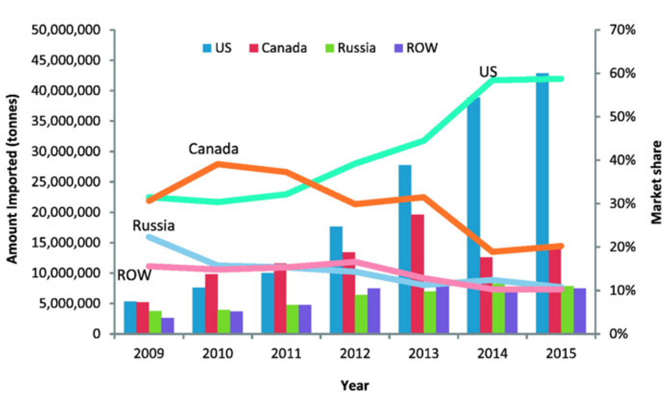

Fig. 1. EU imports of wood pellets from the US, Canada, Russia and the rest of the world as total annual amount (tonnes) and annual proportion of market share (%).
Source: EUROSTAT.

Applied to imports, the AIDS model assumes that purchasing decisions are made in a two-stage budgeting procedure. In the first stage, total expenditure by the EU energy industry is allocated over broad groups of energy commodities. In the second stage, group expenditure on wood pellets, which has been determined in the first stage, is allocated over individual supply sources, including Domestic (EU intra), US, Canada, Russia and the rest of world (ROW). Domestic and imported pellets are assumed to be distinct groups and separable. Wood pellets produced and traded within the EU are mostly for residential use whereas imported wood pellets are for industrial use, mainly for co-firing in large power plants.

The basic AIDS model is developed from a particular cost (expenditure) function, representing the Price Independent Generalized Logarithmic (PIGLOG) preference, which allows exact aggregation over consumers. The cost function $c\,(u,p)$ given utility u and price vector p is:

$$\log c(p,u) = (1-u)\,\log(a(p)) + u\log(b(p)) \tag{1}$$

where $a(p)$ is a translog price index given by:

$$\log a(p) = \alpha_0 + \sum_k \alpha_k \log(p_k) + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j \tag{2}$$

and

$$\log b(p) = \log a(p) + \beta_0 \prod_k p_k^{\beta_k} \tag{3}$$

where α, β, and γ^* are parameters, and the subscripts $k, j = 1, \ldots n$ denote product origins.

Thus, the cost function can be rewritten as:

$$\log c(p,u) = \alpha_0 + \sum_k \alpha_k \log(p_k) + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j + \beta_0 u \prod_k p_k^{\beta_k} \tag{4}$$

Shephard's lemma yields $\partial c(p,u)/\partial p_i = q_i$. Multiplying both sides by $p_i/c(p,u)$ we find the budget share equations for wood pellets from origin i:

$$w_i = \frac{\partial \log c(u,p)}{\partial \log p_i} = \frac{p_i q_i}{c(p,u)} \tag{5}$$

That is, the logarithmic differentiation of the cost function provides the budget shares, which is a function of prices and utility:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod p_k{}^{\beta_k} \tag{6}$$

where $\gamma_{ij} = \frac{1}{2}\,(\gamma^*_{ij} + \gamma^*_{ji})$. Solving Eq. (4) for the indirect utility function u and substituting it into Eq. (6) results in expenditure share form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\{M/P\} \tag{7}$$