Planting Rights Liberalization in the European Union: An Analysis of the Possible Effects on the Wine Sector in Rheinland-Pfalz, Germany

Die Liberalisierung der Pflanzrechte in der Europäischen Union: Analyse der möglichen Konsequenzen für den Weinsektor in Rheinland-Pfalz, Deutschland

Mariia Bogonos and Barbara Engler
Universität Hohenheim, Stuttgart, Germany

Jürgen Oberhofer and Marc Dreßler
Dienstleistungszentrum Ländlicher Raum Rheinpfalz, Neustadt/Weinstraße, Germany

Stephan Dabbert
Universität Hohenheim, Stuttgart, Germany

Abstract

This study investigates the effects of planting rights liberalization on the largest wine-producing region in Germany, Rheinland-Pfalz. Introduced by the reform of the Common Agricultural Policy (CAP) of the European Union (EU) in 2008, the abolishment of restrictions on the planting of new vineyards is still a subject of controversial discussions regarding possible effects on the sector's structure and the quantity of wine production. For a simulation of these effects, this study uses partial equilibrium modeling and Markov chain projection. The results reveal that the effects of abolishment of planting rights depend on the assumed wine must prices. Relatively high market prices for wine must would lead to increases in the production of both standard and basic quality wine must and in the number of more cost-effective wine farms in the region. If low prices for wine must are assumed, the reform might result only in minor impacts.

Key Words

planting rights; wine must; farm distribution; partial equilibrium model; Markov chain

Zusammenfassung

Dieser Artikel beschäftigt sich mit möglichen Auswirkungen einer Liberalisierung der Pflanzrechte im Weinbausektor für die Anbaugebiete in Rheinland-Pfalz. Die Folgen einer Abschaffung der seit 2008 durch die Gemeinsame Agrarpolitik (GAP) der Europäischen Union vorgeschriebenen Beschränkungen für die Anlage neuer Rebflächen auf die Struktur des Weinsektors und die produzierte Menge an Weinmost wird kontrovers diskutiert. Zur Simulation der möglichen Auswirkungen wurde ein partielles Gleichgewichtsmodell verwendet sowie Projektionen mit Markovkette durchgeführt. Die Ergebnisse zeigen, dass die Auswirkungen einer Liberalisierung der Pflanzrechte in Rheinland-Pfalz wesentlich von den Preisannahmen für den Weinmost abhängen. Relativ hohe Marktpreise für Weinmost führen zu einer Zunahme der produzierten Menge sowohl an Weinmost zur Erzeugung von Qualitätswein als auch von Schaumwein und der Anzahl an kosteneffizienter wirtschaftenden Weinbaubetrieben in der Region. Unter der Annahme niedriger Preise ergeben sich nur sehr geringfügige Änderungen.

Schlüsselwörter

Pflanzrechte; Weinmost; Verteilung der Weinbaubetriebe; partielles Gleichgewichtsmodell; Markovkette

1 Introduction

The production and marketing of wine in the European Union (EU) are governed by the Common Market Organization (CMO) of the EU Common Agricultural Policy (CAP). Since 1976, a crucial point of the CMO with respect to wine has been the prohibition on planting new vineyards. Consistent with the goal of increasing competitiveness of the EU wine producers on

the world market, the 2008 CAP reform included abolishment of the planting rights regime by 2016 (EUROPEAN COMMUNITY, 2008: 6-7, 32). Many wine producers, experts, policy makers and other interested parties expressed doubts regarding the efficiency of such a change (HLG, 2013). Although the planting rights system has recently been converted into the scheme of authorizations for vine plantings, which enters into force in 2016 and is valid until 2030 (EUROPEAN UNION, 2013: 676), discussions continue about how the abolishment of restrictions on planting new vineyards will affect the EU wine sector.

Public attention regarding the issue motivated a few studies regarding the effects of planting rights liberalization on the EU wine sector including DECONINCK and SWINNEN (2013), MONTAIGNE et al. (2012), SARDONE et al. (2012), MONTAIGNE and COELHO (2006) and FURLANI et al. (2004). Most agree that the reform might result in increased wine production and an emphasis on more cost-effective forms of production. To our knowledge, no attempts have been made to quantitatively estimate the effects of planting rights liberalization on the production of standard and basic quality wine must and the distribution of wine farms according to their size classes and area type. This study aims to fill this gap using a southwestern region of Germany, Rheinland-Pfalz, as a case study.

The remainder of the study is organized as follows. The next section describes the wine sector in Rheinland-Pfalz. Sections 3 and 4 present the database, model and simulation scenarios. The results of the modeling are presented in Section 5, and the final section concludes the analysis.

2 The Rheinland-Pfalz Wine Sector

The planting rights regime in Rheinland-Pfalz implies two types of permission granted to cultivate a vineyard: a new planting right and a replanting right. New planting rights can be granted for the production of protected designation of origin (PDO) or protected geographical indication (PGI) wines within the limits of specified production regions. Replanting rights refers to a possible transfer of planting rights. Rights cannot be transferred from farms in areas of more than 30% slope to farms in areas of less than 30% slope and vice versa or from one wine production region to another (BMJ, 2011: 8).

Whereas the system of planting rights limits total acreage of vineyards, the scheme of authorizations for vine plantings regulates their annual increase. Beginning in 2016, permissions to cultivate vineyards for production of PDO and PGI wines will be granted to vine growers in such a quantity that the total area actually planted with vines increases by maximum 1% annually (EUROPEAN UNION, 2013: 676).

Almost two-thirds of the total wine production potential of Germany is realized in Rheinland-Pfalz (EUROPEAN COMMISSION, 2012: 32; SB, 2011). The size of the vineyards in this region ranges from less than 1 to more than 50 ha. The smaller the acreage of the vineyard and the steeper its slope, the higher the per-unit cost of wine production. This explanation could be one of the reasons behind the trend toward average farm size growth that has been observed throughout the last decade.

Four main quality categories of wine are currently defined in Germany: Grundwein; Deutscher Wein; Landwein, labeled with PGI and Qualitätswein bestimmter Anbaugebiete (QbA), labeled with PDO (BMJ, 2011: 5). More than 90% of the total amount of wine produced in Rheinland-Pfalz is QbA (SB, 2011). Wine must production in Rheinland-Pfalz is restricted by per ha production quotas (DABBERT and OBERHOFER, 1990) as well. The quotas vary between production regions of Rheinland-Pfalz and by the quality category of wine.

3 Materials and Methods

A comparative static regional partial net-trade equilibrium model is used to investigate the effects of planting rights abolishment on the wine sector of Rheinland-Pfalz. The reform is assumed to enter into force in 2016, and the markets are expected to clear by 2021. The model simulates the distribution of wine farms in Rheinland-Pfalz according to their size classes and area type, the demand for standard and basic quality wine must in Germany and production quantities of standard and basic quality wine must in Rheinland-Pfalz. The model is run for the scenarios of different levels of market prices for wine must and land rental prices, restricted and liberalized planting rights and the scheme of authorizations for vine plantings.

3.1 Data

The current study utilizes data from publicly available statistical sources, provided by the National Bureau of Statistics of Rheinland-Pfalz and Verband Deutscher Weinexporteure e.V. via personal communication. The records include values related to wine production, consumption, trade, stocks, prices, wine must produc-

tion costs, and distribution of vineyards among wine farm groups in Rheinland-Pfalz. The data on vineyard distribution are from 1999 and 2010, and the data on production costs are from 2009.

In this study, standard and basic quality wine must are differentiated. Wine must of standard quality is used for further processing into QbA, and wine must of basic quality is Grundwein. The important advantages of this disaggregation include relative homogeneity of prices and production costs as well as availability of some of the modeling parameters, such as elasticities of demand. Production of the top-premium wine must is not considered.

Volumes of wine must production, consumption and trade are represented by the respective volumes of wine. Wine is translated into wine must with a processing ratio of 1:1. Trade of standard quality wine must corresponds to QbA, and trade of basic quality wine must corresponds to the sum of barrel and bottled table wine, liquors, sparkling and aromatized wines (excluding Champagne). Because records on wine consumption in Germany are limited to the aggregated and per capita values, quantities of basic and standard quality wine consumed are estimated as the difference between the respective volumes of production, net-trade, distillation (only for basic quality wine must) and change in stocks of wine.

Prices for standard and basic quality wine must in Germany are represented by the wholesale market prices for QbA and Grundwein wines in Rheinland-Pfalz from September to November and include 10.7% of the VAT. The wholesale prices for wine from September to November represent the prices for wine must because in Rheinland-Pfalz the wine grapes are harvested in autumn. The original records of prices are disaggregated according to wine grape varieties and wine production regions. Thus, prices employed in the analysis correspond to the weighted average values, and the weights are the quantities of the wine varieties produced in the production regions of Rheinland-Pfalz.

Wine must production costs include expenditures for labor, machinery, plant protection and fertilization measures, buildings, vineyard development, bookkeeping, costs to process grapes into wine must and rental prices for land. Direct payments within the "Umweltschonende Steil- und Steilstlagenförderung" category of the PAULa Programme are also considered.

Standard and basic quality wine must production costs correspond to the costs of ten groups of wine farms. These groups are mutually exclusive and comprise two types of area, i.e., vineyards situated in areas of more than 30% slope and those in areas of less than 30% slope, and five size classes. The size classes represent farms with <5, 5-10, 10-20, 20-50 and >50 ha of cultivation area. A >50 ha farm in a region of less than 30% slope produces wine must at the lowest costs, whereas a <5 ha farm in an area of more than 30% slope produces wine must at the highest costs.

Parameters included in the model are elasticities of demand, income and population growth rates. Income and population growth rates are projected for 2021 by the USDA (2014a, b).

3.2 The Model

The model consists of four main simulation blocks: demand, supply, sector restructuring, and closure. The General Algebraic Modeling System (GAMS) 23.7 (GAMS Development Corporation, Washington, DC 20007, USA) software package is used to estimate the model.

Standard and basic quality wine must are modeled as normal goods (LABYS, 1976). This study assumes that over a long period of time, retail demand is the determining factor, whereas processing demand is derived demand. The functions of demands for wine must are presented in Eqs. (1)-(2).

$$(1) \quad D_q = aP_q^{eo\_q}P_v^{ec\_qv}I_{GDP}^{ei}Pop,$$

$$(2) \quad D_v = bP_v^{eo\_v}P_q^{ec\_qv}I_{GDP}^{ei}Pop,$$

where D_q (D_v) denotes demand for standard (basic) quality wine must in Germany, a and b are constant terms, P_q (P_v) is the price of standard (basic) quality wine must, I_{GDP} is growth rate of the per capita real gross domestic product (GDP), Pop is population growth rate, and eo, ec and ei are, respectively, own-price, cross-price and income elasticities of demand for standard and basic quality wine must.

Whereas the demand side of the model considers the entire country, changes in wine must supply are simulated only for Rheinland-Pfalz. The functions of wine must supply by the producers in Rheinland-Pfalz are presented in Eqs. (3)-(4).

$$(3) \quad S = \sum_{n=1}^{10} M_n A_n, \text{ if } (P \geq AVC_n),$$

$$(4) \quad S = 0, \text{if } (P < AVC_n),$$

where index n denotes ten groups of wine farms, S is the quantity of standard (basic) quality wine must supplied in Rheinland-Pfalz, M is the per ha quantity of standard (basic) quality wine must supplied by the n^{th} farm group, A is the area of vineyards distributed

to the n^{th} farm group, P is the price of standard (basic) quality wine must and AVC is the average variable costs of standard (basic) quality wine must production.

Each stage of the supply functions represents production volumes of standard and basic quality wine must as functions of optimal per ha production quantities, total acreage of vineyards distributed to the farm groups, prices for wine must, and variable production costs of wine must.

Optimal per ha quantities of standard and basic quality wine must production by each of the farm groups are estimated using the optimization models presented in Eqs. (5)-(7).

$$(5)\qquad \max \mathrm{NB_n} = \left(\left(\mathrm{P^q} - \frac{\mathrm{ATC_n^q}}{\mathrm{H^q}}\right)\mathrm{M_n^q} + \left(\mathrm{P^v} - \frac{\mathrm{ATC_n^v}}{\mathrm{H^v}}\right)\mathrm{M_n^v} + \left(\mathrm{P^v} - \frac{\mathrm{ATC_n^q}}{\mathrm{H^{qv}}}\right)\mathrm{M_n^{qv}}\right),$$

subject to

$$\frac{\mathrm{M_n^q}}{\mathrm{H^q}} + \frac{\mathrm{M_n^v}}{\mathrm{H^v}} + \frac{\mathrm{M_n^{qv}}}{\mathrm{H^{qv}}} \leq 1,$$

$$\mathrm{M_n^q},\ \mathrm{M_n^v},\ \mathrm{M_n^{qv}} \geq 0,$$

$$(6)\qquad \max \mathrm{NB_n} = \left(\left(\mathrm{P^q} - \frac{\mathrm{ATC_n^q}}{\mathrm{H^q}}\right)\mathrm{M_n^q} + \left(\mathrm{P^v} - \frac{\mathrm{ATC_n^q}}{\mathrm{H^{qv}}}\right)\mathrm{M_n^{qv}}\right),$$

subject to

$$\frac{\mathrm{M_n^q}}{\mathrm{H^q}} + \frac{\mathrm{M_n^{qv}}}{\mathrm{H^{qv}}} \leq 1,$$

$$\mathrm{M_n^q},\ \mathrm{M_n^{qv}} \geq 0,$$

$$(7)\qquad \max \mathrm{NB_n} = \left(\left(\mathrm{P^q} - \frac{\mathrm{AVC_n^q}}{\mathrm{H^q}}\right)\mathrm{M_n^q} + \left(\mathrm{P^v} - \frac{\mathrm{AVC_n^q}}{\mathrm{H^{qv}}}\right)\mathrm{M_n^{qv}}\right),$$

subject to

$$\frac{\mathrm{M_n^q}}{\mathrm{H^q}} + \frac{\mathrm{M_n^{qv}}}{\mathrm{H^{qv}}} \leq 1,$$

$$\mathrm{M_n^q},\ \mathrm{M_n^{qv}} \geq 0,$$

where index n denotes ten groups of wine farms, NB is total net benefit, P^q (P^v) is the price of standard (basic) quality wine must, ATC^q (ATC^v) is the average per ha total costs of standard (basic) quality wine must production by the n^{th} farm group, AVC^q (AVC^v) is the average per ha variable costs of standard (basic) quality wine must production by the n^{th} farm group, H^q (H^v, H^{qv}) is the maximum per ha production quantity of standard quality wine must (basic quality wine must, standard quality wine must and its sale as wine must of basic quality), and M^q (M^v, M^{qv}) is the optimal per ha quantity of production of standard quality wine must (basic quality wine must, standard quality wine must and its sale as wine must of basic quality) by the n^{th} farm group.

The maximization models in Eqs. (5)-(7) are based on two assumptions: 1) the quantity produced equals the quantity sold and 2) given a fixed quantity of land, an increase in the yield of wine must results from a proportional increase in production inputs. The model is solved separately for each of the farm groups. The values to be maximized are net benefits, which are defined as the difference between the total revenue from selling wine must and the production costs. The models are restricted by the non-negativity conditions and the maximum per ha production quantities.

In Eqs. (5)-(7), maximum per ha production and marketing quantities of basic quality wine must correspond to the quota on production of this type of wine must in Rheinland-Pfalz, i.e., 200 hl/ha. The marketing quantity of standard quality wine must is also limited to 108.07 hl/ha. This quantity is the average production quota of standard quality wine must weighted on the areas of the vineyards in each of the production regions in Rheinland-Pfalz.

Most wine producers in Rheinland-Pfalz aim to achieve a yield of 120 hl/ha of standard quality wine must despite the average restriction of 108.07 hl/ha. By targeting a yield that is higher than the respective production quota, the farmers secure themselves against poor or low-quality harvests. Thus, the wine producers have the option to sell some of the standard quality wine must as a basic quality product. Therefore, the models consider three wine must production and marketing options: 1) the production and marketing of standard quality wine must, 2) the production and marketing of basic quality wine must and 3) the production of standard quality wine must and its sale as basic quality wine must.

Three types of vineyards are identified in the maximization models: those that are established in the areas with steeper slopes after 2009, those established in areas with flatter slopes after 2009 and those established before 2009. Basic quality wine must is not usually produced by vineyards situated in areas with a

steeper slope due to exceptionally high production costs. It is also not produced by vineyards established before 2009. These vineyards have been cultivated for the production of only standard quality wine must (SB, 2011). Thus, only two production options are available for farms with such vineyards: the production of standard quality wine must and its sale as both standard and basic quality products.

The maximization model for farms with vineyards established before 2009 is presented in Eq. (7). It includes the options of production of standard quality wine must and its sale as both standard and basic quality products, and it accounts for the respective variable production costs. The maximization model for farms with vineyards established in the areas with a steeper slope after 2009 is presented in Eq. (6). It includes the two aforementioned production options and accounts on the total production costs. The maximization model for farms with vineyards established in the areas with a flatter slope after 2009 is presented in Eq. (5). It includes all three production options and accounts for the total production costs. When vineyards are already established and part of the production costs are fixed, only the variable costs are accounted on in the model. When vineyards have not been established yet, total costs are considered.

The optimal per ha quantities of standard and basic quality wine must that are produced by the vineyards established after planting rights have been abolished are not estimated with the optimization problems but are set equal to the respective production quotas.

The data indicate the areas of the vineyards that were established before 2009. The areas of the vineyards established after 2009 are calculated using Eqs. (8)-(9).

$$(8) \quad d_n^t - d_n^{t-1} \geq 0, d_n^t - d_n^{t-1} = A_n^r,$$

$$(9) \quad d_n^t - d_n^{t-1} < 0, d_n^t - d_n^{t-1} = A_n^c,$$

where index n denotes ten groups of wine farms, d_n^t is the total acreage of vineyards of the n^{th} farm group in period t, d_n^{t-1} is the total acreage of vineyards of the n^{th} farm group in period t-1, A_n^r is the total area of vineyards of the n^{th} farm group that have been reallocated to it, and A_n^c is the total area of vineyards that have left the n^{th} farm group.

If the difference between the areas of vineyards in periods t and t-1 is positive or zero, it corresponds to the acreage of reallocated vine plantations. If the difference is negative, it corresponds to the acreage of vineyards that have left the group.

The projection of the distribution of vineyards among farm groups in 2021 is performed by applying a first-order stationary discrete time absorbing Markov chain. Because only macrodata are available and the number of observation periods is limited, the estimation of the matrices of transition probabilities follows set of assumptions as suggested by KEANE (1991). The projection is based on the period from 1999 to 2010, and is conducted separately for the vineyards situated in regions of steeper and flatter slopes. This projection reflects the dynamics of the industry observed in the previous periods and does not explicitly consider profitability of wine farms. Because the latter is a key factor influencing entry and exit decisions of farms, additional rules for simulation of vineyard allocation among wine farm groups are implemented into the model (Table 1).

As presented in Table 1, a farm group may allocate new vineyards if it is characterized by increasing acreage of vineyards according to the projection by the Markov chain and its total production costs do not exceed the total revenue. The acreage of a farm group declines as projected by the Markov chain if this group is characterized by decreasing acreage of vine

Table 1. Rules for simulation of vineyard allocation among the wine farm groups

$Trend_n$ [a)]	$P - ATC_n$ [b)]	$P - AVC_n$ [c)]	The wine farm group[d)]
increasing	not negative	not negative	is characterized by increasing acreage of vineyards
increasing	negative	not negative	is characterized by constant acreage of vineyards
increasing	negative	negative	exits the market
decreasing	not negative	not negative	is characterized by decreasing acreage of vineyards as projected by the Markov chain if at least one farm group situated in similar area type can allocate new vine plantations
decreasing	negative	negative	exits the market

a) $Trend_n$ denotes increasing or decreasing acreage of vineyards in a wine farm group according to the projection by Markov chain.
b) $P - ATC_n$ denotes the difference between the price of wine must and average total costs of wine must production by the n^{th} farm group
c) $P - AVC_n$ denotes the difference between the price of wine must and average variable costs of wine must production by the n^{th} farm group.
d) The wine farm group denotes whether the n^{th} farm group is characterized by increasing, constant or decreasing acreage of vineyards or exits the market. This result is the outcome of two characteristics of the farm group: profitability (i.e., $P - ATC_n$,. $P - AVC_n$) and change in vineyard areas projected by the Markov chain ($Trend_n$)

Source: authors' presentation

yards according to the projection by the Markov chain, and at least one farm group of a similar area type can allocate new vineyards. A farm group exits the market if its total revenues are less than the variable production costs. Total area of vineyards of a farm group remains constant if: a) the farm group is characterized by increasing acreage of vineyards according to the projection by the Markov chain but its total revenue covers only the variable production costs; b) the farm group is characterized by decreasing acreage of vineyards according to the projection by the Markov chain but no farm group of a similar area type exists that can allocate new vineyards. The rules presented in Table 1 apply to the farms producing both types of wine must. If planting rights are restricted, the reference year for vineyard distribution is the calibration year, i.e., 2009. If planting rights are abolished, the reference year is the year of the reform, i.e., 2016.

Wine farms that enter the sector after abolishment of planting rights draw their profitability levels from the distribution of vineyards between farm groups in 2016, which is estimated by applying the rules of Table 1 to the output of Eq. (10).

$$(10) \quad Acr2016_n = \frac{Acr2021_n + Acr2009_n}{2},$$

where index n denotes ten groups of wine farms, $Acr2016_n$ is the acreage of vineyards of the n^{th} farm group in 2016, $Acr2021_n$ is the acreage of vineyards of the n^{th} farm group in 2021 projected by the Markov chain, and $Acr2009_n$ is the acreage of vineyards of the n^{th} farm group in 2009.

The German wine market is modeled as open and small.[1] Wine must of foreign origin is assumed to be a perfect substitute for domestic produce. Because the main trading partners of Germany in the wine sector are the EU member states (Verband Deutscher Weinexporteure e.V.) and the transaction costs associated with importing and exporting wine must are considered equal, domestic market prices for standard and basic quality wine must without the VAT represent the import and export prices in the model. The model is closed by setting the quantity of wine must demanded equal to the sum of the quantities supplied by Rheinland-Pfalz and the rest of Germany minus the net-trade quantity. The stocks and distillation quantities, the production of top-premium wine must in Rheinland-Pfalz and the production of standard and basic quality wine must in the rest of Germany are held constant at the level of the calibration year.

The potential maximum acreage of land suitable for vine cultivation is limited in the model by the estimation of AGROSCIENCE GMBH (2012). This study takes into account environmental and anthropogenic limits on wine production. Thus, under the liberalized planting rights, the area of less than 30% slope occupied by the vineyards in Rheinland-Pfalz cannot exceed 196 309 ha, and the area of more than 30% slope occupied by the vineyards in Rheinland-Pfalz cannot exceed 5 319 ha. Under the restricted planting rights regime, the total area of vineyards is limited by the acreage observed in the reference period. Under the scheme of authorizations for vine plantings, total area of vineyards in 2021 is limited to the annual 1% increase of the acreage of vineyards planted at the end of 2015 and by the estimation of AGROSCIENCE GMBH (2012).

3.3 Calibration and Validation of the Model

The demand functions of the model are calibrated to the demand in 2009, and the unknown constant terms are estimated by solving the respective demand functions as equations with one unknown.

To assess the accuracy of the simulations, the model is validated to 2007. Although the model tends to underestimate the demand for wine must, the results of the simulation are, in general, compatible with the observed situation. Thus, movement of the units among the farm groups modeled for the 1999-2007 period follows the observed trend, and the difference between the total simulated acreage of vineyards in Rheinland-Pfalz and the total observed acreage is around -5.59%.

4 Modeling Scenarios

The standard and basic quality wine must markets are simulated for 2021 using baseline and ten scenarios: the baseline “Planting rights, 2009 prices”; scenario I, “Liberalization, 2009 prices”; scenario II, “Authorizations, 2009 prices”; scenario III, “Planting rights, higher prices”; scenario IV, “Liberalization, higher prices”; scenario V, “Authorizations, higher prices”; scenario VI, “Liberalization, lower prices”; scenario VII, “Authorizations, lower prices”; scenario VIII, “Liberalization, lower prices for land”; scenario IX, “Liberalization, lower price for basic quality wine

[1] The term “open market” refers to a situation of free international trade. The term “small market” refers to a situation when changes in demand for – and supply of – wine must on the German market does not influence the world market price of wine must.

must and higher price for standard quality wine must" and scenario X, "Authorizations, lower price for basic quality wine must and higher price for standard quality wine must".

The scenarios differ with respect to whether planting rights are retained (i.e., "planting rights"), liberalized (i.e., "liberalization") or converted into the scheme of authorizations for vine plantings (i.e., "authorizations"), with respect to prices for standard and basic quality wine must and with respect to land rental prices. Baseline is a simulation of the situation wherein wine must markets are under the current planting rights regime and market prices for standard and basic quality wine must agree with those of 2009 (i.e., "2009 prices"). "Higher prices" correspond to the prices for standard and basic quality wine must that allow only the most cost-efficient farm group to cover its total costs of the production of both types of wine must. "Lower prices" represent market prices for standard and basic quality wine must that are lower than those observed in 2009 by 12.55% (from 74.27 €/hl to 64.95 €/hl) and 49.4% (from 34.36 €/hl to 17.39 €/hl), respectively. These percentage changes correspond to the increase in prices in scenarios with "higher prices". In scenario VIII, land rental prices paid by the farmers in Rheinland-Pfalz are reduced to account for the elimination of planting rights payments when planting rights are liberalized. For areas of less than 30% slope, the land rental price decreases from 900 €/ha to 400 €/ha, and for areas of more than 30% slope, it decreases from 459 €/ha to 204 €/ha. The reduction rate is based on the expected future prices for land suitable for wine grapes cultivation after the liberalization of planting rights. Prices for wine must in this scenario correspond to the average production costs of the most cost-efficient farm group.

5 Results

The modeling output and the state of the market in 2009 are presented in Table 2.

5.1 Baseline "Planting rights, 2009 prices", Scenario I "Liberalization, 2009 prices" and Scenario II "Authorizations, 2009 prices"

If prices for standard and basic quality wine must remain at the 2009 rate, the total acreage of vineyards cultivated in Rheinland-Pfalz will be 38 122 ha, irrespective of whether planting rights are retained, abolished or converted into the scheme of authorizations. This area is around 21.79% smaller than the acreage observed in 2009. Such a decrease results from the exit of farms situated in areas with steeper slopes and farms smaller than 5 ha situated in areas with flatter slopes from the market. At 2009 prices, the variable production costs of these farms exceed revenues. Although most of the farms situated in areas with flatter slopes remain, their total production costs are greater than revenues, and an incentive to invest in the establishment of new wine must production capacity is consequently absent. Accordingly, the distribution of vineyards among these farms in the three simulation scenarios corresponds to that observed in 2009.

The total area of vineyards is used for the production of 4 120 thousand hl of standard quality wine must at 108.07 hl/ha. Due to the increased demand for standard quality wine must, its net-trade quantity will decrease from -2 065 thousand hl in 2009 to -2 983 thousand hl in 2021. Zero production of basic quality wine must and greater demand result in an increase in the importation of this product.

5.2 Scenario III "Planting rights, higher prices", Scenario IV "Liberalization, higher prices" and Scenario V "Authorizations, higher prices"

If the prices for standard and basic quality wine must are 83.59 €/hl and 51.34 €/hl, respectively, and planting rights are liberalized, the total area of vineyards in Rheinland-Pfalz increases to 115 822 ha. If planting rights are restricted, the total area of vineyards is 44 961 ha, and if they are converted into the scheme of authorizations, it is 47 727 ha. The latter is the maximum acreage that can be planted with vines according to the maximum annual increase limit of 1%.

In all three scenarios, farms with vineyards located in areas with steeper slopes exit the market because their variable production costs are greater than revenues. Farms smaller than 50 ha and situated in areas with flatter slopes cover only their variable production costs and, therefore, remain in the industry. Because farms of the most cost-efficient farm group, i.e., "<30% slope, >50 ha", cover their total production costs, this group accommodates less profitable wine farms and new entrants into the sector. Respectively, 54.88% of acreage of vineyards of "<30% slope, <5 ha" farm group, 47.71% of "<30% slope, 5-10 ha" farm group and 14.36% of "<30% slope, 10-20 ha" farm group that have been observed in 2009 are reallocated to the most cost-efficient farm group. In addition, 70 861 ha of new vineyards are planted within

the most cost efficient farm group, if planting rights are liberalized, and 2 766 ha if planting rights are converted into the scheme of authorizations. Although farms with vineyards of 20-50 ha and situated in areas with flatter slope do not cover their total production costs, they do not move to the most cost-efficient farm group. According to the rules presented in Table 1, farms of the farm group that has been growing until 2009 do not exit this group. Because "<30% slope, 20-50 ha" farm group has been expanding until 2009, acreage of vineyards of this group in the three simulation scenarios corresponds that observed in 2009.

The total quantity of standard quality wine must production in 2021 is 3 715 thousand hl, if planting rights are restricted or converted into the scheme of authorizations, and 8 073 thousand hl, if they are liberalized. The total quantity of basic quality wine must production in 2021 is 2 117 thousand hl, if planting rights are restricted, 2 670 thousand hl, if they are converted into the scheme of authorizations, and 8 225 thousand hl, if they are liberalized. The yield of standard and basic quality wine must are 108.07 hl/ha and 200 hl/ha, respectively. Increase in production of basic quality wine must in scenarios III and V relative to the baseline is due to its higher profitability compared to production of standard quality wine must. Such a situation results from higher yield of basic quality wine must and from equal profit from produc-

Table 2. Situations observed in 2009 and simulated for 2021 regarding the markets for standard and basic quality wine must in Germany and Rheinland-Pfalz

Parameter	Units	Observed in 2009	Baseline[a] Scenarios I[b], II[c]	Scenario III[d]	Scenario IV[e]	Scenario V[f]	Scenarios VI[g], VII[h]	Scenario VIII[i]	Scenarios IX[j], X[k]
Standard quality wine must market									
Price[l]	€/hl	74.27	74.27	83.59	83.59	83.59	64.95	78.97	83.59
Demand[m]	1 000 hl	9 217	10 151	11 121	11 121	11 121	8 478	11 173	7 705
Production[n]	1 000 hl	4 425	4 120	3 715	8 073	3 715	1 325	8 124	4 859
Net-trade[o]	1 000 hl	-2 065	-2 983	-4 358	0	-4 358	-4 105	0	202
Basic quality wine must market									
Price[l]	€/hl	34.36	34.36	51.34	51.34	51.34	17.39	48.84	17.39
Demand[m]	1 000 hl	10 300	11 344	8 227	8 227	8 227	20 009	8 441	21 796
Production[n]	1 000 hl	316	0	2 117	8 225	2 670	0	8 438	0
Net-trade[o]	1 000 hl	-10 619[p]	-11 341	-6 108	0	-5 554	-20 006	0	-21 793
		48 743	38 122	44 961	115 822	47 727	12 258	117 370	44 961
Distribution of vineyards and profitability of wine farm groups in Rheinland-Pfalz									
≥30, <5[q]	ha	1 580	0e[r]	0e	0e	0e	0e	0e	0e
≥30, 5-10		1 076	0e	0e	0e	0e	0e	0e	0e
≥30, 10-20		701	0e	0e	0e	0e	0e	0e	0e
≥30, 20-50		335	0e	0e	0e	0e	0e	0e	0e
≥30, >50		92	0e	0e	0e	0e	0e	0e	0e
<30, <5		6 838	0e	3 086s	3 086s	3 086s	0e	3 086s	3 086s
<30, 5-10		9 348	9 348s[s]	4 888s	4 888s	4 888s	0e	4 888s	4 888s
<30, 10-20		16 515	16 516s	14 144s	14 144s	14 144s	0e	14 144s	14 144s
<30, 20-50		9 982	9 982s	9 982s	9 982s	9 982s	9 982s	9 982s	9 982s
<30, >50		2 276	2 276s	12 861p[t]	83 722p	15 627p	2 276s	85 270p	12 861p

[a] Baseline "Planting rights, 2009 prices"
[b] Scenario I "Liberalization, 2009 prices"
[c] Scenario II "Authorizations, 2009 prices"
[d] Scenario III "Planting rights, higher prices"
[e] Scenario IV "Liberalization, higher prices"
[f] Scenario V "Authorizations, higher prices"
[g] Scenario VI "Liberalization, lower prices"
[h] Scenario VII "Authorizations, lower prices"
[i] Scenario VIII "Liberalization, lower prices for land"
[j] Scenario IX "Liberalization, lower price for basic quality wine must and higher price for standard quality wine must"
[k] Scenario X "Authorizations, lower price for basic quality wine must and higher price for standard quality wine must"
[l] The parameter is exogenous to the model.
[m] Demand in Germany
[n] Production in Rheinland-Pfalz
[o] Net-trade in Germany
[p] Part of the imported basic quality wine must is stored
[q] ≥30% slope, <5 is a farm group, the units of which are not larger than 5 ha and are situated in areas of more than 30% slope.
[r] E indicates that the variable costs of wine must production are greater than the total revenues.
[s] S indicates that total revenues are not smaller than variable production costs but smaller than total production costs.
[t] P indicates that the total costs of wine must production are not greater than the total revenues.
Source: authors` calculations, data presented in Section 3.1

tion of a hl of standard and basic quality wine must. The latter is implied by the assumed market prices.

The net-trade quantities of standard and basic quality wine must under the liberalized planting rights are zero, which indicates that the production in Germany satisfies the domestic demand. Under the restricted planting rights and authorizations for vine plantings, the quantity of imported standard quality wine must increases and the quantity of imported basic quality wine must decreases compared to the baseline.

5.3 Scenario VI "Liberalization, lower prices" and Scenario VII "Authorizations, lower prices"

If planting rights are liberalized or converted into the scheme of authorizations for vine plantings and prices for standard and basic quality wine must decrease by 12.55% (from 74.27 €/hl to 64.95 €/hl) and 49.4% (from 34.36 €/hl to 17.39 €/hl), respectively, compared to those observed in 2009, the total acreage of vineyards in Rheinland-Pfalz decreases to 12 258 ha. Only farm groups with vineyards that are situated in flatter areas and are larger than 20 ha remain on the market. These groups neither expand nor exit because they cover only their variable production costs.

A decline in the total acreage of vineyards results in a decreased quantity of standard quality wine must production. Specifically, it decreases from 4 120 thousand hl in the baseline to 1 325 thousand hl. The yield is 108.07 hl/ha. Basic quality wine must is not produced because of the low market price. Due to increased demand for standard and basic quality wine must, imports of both products increase compared to the baseline.

5.4 Scenario VIII "Liberalization, lower prices for land"

If rental prices for land are reduced, the lowest prices at which standard and basic quality wine must can be produced by the most cost-efficient farm group in the long run are 78.97 €/hl and 48.84 €/hl, respectively. In this case, and if planting rights are liberalized, the total acreage of vineyards in Rheinland-Pfalz in 2021 increases to 117 370 ha. Only the "<30% slope, >50 ha" farm group expands. It allocates 10 585 ha of vineyards from smaller farm size groups and 72 409 ha of new vineyards.

Under this scenario, the vineyards are expected to produce 8 124 thousand hl of standard quality wine must at 108.07 hl/ha and 8 438 thousand hl of basic quality wine must at 200 hl/ha. Because total quantities of standard and basic quality wine must production in Germany fulfill the domestic demand, the net-trade volumes of these products are zero.

5.5 Scenario IX "Liberalization, lower price for basic quality wine must and higher price for standard quality wine must" and Scenario X "Authorizations, lower price for basic quality wine must and higher price for standard quality wine must"

If planting rights are liberalized or converted into the scheme of authorizations for vine plantings and prices for standard and basic quality wine must change by +12.55% (from 74.27 €/hl to 83.59 €/hl) and -49.4% (from 34.36 €/hl to 17.39 €/hl), respectively, compared to those observed in 2009, the total acreage of vineyards in Rheinland-Pfalz is 44 961 ha. Farms situated in steeper areas exit the sector because their variable production costs exceed revenues. Because farm group "<30% slope, >50 ha" is the only one with positive economic profits, it accommodates 10 585 ha of vineyards that move from farm size groups that only cover their variable production costs.

The total area of vineyards is used for the production of 4 859 thousand hl of standard quality wine must at 108.07 hl/ha. The net-trade quantity of standard quality wine must is 202 thousand hl, which indicates that there is export of standard quality wine must. The imports of basic quality wine must are greater than in the baseline due to the increased demand for this product in Germany and the fact that it is not produced in Rheinland-Pfalz.

6 Conclusion

This study analyzed the effects of liberalization of planting rights on the wine sector of Rheinland-Pfalz. The net-trade partial equilibrium model with the nested output of a Markov chain projection was used as a simulation tool. The study finds that abolishing the planting rights regime will encourage the increase of acreage of more cost-effective wine farms, growth of the total acreage of vineyards and the quantity of wine must production in Rheinland-Pfalz. Such an outcome is possible if the prices for wine must result in positive profitability of wine farms. If the prices for wine must remain at the 2009 level or fall, then the liberalization

of planting rights and conversion into the scheme of authorizations may have minor or no effects on the Rheinland-Pfalz wine sector.

If wine must prices are relatively high, the effects of liberalization of planting rights and conversion of the latter into the scheme of authorizations on the Rheinland-Pfalz wine sector are different. In the first case, increases in standard and basic quality wine must production correspond to the demand for these goods and are limited only by availability of agricultural land. In the second case, increases in vineyard acreages are strongly restricted by the regulation. The process of expansion of the total acreage of vineyards in Rheinland-Pfalz will be slow and the trend toward the production of standard quality wine must will continue.

In the community of German wine producers and experts, it is argued that planting rights liberalization could lead to lower prices for wine and wine must. Consequently, smaller and less cost-efficient wine farms, particularly those situated in areas with steeper slopes, could become unprofitable and leave the market (HLG, 2013, and BOGONOS et al., 2012). The current analysis indicates that the number of the least cost-efficient wine farms will drop considerably regardless of whether the reform occurs because even at the prices for wine must throughout the period of planting rights regime, their profitability rates have been rather low. Such farms will have the options to exit the wine producing industry, move to more cost-efficient farm size classes by increasing acreage of their vineyards, and switch to production of another wine product such as top-premium wine. As the analysis demonstrates, smaller farms are most likely to move to larger farm size classes. Consequently, the distribution of vineyards is likely to be skewed toward farm groups larger than 20 ha. However, if none of the farm groups receive non-negative economic profits, an incentive to invest in wine must production will be absent and the acreage of the vineyards in all farm groups might eventually decline.

Although our findings support the conclusions presented in the literature, assumptions regarding the constant-cost industry and perfect substitutability of domestic and foreign wine must should be considered when interpreting the results of Table 2. A particular advantage of this work is that it accounts for the specific features of wine growing in Rheinland-Pfalz, such as the existence of a target yield of wine must, a target quality of wine must, and the impossibility of the profitable production of basic quality wine must in areas with steeper slopes.

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Contact author:
MARIIA BOGONOS
Institute of Farm Management (410a),
Universität Hohenheim, 70593 Stuttgart, Germany
e-mail: mbogonos@yahoo.com