Vienna 2019 Abstract Submission

Title
Wine, soil and subsidies: what determines wine farmers' participation in soil erosion prevention measures?

I want to submit an abstract for:
Conference Presentation

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Keywords
wine, soil erosion, adoption of conservation measures, agricultural policy, Austria

Research Question
What are the determinantes in wine grap growers in the 'erosion protection for vineyards' scheme. We identify determinantes at the plot level and at the farm level.

Methods
econometrics: cluster-specific fixed effects regression, binary random effects models with a Mundlak device, large data set: 9,036 farms with on average 12.4 plots

Results
biophysical plot characteristics as well as farm and farmer characteristics have a significant influence on participation in the erosion protection scheme; larger and more specialized farms care more about soil.

Abstract
Wine, soil and subsidies: what determines wine farmers' participation in soil erosion prevention measures?
Keywords: wine, soil erosion, adoption of conservation measures, agricultural policy, Austria
JEL: C24, Q15, Q18, Q24

Introduction
Soil degradation and erosion are problems of global scale that in recent years 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). Vineyards are especially prone to soil erosion. For example, based on an extensive dataset for 19 European countries, Cerdan et al. (2010) derive that the average erosion rates of vineyards are almost five times the erosion rates of arable land. Soil erosion causes reduced productivity and increased production costs for wine farmers in the medium and long term. For example, for the wine region Penedés–Anoia in Northern Spain, Martinez-Casasnovas and Ramos (2006) estimate that the costs of

soil erosion including replacement costs of N and P and costs of infrastructures damaged sum up to € 220 to € 280 per ha and year. Beside these on-site costs, soil erosion also has off-site costs incurred by agents other than the farmer, including damage to roadways and sewers, basement siltation or drainage disruption (Galati et al. 2015).
In many countries, policymakers have responded to the threat of soil degradation and erosion through farming and have made attempts to foster soil conservation. A widespread option to incentivise farmers to conserve their soils are agri-environmental schemes (AES), where farmers receive a compensation for adhering to soil protection measures such as cover crops. One such scheme for winemakers has been introduced in Austria under the second pillar of the EU's Common Agricultural Policy (CAP). Wine farmers under this 'erosion protection for vineyards' (EPV) scheme receive per-hectare subsidies for keeping the soil in their vineyards covered year-round or at least in winter (depending on the slope of the plot). Cover crops decrease the rate of soil loss and increase nutrient retention (P, K, N) and organic matter levels (Galati et al. 2015). Moreover, cover crops also increase the soil organic carbon sequestration rate (Novara et al. 2019).
According to Anderson and Jensen (2016) Austria is the country with the highest per hectare and per kiloliter support for wine farmers within the EU. A considerable share of this support comes from AES. For example, more than 62% of the 11 million euros of the EU's expenditures for integrated production of wine go to Austria (Anderson and Jensen 2016). To target such schemes properly, it is vital for policymakers to know who is likely to participate in AES, and why. A vast literature has developed around this question, but little consensus has yet emerged (Lastra-Bravo et al. 2015). Several driving factors have been identified including farmers' attitudes towards the environment, (Wynn et al. 2001, Sattler and Nagel 2010), financial incentives (Wilson and Hart 2000, Ruto and Garrod 2009), farm characteristics (Wilson and Hart, 2000; Wynn et al., 2001) and the 'goodness-of-fit' of a measure with respect to the farming operation (Wynn et al., 2001; Sattler and Nagel, 2010; Wilson and Hart, 2000).
We want to contribute to the understanding especially of the last two determinants by making use of a large and detailed cross-sectional dataset that contains not only economic characteristics of wine farms, but also biophysical parameters of individual plots. More precisely, we use a plot-level dataset from the Integrated Accounting and Control System (IACS), containing information on biophysical characteristics of vineyards (slope, plot size, distance to farm house, ...) as well as whether the plot is under the EPV scheme or not (until 2015, farmers were not required to sign up all their plots for the scheme, but could choose to select only some). All plots are linked to the farm farming them, where some farm-level information such as farm size, farm type, and income from other AES are available. This dataset covers all plots of virtually all Austrian farms. In total, 9334 farms farm at least one plot with grapevines. We use data from the year 2012, as this is the last year where all information is available in sufficient detail.
We address the following questions: 1) What characterises participants and non-participants in the EPV scheme at the farm level? 2) How do plots under the scheme differ from plots not under the scheme (especially plots by the same wine farmer)? 3) How much do plot-level and farm-level characteristics contribute to explaining participation?

Method
We use several approaches to investigate these questions. After comparing summary statistics for participants and non-participants at the farm level, we use binomial regression analysis to get a more detailed insight into determinants of farm-level participation in EPV. Though our data includes only one year of observation, it has a structure similar to panel-data with cross-sections being 9,036 farms with on average 12.4 observations (plots). In a first step we use only information on the farm level in a simple binominal regression to investigate the effects of a vector of different farm characteristics (x_i) on farms probability to participate in the EPV ($P(y_i=1)$):
$P(y_i=1)=\Phi(x_i \beta)$
where β is a vector of coefficients to be estimated.
In a second step we utilize plot level biophysical characteristics of vineyards (z_{it}), e.g. slope and plot size, to apply a cluster-specific fixed effects regression, where the clusters are farms (Cameron and Trivedi, 2005):
$P(y_{it}=1)=\Phi(z_{it} \gamma+c_i)$
with γ being a vector of coefficients to be estimated, t being the number of plots and c_i is the unobserved cluster effect. This allows us to compare plots of individual farms, and how their characteristics are related to the probability of a plot being signed up for the scheme or not. In addition, we plan to apply a binary random effects models with a Mundlak device (Wooldridge, 2010). In particular we model the cluster specific fixed effects through observed farm characteristics and means over plots $c_i=x_i \beta+\bar{z}_{it}\delta$.The coefficients of this fixed effects will give some indication which farm characteristics increase the probability of participation.
Descriptive results of the farm-level data in Table 1 show that the EPV scheme is very popular amongst Austrian wine farmers: more than 75% of farmers who farm at least one vineyard participate in the scheme. Of all

participants, almost 90% have all their plots covered by the EPV scheme. When comparing participants with non-participants, we find that participants farm considerably more hectares of vineyards but own a smaller share, have a larger standard output (measuring farm size in economic terms), and are more likely to be classified as 'permanent crop' farms than non-participants. Average plot size, age and gender do not appear to be related to participation. Interestingly, EPV non-participants farm steeper slopes than participants and there are substantial regional differences in participation rates. EPV participants on average participate in more other AES, but are less likely to be organic farmers than non-participants. A particularly large difference exists with respect to participation in the AES 'pesticide renouncement in vineyards' (integrated wine production): over 76% of EPV participants also participate in this measure, while only 7.6% of non-participants do so.

Results
First regression results of a binomial (logistic) regression in Table 2 confirm the impression that more specialised wine farmers are more likely to participate in the EPV scheme: A larger share of wine (of total utilized agricultural area) is associated with a greater likelihood of participation, as is being classified as a permanent crop farm. Larger farms (both in terms of area as well as in terms of standard output) are also more likely to participate. Variables that can be interpreted as reflecting a pro environmental attitude show conflicting results: while organic farmers are less likely to participate in the EPV scheme, those farmers that receive more subsidies from other AES and that participate in more other schemes are more likely to also participate in EPV. Moreover, we find in the regression analysis that – other things equal – farms with steeper vineyards are more likely to participate, contrary to what the descriptive results have shown. Finally, the share of rented land does not seem to be related to AES-participation.
Results of the cluster-specific fixed effects regression in Table 3 show that for the individual wine farmer, participation of a single plot is more likely for larger plots, less likely for steeper plots, more likely for rented than for owned plots, and more likely for plots at higher altitude. On the contrary, the distance of the plot to the farm house has no significant effect. In a last step we will combine plot-level information with farm-level information in a random effects probit model with a Mundlak device.

Conclusions
Based on our preliminary results we conclude that biophysical plot characteristics as well as farm and farmer characteristics do have a significant influence on participation in the agri-environmental program 'erosion protection for vineyards' (EPV). Overall it seems that larger and more specialized farmers do care more about the soil in the vineyards. This is to some extent contrary to a very common narrative about Austrian agriculture of 'small farms being better for the environment'. Yet one has to keep in mind that even large wine farms in Austria are relatively small on an international scale.

Table 1: Descriptive statistics of EPV participants and non-paricipants
Variables Participants Non-participants
No. of farms 7144 2190
No. of farms participating with part of plots 787
Farm and Farmer characteristics
Total utilized agricultural area (mean) 24.32 ha 20.98 ha
Total utilized wine area (mean) 5.16 ha 1.84 ha
Average plot size of vineyards (mean) 0.4 ha 0.3 ha
Share rented land (of UAA, mean) 19.05% 12.51%
Share owned land (of UAA, mean) 1.) 34.63% 34.59%
Share rented vineyards (mean) 17.41% 15.24%
Share of owned vineyards (mean) 1.) 38.52% 51.71%
Standard output (mean) 104 420 € 68 284 €
Farm type:
Permanent crops 75.8% 44%
Mixed farm 16.3% 26.5%
. . .
Firm type: natural person or jointly with spouse 94.1% 91.5%
If so: Farmer age (mean) 47.2 47.9
If so: Women as farm manager 44.6% 45.9%
Environmental characteristics

Average slope of vineyards (mean) 12.2% 15.4%
Production area
South-eastern lowland and hills 15.4% 42%
North-eastern lowland and hills 82.2% 51.8%
. . .
AES Participation
No. of other AES participation (mean) 2.97 1.88
Integrated wine production 76.2% 7.6%
Organic farms 5.2% 6.5%
Total subsidies per ha (mean) 368€ 137€
Subsidies from non-EPV AES per ha (mean) 287€ 137€
1.) Since we do not know the property status of all plots, the percentage of rented and owned plots does not sum to 100%

Table 2: Logit model explaining EPV participation (Farm level data):
Dependent variable:
EPV Participation
Total UAA 0.007*** (0.002)
Standard Output 0.00000*** (0.00000)
Share Wine of UAA 2.463*** (0.145)
Farm type
Forestry -1.989*** (0.490)
Cash crops -2.240*** (0.136)
Horticulture -0.718 (0.816)
Fodder crops -3.075*** (0.321)
Animal husbandry -1.685*** (0.238)
Mixed -0.824*** (0.103)
Production area
Alpen -3.084*** (1.180)
Voralpenland -1.895*** (0.623)
Alpenostrand -0.325 (0.276)
Wald- und Mühlviertel -0.307 (0.394)
Kärntner Becken -1.038* (0.567)
Alpenvorland -1.344*** (0.273)
Südöstl. Flach- und Hügelland -0.421*** (0.106)
Organic farm -1.024*** (0.154)
No. of other AES 0.568*** (0.028)
Non-EPV subsidies per ha 0.003*** (0.0003)
Age -0.009*** (0.003)
Gender 0.027 (0.065)
Average plot size -0.273*** (0.102)
Average slope 0.034*** (0.004)
Share of rented vineyards -0.059 (0.111)
Constant -1.281*** (0.209)
Observations 9,036
Log Likelihood -3,249.904
Akaike Inf. Crit. 6,549.807
Note: *p<0.1; **p<0.05; ***p<0.01
Base effect farm type: permanent crops farms. Base effect area: North-eastern lowlands and hills

Table 3: Linear probability model with farm fixed effects (robust standard errors)
Dependent variable:
EPV participation (plot level)
Unknown ownership -0.001 (0.002)

Rented 0.006*** (0.002)
Log(plot size) 0.017*** (0.001)
Slope gradient (%) -0.002*** (0.0003)
Altitude (m) 0.0001** (0.00003)
Log(distance to farm house) -0.001 (0.001)
Observations 112,161
R2 0.803
Adjusted R2 0.785
Residual Std. Error 0.147 (df = 102899)
Note: *p<0.1; **p<0.05; ***p<0.01

References
(see PDF)

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Introduction

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We want to contribute to the understanding especially of the last two determinants by making use of a large and detailed cross-sectional dataset that contains not only economic characteristics of wine farms, but also biophysical parameters of individual plots. More precisely, we use a plot-level dataset from the Integrated Accounting and Control System (IACS), containing information on biophysical characteristics of vineyards (slope, plot size, distance to farm house, …) as well as whether the plot is under the EPV scheme or not (until 2015, farmers were not required to sign up all their plots for the scheme, but could choose to select only some). All plots are linked to the farm farming them, where some farm-level information such as farm size, farm type, and income from other AES are available. This dataset covers all plots of virtually all Austrian farms. In total, 9334 farms farm at least one plot with grapevines. We use data from the year 2012, as this is the last year where all information is available in sufficient detail.

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(1) $$P(y_i = 1) = \Phi(\boldsymbol{x}_i\boldsymbol{\beta})$$

where $\boldsymbol{\beta}$ is a vector of coefficients to be estimated.

In a second step we utilize plot level biophysical characteristics of vineyards ($\boldsymbol{z}_{it}$), e.g. slope and plot size, to apply a cluster-specific fixed effects regression, where the clusters are farms (Cameron and Trivedi, 2005):

(2) $$P(y_{it} = 1) = \Phi(\boldsymbol{z}_{it}\boldsymbol{\gamma} + c_i)$$

with $\boldsymbol{\gamma}$ being a vector of coefficients to be estimated, *t* being the number of plots and c_i is the unobserved cluster effect. This allows us to compare plots of individual farms, and how their characteristics are related to the probability of a plot being signed up for the scheme or not. In addition, we plan to apply a binary random effects models with a Mundlak device (Wooldridge, 2010). In particular we model the cluster specific fixed effects through observed farm characteristics and means over plots $c_i = \boldsymbol{x}_i\boldsymbol{\beta} + \overline{\boldsymbol{z}_{it}}\boldsymbol{\delta}$.The coefficients of this fixed effects will give some indication which farm characteristics increase the probability of participation.

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Results of the cluster-specific fixed effects regression in Table 3 show that for the individual wine farmer, participation of a single plot is more likely for larger plots, less likely for steeper plots, more likely for rented than for owned plots, and more likely for plots at higher altitude. On the contrary, the distance of the plot to the farm house has no significant effect. In a last step we will combine plot-level information with farm-level information in a random effects probit model with a Mundlak device.

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Based on our preliminary results we conclude that biophysical plot characteristics as well as farm and farmer characteristics do have a significant influence on participation in the agri-environmental program 'erosion protection for vineyards' (EPV). Overall it seems that larger and more specialized farmers do care more about the soil in the vineyards. This is to some extent contrary to a very common narrative about Austrian agriculture of 'small farms being better for the environment'. Yet one has to keep in mind that even large wine farms in Austria are relatively small on an international scale.

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Table 1: Descriptive statistics of EPV participants and non-paricipants

Variables	Participants	Non-participants
No. of farms	7144	2190
No. of farms participating with part of plots	787	
Farm and Farmer characteristics		
Total utilized agricultural area (mean)	24.32 ha	20.98 ha
Total utilized wine area (mean)	5.16 ha	1.84 ha
Average plot size of vineyards (mean)	0.4 ha	0.3 ha
Share rented land (of UAA, mean)	19.05%	12.51%
Share owned land (of UAA, mean) [1.)]	34.63%	34.59%
Share rented vineyards (mean)	17.41%	15.24%
Share of owned vineyards (mean) [1.)]	38.52%	51.71%
Standard output (mean)	104 420 €	68 284 €
Farm type:		
Permanent crops	75.8%	44%
Mixed farm	16.3%	26.5%
. . .		
Firm type: natural person or jointly with spouse	94.1%	91.5%
If so: Farmer age (mean)	47.2	47.9
If so: Women as farm manager	44.6%	45.9%
Environmental characteristics		
Average slope of vineyards (mean)	12.2%	15.4%
Production area		
South-eastern lowland and hills	15.4%	42%
North-eastern lowland and hills	82.2%	51.8%
. . .		
AES Participation		
No. of other AES participation (mean)	2.97	1.88
Integrated wine production	76.2%	7.6%
Organic farms	5.2%	6.5%
Total subsidies per ha (mean)	368€	137€
Subsidies from non-EPV AES per ha (mean)	287€	137€

[1.)] Since we do not know the property status of all plots, the percentage of rented and owned plots does not sum to 100%

Table 2: Logit model explaining EPV participation (Farm level data):

	Dependent variable:
	EPV Participation
Total UAA	0.007^{***} (0.002)
Standard Output	0.00000^{***} (0.00000)
Share Wine of UAA	2.463^{***} (0.145)
Farm type	
Forestry	-1.989^{***} (0.490)
Cash crops	-2.240^{***} (0.136)
Horticulture	-0.718 (0.816)
Fodder crops	-3.075^{***} (0.321)
Animal husbandry	-1.685^{***} (0.238)
Mixed	-0.824^{***} (0.103)
Production area	
Alpen	-3.084^{***} (1.180)
Voralpenland	-1.895^{***} (0.623)
Alpenostrand	-0.325 (0.276)
Wald- und Mühlviertel	-0.307 (0.394)
Kärntner Becken	-1.038^{*} (0.567)
Alpenvorland	-1.344^{***} (0.273)
Südöstl. Flach- und Hügelland	-0.421^{***} (0.106)
Organic farm	-1.024^{***} (0.154)
No. of other AES	0.568^{***} (0.028)
Non-EPV subsidies per ha	0.003^{***} (0.0003)
Age	-0.009^{***} (0.003)
Gender	0.027 (0.065)
Average plot size	-0.273^{***} (0.102)
Average slope	0.034^{***} (0.004)
Share of rented vineyards	-0.059 (0.111)
Constant	-1.281^{***} (0.209)
Observations	9,036
Log Likelihood	-3,249.904
Akaike Inf. Crit.	6,549.807
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Base effect farm type: permanent crops farms. Base effect area: North-eastern lowlands and hills

Table 3: Linear probability model with farm fixed effects (robust standard errors)

	Dependent variable: EPV participation (plot level)
Unknown ownership	-0.001 (0.002)
Rented	0.006*** (0.002)
Log(plot size)	0.017*** (0.001)
Slope gradient (%)	-0.002*** (0.0003)
Altitude (m)	0.0001** (0.00003)
Log(distance to farm house)	-0.001 (0.001)
Observations	112,161
R^2	0.803
Adjusted R^2	0.785
Residual Std. Error	0.147 (df = 102899)
Note:	*p<0.1; **p<0.05; ***p<0.01