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The influence of the oil price on timber supply

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ABSTRACT

The world is dependent on oil, as economy relies on a constant oil supply. Therefore, other markets seem to be influenced by the oil market. Recent developments in timber prices – for example, rising fuelwood prices – as well as shifts in supply and demand on the timber markets are an indication of this influence on that particular market. This paper uses oil price scenarios to investigate the effects of this influence on timber supply. Oil price scenarios were developed and connected to timber price scenarios. These scenarios then acted as input variables to felling plans for forest enterprises. The link between timber price and planning decision was established by calculating financially optimized management scenarios using the risk-sensitive planning support tool, YAFO. To analyze these effects at a general level, 54 hypothetical forest enterprises were built from forest inventory data of Bavaria, Germany. Every enterprise's management plan was optimized separately under both a base scenario with constant timber prices, and a scenario based on predicted moderate oil price increases. Comparing the results of the scenario analysis showed significant changes in timber supply and grading ratios, tending towards an increase in wood graded for energy use with rising oil and timber prices.

1. Introduction

Oil is the main fuel of the modern economy. It is used not just as fuel to provide heat, power and transport services, but also as a base material for many products used in our daily lives. Thus, it is no surprise that developments in the oil market have large impacts on many other branches. High oil prices in recent times have caused people to think about alternatives to oil for producing heat or electricity. Because fossil fuels are finite, obvious alternatives are renewable resources like wind, water and solar power, and biomass. In 2008, 13% of the world primary energy demand was satisfied from these resources (OECD/IEA, 2010). In Germany 8% was satisfied (AGEB, 2013), and in Bavaria 10% (Bayerische Staatsregierung, 2011). Almost two thirds of that were produced from biomass, and 40% of all biomass comes from fuelwood (Schäfer and Ortinger, 2007). It is thus apparent that the timber[1] markets are influenced by oil markets. Private home owners as well as public and private companies are trying to use more of these alternatives. In Bavaria, – one third of which is covered with forests with a high level of growing stock (396 m^3/ha over bark according to BMVEL (2005)) – the use of this resource has intensified in recent years. People are buying more masonry stoves and woodburners fueled by either pellets, woodchips or split logs, and companies as well as municipalities are building large biomass/woodchip-fueled power/heating plants. The fuelwood demand from private households in Germany as a whole doubled between 1994 and 2005 (Mantau and Sörgel, 2006; Zormaier and Borchert, 2007), and forest owners have long waiting lists of fuelwood buyers. According to Mantau (2012), in 2010 more wood was used for thermal than for material purposes in Germany. Accordingly, the consumption of wooden biomass increased from 12 million m^3 in 2000 to 34 million m^3 in 2010.

The renaissance of fuelwood use demonstrates that wood – although a renewable resource – is not available in unlimited amounts. If there is an increase in demand for a limited resource, then two things can happen: First, the price of this good will rise. Second, the production of it will increase. As we have just mentioned, option two is limited for forest products. Sustainable management of timber resources, as well as the usable production area and the long production time horizon place limits on increases in forest product volumes. Of course it is possible to use this more or less fixed maximum amount of wood in different ways. But in this instance, that means, higher supplies of fuelwood will probably lead to reduced supply of other timber grades. Besides that, there are other new technologies to substitute oil based products in the material sector, like plastics. Materials based on renewable resources start to create new demands of timber (biorefinery). This secondary effect will even intensify the price reactions discussed in the following. Politically motivated subsidies of renewable energy influence supply and demand as well, as they modify the prices. We did not consider them here as they change often.

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[1] “Timber” here means any wood used from forests.

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The rising demand for fuelwood created an active competition for wood resources, especially in the lower quality timber grades (Hillring, 2006; Mantau and Sörgel, 2006; Raunikar et al., 2010; Buongiorno et al., 2011; Mantau, 2012). The price development of fuelwood during recent years in Bavaria – as well as in areas outside Germany – indicated the rising demand for pulpwood and low quality sawlogs, as well as for biomass for thermal uses in general (Albrecht et al., 2012). This increase in demand was reinforced by political frameworks designed to reduce emissions of greenhouse gases (Röser et al., 2008). For example, a declared goal of the Bavarian government is to raise the thermal use of wood by 15% by 2021 (Bayerische Staatsregierung, 2011).

At the national level, Wittkopf (2005), Bauer et al. (2006), Schulte (2006) and Knoll and Rupp (2007) showed a correlation between the price of energy and the price of fuelwood, that is becoming stronger (especially Schulte, 2006; Knoll and Rupp, 2007). Wenzelides et al. (2006) investigated the market for woody biomass and found rising prices. In their study, Isermeyer and Zimmer (2006) demonstrated the influence of the oil price on all agricultural products, including herbaceous plants used for bioenergy. In combination with the other studies mentioned, it is obvious that prices for woody bioenergy fuel will follow the same trends. This development was seen not just for fuelwood but also for woodchips in Sweden, Germany, and Austria (Olsson et al., 2011). Erdmann (2008) used the oil price as an impact factor for the fuelwood price in one of his scenarios as well. International publications have reached the same conclusions. Although there are older studies that reported stable fuelwood prices – even when the demand is rising (e. g. Hillring, 1997) – more recent publications painted a different picture. Raunikar et al. (2010) and Buongiorno et al. (2011) modeled rising prices up to 2060 for two IPCC scenarios, with the prices for fuelwood and timber merging in 2025, accompanied by a 60% rise in fuelwood consumption in Europe.

For Norway, Trømborg and Solberg (2010) showed an increase in pulpwood price with rising energy prices. According to Roberts (2008), higher oil prices led to rising amounts of timber used for energy purposes. Thus, the thermal use of wood was beginning to dominate the market for low quality timber. The pulp and paper industries will be a major loser in this development. (Moiseyev et al. (2011) analyzed the effects of rising energy wood prices in different IPCC scenarios for Europe. The results showed an increase in reallocation of wood away from pulp and paper and towards fuelwood. Also, the analysis of Schwarzbauer and Stern (2010) of the Austrian timber market led to the conclusion that a higher demand for fuelwood will be accompanied by higher competition between energy and pulpwood grades — and ultimately, in higher prices for the latter. These results affirm the findings of Raunikar et al. (2010) and Buongiorno et al. (2011). Schwarzbauer et al. (2009) showed a reaction in supply of both public and private forest timber to price fluctuations, and confirmed the influence of fuelwood prices on the supply of pulpwood and fuelwood. For the Bavarian state forest, this correlation between the oil price and the supply of pulpwood and fuelwood was verified by Stimm (2012).

Keeping these considerations in mind, we posed three hypotheses:

1. Prices of fuelwood are influenced by oil prices. Meaningful scenarios on timber prices will thus depend on oil prices.
2. Fuelwood prices will affect the prices of other timber grades.
3. Forest owners will react to these price developments, and will shift the amount of harvested wood by changing their grading behavior and/or the total amount of harvests.

Using a scenario analysis approach hypotheses 1 and 2 were investigated methodologically and hypothesis 3 through simulation runs. The first step in our analysis was to build a reliable oil price model from which we could derive oil-price dependent timber price developments. Next we used optimization procedures for forest enterprises which are sensitive to timber prices.

2. Price developments

2.1. Derivation of oil price scenarios

Oil price and price changes are the focus of many studies, due to the dependence of modern civilization on this resource. The predictions made by these studies differ vastly from one another (Ullrich, 2012). Obviously one reason for this is that many studies simply extrapolate the price trends found at the time the study is made, without considering the possibility of major distortions in the markets (Austvik, 1992). New developments in this field of research tried to cover these problems for short-term (Cortazar and Schwartz, 2003; Ye et al., 2005; Coppola, 2008) as well as long-term predictions (Rehrl and Friedrich, 2006; Azadeh et al., 2012). Other variations are due to the scenario conditions chosen. Some studies assumed a heavy peak-oil effect (e. g. IMF, 2011; Lutz et al., 2012), whereas others expected compensational mechanisms from other sources, such as a rising exploitation of unconventional oils (oil sands or oil-bearing shales) (e. g. Kesicki et al., 2009). The turbulent developments on the oil market in recent years already exceeded many outlooks of the recent past.

The following approach was chosen to derive resilient scenarios for our study: Eighteen scenarios from four major studies (Kesicki et al., 2009; OECD/IEA, 2010; EIA, 2011; IMF, 2011) were ordered according to the crude oil price predicted for the year 2035. This ordered distribution of prices was then classified into three groups by their quartiles. Group 1 combined all scenarios below the first quartile, group 3 all those above the third quartile, and group 2 contained the remaining scenarios. Group 1 was considered to be a cluster of constant oil price scenarios — that is, the low oil price case of EIA (2011) that assumed a moderately rising demand for oil in the future that will be compensated by increase in supply. Then a scenario was included assuming the break-up of the OPEC cartel, which Kesicki et al. (2009) considered the main influence factor on the oil market model they used. A second scenario from Kesicki et al. (2009) was placed in the group that assumed a better exploitation rate of oil fields, a large increase in the production of unconventional oil sources (for example, oil sands) as well as biofuels, and a high substitution of fossil fuels by nuclear power. The group 2 scenarios predicted an average increase in the oil price, and group 3 a considerably higher increase. The latter group included the high oil price case used by EIA (2011) that assumed a steep increase in demand for liquid fuels combined with low capability for expansion of oil production. Group 3 also included the benchmark scenario of the post-peak-oil simulations in IMF (2011) that predicted an oil scarcity due to decreasing oil production during the whole time horizon of their scenarios. Also in this group were their moderate scenario, that presumed a greater substitution away from oil, and a scenario that predicted a reduced demand from oil-based technology sectors due to higher prices. Two extreme scenarios – a quite optimistic scenario of Kesicki et al. (2009) (COMBI + CO2) and the oil production decline scenario of EIA (2011), with a very high price prediction of 675 US-$/bbl in 2035 – were excluded from our analysis as unlikely cases. All other scenarios made up the moderate group 2 with an expected real price of 82–135 US-$/bbl for crude oil in 2035. The base year used is 2009.

Within each group, the average crude oil price was calculated for 2015 and 2035. We chose these years, as they represent the maximum time horizon that is covered by all of the investigated studies. To derive fuel oil prices for Germany from these crude oil prices we analyzed the correlation between the price of domestic heating oil in Germany and the price of Brent crude oil, as published in OECD/IEA (2011). Similar prices for Germany can be found in DESTATIS (2012). A linear regression for the data from 1999 to 2010 showed a significant correlation of 0.997 between both prices with a probability of error below 0.01:

$$h = 10.13b + 89.45 \quad (1)$$