How the ownership structure of a farm determines the price elasticity of wood supply

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***Abstract* – The price for wood influences the supply of wood. This is no news. However, as it appears the relative size of farm land to forest land owned by a farm as well as the absolute size of the forest land changes the sensitivity of the farmer or small scale forest owner on price signals. In order to quantify this change in sensitivity, the underlying unique panel data set of 12 000 farmers and small-scale forest owners is divided into categories of two measures, respectively. First, the absolute size of forest land is divided into 8 different size classes. Secondly the farm structure which is here understood as the relation of forest land owned to forest land plus farm land owned is divided into 5 subcategories. Then all subsamples are analysed individually according to their price elasticity and the odds ratio of the price. Results suggest a strong interrelation.**

Objective

Suppliers of wood in principle adjust their quantity according to the price offered at the markets (Schwarzbauer et al. 2012). That does not mean that all suppliers react in the same way on the price signal. This short paper analyses - with the help of a unique panel data set of 12,000 associated[2] forest owners - the response intensity, i.e. price elasticity, of wood suppliers which can be categorized in two different ways: forest area and farm structure.

First, the price elasticity is put into interdependence with the forest lot size but beyond the common differentiation of *Bundesforste*, forest enterprises with more than 200 ha, and small-scale forest owners. In this panel data set mostly all small-scale forest owners which are subject to this research own forests significantly less than 200 ha.

The second line of investigation is whether the price elasticity changes with respect to the structure of the farm. Structure here refers to the exposure of the farm towards agriculture on the one side and forestry on the other side. Background for this line of differentiation is the family income which is generated by both forestry and agriculture. But depending on the exposure of each operational unit income generation is subject to a different set of constraints. A farm which has 20 ha of farm land (i.e. for agricultural use) and 4 ha of forest land is believed to have different constraints than a farm which has 50 ha of forest land and no farm land at all. This might lead to a differing in supply behaviour.

Method

For the description of the model that was used to analyse the two objectives the reader is referred to Koch et al. (2012).

In order to analyse the effect of forest area respectively farm structure on the price elasticity, the results will be given in dependence of different categories of the variables. Further, also the odds ratio will be stated which give an indication about the probability change of the harvesting decision following a change in price.

Price Elasticity and Size of forest area

The larger the forest area, the more family income is generated on average through forestry. If the generated income reaches a certain point, the income generated is not only an additional income but may become the main source of the family income. This leads to a strong dependence on regularly repeating generation of income through the sale of wood, which in turn might result in the fact that the family becomes less price sensitive. Thus, the hypothesis is that as a result of this dependence, the price elasticity decreases with an increase in forest area.

For this purpose the data set was divided into subsamples of size classes as depicted in Table 1. Then the model was re-estimated for each size class. The results are shown in the following table.

Table 1. Odds ratios of price and price elasticities of different size classes.

	odds ratio of price	*price elasticity*
overall	1.066***	1.037***
0 – 5 ha	1.077***	1.272***
5 – 10 ha	1.066***	1.447***
10 - 15 ha	1.069***	1.031***
15 - 25 ha	1.063***	1.171***
25 - 50 ha	1.062***	0.822***
50 - 100 ha	1.059***	0.556***
100 - 200 ha	1.048***	0.244
> 200 ha	1.097***	1.041

Table 1 confirms the hypothesis. As the "***" indicate all coefficients are statistically significant on the 1%-level with the exception of the two size clas-

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ses with the largest forest areas. The table shows clearly that, beginning with the 5 - 10 ha size class, the price elasticity almost gradually declines from a value of 1.45 to 0.56. That means that the average small-scale forest owner with a forest area between 5 and 10 ha usually reacts on a price increase of 1% with an increase of wood supply by 1.45 percent while a forest owner with 100 to 200 ha increases his or her supply only by 0.6 percent. Only the smallest size class (less than 5 ha) does not perfectly fit into the scheme of a gradual decline. This might be related to the fact that the odds ratio of the price is considerably higher than all larger size classes. The odds ratio of the price tells about the probability increase of the harvest decision which appears after an increase in the price of 1 Euro. Thus, the odds ratios for the smallest size class in table 1 can be interpreted as the increase in probability to harvest by a factor of 1.077. An increase of 2 Euro increases the odds of becoming a supplier of wood by factor of $1.077^2 = 1.160$.

Price Elasticity and Farm Structure

While it is widely known that the typical farmer and small-scale forest owner have forests which are rather small (around 15 ha) or very small (around 3ha), not many know the distribution of the relation of forest land to total land owned by the farm which is here summarized by the variable farm structure.

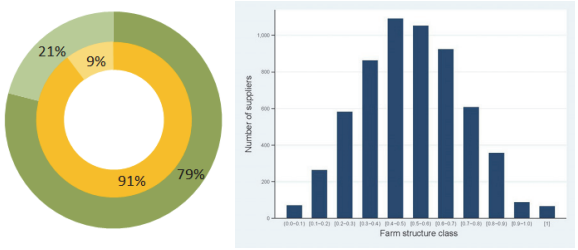

Figure 1. Farm structure (forest land divided by total land) and its distribution.

The double doughnut chart in Fig. 1 gives a first overview. Ninety-one percent of all registered farms in Austria own farm land while only 79% of them own forest land.

Since - per construction - the panel data set only consist of forest owners, the variable farms structure which is derived by the division of forest land divided by total land (the sum of forest land and farm land) takes only values from greater than 0 to 1. The histogram in Fig.1 shows the distribution of the farm structure with the most "mass" around the value 0.5. This means that for around 2/3 of the farmers or small scale forest owners more or less (i.e. 40% to 60%) farm land and forest land are of similar size.

In comparison to the case before of dependence on the absolute size of the forest, the line of reasoning goes similar however not equal. The difference is that independent of the absolute size of the forest land those farmers or small scale forest owners whose primary focus is on agriculture, generate more income through agriculture and thereby are also less dependent on regular income streams generated by forestry. Through this independence they can afford not to sell their wood when prices are 'bad' but wait until prices are 'good'. Thus, the hypothesis is that the higher the value of farm structure variable, the lower the price elasticity.

Table 2. Odds ratio and price elasticity for different farm structure categories.

	odds ratio of price	*price elasticity*
overall	1.066***	1.037***
0 < and ≤ 0.2	1.080***	2.053***
0.2 < and ≤ 0.4	1.072***	1.435***
0.4 < and ≤ 0.6	1.065***	1.233***
0.6 < and ≤ 0.8	1.065***	0.652***
0.8 < and ≤ 1.0	1.058***	0.627***

The results for farm structure as listed in Table 2 show that the price elasticity declines with an increasing focus on forestry which is in line with the a priori considerations. The price elasticity of 2.052 means that, if a farm owns much more farm land than forest land (i.e. the farm structure value between 0 and 0.2), a 1% increase in the price leads to a 2% increase in the quantity of wood harvested. The odds ratios are interpreted analogue to table 1.

Discussion

This analysis is one step further towards understanding the interrelationship of wood supply and wood prices and the final goal of predicting future wood supply. However, as newest research with multivariate time series techniques indicate, price signals move their way through the production chain, from the housing market to the price of raw materials such as the round wood price. Thus, receiving those price signals at the very beginning of the chain, i.e. the housing market, might provide the necessary head start needed to predict future round wood supply. But this might need the room of a full paper.

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