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# Impacts of agent information assumptions in forest sector modeling

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### ABSTRACT

The forest sector faces changing political paradigms and volatile policy measures. Policy makers rely on economic and biological models to inform them of the impacts and risks associated with both anticipated and unforeseen policies or shocks to the system. Assumptions about agents' knowledge of future events are fundamental in all forms of models suggesting that the degree of information of future events may have large behavioral impacts. Despite the importance of this assumption, few studies have looked into what this difference in information may imply, and few studies have analyzed the importance of varying the degree of *a priori* information on the impacts of policy measures. This paper attempts to elucidate some of these impacts by comparing how an exogenous shock affects the Norwegian forest sector if the agents are assumed to have: (i) perfect information, (ii) information about the market shift only a limited time before its implementation or (iii) no *a priori* information. The shock analyzed is an import ban on all coniferous wood into Norway, which is possible if the Pinewood nematode (PWN) becomes more widespread in Europe. To examine this question, we adapt the Norwegian forest sector model NorFor to reflect perfect, limited and no prior information. The results indicate that if the agents anticipate the shock, they will begin to adjust harvest and production levels before it occurs. Due to high opportunity costs, harvest is reduced in the first periods to allow increases later. Bioenergy, with much lower profit than pulp and paper on the margin, is the hardest hit by the ban, while paper production is little affected. This may also be due to high capital costs in the paper

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industry and a perfectly elastic wood demand curve for bioenergy use. Substantial price increases for both raw materials and final products are suggested under either limited or perfect foresight. The analysis may provide useful insight about how agents react to sudden changes depending on their *a priori* information.

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## Introduction

Forest sector models are widely used to analyze the impacts of changes in economic or policy frames, which may be gradual or occur as shocks. Depending on the assumptions about agent foresight in the models, such changes may imply different policy impacts. In a perfect foresight model, the agents are assumed to have perfect market information for the whole projection horizon. Thus, market shocks are actually not shocks in such models, as they are anticipated from the first period and the behavior is adapted accordingly. Examples of forest sector models assuming perfect information include the FASOM model (Adams et al., 1996), the various regional models of Oregon developed by Adams and Latta (2005, 2007), the Timber Supply Model (TSM) (Sedjo and Lyon, 1990) and models related to the TSM by Sohngen and Mendelsohn (1998) and Sohngen et al. (1999).

Yet, most models assuming that information available to the agents is imperfect are myopic models. These models assume that agents only possess information about the current period and the past, and know nothing about future conditions. The GTM (Global Trade Model) family, such as the GTM (Kallio et al., 1987), CGTM (Cardellicchio et al., 1989), EFI-GTM (Kallio et al., 2004) and NTM (Trømborg and Solberg, 1995; Bolkesjø, 2004) as well as the Global Forest Products Model (GFPM) (Buongiorno et al., 2003) all operate under this assumption.

Questions have arisen over the degree to which perfect foresight models are fit to predict behavior since the underlying assumption of perfect information over the whole time horizon is extreme and rather far from observed behavior. On the other hand, it is also a simplification to assume that agents have no information beyond the current period. The questions should rather be how much information agents are assumed to have, and how different degrees of information impact behavior?

The purpose of the present study is to analyze behavioral impacts resulting from agents' foresight conditions, i.e., no foresight, or foresight limited to some time, or full foresight, in a forest sector model. The study utilizes the Norwegian forest sector model NorFor, a dynamic equilibrium model with the default assumption of perfect foresight. The model is adapted to be able to reflect limited or no *a priori* knowledge of a future market shift.

We analyze the impacts of a general import ban on all coniferous timber to Norway beginning in 2020. Based on economic theory, several different forms of response are possible:

- i. Having full information, agents will begin adapting from the first period of the simulation.
- ii. If forest owners anticipate the ban, they will reduce timber harvest in the years before the ban in order to save timber for later periods when prices are higher.
- iii. Due to (ii), harvests will increase more after the ban is introduced if the agents have perfect foresight than if they have not.
- iv. If industry agents do not possess information about the ban, industrial production will be reduced considerably after the ban is imposed.

To test these hypotheses, four scenarios are run:

1. Base scenario with no ban (BASE).
2. Import ban in 2020 with perfect knowledge, i.e., the ban is known from 2010 (PK).
3. Import ban in 2020 with limited knowledge, i.e., the ban is known from 2015 (LK).
4. Import ban 2020 with no knowledge, i.e., the ban is known from 2020 (NK).

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