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Do Farmers Care About Rented Land?

A Multi-Method Study on Land Tenure and Soil Conservation

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Abstract

Does ownership status of agricultural land determine farmers' soil use behaviour? Why (not)? We investigate this old question using multiple methods and data. We apply econometric analysis to plot-level data to determine whether planting decisions differ between rented and owned plots. In addition, we analyse interviews with Austrian farmers with the aim of explaining (a lack of) differences. We find a very small influence of tenancy on crop choice in the quantitative part of the study, and qualify these findings in the qualitative part. If at all, interviewed farmers treat rented and owned land differently primarily with respect to fertilization or liming, particularly if the rental is insecure or short-term. We find that renting is often perceived as long-term and secure in Austria, resulting in equal soil conservation behaviour on rented and owned plots. Personal relationships between renter and landowner as well as farmers' attitudes additionally support soil conservation.

Keywords: property rights; land ownership; land rental; soil conservation; farmer behaviour

JEL codes: Q150, Q240

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1 Introduction

The question of how different land property rights affect farmers' resource allocation decisions is a classic economic question. Scholars including Adam Smith, John Stuart Mill and Alfred Marshall have already debated the influence of land tenure arrangements on farmers' investment in land (Johnson, 1950). While the debate has its origins in the efficiency effects of sharecropping arrangements compared to full ownership ('Marshallian inefficiency', see e.g., Quibria and Rashid, 1984 for a discussion), it has since expanded to cash rental arrangements and soil conservation. The general reasoning conceives of a trade-off between short-run economic payoffs and long-term investments, e.g., into soil fertility and soil erosion control. While farmland owners tend to have strong incentives to invest in soil conservation to protect the value of their land, renters, due to their shorter planning horizon, are assumed to focus on short-term profits and, in doing so, deplete the soil (Lee, 1980).

Previous research on the relationship between tenure and investments in land quality is most abundant for countries of the Global South. Interest has largely focused on these countries as rental and ownership are both not necessarily secure in less developed countries and the institutional background is generally weaker than elsewhere. Moreover, land markets have been established only recently in some countries, e.g., China (Gao et al., 2012). While many studies show that security of rental (and ownership) tends to have positive effects on investments in most cases, there is also contradictory evidence. For example, Gebremedhin and Swinton (2003), Abdulai et al. (2011), and Lovo (2016) empirically show that more secure forms of tenure have a positive effect on soil conservation investments in different African countries, as do Muraoka et al. (2018), who additionally show that this is primarily true for productivity and long-term investments, but not for investments that pay off in the same year. Brasselle et al. (2002) find no effect of tenure security on investments. Comparing rental and ownership, Jacoby and Mansuri (2008) investigate the application of manure on plots with different property status in Pakistan, and find that both sharecropping and cash rental decrease this investment into soil fertility, but long-term contracts minimise this effect. Conversely, Shaban (1987) finds an effect on input and output intensities only for sharecropping and not for cash rental as compared to ownership in India. More general, a review of studies from middle- and low-income countries (Higgins et al., 2018) and a review of African studies only (Fenske, 2011) conclude that the effect of tenure security on investments in land quality is positive to ambiguous, but results depend on the indicators and methods used. Importantly, some authors show that causality may also be reversed in this context, such that investments into land increase farmers' tenure security (e.g., Brasselle et al., 2002; Deininger and Jin, 2006; Moreda, 2018).

This literature provides some insights that may also be relevant for other contexts. First, a negative effect of rental on investments appears to be more robust for sharecropping arrangements than for cash rental, although evidence is not fully conclusive and impacts may depend on supervision by landowners (Deininger et al., 2013; Jacoby and Mansuri, 2009; Shaban, 1987). Second, effects appear to be more pronounced where rental is insecure and/or short-term (e.g., Jacoby and Mansuri, 2008). Third, the studied variables vary widely, and different types of investments may by influenced differently by property status. Last, empirical methods to estimate the effect of property status have been continuously developed in these studies, with econometric methods using household fixed effects (that essentially compare plots of farms that are owner cum tenants) now being widely applied as a robust approach.

With this background in mind, one might expect that in countries of the Global North, the effects of property status on investments into land and conservation behavior in particular may be less pronounced, as security of tenure (and ownership) is usually guaranteed. Moreover, focusing on cash rental, which is the focus of our paper, may also reduce potential effects. However, the existing empirical studies, primarily from North America, produce inconclusive results. The earliest studies on the impact of land tenancy on soil conservation date back to the 1930s, when soil erosion became an important issue in the wake of the 'Dust Bowl' in the US. Schickele and Himmel (1938) were among the first to provide empirical evidence that land rental may indeed discourage soil conservation, but they also emphasize the importance of the relationship between landlord and renter (e.g., family relations) for land use decisions. Further findings for North America from the 1980s range from higher soil erosion rates and fewer conservation practices on rented fields than on owned fields (Ervin, 1982), to no difference in soil erosion between rented and owned land (Lee, 1980), to renters being actually more likely than owners to adopt minimum tillage, a soil conservation system (Lee and Stewart, 1983). Twenty years later, Soule et al. (2000) find renters to be less likely to adopt soil conservation practices than owners, Cole and Johnson (2002) find no effect of tenure on soil erosion (accounting the finding to community norms and farmers' concerns about their reputation), and Fraser (2004) finds that owners plant more soil-conserving crops (such as perennials, grain and forage legumes) than renters. Most recently, Varble et al. (2016) find that while renters are less likely to rotate crops, they are more likely to use conservation tillage.

In contrast to North America, very little empirical evidence exists for Europe. To the best of our knowledge, only three European studies explicitly address the topic: Myyrä et al. (2005) find that in Finland, plots farmed by their owner have higher levels of soil pH and soil phosphorus than rented plots, suggesting that farmers invest more into owned land. Sklenicka et al. (2015) investigate the link between tenancy and crop choice in the Czech Republic and conclude that renters are more likely to plant wide-row crops (prone to soil erosion) than owners, but differences are mitigated by the more common participation of renters in agri-environmental schemes (AES) to some extent. Walmsley and Sklenicka (2017) show that soil quality is higher for owned plots than for rented plots under conventional farming, but find no differences for organic farms. All three studies rely on relatively small samples. Additional research based on large samples therefore appears desirable. Moreover, there are at least two further reasons to contribute empirical evidence for Europe.

First, the historical and institutional background of farming as well as agricultural land markets differ substantially from those in other parts of the world, such that results found elsewhere cannot easily be transferred. In (Western) Europe, institutions are strong and land markets, including the rental market, are often strongly regulated (Swinnen et al., 2016). This increases the security of rental (and ownership), at least for the agreed rental period. However, differences between rental and ownership with respect to the farmers' time horizons and thus pay-back time for investments remain, depending on the length of rental. We thus expect the situation to be different from countries with weak institutions, but as the examples from the Czech Republic and Finland show, it appears still plausible to find an effect of rental on soil conservation practices.

Second, recent developments in agricultural land markets demand increased attention. In particular, agricultural land sales markets are extremely tight in most EU countries, with the share of land changing owner at less than 1% per year in several of the old EU member states (Ciaian et al., 2012a). At the same time, the average farm size in EU-27 (EU-15) countries has increased by almost 40 (30)% in total and 3.1 (2.4)% per year from 11.9 (23.4) hectares (ha) in 2005 to 16.2 (27.8) ha in 2016 (Eurostat, 2018). As a result, the rental market is gaining importance. For example, rental shares already exceed 50% of the total utilized agricultural area (UAA) in France, Belgium, Germany, Slovakia, the Czech Republic, and Hungary, and they are increasing in most EU countries (Ciaian et al., 2012b). At the same time, soil degradation and erosion have increasingly become a concern. Globally, a third of all land is at least moderately degraded, with Europe having an especially long history of human-induced threats to soil fertility (FAO and ITPS, 2015). The costs of soil degradation for agricultural production are considerable, with estimates ranging from 212 to 620 million British pounds just for the UK (Graves et al., 2015). Agriculture is a key factor in this respect. Farmers experience the immediate impacts of soil degradation first-hand but also cause soil depletion and exhaustion through their land use. Therefore, governments and other actors increasingly aim to incentivise farmers to conserve soil (Louwagie et al., 2009; Panagos et al., 2016).

In light of these considerations, it is of interest to investigate whether efforts to support soil conservation may be counteracted by the recent developments in European land markets. To do so, we need to understand whether the formal property context – in our case, ownership and rental – of a piece of land is one of the mechanisms that determine farmers' soil conservation and the context in which this mechanism may be (in)active. We distinguish between land ownership and rental by referring to the analytical notion of property rights. Property defines a social relationship between actors with regard to a valuable property object, in our case land (Bromley, 1991; von Benda-Beckmann et al., 2006). Ownership expresses the fullest bundle of property rights. Owners can transfer partial rights to renters, who can make use of the land for an agreed period of time but usually do not hold further rights such as the right to transfer or to change the land. The metaphor of the bundle of property rights, which has found cross-disciplinary recognition (Bromley, 1991; von Benda-Beckmann et al., 2006), highlights that the involved parties are tied together in social as well as legal relationships. It is important to distinguish the formal rights ('categorical property relationships') from actual social relationships ('concretised social relationships'), as the de-jure property rights status may be quite different from actual property practices (von Benda-Beckmann et al., 2006). This makes it necessary for us to consider not only the legal relationship but also the wider social context between renter and landowner when analysing the potential effect of property rights. In addition, not only the mere type of property rights to a piece of land but also the nuanced formal and informal arrangements thereof matter for farmers' behaviour. Both are usually not covered in the existing literature. We address all these aspects in this study.

The aims of this study are (1) to test the hypothesis that farmers practise less soil conservation on rented land than on owned land and (2) to investigate the circumstances of rental that may cause or counteract this purported relationship. To address both aims, we first use regression analysis of an extensive secondary dataset at the plot level from the Austrian Integrated Accounting and Control System (IACS). We test whether there is an observed difference in crop choice between rented and owned land at the empirical level. To gain a deeper insight into the relationship between rental and soil conservation we then qualitatively analyse transcripts of semi-structured interviews with Austrian crop farmers. This gives us a deeper insight into when and why farmers make (no) differences in soil conservation between rented and owned plots. The present study will thus add to the existing literature by expanding its geographical focus to the European situation, by providing well-founded evidence due to the exceptionally large and detailed dataset we use in the quantitative part, and by offering additional context through its combined use of quantitative and qualitative methods.

Soil conservation covers many aspects of farming, including crop residue management, soil amendments such as fertilisation and application of manure, contour farming and strip cropping, and the choice of cropping system (Beste, 2005; Blanco-Canqui and Lal, 2010). We consider both prevention of degradation (e.g., erosion), as well as active enhancement of soil as conservation. In the quantitative part of the study we use crop choice as an indicator for a practice that is within a farmer's control and that is available in our dataset. In the qualitative part we take a broader approach and do not predefine soil conservation, but use farmers' own understanding of the concept.

The remainder of this paper is organized as follows: We first introduce our study area, Austria. We then describe the quantitative and qualitative data, indicators, and methods used in chapter three. The fourth chapter presents the results from both study parts. Finally, the discussion brings both results together and puts them into the wider context.

2 Study area: Austria

Austria is a good example of a country that follows the general European trend of rental and structural change. Both the sales market and the rental market for agricultural land in Austria are regulated relatively tightly (Swinnen et al., 2016) at the level of the nine 'Bundesländer' (provinces). The respective 'Grundverkehrsgesetze' (property transaction laws) of each province regulate agricultural land sale transactions. While differences between provinces exist, these laws generally favour the transfer of land to neighbouring and active farmers over non-agricultural investors. Reference durations for different farming types provide a guideline for rental contract lengths, and, despite not being as strong as legal minimum durations, ensure some protection of renters (Holzer et al., 2013). Rental prices are, similarly, not explicitly regulated, but the law includes the concept of an 'adequate rent'.

While the number of farms is steadily decreasing, the utilized agricultural area (UAA) per farm increased from 12.6 ha in 1990 to 19.7 ha in 2016 (BMLFUW, 2017). This increase in farm area has largely happened via the rental of land that has been given up by other farmers (Holzer et al., 2013). According to IACS data, the share of rented land increased from 22.6% of UAA in 2001 to 39.2% in 2012, and the share of farms renting at least some part of their land has increased from 41.9% to 69.6% of farms (BMLFUW, 2013, 2002). Due to differing inheritance laws and traditions, there are substantial regional differences in rental shares between provinces, ranging from 24.6% in Salzburg (in the mid-west of Austria) to 63.6% in Burgenland (in the east). Moreover, cropland (43.8%) was rented more often than grassland (32.7%) in 2013 (BMLFUW, 2013). As a consequence, farmers' expenditures for rent as a share of total expenditures have increased continuously over the last few years (BMLFUW, 2016). In Austria, rental of farmland is predominantly cash rent, while sharecropping is virtually inexistent.

3 Data and Methods

3.1 Quantitative data and indicators

Aside from having an immediate effect on the economic outcome of farming, individual crops also differ in their capacity to enhance or exhaust soils in the long run, and to foster erosion due to differing row spacing and canopy cover (see also Universal Soil Loss Equation, Wischmeier and Smith, 1978). We therefore use farmers' choice of crops as a proxy for their soil conservation efforts. We classify crops into three groups: wide-row crops, corn, and legumes. Wide-row crops tend to increase soil loss through run-off, particularly on sloping plots, as a large part of the soil remains uncovered for a prolonged period. Farmers can mitigate this effect by taking specific measures such as using mulch-till/no-till technology. Nevertheless, following Sklenicka et al. (2015), we propose that on average and compared to other crops, wide-row crops are more prone to erosion than other crops and thus we use them as an indicator for soil non-conservation.[1] Wide-row crops are comprised of corn, beets, potatoes, and sunflowers. Austrian farmers frequently grow potatoes and beets under contract, limiting their crop choice decisions to some extent. We therefore use corn alone as a second indicator for an intensive and erosion-prone crop choice. Conversely, legumes are considered soil enhancing, as they increase the available nitrogen in the soil. We use them as an indicator for a soil-conserving crop choice. Legumes include: clover, grass-clover ley, alfalfa, lupin, peas, peavine, beans (soy beans, field beans), lentils, chickpeas, and vetch.

The Austrian IACS dataset contains plot-level information on the main crops planted on each plot for all farms receiving direct payments under the Common Agricultural Policy of the EU, i.e., 86% of Austrian farms (Hofer and Gmeiner, 2012). Due to the minimum eligibility criteria for most AES, the dataset does not cover most farms that farm less than 2 ha UAA. Nevertheless, for cropland the coverage amounts to 99.3% when comparing the IACS dataset with the farm structure survey (FSS) (Hofer and Gmeiner, 2012), such that any potential bias from this lack of data should be negligible. The farms in our final dataset farm between 0.1 ha and 2800 ha with crops (mean: 22 ha, median: 12 ha) on up to 1089 plots (mean: 15 plots, median: 10 plots).

The dataset has three levels: plots, fields, and legal property items. Plots are the actual management units, planted with a single crop in one year (descriptive statistics for plots see below). Fields are a larger entity and may contain several plots, and thus several different crops. The average field in our dataset contains 1.18 plots, and field sizes range from 0.1 ha

[1] We also test only those farms not using mulch-till/no-till technology, see below.

to 165 ha (median: 0.97 ha, mean: 1.7 ha). The property status of a piece of farmland is not assigned to the single farmed plot, but to underlying legal property items. These legal property items are not always congruent with plots or fields. Due to this mismatch and the structure of the data, property status can be extrapolated for only two thirds of plots and is unclear for the rest; we assign the property status ‘unknown’ to the latter. In addition, farmers occasionally swap plots, or farm plots without formally renting them (e.g., plots belonging to neighbours, family, etc.). We assign these plots (property status ‘right to use’ in the original dataset) to the same category, ‘unknown’. All other plots are either ‘rented’ or ‘owned’.

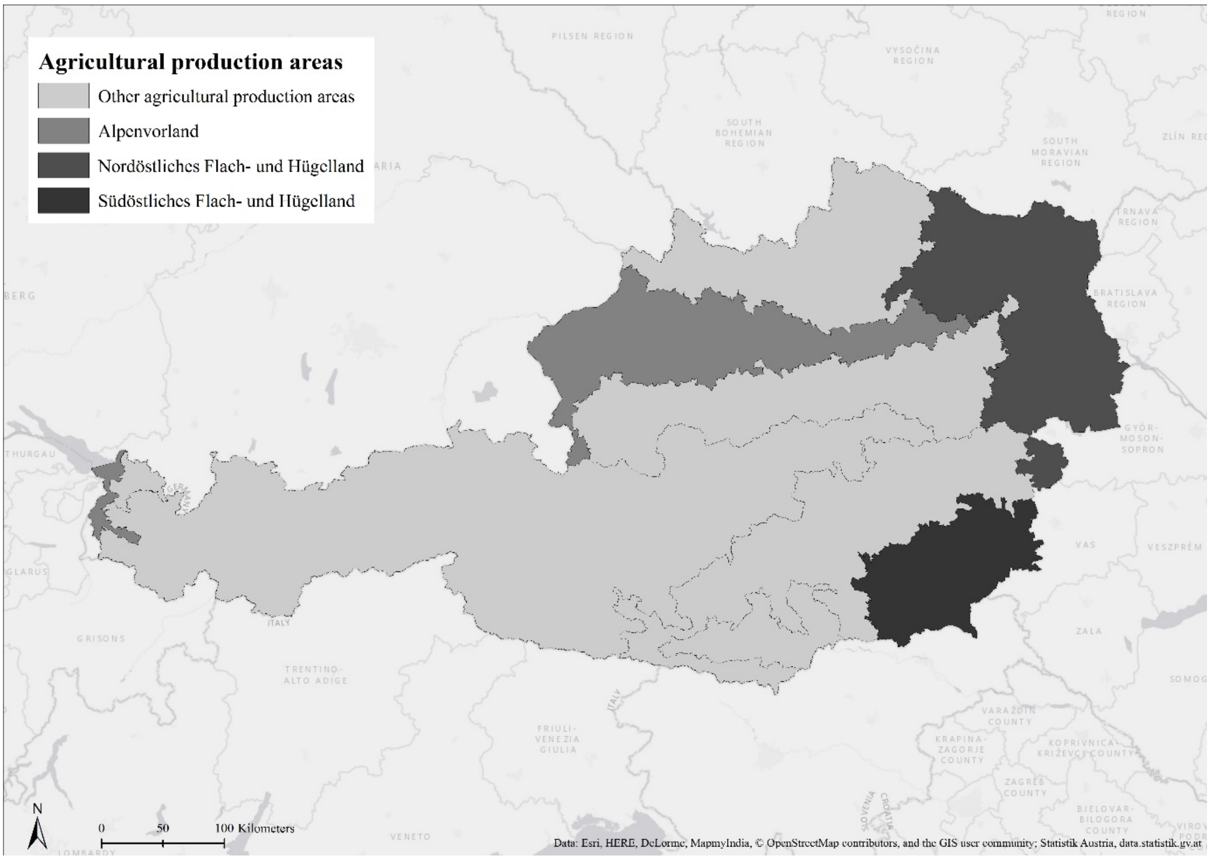
In addition, the dataset includes the following information at the plot level (either directly at that level, or extrapolated from the field level): plot size, slope angle, a crop yield indicator reflecting soil quality, altitude, information on plot-level AES participation (some of which can be used as indicators for ecologically sensitive areas), and geo-spatial location (coordinates). All plots are linked to the farm that farms them. Using geo-spatial information on the location of the farmhouse, we calculate a linear distance between a plot and the farmhouse to reflect accessibility of a plot.[2] The dataset additionally contains some information at the farm level: organic/conventional farming, participation in soil-enhancing AES, farm standard output, and farm type.[3] We use this information to split the sample and investigate the farm type-specific effects of rental.

Based on climate, altitude, soil and topology, Austria is divided into eight main agricultural production areas (Statistik Austria, 2018). We select three production areas with a strong presence of crop production for this study (see Figure 1): Alpenvorland (alpine foothills), Nordöstliches Flach- und Hügelland (north-eastern lowland and hills), and Südöstliches Flach- und Hügelland (south-eastern lowland and hills). We use all available data from these regions. Assuming that the cropland coverage of the IACS is approximately 99% for all regions alike, our dataset covers the vast majority of cropland in our study area.

2 This introduces some error due to data and measurement errors, justifying a removal of outliers. We remove all plots from the sample that are outside 2 times the interquartile range of the lower and upper quartiles of the distance in logs, corresponding to plots closer than 17.4 meters to, or more than 63 kilometres away from the farmhouse. This excludes 688 plots farmed by 289 different farms.

3 Standard output is a standardised measure of farm revenues from different activities. It is used to classify farms by economic size and farming type (European Commission, 2014).

Figure 1: Main Agricultural Production Areas of Austria



We use data for the year 2012, the most recent year where all necessary information is available. The final sample includes 43,102 farms farming 670,760 plots with field crops. Out of these, 18.894 farms with 326.219 plots farm at least one (known) rented and one owned plot. Table 1 provides summary statistics of all plots by property status. We see that compared to owned plots, rented plots are slightly more frequently planted with wide-row crops, and slightly less frequently planted with legumes. Rented plots are smaller, flatter, of better soil quality, and at a lower altitude than owned plots, but all of these differences are small. Rented plots are also somewhat more frequently located in ecologically sensitive areas (areas designated as ecologically valuable with specific management requirements, compensated via AES) than owned plots. A large difference between rented and owned plots exists in their distance to the farmhouse. Rented plots are on average 1.3 kilometres further away from the farmhouse than owned plots. Plots with an ‘unknown’ status show similarly minor differences to those with a known property status. We therefore retain these plots in our quantitative analysis to control for potential structural differences. To test the statistical significance of the differences in means between plots of different property status, we regress all variables on property status in turn. This allows us to account for the clustered structure of the data beyond a simple ANOVA by introducing cluster-robust standard errors at the farm level. With two exceptions[4], differences are statistically significant at the 1% level.

[4] The percentage of corn does not differ significantly between rented and owned plots. The percentage of plots under AES does not differ significantly between rented and unknown plots, and differs significantly only at the 10% level between owned and unknown plots.

Table 1: Summary statistics of plot-level IACS data by property status

	Owned	Rented	Unknown	Total
Number of plots	213,465	249,620	207,675	670,760
% of plots with wide-row crops	28.92	29.64	30.73	29.75
% of plots with corn	23.07	23.51	24.99	23.83
% of plots with legumes	9.17	8.68	8.17	8.68
Mean plot size (ha) (min-max)	1.49 (0.01-117.76)	1.26 (0.01-77.84)	1.6 (0.01-73.33)	1.44 (0.01-117.76)
Mean slope (%) (min-max)	6.48 (0.01-50.64)	5.58 (0.01-93.18)	5.99 (0-85.54)	5.99 (0-93.18)
Mean soil quality index (1-100) (min-max)	49.54 (0.1-100)	50.02 (0.2-99.7)	49.28 (0.1-99.9)	49.64 (0.1-100)
Mean altitude (m) (min-max)	312 (113-927)	272 (113-891)	288 (113-849)	290 (113-927)
% protected by AES	2.81	3.15	2.99	2.99
Mean distance to farmhouse (m) (min-max)	1,505 (17-62,714)	2,843 (18-63,353)	1,999 (18-62,911)	2,156 (17-63,353)
Number of farms				43,102

3.2 Quantitative model and estimation strategy

Some problems may arise when analysing the treatment effect of property status for crop choice. First, endogeneity problems due to a correlation of farm characteristics with property status as well as crop choice can bias the results. Our data set includes little information at the level of the farm, such as socio-economic factors including farmer's education, gender and age, and farm structural factors such as share of family labour, mechanisation, etc. Similarly, information at the district or regional level such as the presence of biogas facilities, climatic conditions, or regional traditions are missing. To control for such farm characteristics, we introduce cluster-specific fixed effects at the level of the farm. This allows us to estimate the treatment effect of property status in an unbiased way, as characteristics at the farm level (or higher, e.g., the regional level) that influence crop choice are now contained in and controlled for by the fixed effects. It is important to note that as a consequence only farms with both rented and owned plots will effectively contribute to the results concerning property status, reducing the number of farms and plots contributing to these results to 18.894 and 326.219, respectively[5]. Second, land quality differences between rented and owned plots may cause different crop choices and at the same time be related to differences in property status. We introduce all control variables available in the IACS dataset covering soil quality, slope, plot size, etc. at the plot level to account for such a potential bias. However, we cannot account for land quality differences that are e.g., caused by previous farming and management. This factor may correlate with property status, especially for newly rented plots (as previous farmers may

[5] We nevertheless retain also full-owners and full-renters in our analysis in order to get correct estimates of the influence of our control variables on crop choice.

have overused or otherwise degraded the land before losing the plot or quitting farming). This may bias our results. For example, such a (newly) rented plot then requires special care and the farmer will be more likely to plant e.g., legumes rather than corn during the first years, i.e., acting opposite to what we would initially expect. We however believe that this potential bias is small, as we have the impression that land transfers (via sale or rental) are relatively rare (see discussion section). Third, statistical problems may arise from sampling issues, such as farms being clustered. Given that our dataset covers >99% of cropland and we include the entire dataset in our analysis we can avoid this problem.

To estimate the relationship between rental and crop choice, we thus use the following model:

$$ind_{ij} = \alpha_i + \boldsymbol{\beta}'\mathbf{D}_{ij} + \boldsymbol{\gamma}'\mathbf{X}_{ij} + \varepsilon_{ij} \quad [1]$$

where ind_{ij} is the respective indicator (e.g., presence of a wide-row crop) on plot *j* belonging to farm *i* and $\mathbf{D}_{ij}$ is a set of dummies indicating whether the plot is owned (default), rented, or the property status is unknown. α_i are cluster-specific fixed effects, $\boldsymbol{\beta}'$ and $\boldsymbol{\gamma}'$ are vectors of parameters to be estimated, $\mathbf{X}_{ij}$ is a vector of control variables, and ε_{ij} is an error term (Cameron and Trivedi, 2005).

We begin with a very simple model with no control variables $\mathbf{X}_{ij}$ and no cluster specific fixed effects b_i (model (1)). In the second step (model (2)), we extend the model by the following control variables $\mathbf{X}_{ij}$: size of the plot (hectares in logs), its slope angle (%), a soil-quality indicator (crop yield indicator, scale from 0 – 100), altitude (meters above sea), whether the plot is located in an ecologically sensitive area (dummy variables), and the linear distance between farmhouse and plot (metres in logs). For both models (1) and (2) we calculate cluster-robust standard errors (Cameron and Trivedi, 2005), as the observations are likely to be clustered by farm.

To account for farm-level heterogeneity, we introduce the cluster-specific fixed effects α_i, first without (3), then with control variables $\mathbf{X}_{ij}$ (4). These fixed effects (corresponding to farm-specific intercepts) are not explicitly calculated. Instead, they are eliminated using the within transformation (Cameron and Trivedi, 2005; Wooldridge, 2010).

The dependent variables ind_{ij} are all binary and describe the presence ($ind_{ij} = 1$) or absence ($ind_{ij} = 0$) of a specific crop on a plot. For such binary dependent variables, probit or logit models are usually preferred. However, in a fixed effects setting, these models suffer from the so-called 'incidental parameters problem' (Greene, 2004; Lancaster, 2000). Random effects probit or logit models are not affected by this problem, but assume the unobserved farm effects to be random and uncorrelated with the other explanatory variables. We therefore estimate a linear probability model (LPM). The estimated parameters of the model can then be interpreted as changes in the probability of the presence of a specific crop, i.e., wide-row crop, corn or legumes.

As the farm fixed effects eliminate all plot-invariant farm level characteristics, we cannot estimate whether different types of farms exhibit different effects of rental. To investigate this, we can, however, split the full sample according to various farm characteristics. We consider the following characteristics: (i) farms with a small, medium, or large standard output (cut-off points at 30,000 and 100,000 € standard output), (ii) different types of farms (predominantly animal husbandry, field crops, fodder crops, mixed farming), (iii) organic/conventional farms, (iv) farms participating in any of the following soil conserving AES (or not): direct seeding or and seeding on mulch (mulch-till/no-till), environmentally sound management of arable and grassland surfaces (‘UBAG’), and greening of arable land.

3.3 Qualitative data and method of analysis

For the qualitative part of our study, we analyse the transcripts of 26 semi-structured interviews conducted with Austrian farmers in December 2017 and January 2018. All interviewees farm some amount of cropland, farm rented and owned plots and are situated in one of the three chosen agricultural production areas depicted in Figure 1. Considering only farmers with both rented and owned land limits our results, as full owners or full tenants (very rare) may have a different attitude and report different practices than mixed tenure farmers. However, it also ensures compatibility with the quantitative analysis, where only farms with both types of plots contribute to the results.

Beyond these main criteria, participants were selected to cover a wide range of different farm types and farmers. We recruited interviewees via several channels, depending on the province: farm advisors of the Austrian Chamber of Agriculture provided direct farm contacts (Styria) or lists with contact information (Burgenland), an open call for participants in a newsletter of the Chamber of Agriculture of the province of Lower Austria, a call for participants among students of [*name withheld for anonymity during peer review*] (yielding contacts in Burgenland, Lower Austria and Upper Austria, mostly students’ parents or relatives), and contacts via environmental NGOs and extension services (mainly Upper Austria). In two cases, interviewees established contact with further farmers from their neighbourhood. In total, we approached 32 interviewees (none declined the interview, however 6 interviews could not be used due to no rented land, not in the required agricultural production area). We interviewed the main decision maker of each farm, which in four cases were two people (husband and wife or father and son). Aside from the interviewed couples, only one of the 26 analysed interviews was with a female farmer. Six farms were run as part-time farms (self-described) at the time of the interview, eleven had some kind of livestock, and six were organic farms. The interviewees were farming between 11 and 800 hectares of cropland and were renting between approximately 10% and over 90% of their cropland. The interviewees held different rental contracts, many permanent with a 6- or 12-month notice period, others had contracts limited to three, five or ten years.

Table A in the appendix provides more detailed information about the interviewees.

Each interview lasted between 45 and 90 minutes. The interview guideline covered several topics: general information about the farm, rental conditions (including differences between rented and owned plots), soil conservation measures, and farmers’ connection with soil. We did not define a priori what ‘soil conservation’ comprises, but let the interviewees decide what to include. For the present paper, we analyse only those parts of the interview transcripts that concern land rental and ownership. Transcripts were coded using qualitative content analysis with inductive category formation (Mayring, 2015). The category definitions for coding are defined as follows: (1) differences in land use between rented and owned plots explicitly mentioned by the farmers (referring to themselves or others); (2) circumstances of rental that farmers state as reasons for (not) treating rented plots differently than owned plots.

Coding and initial analysis were done using the software atlas.ti (Muhr, 2014). We coded relevant text parts and grouped emerging codes into code families named ‘differences’, ‘yes’ and ‘no’ for category (1), such that co-occurrences could be explored. For category (2), we analysed co-occurrences of the same families with the code families ‘rationale for differences’ and ‘rationale for no differences’. Codes were then synthesised to produce a small number of central topics raised by the interviewees. To a limited extent, we accounted for the context of the farmers (e.g., organic/conventional farming) for analysis, but no effort was made to do, e.g., systematic axial coding.

4 Results

4.1 Quantitative results

Table 2 depicts the results of the linear probability model (LPM) for wide-row crops. We find that there is a statistically significant correlation between the planting of wide-row crops and land rental in a simple LPM without and with control variables (models (1) and (2)): The probability that a wide-row crop is planted on a rented plot is 2.3 percentage points higher than on an owned plot when controlling for plot-specific variables. However, this effect becomes insignificant once farm fixed effects are introduced (models (3) and (4)). On average, an individual farmer is thus equally likely to plant wide-row crops on an owned plot and a rented plot when farm and plot characteristics are accounted for.

Table 2: Regression results for wide-row crops

	Dependent variable: wide-row crops			
	(1)	(2)	(3)	(4)
Farm fixed effects	**No**	**No**	**Yes**	**Yes**
Unknown ownership	0.018*** (0.002)	0.021*** (0.002)	0.001 (0.002)	-0.004** (0.002)
Rented	0.007*** (0.003)	0.023*** (0.003)	-0.007*** (0.002)	0.002 (0.002)
log(size)		0.039*** (0.001)		0.052*** (0.001)
Slope angle		-0.001*** (0.0002)		-0.005*** (0.0002)
Soil quality indicator		0.002*** (0.0001)		0.002*** (0.0001)
Altitude		0.0002*** (0.00001)		-0.0004*** (0.00004)
Ecologically sensitive area		-0.218*** (0.005)		-0.125*** (0.005)
log(distance)		-0.009*** (0.001)		-0.002* (0.001)
Constant	0.289*** (0.002)	0.246*** (0.012)		
Observations	670,760	670,760	670,760	670,760
Households	-	-	43,102	43,102
R^2 (full model)	0.0003	0.025	0.264	0.289

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

For corn alone (see Table 3), the results are similar to wide-row crops. In an LPM with no farm-fixed effects, the probability that corn is planted on a rented plot is 3.2 percentage points higher than on an owned plot. Once farm-fixed effects are introduced, a statistically significant difference between rental and ownership remains, but its effect (0.7 percentage points difference in probability) is relatively small.

Table 3: Regression results for corn

	Dependent variable: corn			
	(1)	(2)	(3)	(4)
Farm fixed effects	No	No	Yes	Yes
Unknown ownership	0.019*** (0.002)	0.030*** (0.002)	0.004** (0.002)	-0.001 (0.001)
Rented	0.004 (0.003)	0.032*** (0.003)	0.002 (0.002)	0.007*** (0.002)
log(size)		0.028*** (0.001)		0.041*** (0.001)
Slope angle		-0.001*** (0.0002)		-0.003*** (0.0002)
Soil quality indicator		0.0001 (0.0001)		0.001*** (0.0001)
Altitude		0.0004*** (0.00001)		-0.0004*** (0.00003)
Ecologically sensitive area		-0.168*** (0.005)		-0.077*** (0.004)
log(distance)		-0.010*** (0.001)		0.001 (0.001)
Constant	0.231*** (0.002)	0.173*** (0.012)		
Observations	670,760	670,760	670,760	670,760
Households	-	-	43,102	43,102
R^2 (full model)	0.0004	0.024	0.331	0.347

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

Table 4: Regression results for legumes

	Dependent variable: legumes			
	(1)	(2)	(3)	(4)
Farm fixed effects	No	No	Yes	Yes
Unknown ownership	-0.010*** (0.001)	-0.006*** (0.001)	-0.0003 (0.001)	-0.001 (0.001)
Rented	-0.005*** (0.002)	0.004*** (0.002)	0.002* (0.001)	0.004*** (0.001)
log(size)		0.005*** (0.0004)		0.006*** (0.0004)
Slope angle		-0.0003** (0.0001)		0.001*** (0.0001)
Soil quality indicator		-0.001*** (0.0001)		-0.0001** (0.00005)
Altitude		0.0001*** (0.00001)		0.0001*** (0.00002)
Ecologically sensitive area		-0.050*** (0.003)		-0.043*** (0.004)
log(distance)		-0.003*** (0.001)		-0.002*** (0.001)
Constant	0.092*** (0.001)	0.113*** (0.008)		
Observations	670,760	670,760	670,760	670,760
Households	-	-	43,102	43,102
R^2 (full model)	0.0002	0.006	0.233	0.234

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

Similarly, the planting of legumes appears to be almost unrelated to the property status of a plot (see Table 4). Already the simple LPM shows only a very small effect of rental for the probability of legumes being planted on a plot, which is, contrary to expectations, positive (+0.5 percentage points difference in probability). This remains the same once farm fixed effects are introduced: It is on average 0.4 percentage points more likely for legumes to be planted on a rented plot compared to an owned plot for the same farmer.

In terms of model specification, the R^2s of models (1) and (2) show that not considering farm-level characteristics altogether provides a very poor fit of the data. Similarly, comparing models (1) and (3) as well as (2) and (4) with F-tests reveals the farm fixed effects to be significant at least at the 1% level, with F (43,101, 627,650) = 5.4195 for wide-row crops with no control variables and F (43,101, 627,660) = 5.2069 with control variables included.[6]

The coefficients of the control variables largely show expected signs: The larger a plot, the more likely a farmer will plant wide-row crops or corn. Legumes are also found more frequently on larger plots, but the effect here is much smaller. Better soil quality is positively correlated with the planting of wide-row crops and corn, but negatively (albeit with a very small effect) correlated with legumes. Steeper plots and plots at a higher altitude are less likely to be farmed with wide-row crops and corn, but more likely to be farmed with legumes. There is only a small negative and barely significant effect of the distance between a plot and the farmhouse on the planting of wide-row crops and an insignificant effect for corn. For legumes, the effect is slightly positive and statistically significant. The results for the indicator variable for 'ecologically sensitive area' are also as expected: being located in such a designated area greatly reduces the probability of wide-row crops (including corn) being planted on a plot but also reduces the probability of legumes. This confirms that farmers comply with the individually designed management plans for these plots, which may require leaving the land fallow or using it for fodder crops only.

Looking at different subgroups of farms for differences in the planting of crops, we do not find statistically and economically significant (defined here as a difference greater than one percentage point between rented and owned plots) effects of rental for most subsamples. Table 5 shows coefficients and standard errors for the variable 'rented' for the model specification (4), i.e., including fixed effects and control variables. We find most significant effects at the level of farm types: livestock farmers are more likely to plant wide-row crops on rented plots than on owned plots (+1.6 percentage points difference, opposite sign than other farm types), and the relationship holds for corn (+1.7 difference). Mixed farms show a similar effect for corn (+1 difference), while fodder-crop farms are more likely to plant legumes on rented plots than on owned plots (+1.1 difference). Large farms show a tendency to plant more wide-row crops and in particular corn on rented plots (+0.9 difference for wide-row crops, +1.2 difference for corn). Conversely, organic farmers are less likely to plant wide-row crops on rented plots as opposed to owned plots (-1.3 difference, opposite sign than conventional farms), and farms that do not participate in the greening AES appear to be more likely to plant corn on rented plots than on owned plots (+1.2). All other subsamples do not exhibit a significant effect of rental, comparable to the full sample.

[6] Results for corn and legumes are very similar and available upon request.

Table 5: Effects of rental on crop choice (model specification (4)) for different subsamples

		Coefficient (SE) wide-row	Coefficient (SE) corn	Coefficient (SE) legumes	No. of farms	No. of plots
Farm standard output (€)	Small	-0.006 (0.004)	0.001 (0.004)	0.008** (0.003)	19,532	153,652
	Medium	-0.001 (0.003)	0.004* (0.002)	0.003* (0.002)	13,897	268,091
	Large	0.009*** (0.003)	0.012*** (0.003)	0.001 (0.002)	9,325	246,106
Farm type	Animal husbandry	0.016*** (0.005)	0.017*** (0.005)	-0.0004 (0.002)	5,709	98,679
	Field crops	-0.0002 (0.003)	0.003 (0.002)	0.003* (0.002)	16,307	303,790
	Fodder crops	-0.004 (0.005)	0.001 (0.005)	0.011*** (0.004)	9,484	95,960
	Mixed farming	-0.002 (0.004)	0.010*** (0.004)	0.006** (0.003)	6,083	117,386
Participation in no-till/ mulch-till AES	Yes	0.00002 (0.002)	0.005*** (0.002)	0.003** (0.001)	12,711	329,352
	No	0.005* (0.003)	0.009*** (0.003)	0.004** (0.002)	30,391	341,408
Organic farms (AES participation)	Organic	-0.012*** (0.004)	-0.009** (0.004)	0.005 (0.007)	3,556	70,201
	Conventional	0.004* (0.002)	0.009*** (0.002)	0.003*** (0.001)	39,546	600,559
Participation in UBAG AES	Yes	0.0004 (0.002)	0.005*** (0.002)	0.005*** (0.001)	18,977	405,006
	No	0.005 (0.003)	0.009*** (0.003)	0.001 (0.002)	24,125	265,754
Participation in greening AES	Yes	0.001 (0.002)	0.006*** (0.002)	0.004*** (0.001)	26,217	541,932
	No	0.009* (0.005)	0.012** (0.005)	0.003 (0.003)	16,885	128,828

Note: *p<0.1; **p<0.05; ***p<0.01. Standard errors (SE) are cluster-robust.

4.2 Qualitative results

The results from the qualitative part of the study concerning whether or not property status has an impact on soil conservation are mixed. While some interviewees state that they do differentiate between rented and owned plots, or would do so under certain circumstances, others maintain that they treat all their plots equally, irrespective of property status. Some assert that it is ‘common’, e.g., among their neighbours, to take less care about soil on rented plots compared to owned plots, or provide anecdotal evidence of such behaviour. Others, however, claim that they have not experienced this.

When interviewed farmers do mention differences in soil conservation (for themselves or others) between rented and owned plots, it is (in declining order of importance) with respect to the following: fertilization, liming, crop choice, soil compaction, and soil exploitation or soil quality improvement in a general sense. However, for all of these practices we also find opposing statements. Examples that interviewees mention explicitly where they make no difference include: fertilization, liming, crop rotation, soil improvement through cover crops, erosion prevention measures (cover crops, reducing slope length), soil testing, and general soil exploitation or improvement.

When talking about differences in soil conservation practices, interviewees provide three arguments that justify why they do (or would) apply different soil conservation measures. First, the imminent end of rental is a (hypothetical) reason for not implementing measures with a long-term effect, such as specific types of fertilization (phosphorus-potassium (PK) fertilizer, heavy organic fertilizer) or liming: *"There would only be a difference if I knew that the rental contract is ending and … I cannot expect that I may or can continue renting that [plot], in that case I maybe would … cut down on fertilisation, at least with phosphorus and potash … so that I sort of … that I don't increase nutrients, but rather live on the substance that's there."* (P16 052). Crop choice or crop residue removal from a plot may also be adapted in the last year of a contract, to make good use of a plot: *"He lost 20 hectares and then he did everywhere … he had never, I believe, baled the straw, but when he heard this he suddenly baled everything. That he squeezes the last out of it."* (P17 213)

Second, insecure rental is a reason for interviewees not to undertake investments in soil conservation. This is especially important when the costs of investment are high (e.g., soil quality of a rented plot is initially very low): *"What I am not so careful about on the rented plots that's the liming, right. … Because that is simply too much money for me at once that I am investing. And because, well, in my opinion, the landowner should also contribute a little bit."* (P4 110)

Third, the distance between a plot and the farmhouse may determine management decisions, and this distance is itself related to the property status. In particular, two interviewees mention that their rented plots are further away from the farmhouse than their owned plots, and thus the application of manure or crop rotations differ. Transporting manure across large distances is costly and time-consuming, as is travelling to distant plots for any farming operation, such that low-maintenance crops or fallow may be chosen for this land.

The reasons that interviewees provide for *not* having any differences in soil conservation practices can again be grouped into three categories: the social (property) relationship, rental security, and the general attitude of the farmer. In many cases, the relationship between landowner and renter appears to be close and personal (family, neighbours). To some extent, this ensures long-term rental by default (e.g., when a farmer rents land from their spouse) but also leads to a sense of responsibility towards the landowner. On the other hand, a landowner can also exert social control over a renter. Knowing the leaseholder personally and observing their conduct, landowners may impose informal requirements for (continued) rental, such as adhering to crop rotation or avoiding soil compaction: *"Actually, I have one landowner… It was like this: I got this plot three years ago, because he [the landowner] was not satisfied with the* *previous renter anymore, because for 15 years he had grown only corn. And he did tell me that it doesn't work like this. That if I want the plot, I have to work differently."* (P4 60) Ignoring these requirements may lead to the loss of rented plots in the long run, even if such conditions are not formally included in rental contracts (such contractual management requirements have been reported as being very rare). However, personal connections and resulting mutual trust appears to be under threat as landowners cease to live in the countryside and lose their connection to farming. One farmer illustrates this development and its consequences nicely: *"This one plot … that we lost, that was an indirect generational change. The old owner unfortunately died and his nieces inherited it. … And they live in [town near Austria's capital] and God knows where. And they wanted to see money. … When there is a generational change, then the connection to land and property itself isn't there anymore. … Then it all comes down to money. And this will, I believe, increase."* (P19 414-423).

Beyond the individual social ties between landowner and renter, social norms and expectations about what it means to be a good farmer (including conserving soil) by neighbours and villagers also play a role. Farmers expect others to gossip about them if they farm their (rented) soils badly, and talk disparagingly about other farmers who treat rented land inadequately and who thus "*don't think much*" (P15 364).

In addition, many interviewed farmers consider their rental secure, despite holding contracts that are terminable at short notice (6 months/one growing season), and this security induces them to conserve soil for their own future farming. The perceived security of rental may be due to the personal ties just mentioned, but it may also be due to fragmented and interlaced plot structures that make access to individual plots difficult for other farmers, or because it is simply not common to terminate contracts. We find that some interviewees actively try to enhance their rental security by strengthening their relationship with the landowners or by 'signalling' to them that they are taking good care of their plots. For example, one interviewee pays his rent in person and brings Christmas presents to his landowners to "*keep the people with me*" (p17 430). Others make sure that their plots look neat and tidy to signal diligence to landowners.

Lastly, some farmers appear to not differentiate between rented and owned plots in terms of soil conservation as a matter of principle; this is either because of their generally positive attitude towards soil (protection) or their attitude towards property: *Farmer: "I don't have this feeling towards the farm or the plot, when I'm out there, to say 'There, this is mine now'. … I never had that. … I am farming it, and I am looking after it so that it is being preserved. But to say 'Ah, now I am on my field', I don't have that." Son: "Yes, and this is why the difference rented plot – owned plot, this is never there, somehow." (P19 645-650).*

5 Discussion and Conclusion

In this paper, we investigate whether the property status of a piece of land is one of the mechanisms that determine farmers' soil conservation behaviour and under which circumstances this mechanism is in effect. More precisely, we first test the hypothesis that farmers treat rented land differently than owned land by statistically analysing this relationship using crop choice as an indicator. Subsequently we illustrate and broaden the results by means of a qualitative analysis of interviews with farmers.

Our econometric analysis is based on practically all plots of the main crop production areas in Austria. Results show an initial *correlation* between rental and the planting of erosion-prone wide-row crops. However, this relationship virtually disappears once farm heterogeneity is accounted for by introducing farm fixed effects, such that we do not find a sizeable *treatment effect* for rental. This means that there must be some characteristics at the level of the farm (or the region), which correlate with rental and simultaneously with the planting of wide-row crops. However, given the limited information in our data set, we cannot identify these characteristics. Instead, an analysis of different subsamples reveals that for some farm types, a (small) treatment effect of property status for crop choice does exist. This is most notably for livestock farms, which tend to plant more wide-row crops and corn on their rented plots than on their owned plots, contrary to other types of farms. A similar tendency exists for larger farms, and the opposite is true for organic farms. All other types of farms show no significant effect of rental on crop choice. Organic farms operate on a different rental market than conventional farms, due to the required transition period when converting conventional land to organic land. It may thus be that organic farmers are more dependent on particular rented plots and want to increase their rental security by planting less wide-row crops on these plots in particular. On the other hand, hog farmers who operate in a very competitive environment, or large farmers in general may be more economically-minded than others and thus exhibit a ‘rental effect’. Other than that it is unclear why some types of farms or farmers should make a difference in crop choice between rented and owned plots and others do not.

However, the general findings of the quantitative analysis confirm some previous research. While evidence is generally mixed, especially studies that control for household fixed effects have shown to rarely produce significant results for rental in the context of countries of the Global South (Fenske, 2011). It is plausible that we find an even smaller effect in an institutional setting like Austria’s. Nevertheless, even where we do not control for farm heterogeneity, the correlation between rental and crop choice is much smaller than, for example, the correlation found by Sklenicka et al. (2015) in a similar study based on a smaller sample for the neighbouring Czech Republic. While in this particular case historical and institutional differences may be of overriding importance, our qualitative analysis provides rich results that may explain and illustrate this (lack of a) finding.

First, given our quantitative data, we could only investigate farmers’ crop choice. However, the interviews show that differences in soil conservation may, if at all, rather occur in terms of fertilization or liming. Analysing the application of fertilizer or other long-term investments may thus lead to different results (Myyrä et al., 2007, 2005). However, our dataset does not include such information, and large plot-level datasets including these variables are generally difficult to find. Future research, e.g., based on data from the Farm Accountancy Data Network, which provides detailed farm-level (but not plot-level) information, is needed to investigate this question.

Second, most theories of why farmers treat rented land differently than owned land rest on the assumption that rental is less secure than ownership and that limited rental periods shorten a farmer’s planning horizon. Our interviewees, however, are often confident that their rental is secure and they will farm their rented land for a long time in the future, at least as long as they adhere to good agricultural conduct. This may either be because rental contracts are generally (and officially) long-term, or because even though contracts are short-term or terminable at short notice, farmers may perceive their rental to be secure and long-term. This links with what we pointed out in the beginning of this paper, that the nature of property in practice may be different from legal property rights (von Benda-Beckmann et al., 2006), and that there may be a difference between perceived tenure security and legal tenure security (van Gelder, 2010). Both situations will incentivise farmers to treat their rented plots like their own plots. Our findings concerning farmers' behaviour at the end of rental confirm that long-term and secure rental may indeed be an important mechanism mitigating a potential negative effect of rental for soil conservation. If farmers know that they are going to lose a plot in the near future, some farmers will indeed change their soil conservation practices, such as avoiding investments and/or adjusting their crop choice in order to receive an adequate return in the last year of rental. Due to a lack of data on the details of rental contracts we cannot substantiate this relationship in our quantitative analysis, as such contracts are usually not registered with authorities in Austria. Moreover, to our knowledge, there is also no data on the average turnover of rented land in Austria. We can therefore not substantiate the impression that terminating or not renewing a rental contract is rather the exception than the rule, explaining why any possible 'last year' effect of rental does not appear in our quantitative analysis. Thus, investigating the official length of rental contracts may still not lead to satisfactory results, as contracts may be limited on paper, but prolonged on a regular basis in practice.

Third, we find further factors that may counteract a potential negative effect of rental for soil conservation: social ties and farmers' attitudes. Our interviews show that many landowners and renters have close personal contact, with landowners exerting social control. In particular, landowners that have farming knowledge and live in the area observe farming and soil conservation practices of renters. They may either pick their renters carefully, and/or punish misconduct with a termination of rental. Farmers know this and adjust their behaviour accordingly, preventing differences in soil conservation between owned and rented plots. This is in line with findings from Sweden (Grubbström and Eriksson, 2018), where landowners have been found to carefully choose who they sell or rent their land to, placing importance on good farming rather than purely economic considerations. In addition, we find that farmers generally want to live up to the expectations of their social surroundings about what it means to be a 'good' farmer, which includes farming all fields equally well. Again, it would be interesting to substantiate this in a quantitative analysis, but we have no data on contracting parties (e.g., family membership, place of residence) available.

In terms of farmers' attitudes, we find that, for some farmers, treating all their land equally is a matter of principle. Their motivation is either a holistic interest in conserving soil (e.g., for the future of humankind), or a matter of experiencing the same feelings of (non-)ownership towards all plots, independent of property status. This finding may connect with the literature on farming styles (Schmitzberger et al., 2005; van der Ploeg, 1994) – for example, the convictions or self-identity of some types of farmers could make them 'immune' to a potential negative rental effect. It would certainly be interesting to investigate this with respect to established farming styles or farmer identities. However, as our analysis includes only farmers with both rented and owned plots, it is important to note that we might miss out on particular farming styles and conservation practices among, for example, full owners.

Last, we find that the distance between a plot and the farmhouse may influence farmers' soil conservation efforts, confirming previous research (Grammatikopoulou et al., 2013). While not a direct effect of rental, this seems important given that rented plots are on average almost twice as far away as owned plots (see Table 1), and farms are becoming larger. Again, this appears to be most relevant with regard to fertilization, and thus it is not visible in our econometric model. Future research on this aspect should, however, take this finding into account.

Seen from a more general perspective, our findings also show that it is not simply the binary distinction 'rented' and 'owned' that matters, but rather several continuous dimensions such as tenure security, contract length, or strength of social relationship between landowner and renter. This puts into question the crude distinction between rental and ownership made in many studies, including the present one. It may be a convenient approach driven by data availability, but any such approach will limit the insights into causal mechanisms that are to be gained. Our aim here was to contribute to already existing literature on the topic, which often uses the same classification. Our results have both shown the limits of this approach but at the same time have enabled us to name some of the circumstances and thus dimensions of the property relationship that should be considered in the future.

In summary, our results show that formal and informal institutions matter for behaviour (cf. Vatn, 2015), i.e., they are mechanisms that do determine soil conservation, but they may have not only continuous, but also counteracting effects. Regarding formal institutions, it is not only the mere legal property status of a piece of land that is important but also its specificities such as the length and security of rental. We find that insecure rental and the near end of a rental contract may have particularly negative consequences for soil conservation. Informal institutions that appear important include personal relationships and social norms. This resonates with the definition of property given in the introduction to this text. Social relationships are an integral part of property relations. We find that in Austria, the shape of these social relationships supports rental security and soil conservation, and they thus counteract a potentially negative effect of rental. What is important in this context is that farmers and landowners can – and do – also actively influence the social circumstances of rental. For example, we find some 'signalling' behaviour of farmers towards their landowners with the aim of increasing rental security.[7] Others actively nurture their personal relationship with landowners. Conversely, landowners who have an interest in soil conservation use informal requirements to incentivise their renters to comply with their wishes.

We find some indications that problems may arise when the relationship between landowner and renter is less personal. This might become a more pressing issue in the future. The next generation of landowners may have less connection to the land they inherited and less farming knowledge than their parents (cf. our interviews). Informal requirements by landowners towards farmers will then decrease, and farmers will have fewer opportunities to prove that they 'deserve' a long-term rental due to their soil conservation behaviour. Social norms may still incentivise farmers to adhere to what is seen as good farming practices, but this may be

[7] This resonates with studies that show that tenure security is also a function of investments, not only the other way around. Farmers have been found to increase their tenure security by investing in the land (Brasselle et al., 2002; Moreda, 2018).

not enough to outweigh the loss in direct contact with landowners. Formal provisions in rental contracts concerning soil quality could be an option that appears to be already in use in rare cases. Legal regulations (such as minimum rental periods) or specifically-designed AES may be another option to avoid potential negative effects of increasing rental shares. However, further research on the developments of landowner-renter relationships is required to substantiate this impression and help design adequate incentive schemes.

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Appendix

Table A: Interviewee details

No.	Prod. area	Interviewee(s)	part-time (self-stated)	Livestock, other	organic	Cropland (ha)	% rented (approx.)	usual rental contract length	farm manager since
P01	Alpenvorland	farmer couple		Hogs, bulls		21	38%	permanent, 6 months notice	2002
P02	Nordöstl. Flach- und Hügelland	male farmer (sen.)		Hogs, horses	x	75	47%	permanent, 12 months notice	2002
P03	Nordöstl. Flach- und Hügelland	farmer couple	x	-		19	18%	permanent, 12 months notice	1990
P04	Alpenvorland	male farmer (jun.)	x	Vegetables		11	87%	permanent, 6 months notice	2018
P05	Südöstl. Flach- und Hügelland	male farmer		-		320	63%	10 years, 12 months notice (if sold)	1975
P06	Südöstl. Flach- und Hügelland	male farmer		Hogs		34	59%	5 years and permanent	1999
P07	Nordöstl. Flach- und Hügelland	male farmer		-	x	190	63%	5 years	2013
P08	Südöstl. Flach- und Hügelland	male farmer (sen.)		Hogs		25	48%	5 years and permanent	1997
P09	Südöstl. Flach- und Hügelland	male farmer	Until recently	-	x	18	0% (28%)[8]	permanent	1995
P10	Südöstl. Flach- und Hügelland	male farmer (jun.)	x	-	x	56	46%	5 years	2018
P11	Nordöstl. Flach- und Hügelland	male farmer		-		270 (more abroad)	80%	permanent	1987
P12	Nordöstl. Flach- und Hügelland	male farmer		-	x	60	50%	permanent, 12 months notice	1985

[8] Farmer had very recently lost his rented plots (7 ha).

No.	Prod. area	Interviewee(s)	part-time (self-stated)	Livestock, other	organic	Cropland (ha)	% rented (approx.)	usual rental contract length	farm manager since
P13	Südöstl. Flach- und Hügelland	male farmer		Dairy cows		39	46%	5 years	2014
P14	Südöstl. Flach- und Hügelland	male farmer		Hogs		80	50%	permanent	2006
P15	Nordöstl. Flach- und Hügelland	male farmer		-		800 (partly abroad)	50%	5 years and permanent, 6 months notice	2006
P16	Nordöstl. Flach- und Hügelland	male farmer		-		110	77%	permanent	2015
P17	Südöstl. Flach- und Hügelland	male farmer		-		190	92%	Permanent and some limited, 6 months notice	1995
P18	Nordöstl. Flach- und Hügelland	female farmer	x	-		40	63%		2014
P19	Alpenvorland	male farmer (sen. + jun.), partly wife		-		175	66%	permanent, 12 months notice	1993
P20	Alpenvorland	male farmer		Hogs		55	31%	3 years	2016
P21	Nordöstl. Flach- und Hügelland	male farmer		Hogs		95	63%	permanent, 12 months notice	1991
P22	Nordöstl. Flach- und Hügelland	male farmer (sen.)	x	-	x	38	32%	5 years	2010
P23	Südöstl. Flach- und Hügelland	male farmer	x	-		20	50%	5 years (AES period)	2015
P24	Südöstl. Flach- und Hügelland	male farmer		Hogs, Vegetables		77	10%	permanent	2014
P25	Alpenvorland	male farmer, partly wife		Dairy cows		31	81%	permanent, 6 months notice	1999
P26	Südöstl. Flach- und Hügelland	male farmer, partly wife		Hogs		43	77%	permanent, 6 months notice	1998