Annals of Forest Science (2019) 76: 103
https://doi.org/10.1007/s13595-019-0894-z

RESEARCH PAPER

How does wood mobilization depend on marketing decisions? A country comparison based on choice experiments

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Received: 23 August 2018 / Accepted: 14 October 2019 / Published online: 29 October 2019

Abstract

• ***Key message*** **There is no one-size-fits-all policy instrument to enhance wood mobilization. The success of implementing such policy measures can vary among countries and regions depending on the specific structural and institutional conditions as well as on behavioural aspects of the particular public and private decision makers.**
• ***Context*** Forestry has a huge potential to contribute to a sustainable bio-economy by providing wood as a renewable resource. Making wood available to meet the future demand is one of the goals of forest policy and private initiatives.
• ***Aims*** Understanding the market behaviour of forest owners and managers is important to identify effective and efficient policy instruments that enhance wood provisioning.
• ***Methods*** We conducted a choice experiment at two study sites in south-eastern Germany (Upper Bavaria and Lower Franconia) and two in north-eastern Switzerland (Grisons and Aargau) to elicit foresters' preferences for different supply channels, contract lengths, wood prices and duration of business relations.
• ***Conclusion*** Our study site comparison identified regional differences and particularities, which should be taken into account when promoting wood mobilization. The success of policy instruments, such as the promotion of bundling organizations and long-term contracts, can vary depending on the specific structural and institutional conditions, like existing marketing channels, as well as on behavioural aspects of the particular public and private decision makers.

Keywords Distribution channels · Wood harvest · Forest owners · Trading preferences

1 Introduction

Forestry has a huge potential to contribute to a sustainable bio-economy by providing wood as a renewable resource. The European Forest-based Sector Technology Platform has targeted an increase of wood availability of about 30% by 2030 through optimizing forest management and increasing growth rates of forests (FTP 2013). However, forests are seen not only as a source of diverse material uses and energy production, but also as providers of protection services and recreational opportunities, as well as carbon sinks and habitats to conserve biological diversity (Thompson and Hansen 2012; Jacobsen et al. 2008; Meyerhoff et al. 2009; Bernath and Roschewitz 2008; Olschewski et al. 2012; Thees and Olschewski 2017; Müller et al. 2019). Consequently, competition among different services of forests is expected to widen the gap between timber supply and demand (GSTA 2015). This is also due to the fact that wood resources stocking in the forest will not 'automatically' be mobilized and made physically available to the processing industry (Markowski-

Handling Editor: John Moore

Contribution of the co-authors RO: co-developed the project idea, applied successfully for financing, conceptualized and conducted the choice experiment in Switzerland, analysed the data and wrote the main parts of the article.
PT: co-developed and supervised the choice experiment in Germany and contributed to the analysis and writing the article.
OT: co-developed the project idea, applied successfully for financing, supported the choice experiment in CH and contributed to writing the article.
PP: co-developed and conducted the choice experiment in Germany, analysed the date and contributed to writing the article.

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Lindsay et al. 2012a; Olschewski and Thees 2012). The extent to which wood will be supplied on markets largely depends on the forest owners' and managers' harvesting and marketing decisions. Their management and supply behaviour has been analysed by numerous studies in the past (e.g. Feliciano et al. 2017; Toppinen and Kuuluvainen 2010; Amacher et al. 2003; Prestemon and Wear 2000; Joshi and Mehmood 2011; Barua et al. 2011; Holm et al. 2018). However, fewer studies have considered the marketing behaviour and distribution channels of small forest owners (Ficko et al. 2017; Ficko and Boncina 2013; Kimmich and Fischbacher 2016; Kuuluvainen et al. 1996). Although several studies focus on alternative wood usage and trade flows as well as on the motivation of forest management, these studies often refer to forest owners in general and do not consider specific decision factors linking up objectives and values of forest owners and managers with their actual marketing behaviour, such as choosing distribution channels (Ní Dhubháin et al. 2007).

A thorough analysis of forest owners' and managers' incentives is of great importance to better understand their marketing decisions. The practical relevance of these aspects is emphasized by the fact that industry associations and committees for the wood-based sector in Europe have recently highlighted their intention to foster round wood mobilization (GSTA 2015; FTP 2015; EU 2013; FOEN/SFOE/SECO 2017).

In our study, we focus on forest owners and managers as the most important decision makers with respect to timber marketing and analyse different distribution channels: selling round wood directly, bundling and selling it via forest owner associations and involving forest entrepreneurs as well as timber traders. We selected two study regions in south-eastern Germany (Upper Bavaria and Lower Franconia) and two in north-eastern Switzerland (Grisons and Aargau) (Fig. 1). Compared to other German Federal States, the Free State of Bavaria has the greatest forest area with 2,605,563 ha, which is 37% of the overall land area (BWI 2012). Most of these forests are in private ownership (55.7%, about 700,000 owners (BWI 2012)). Corporate ownership accounts for 12.4% of the forest area, while 29.8% are owned by the state (forest of the Free State of Bavaria). Only a marginal percentage is owned by the German Federal Government (2.1%).

In Switzerland, forests cover 31% of the overall land area (1,267,007 ha). Compared to Bavaria, the ownership situation is substantially different. Most of the forests (71%) are in public ownership: civil communities own 28%, political communities 30%, other public 8%, cantons 4% and the federal government 1%. In addition, there are about 244,000 private owners comprising 29% of the Swiss forest area (FOEN 2017).

Fig. 1 Study regions in south-eastern Germany (dark red, Lower Franconia and Upper Bavaria) and north-eastern Switzerland (light red, Aargau and Grisons)

In Bavaria, the dominant species for roundwood production are Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*), European oak (*Quercus robur*) and European beech (*Fagus sylvatica*). The main assortments for the administrative districts in Bavaria are softwood sawlogs (Upper Bavaria and Lower Franconia) as well as hardwood logs for energy (Lower Franconia) (compare Table 1). In Switzerland, the dominant round wood species are Norway spruce and European beech. In 2016, the main assortments were softwood sawlogs in Grisons (247,919 m^3) and energy wood and softwood sawlogs in Aargau (168,220 m^3 respectively 109,901 m^3). Hardwood sawlogs account for just 432 m^3 in Grisons but 34,975 m^3 in Aargau (FOEN 2017).

There are different distribution channels, which have influence on the provisioning of wood and the economic outcome: Forest owners or managers might harvest and sell wood directly to the wood processing industry. Alternatively, they can use the services of bundling organizations or traders, as well as sell the standing timber to forest entrepreneurs, which harvest and market the wood on their own (Fig. 2).

In our Bavarian study sites, private forests are mainly managed by the respective owners. Municipal forests

Table 1 Structural aspects of the four study regions. The comparison comprises forest area, ownership, species distribution, growth conditions, harvested quantities and main assortments

	Bavaria		Switzerland	
	Upper Bavaria	Lower Franconia	Grisons	Aargau
Total area (ha)	1,752,963	853,099	710,500	140,381
Total forest area (ha; %)	634,339 (36%)	360,068 (42%)	199,350 (28%)	48,931 (35%)
Productive forest area (% of total forest area)	30	25	79	95
Protection forest (%)	45	35	61	3
Private forest (ha; %)	328,873 (52%)	97,621 (27%)	18,368 (9%)	11,063 (23%)
Municipal/public forest (ha %)	37,407 (6%)	160,032 (45%)	180,982 (91%)	37,868 (77%)
State forest (ha; %)	268,058 (42%)	102,416 (28%)	676 (0.3%)	3,272 (9%)
Annual growth (m^3/ha)	14	12	6	11
Harvest volume (m^3/ha)	9.1	7.4	2.3	7.9
Average productive area per forest unit/enterprise (ha)	21,241	38,280	2,186	574
General species distribution (deciduous/coniferous)	36%/64%	63%/37%	9%/91%	60%/40%
Main assortments of respondents	Soft wood sawlogs	Soft wood sawlogs Hard wood logs for energy	Soft wood sawlogs	Hard wood logs for energy Soft wood sawlogs

Sources: BWI 2012, LWF 2016, FOEN 2017, FSO 2017, Olschewski et al. 2015

are managed in most cases by the Bavarian Forest Administration, respectively, by the responsible district manager (forester), sometimes by a forest owner association. The involvement of forest entrepreneurs, e.g. in the form of specific contract models (private sale as pre- or post-auction-sale; stock sales), plays a minor role, only. Timber marketing was mainly done by the forest owners until the end of the 1980s. Accordingly, there was a dense network of small sawmills and timber merchants. At that time, timber marketing of private and municipal forests was not an official task of the Bavarian Forest Administration. Later on, the importance of forest owner associations for timber marketing grew considerably due to the market developments during the 1990s, which were characterized by a stronger integration of timber supply into international wood markets.

In Switzerland, forest management is mostly carried out by public forest managers, corresponding to the high proportion of public forests (71%, predominantly communal forests). There is a total of about 700 public forest enterprises managing 59% of the Swiss productive forest area. In Grisons, 65 public enterprises are responsible for 90% of the productive forest area, while in Aargau 59 public enterprises cover 73%. Small private forest owners usually manage their forests themselves, supported by public forest enterprises or forest owners' associations with respect to wood marketing. However, more than 50% of the private forest are not managed at all (Zimmermann and Wild-Eck 2007). Concerning timber marketing, some effort has been put on establishing bundling organizations, e.g. in Grisons, to enhance wood provisioning for the regional wood industry (Olschewski et al. 2015).

We considered our four study regions as independent replicates and developed a questionnaire, including a choice experiment, to address the following leading research questions: (i) What are the forest owners' and managers' preferences for different supply channels, contract lengths, wood prices and durations of business relations, and how can they be determined? (ii) How do these preferences differ among the study regions? (iii) What are the policy implications in the context of wood mobilization efforts?

2 Material and methods

2.1 Survey

The questionnaire comprised production economic and institutional economic aspects, as well as a choice experiment (CE) to identify and explain behavioural differences and similarities (for details please refer to Olschewski et al. (2019)). First, the survey was conducted in Switzerland, where the average area per forest enterprise varies between about 600 ha in Aargau and 2200 ha in Grisons. All public forest managers in the study regions were contacted by mail and invited to participate in the survey, of which 116 completed the questionnaire. In Bavaria, all managers of forest owner associations as well as the district managers of the Bavarian

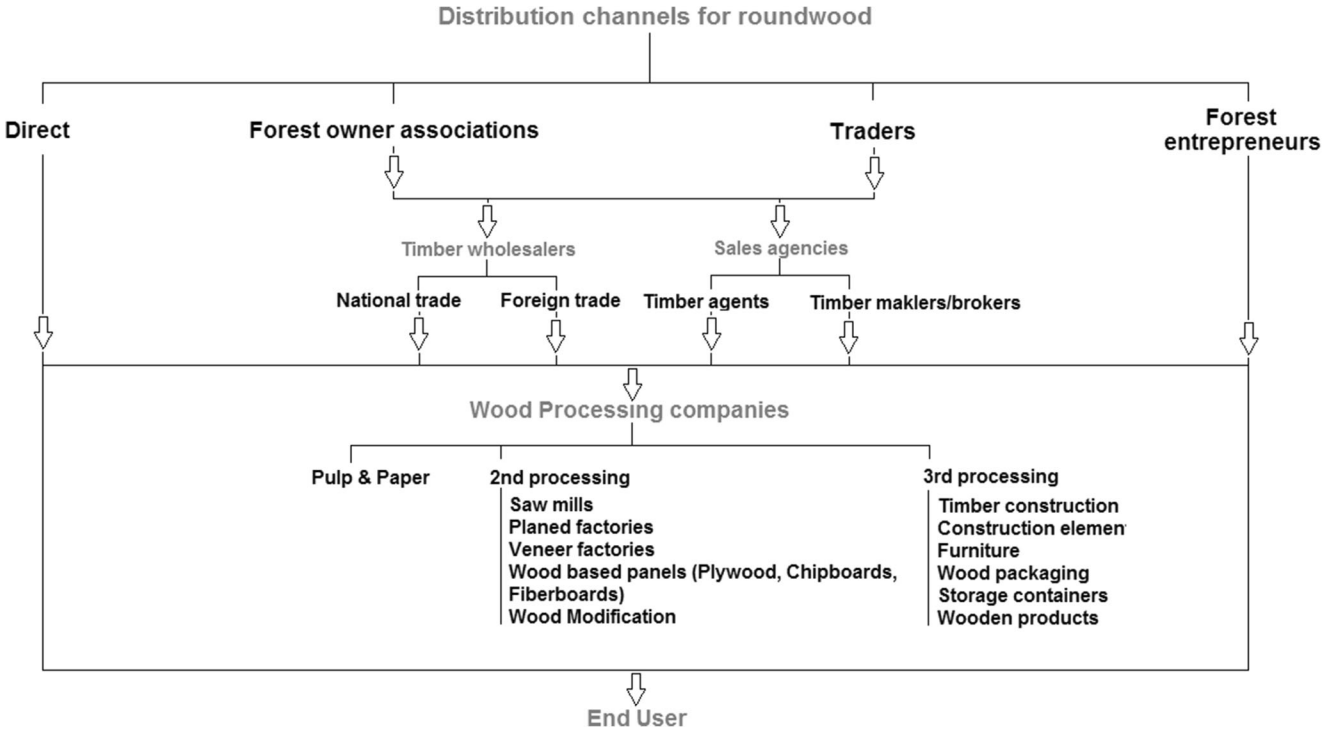

Fig. 2 Distribution channels for round wood (representation by the authors). Round wood can be directly sold to the wood processing companies or via forest owner associations, traders and forest entrepreneurs. Timber wholesalers and sales agencies can serve as intermediaries. Wood processing companies comprise pulp and paper plants as well as 2nd and 3rd processing entities

Forest Administration in the study regions were contacted by email and instructed to forward the questionnaire to at least 10 forest owners with less than 200 ha of forest. In the case of communal forest owners, the questionnaires were filled in by the foresters of the Bavarian Forestry Administration participating as representatives of the municipals. This procedure resulted in 264 and 136 respondents in Upper Bavaria and Lower Franconia, respectively, of which 118 completed the questionnaire (Table 2). While non-response bias seemed to be a minor issue at the Swiss study sites, we found rather low response rates for the municipal forest owners in Bavaria. Therefore, the CE results in Upper Bavaria and Lower Franconia are dominated by the private owners' responses (Table 2). To solve this problem, conducting a latent class analysis would have been helpful (Hensher et al. 2012; Villamayor-Tomas et al. 2019). However, in our case, this procedure was not feasible due to the small sample size.

2.2 Choice experiment

Choice experiments are often referred to as discrete choice analyses and belong to the stated preferences approaches (Kallas et al. 2011). In contrast to the traditional conjoint analysis, where a ranking of given alternatives is mathematically represented as an outcome of systematic manipulation of decision situations, CE are based on well-established behavioral theory, namely the random utility theory (Louviere et al. 2001). The utility function U represents the utility of an individual i derived from an option n and is composed of the deterministic part V, comprising the observable attributes of the options, and the unobserved random component ε (Louviere et al. 2001). It is assumed that the respondents are utility-maximizing individuals with a linear-additive relationship of the involved attributes. The utility function has the following form:

$$U_{ni} = V_{ni} + \varepsilon_{ni}$$
$$with\, V = \beta_1 {*} CL + \beta_2 {*} PD + \beta_3 {*} WB + \beta_4 {*} DU$$

Our CE comprises the attributes contract length (CL), price difference compared to direct selling (PD), type of wood buyer (WB), and duration of business relation (DU) (compare Table 3). These attributes and their respective levels were determined through focus group meetings and expert interviews in Grisons and Aargau.

The focus of the CE was on the identification of preferences relevant for choosing different wood distribution channels. This information can contribute to better understand the behavior of forest decision makers and can be useful for governmental and administration entities to elicit how to enhance future wood provisioning. The utility function is specified as follows:

Table 2 Survey and respondents details. Response rates are calculated based on the number of individuals invited and the number of questionnaires actually returned. The sample size is lower because not all respondents completed the choice experiment. The number of observations is derived based on the sample size and the number of choice sets filled in

	Upper Bavaria		Lower Franconia		Grisons	Aargau
Possession type	Private	Public	Private	Public	Public	Public
Number of individuals invited	230*	670*	220*	630*	85	65
Number of questionnaires returned	220	44	98	38	68	48
Response rate (in %)	96	7	45	6	80	74
Number of choice experiments completed	59	12	31	16	68	48
Sample size	71		47		68	48
Number of observations	844		564		802	567

*Note that the indicated number of respondents invited is an estimated maximum based on the invitation procedure, where 23/22 owner associations and 67/63 district managers in Upper Bavaria//Lower Franconia have been contacted with the instruction to forward the questionnaire to 10 (private/public) forest owners in each case

Option 1:

$$U_1 = \beta_0 + \beta_1 *CL + \beta_{2(0)} *PD_0 + \beta_{2\ (POS)} *PD_{POS} + \beta_{2(NEG)} *PD_{NEG} + \beta_{3(DM)} *WB_{DM} + \beta_{3(BU)} *WB_{BU} + \beta_{3(FE)} *WB_{FE} + \beta_{3(TR)} *WB_{TR} + \beta_4 *DU + \varepsilon$$

Option 2:

$$U_2 = \beta_0 + \beta_1 *CL + \beta_{2(0)} *PD_0 + \beta_{2\ (POS)} *PD_{POS} + \beta_{2(NEG)} *PD_{NEG} + \beta_{3(DM)} *WB_{DM} + \beta_{3(BU)} *WB_{BU} + \beta_{3(FE)} *WB_{FE} + \beta_{3(TR)} *WB_{TR} + \beta_4 *DU + \varepsilon$$

Option 3 (Status quo):

$$U_3 = \beta_1 *CL + \beta_{2(0)} *PD_0 + \beta_{2\ (POS)} *PD_{POS} + \beta_{2(NEG)} *PD_{NEG} + \beta_{3(DM)} *WB_{DM} + \beta_{3(BU)} *WB_{BU} + \beta_{3(FE)} *WB_{FE} + \beta_{3(TR)} *WB_{TR} + \beta_4 *DU + \varepsilon$$

An alternative-specific constant (ASC: β_0) was included to reflect a possible systematic influence on utility of variables that are unobserved, i.e. not covered by our attributes. Note that Option 3 represents the current status quo of the individual respondent. The related information was gathered through questions in the first and second part of the questionnaire and later matched with the CE data (compare Olschewski et al. 2019).

For our CE, we combined the different attribute levels in the choice sets using an efficient design generated by the software Ngene (ChoiceMetrix 2018), which consisted of 12 choice sets (compare Table 4). The respondents were invited to choose the best and worst option in each choice set. Data were analyzed with the Biogeme software (Bierlaire 2003, 2008). The experiment was pre-tested with practitioners and experts in Switzerland to assure consistency, comprehension and frictionless technical application.

The standard logit model specification implies that the random component ε is independently and identically 'extreme value' distributed and that the choices are independent from irrelevant alternatives (Hensher et al. 2005). However, a priori, it is often hardly possible to identify all types of correlations among the options provided (Olschewski 2013). The results of the Swiss study showed that for many forest decision makers, Option 3 (status quo) was the preferred option. This motivated us to estimate a nested logit model. Given the status quo on the one hand, Options 1 and 2 belong to the same sub-category or 'nest' on the other, i.e. 'non status quo', based on similarities of the random component associated with these alternatives (Cooper et al. 2012; Olschewski 2013). Log-likelihood estimates confirmed that the nested-

Table 3 Choice experiment attributes with their respective levels. The attributes were the same in each choice set, whereas the attribute levels appeared in different combinations based on the chosen experimental design

Attributes	Levels			
Contract length (CL)	Up to 1 year		5 years	10 years
Price difference compared to direct selling (per m^3) (PD)	+ 5 EUR/CHF		0 EUR/CHF	− 5 EUR/CHF
Type of wood buyer (WB)	Direct selling (DS)	Trader (TR)	Bundling/forest-owner association (BU)	Forest entrepreneur (FE)
Duration of the business relation (DU)	New (less than 1 year)		Mid-term (1–5 years)	Long-term (more than 10 years)

Table 4 Example of a choice set. Exemplified combination of attribute levels, including the option to maintain the status quo. Respondents were asked to choose the best and the worst option. Twelve choice sets were presented subsequently, ideally resulting in 24 observations per respondent

Attributes	Option 1	Option 2	Option 3
Contract length	Up to 1 year	10 years	Keep status quo
Price difference compared to direct selling (per m^3)	+ 5 Euro	− 5 Euro	
Type of wood buyer	Trader	Bundling/forest owner association	
Duration of business relation	New (less than 1 year)	Mid-term (1–5 years)	
Best option			
Worst option			

logit model fits the data better compared to the multi-nomial logit specification. Preliminary model runs including the respondents' 'worst choice' did not result in an improved data fit. Consequently, we omitted the worst choice and focused on the respondents' 'best choice' during the further analysis (Lancsar et al. 2013). Subsequently, the survey was replicated in Bavaria, and data were analyzed with the same model specification to assure comparability with the Swiss results. The data is available in Olschewski et al. 2019.

3 Results

3.1 Distribution channels

Across all our study regions, softwood sawlogs were the main assortment, except for Aargau, where it was the second most important. Therefore, we put the focus of the further analysis on this assortment. In Upper Bavaria, the marketing of softwood sawlogs was conducted by 52% of the responding private forest owners via forest owner associations and 37% via traders (Table 5). Other distribution channels played a minor role, only. In Lower Franconia, private owners' marketing via bundling/forest owner associations was with 59% similar to the one in Upper Bavaria, followed by the involvement of forest entrepreneurs with a share of 38%. The quantities traded via other distribution channels were negligible.

In Upper Bavaria, 52% of the municipal forest representatives chose owner associations for trading wood, followed by traders with a share of 37% (Table 5). Other distribution channels took up relatively small quantities, only. In Lower Franconia, 92% of the municipal respondents traded their wood via forest owner associations, followed by entrepreneurs with a share of 7%.

A comparison between public forest owners in the study regions showed that bundling/forest owners associations were more important in Bavaria than in Grisons and Aargau, whereas in Upper Bavaria direct marketing was more prominent than in Grisons but less than in Aargau. Forest entrepreneurs played a minor role, except for private owners in Lower Franconia and public managers in Grisons. In general, the involvement of wood traders in the distribution channels was low, except contracting with private owners in Upper Bavaria. Overall, we found a heterogeneous situation of wood trading in the different regions.

3.2 Business relationships

Most of the business relationships (64 to 96%) lasted for more than 5 years (Table 6). The majority of the respondents had several distribution channels, except private forest owners in Upper Bavaria and Lower Franconia, where this share was below 50%. At the same time, these owners traded their wood without written contracts more often than municipal owners.

Table 5 Respondents' sales channels for softwood sawlogs (in %). Respondents are grouped according to study region and possession type. Marketing channel types are the same as in the choice experiment, except 'own usage'

Channel type	Upper Bavaria		Lower Franconia		Grisons	Aargau
	Private	Public	Private	Public	Public	Public
Direct marketing	0.4	*37*	2	0.4	11	*68*
Bundling organization	*52*	*52*	*59*	*92*	*38*	8
Forest entrepreneur	4	5	*38*	*7*	*41*	8
Trader	*37*	4	0.3	0	6	*16*
Own usage	5	2	0.2	0	4	0
Other	0	0	0	0	0	0

Table 6 Respondents' business relationship in trading soft stem wood (in % of respondents). Respondents are grouped according to study region and possession type

Characteristic	Upper Bavaria		Lower Franconia		Grisons	Aargau
Possession type	Private	Public	Private	Public	Public	Public
Long-term business relation (> 5 years)	64	89	72	75	90	96
Several distribution channels	47	67	40	56	60	80
Written contracts	27	56	43	63	75	30

Source: Grisons and Aargau (Olschewski et al. 2015)

These alternative types of contracting were also observed in Switzerland even among public managers, where the share of written contracts was by far smaller in Aargau than in Grisons.

3.3 Choice experiment

In a first step, we analyzed the data at the country level. In Switzerland, the *status quo* was significantly preferred compared to any other suggested option, indicated by the significantly negative values of the alternative-specific constant β_0 in Table 7 (Olschewski et al. 2015). Note that this preference was based on systematic influence of non-observed factors captured by the ASC. Contract length had a significant negative impact too, i.e. the longer the contract lasted, the less preferred it was. As expected, a positive price difference compared to direct selling was significantly preferred, whereas a price reduction had a negative impact on utility. Interestingly, there was no significant difference concerning the analyzed marketing channels. However, the estimated positive coefficients for bundling organizations and for forest entrepreneurs tended to result in a preference for these channels compared to direct selling, while the coefficient for traders was negative. The duration of the business relation had a significant positive impact, indicating that the longer a business relation lasted, the higher the utility generated (Olschewski et al. 2015).

In Bavaria, we found results similar to the ones in Switzerland concerning contract length, price differences and duration of business relation. In contrast to Switzerland, the ASC coefficients were positive (though not significant) indicating that the alternative options offered in the choice sets were tendentially preferred compared to the status quo. With respect to distribution channels, direct marketing was significantly preferred compared to contracting forest enterprises, while the other channels had no significant impact on utility.

In a second step, we took a closer look at the specific regions and cantons, respectively. In Grisons and Aargau, results were similar at the cantonal level, except for distribution channels, where in Aargau direct marketing was the preferred option compared to other potential wood buyers (though not significant for all), while it was the opposite in Grisons, where direct marketing was the least preferred option. In Bavaria, further differences were identified between the regions. First, in Lower Franconia, there was a positive but not significant impact concerning contract length, indicating that the rejection of long-term contracts was not as pronounced as in Upper Bavaria. Second, the ASC coefficients were negative in Lower Franconia, showing a tendency similar to Grisons and Aargau, i.e. preferring the status quo compared to the offered alternative options. Note that in the overall Bavarian-level analysis, both Lower Franconian particularities were dominated by the strong impact of the Upper Bavarian results.

4 Discussion and conclusions

Making wood available to meet the future demand of this renewable resource is one of the goals of forest policy (FOEN/SFOE/SECO 2017) as well as of private initiatives (FTP 2013). Understanding the market behaviour of forest owners and managers is important to identify effective and efficient policy instruments that enhance wood provisioning. Our results show that their success can vary depending on the specific structural and institutional conditions as well as on behavioural aspects of the particular decision makers. Our study site comparison indicates that there are regional similarities and differences, which should be taken into account when promoting wood mobilization. The following discussion focuses on several aspects identified as relevant for mobilizing wood resources: (i) the impact of price changes, management goals and ownership structure; (ii) the role of the status quo and existing business relations; (iii) the promotion of long-term contracts; and (iv) the implementation of new supply channels.

4.1 Price changes, management goals and ownership structure

Similar behaviour of forest decision makers was found concerning price differences, with higher prices being preferred compared to lower ones. While this result has been expected and confirms findings of former studies (Bolkesjø et al. 2007; Favada et al. 2009; Gruchy et al. 2012; Holm et al. 2018), we identified some significant differences among the study regions. The respective coefficients had significantly lower values in Upper Bavaria and Grisons compared to Lower Franconia and Aargau, respectively. This could

Table 7 Choice experiment results. 'Value' refers to the estimated coefficient of the respective attribute/level. Negative/positive coefficients reflect a negative/positive impact on the utility of the respondents. The values of the attributes 'contract length' and 'duration of business relation' were estimated as linear coefficients. 'Std err' is standard error for a particular coefficient. '*t* test' reflects the results of a statistical test, whether the coefficient has a significant impact on the respondents utility (*p* values: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$)

Attributes	Grisons and Aargau+				Grisons				Aargau			
	Value	Std err	*t* test	*p* val	Value	Std err	*t* test	*p* val	Value	Std err	*t* test	*p* val
Alternative-specific constant ($\beta 0$)												
Option C (status quo)	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Option A	− *0.7560*	0.1000	− 7.55	***	− *0.7400*	0.1210	− 6.13	***	− *0.5110*	0.1730	− 2.96	***
Option B	− *0.6680*	0.0982	− 6.80	***	− *0.6780*	0.1140	− 5.97	***	− *0.3920*	0.1760	− 2.23	**
Contract length ($\beta 1$)	− *0.0529*	0.0118	− 4.49	***	− *0.0574*	0.0143	− 4.03	***	− *0.0512*	0.0206	− 2.48	**
Price difference ($\beta 2$)												
None	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Positive	*0.8190*	0.0970	8.44	***	*0.6790*	0.1150	5.91	***	*1.0000*	0.0000	5.75E+07	***
Negative	− *0.6700*	0.0947	− 7.07	***	− *0.6100*	0.1060	− 5.75	***	− *0.9830*	0.2220	− 4.44	***
Wood buyer ($\beta 3$)												
Direct marketing	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Bundler	*0.2180*	0.1320	1.66		*0.5590*	0.2110	2.65	**	− *0.3370*	0.2070	− 1.63	
Forest enterprise	*0.0536*	0.1360	0.39		*0.3530*	0.2130	1.66		− *0.4810*	0.2090	− 2.30	**
Trader	− *0.0777*	0.1420	− 0.55		*0.0432*	0.2220	0.19		− *0.2030*	0.2160	− 0.94	
Duration business relation ($\beta 4$)	*0.1910*	0.0472	4.04	***	*0.1020*	0.0548	1.87	*	*0.3280*	0.0832	3.94	***
	Upper Bavaria and Lower Franconia				Upper Bavaria				Lower Franconia			
	Value	Std err	*t* test	*p* val	Value	Std err	*t* test	*p* val	Value	Std err	*t* test	*p* val
Alternative-specific constant ($\beta 0$)												
Option C (status quo)	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Option A	*0.1200*	0.0984	1.22	**	*0.2530*	0.1100	2.30	**	− *0.1880*	0.1700	− 1.10	
Option B	*0.1803*	0.0933	1.96	*	*0.2640*	0.1080	2.46	**	− *0.0994*	0.1620	− 0.61	
Contract length ($\beta 1$)	− *0.0577*	0.0113	− 5.08	***	− *0.0804*	0.0120	− 6.72	***	*0.0054*	0.0213	0.25	
Price difference ($\beta 2$)												
None	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Positive	*0.4920*	0.0753	6.54	***	*0.3830*	0.0780	5.41	***	*0.5130*	0.1370	3.76	***
Negative	− *0.5230*	0.0842	− 6.22	***	− *0.4590*	0.0772	− 5.95	***	− *0.6810*	0.1860	− 3.66	***
Wood buyer ($\beta 3$)												
Direct marketing	0.000	Fixed			0.000	Fixed			0.000	Fixed		
Bundler	− *0.0601*	0.0875	− 0.69		*0.3340*	0.2242	1.38		*0.1580*	0.1580	1.00	
Forest enterprise	− *0.6940*	0.0918	− 7.56	***	− *0.1180*	0.2520	− 0.47		− *0.8050*	0.1820	− 4.42	***
Trader	− *1.0000*	1.8E+308	0.00		− *0.4990*	0.2610	− 1.91		− *1.0000*	0.0000	− 5.53E+07	***
Duration business relation ($\beta 4$)	*0.1670*	0.0470	3.55	***	*0.0057*	0.0280	0.20		*0.6450*	0.0762	8.47	***

+ The aggregated results of 'Grisons and Aargau' are based on Olschewski et al. (2015)

indicate that price differences had less impact on marketing decisions at least in the mountainous parts of our study regions. This finding seems to contradict the fact that harvesting costs are generally higher in mountainous areas, which would imply a more price-sensitive decision making to avoid financial losses. One reason could be a different management focus in case the main purpose of forest management is to provide protection services against natural hazards. If specific maintenance activities are prescribed by law to ensure protection services, and the costs are (partially) reimbursed by the public, price signals might have a lower impact on decision making. Note that this effect might be augmented due to the fact that forest owners and managers are generally not obliged to harvest. In contrast, if forest management is less oriented towards service provisioning but more towards timber production, as in Lower Franconia and Aargau, price signals play a more important role for harvesting decisions. In addition, differences in price sensitivity could tie back to the different

ownership structure. For example, in the canton of Aargau, so-called citizens' communities account for 89% of the total communal forest area, while in Grisons such institutions do not exist. In contrast to political communities, citizens' communities have no fiscal sovereignty and, thus, might have a stronger incentive to generate profits from the forest. Further, private forest owners, which are generally expected to be more sensitive to wood price changes, hold about 29% of the forest area in Aargau, while with 9% playing a minor role in Grisons. Due to these circumstances, it can be concluded that the type of ownership has impact on the management goals and, subsequently, on the price sensitivity of forest owners and managers. In case that the foresters of the public administration manage (multiple) municipal forests, a further aspect has to be considered. Such a situation can be described as a 'principal-agent-relation', where asymmetric information between the owner (as principal) and the manager (as agent) might lead to inefficient outcomes (Eisenhardt 1989; Voorn et al. 2019), e.g. if price signals are not taken into account due to a restrained information flow. Hence, the success of promoting higher round wood prices as a monetary incentive to enhance wood provisioning might vary depending on regional and topographic circumstances, as well as on different forest management objectives and decision-making procedures. Note that these differences might be more pronounced among regions than indicated by a comparison at the country level.

4.2 Status quo and existing business relations

A similar conclusion can be drawn when analysing the attitude towards the status quo. The results of our CE imply that only in Upper Bavaria the deviation from status quo had a clear positive impact on utility. Forest owners and managers in the other regions seemed to be relatively satisfied with the current marketing situation. Maintaining the status quo can be related to a situation, where a considerable proportion of the annual harvesting volume is continuously pre-assigned to specific customers beforehand. This finding is backed-up by our CE result that long-term business relations were significantly preferred in all study regions. In Switzerland, more than 90% of all respondents sold their softwood sawlogs to customers based on a business relation of more than 5 years. In Bavaria, this share varied between 64 and 89% (Table 6). Relying on long-term business relations with only few customers might be due to the circumstance that other marketing channels are in fact not available. However, such long-term relations also have economic advantages and indicate that building trust, reducing transaction costs and avoiding risk play an important role in wood trade (Olschewski et al. 2015). Notwithstanding, Richter and Furubotn (2010) point out that such a trading behaviour can also end up in a 'lock-in-effect', which leads to inefficiencies, for instance, if alternative distribution opportunities are not used, although higher revenues could be achieved.

4.3 Long-term contracts

In contrast to the desired long-term business relation, respondents preferred short-term commitments with respect to specific contracts. Round wood contracts were usually concluded on a quarterly basis and often based on verbal agreements, only. In Aargau, where direct selling prevailed, only 30% of all respondents sold their softwood sawlogs based on written contracts, while this applied to 75% in Grisons, where wood bundling was more prominent. In Bavaria, this share varied between 27 and 63%, with public municipal owners using more written contracts (compare Table 6). Such a high share of short-term verbal contracts possibly has advantages for the trading partners in terms of flexibility if market conditions are expected to change. In case of increasing prices, forest owners and foresters can adapt the quantity supplied according to their financial goals. In case profit maximization is the goal, they can increase harvesting, or alternatively reduce it, if costs are to be covered. In contrast, this behaviour might have negative impact on the demand side, where the wood processing industry is reliant on a steady provisioning of the production factor wood. Thus, promoting long-term, written contracts would enhance the planning security for this industry in general and for new wood processing firms entering this market in particular. However, for such an approach to be successful, the behaviour, experience and habits of the decision makers on the supply side have to be taken into account. When considering current contracting habits in our study regions, the promotion of long-term written contract seems to be more promising with regard to public forest managers in Grisons and municipal owners in Bavaria, while public forests managers in Aargau and private owners in Bavaria are expected to be more reluctant.

4.4 New supply channels

When aiming to mobilize wood resources, several marketing channels are available. Beside direct selling and involving traders, emphasis is often put on (i) bundling wood supply by forest owner associations and (ii) outsourcing harvesting and marketing activities to forest entrepreneurs. Both alternatives seem to be promising ways of dealing with several problems related to the often non-professional small-scale forest owners, namely the small quantities harvested and the comparatively high harvesting and transaction costs. However, notwithstanding the supposed economic advantages of these channels, the successful implementation depends on the trading regime currently in place. In our Swiss study regions, the majority of wood suppliers chose two to four distribution channels. Nevertheless, 40% of the respondents in Grisons and 20% of the respondents in Aargau sold their softwood sawlogs to one customer type, only. In Bavaria, this share varied between about 40 and 60% (Table 6). Our CE results

indicated a tendency in favour of forest entrepreneurs only in Grisons, while respondents in Aargau, Lower Franconia and Upper Bavaria rejected them (though not significantly for the latter). Bundling organisations had a significant positive impact on utility in Grisons, and a tendency in favour of them in Bavaria, whereas respondents in Aargau rejected this channel. Hence, the success of promoting (new) institutional arrangements such as bundling wood or outsourcing by stumpage sale is not guaranteed a priori. In the short and medium term, their uptake by forest owners and managers might depend not only on expected financial advantages, but also on further aspects, such as existing business relations and contract length as well as attitudes and trust (Markowski-Lindsay et al. 2012a, b; Sullivan et al. 2005). In the longer run, incentives to change supply channels based on financial policy instruments might be successful, as recently demonstrated in Grisons. Here, in the last decade, many wood traders were subsequently superseded by bundling organizations implemented and financially supported by the government. Their increased acceptance in Grisons was confirmed by our CE results. Whether such a replacement of supply channels leads to a substantial wood mobilization or just a relocation of given quantities cannot be foreseen a priori and likewise depends on existing market conditions and the individual decision of forest owners and managers. In this regard, the behaviour of forest owners and managers that are currently neither harvesting nor marketing wood deserves more attention. While going beyond the scope of our study, future research should focus on these so far 'passive' forest stakeholders to comprehensively elicit the potential for mobilizing wood.

Acknowledgements We are grateful to the forest owners and managers in Germany and Switzerland for having participated in our survey. Further, we acknowledge the support of the Bavarian Research Institute of Forest and Forestry as well as the Ministry for Rural Affairs and Consumer Protection of Baden-Württemberg and the Forest Research Institute of Baden-Württemberg, and the cantonal authorities in Switzerland for providing the contact to the survey respondents.

Statement on data availability Materials described in the manuscript, including all relevant raw data, are available upon request to any researcher wishing to use them for non-commercial purposes, without breaching participant confidentiality. Data are provided via WSL repository ENVIDAT (Olschewski et al. 2019) at https://doi.org/10.16904/envidat.90.

Funding information The Swiss study is part of the project 'An economic analysis of Swiss wood markets' and has been financed by the Swiss National Science Foundation through the National Research Programme 'Wood as a Resource' (NRP 66).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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