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Analysis of the effects of abolishment of planting rights in the European Union on the wine sector in Rheinland-Pfalz, Germany

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Content

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Summary

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 regulation of wine production by the system of the planting rights. Consistent with the goal of increasing the competitiveness of EU wine producers on the world market, the 2008 CAP reform included the liberalization of the planting rights regime by 2018 the latest (EC 2008). Many wine producers, policy makers and other interested parties have expressed doubts regarding the efficiency of such a change (HLG 2013). Although the planting rights system has recently been converted into a scheme of authorizations for vine plantings, which enters into force in 2016 and is valid until 2030 (EU 2013), discussions on how the abolishment of restrictions on planting new vineyards will affect the EU wine sector continue.

This dissertation investigates the effects of abolishment of planting rights on the largest wine-producing region in Germany, Rheinland-Pfalz. For this purpose a comparative static regional partial net-trade equilibrium model that includes the output of a Markov chain (MC) projection was used. The model simulates the future distribution of vineyards in Rheinland-Pfalz among wine farm groups according to size classes and area type, the demand for standard and basic quality wine must in Germany and production of standard and basic quality wine must in Rheinland-Pfalz. The distribution of vineyards was modeled in two stages. At the first stage, the probabilities of movement of vineyards within the wine farm groups were estimated by the MC estimation techniques based on Keane (1991) and Lee and Judge (1996). At the second stage, these probabilities were combined with the conditions representing profitability and trends of growth of the wine farm groups, and implemented into the policy simulation model. The model simultaneously simulated the equilibrium quantities of demand for – and production of – standard and basic quality wine must, and the acreage of vineyards distributed to wine farm groups in Rheinland-Pfalz.

The policy simulation model was run for scenarios of different levels of market prices of wine must, different land rental prices, restricted and liberalized planting rights, and a scheme of authorizations for vine plantings. The results revealed that the effects of liberalization of planting rights and of a scheme of authorizations for vine plantings depend on profitability of standard and basic quality wine must production. In particular, if standard and basic quality wine must production is profitable for at least one wine farm

group, and planting rights are liberalized, production of standard and basic quality wine must and, respectively, acreage of vineyards in Rheinland-Pfalz will increase with respect to the demand for these two types of wine must in Germany and availability of land suitable for vine growing. As the simulation output demonstrates, if prices of standard and basic quality wine must allow only the most cost-efficient group of wine farms covering their total production costs, and planting rights are liberalized, 1) production of standard quality wine must in Rheinland-Pfalz will almost double in comparison to the baseline[1] situation, and 2) production of basic quality wine must will increase from less than a million to about eight million hectoliters (hl). Total acreage of vineyards for production of these two types of wine must will approximately triple.

If production of basic and standard quality wine must is profitable and planting rights regime is retained or converted into a scheme of authorizations for vine plantings, the acreage of vineyards in Rheinland-Pfalz might reach the maximum defined by the policy regime. In addition, newly established vineyards will be used for production of either standard or basic quality wine must depending on which type is more profitable. Thus, if prices of standard and basic quality wine must allow some of the wine farm groups covering their total production costs and a scheme of authorizations for vine plantings is valid, 1) production of standard quality wine must in Rheinland-Pfalz will decrease by about 7% in comparison to the baseline situation, and 2) production of basic quality wine must will increase from less than a million to about three million hl. Total acreage of vineyards for production of these two types of wine must will increase by about 30%.

Movement of vineyards within the wine farm groups will take place only if at least one of the farm groups receives positive economic profits. Land for vine growing will be distributed to the farm groups which are profitable and characterized by positive growth rates in the past.

The abolishment of planting rights will have minor or no effects on the wine sector in Rheinland-Pfalz, if production of basic and standard quality wine must is not profitable. Similarly, movement of vineyards within the wine farm groups will not take place, if none of the farm groups receive positive economic profits. According to the modeling output, if prices of standard and basic quality wine must do not allow any of the wine farm groups covering their total production costs, the simulated production of wine must and distribution of vineyards among the wine farm groups will not be different among the

[1] Baseline is a simulation of the situation in 2021 wherein wine must markets are under the planting rights regime and market prices of standard and basic quality wine must agree with those of 2009.

scenarios of restricted and liberalized planting rights, and a scheme of authorizations for vine plantings.

This dissertation provided an empirical examination of the effects of restricted and liberalized planting rights, as well as a scheme of authorizations for vine plantings on the wine sector in Rheinland-Pfalz. It has supplemented the literature on how policy reforms with regard to the limitation of agricultural production input use in order to control the output affect the agricultural production sector. In addition, the challenge was taken up to model structural change within the partial equilibrium modeling framework. In this context, not only provides this dissertation insights on the effects of restricted and abolished planting rights on the wine sector in general, but it may also inspire future research on simulation of the effects of policy reforms with regard to limitation of the production output on quantity and quality of agricultural production and structure of farms.

Zusammenfassung

Die Produktion und Vermarktung von Wein in der Europäischen Union (EU) werden durch die Gemeinsame Marktorganisation (GMO) der Gemeinsamen Agrarpolitik der EU (GAP) geregelt. Ein wesentlicher Aspekt der GMO im Hinblick auf den Weinsektor, ist die seit 1976 bestehende Regulierung der Weinproduktion durch das System der Pflanzrechte. Mit Durchführung der GAP Reform im Jahr 2008 wurde, unter anderem durch eine geplante Abschaffung des Pflanzrechtregimes bis spätestens zum Jahre 2018, die Grundlage für das Ziel einer verbesserten Wettbewerbsfähigkeit der europäischen Weinproduzenten auf dem Weltmarkt geschaffen (EC 2008). Weinerzeuger, deren Interessenvertreter, und politische Vertreter der europäischen Weinbauländer brachten ihre Zweifel am Nutzen der anvisierten Neuregelung zum Ausdruck (HLG 2013). 2016 tritt ein Authorisierungssystem für Rebpflanzungen in Kraft, welches das bisher bestehende Pflanzrechtssystem ablöst und bis 2030 seine Gültigkeit behalten wird (EU 2013). Trotz dieser Tatsache gibt es fortwährende Diskussionen über mögliche Auswirkungen einer Abschaffung der Pflanzrechtsbeschränkungen auf den europäischen Weinsektor.

Diese Dissertation untersucht die Auswirkungen einer Abschaffung der Pflanzrechte auf den Weinsektor von Rheinland-Pfalz, das Bundesland mit der größten Weinproduktion in Deutschland. Hierzu wurde ein regionales, komparativ-statisches, partielles Nettohandels-Gleichgewichtsmodel verwendet, das die Projektion eines Markov-Prozesses enthält. Das Model simulierte die zukünftige Verteilung von Rebflächen auf die Weinbaubetriebe in Rheinland-Pfalz, abhängig von der Betriebsgröße und den Standorteigenschaften, der Nachfrage nach Standard- und Basisqualitätsweinmost in Deutschland und der Produktionsmenge von Standard- und Basisqualitätsweinmost in Rheinland-Pfalz. Die Verteilung der Rebflächen wurde in zwei Simulationsschritten erreicht. Im ersten Schritt wurden die Wahrscheinlichkeiten für eine Umverteilung der Rebflächen innerhalb der gebildeten Betriebsgruppierungen für Weinbaubetriebe, durch Markov-Prozesse zurückgehend auf Keane (1991) und Lee und Judge (1996), geschätzt. Im zweiten Schritt wurden die geschätzten Wahrscheinlichkeiten mit den Bedingungen, die stellvertretend für Profitabilität und Wachstumstrends der Weinbaubetriebsgruppen stehen, verbunden. Dies wurde daraufhin in das Model zur Politikanalyse implementiert. Das Modell simulierte daraufhin simultan die Nachfragemenge für und Produktionsmenge von Standard- und Basisqualitätsweinmost, sowie die Rebflächenverteilung auf die Weinbaubetriebsgruppen in Rheinland-Pfalz.

Die zuvor genannten Modellergebnisgrößen wurden dann noch im Rahmen von Szenarienanalysen für verschiedene Marktpreisniveaus von Weinmost, verschiedene Landpachtpreisen, beschränkte sowie liberalisierte Pflanzrechte und ein Authorisierungssystem für Rebpflanzungen betrachtet. Die Ergebnisse zeigten, dass sich sowohl die Ergebniswirkung einer Liberalisierung der Pflanzrechte als auch der Effekt eines Authorisierungssystems für Pflanzrechte, am angenommenen Weinmostpreis orientiert. Dies bedeutet, wenn die Produktion von Standard- und Basisqualitätsweimost für mindestens eine Betriebsgruppe profitabel ist, unter der Annahme einer Pflanzrechtsliberalisierung, so wird die Produktion von Standard- und Basisqualitätsweinmost und dementsprechend die Weinrebenfläche in Rheinland-Pfalz, abhängig von der Nachfrage nach diesen zwei Mostqualitätsstufen in Deutschland und der Verfügbarkeit von geeigneten Flächen für den Weinbau, ansteigen. Das Simulationsergebnis zeigt, dass wenn die Preise für Standard- und Basisqualitätsweimost es lediglich für die kosteneffizienteste Gruppe von Weinbaubetrieben ermöglicht, ihre Produktionskosten zu decken, unter der Annahme einer Pflanzrechtsliberalisierung, so wird sich 1) die Produktion von Standardqualitätsweinmost in Rheinland-Pflanz im Vergleich zur Basisszenario[2] verdoppeln, und 2) die Produktion von Basisqualitätsweinmost wird sich von weniger als einer Million auf ungefähr acht Millionen Hektoliter (hl) erhöhen. Die Anbaufläche für die Produktion der zwei Mostqualitäten wird sich dann fast verdreifachen.

Im Falle einer profitablen Basis- und Standardqualitätsweinmostproduktion und unter der Annahme entweder der Beibehaltung des Pflanzrechtsregimes, oder einer Umwandlung in ein Authorisierungssystem für Pflanzrechte, wird die Weinanbaufläche in Rheinland-Pfalz, das Maximum erreichen. Zusätzlich geschaffene Anbauflächen werden für die Produktion von Basis- oder Standardqualitätsweinmost verwendet, abhängig davon, welcher eine höhere Profitabilität aufweist. Das Simulationsergebnis zeigt, dass, wenn die Priese für Standard- und Basisqualitätsweinmost lediglich einem Teil der Betriebsgruppen eine kostendeckende Produktion ermöglichen, unter der Annahme eines Authorisierungssystems für Pflanzrechte, so wird sich 1) die Produktion von Standardqualitätsweinmost um ca. 7% im Vergleich zum Basisszenario verringern, und dementsprechend 2) die Produktionsmenge von Basisqualitätsweinmost von weniger als

[2] Das Basisszenario ist eine Simulation der Situation in 2021, in der Weinmostmärkte unter dem Pflanzrechtsregime stehen und Marktpreise für Standard- und Basisqualitätsweinmost den Preisen von 2009 entsprechen.

einer Million auf ungefähr drei Millionen Hektoliter erhöhen. Die Anbaufläche dieser beiden Mostqualitätsklassen wird sich somit um ca. 30 % erhöhen.

Eine Umverteilung der Rebflächen zwischen den Betriebsgruppierungen wird nur stattfinden, wenn mindestens eine Betriebsgruppierung positive Gewinne macht. Landwirtschaftliche Fläche, die zur Weinproduktion geeignet ist, wird sich auf die Betriebsgruppen verteilen, die auch schon in der Vergangenheit positives Wachstum aufzeigen konnten und profitabel wirtschaften.

Die Abschaffung der Pflanzrechte wird im Falle einer nicht gegebenen Profitabilität von Standard- und Basisqualitätsweinmost nur einen geringfügigen Effekt auf den Weinsektor haben. Ebenso wird es keine Umverteilung der Rebflächen zwischen den Betriebsgruppierungen geben, wenn keine der Betriebsgruppen wirtschaftlich produzieren kann. Das Simulationsergebnis zeigt, dass, wenn Preise von Standard- und Basisqualitätsweinmost es keiner der Betriebsgruppen ermöglichen, kostendeckend zu produzieren, so wird sich das Ergebnis für das Produktionsvolumen von Weinmost und die Verteilung der Rebflächen in den Szenarien: Pflanzrechtsbeschränkungen, Liberalisierung der Pflanzrechte und Authorisierungssystem der Pflanzrechte, für die Betriebsgruppen nicht unterscheiden.

In dieser Dissertation wurden die Effekte einer Pflanzrechtbeschränkung, Liberalisierung der Pflanzrechte und ein Authorisierungssystem für Pflanzrechte auf den Weinsektor in Rheinland-Pfalz empirisch untersucht. Sie ergänzt die Literatur im Hinblick darauf wie Politikreformen in Bezug auf die Beschränkung von Produktionsinputfaktoren in der Landwirtschaft, mit dem Ziel, die sektorale Gesamtproduktion zu regulieren, sich auf den landwirtschaftlichen Produktionssektor auswirken. Darüber hinaus hat man sich der Herausforderung gestellt, einen strukturellen Wandel im Rahmen der Gleichgewichtsmodellierung dazustellen. In diesem Kontext bietet diese Dissertation nicht nur Einblicke auf die Effekte von Pflanzrechtbeschränkungen und der Abschaffung der Pflanzrechte auf den Weinsektor im Allgemeinen, es soll für zukünftige Forschungsvorhaben eine Orientierungshilfe darstellen, die sich mit den Effekten von Politikreformen beschäftigen, die landwirtschaftliche Produktion in Menge und Qualität limitieren, sowie Einfluss auf Betriebsstrukturen nehmen.

Abbreviations

CAP	Common Agricultural Policy (of the EU)
CMO	Common Market Organization
EU	European Union
EUR	Euro currency
GDP	Gross Domestic Product
ha	Hectare (-s)
hl	Hectoliter (-s)
LSE	Least squares estimator
MC	Markov chain
ME	Maximum entropy
PAULa	Programm Agrar-Umwelt-Landschaft
PDO	Protected Designation of Origin
PGI	Protected Geographical Indication
QbA	Qualitätswein bestimmter Anbaugebiete
VAT	Value added tax

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CHAPTER 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 restriction on planting of new vineyards. The aim of this measure was to prevent structural surpluses of wine (EEC 1976). Thus, for several decades the total acreage of vineyards in the EU has been strictly regulated. This has been the case for Germany as well.

Germany has realized its total wine production potential by more than 95%: lawful plantings of vineyards occupy around 100,000 hectares (ha). Almost two thirds of this area are found in the production regions in Rheinland-Pfalz. Consequently, more than 65% of the German wine is produced in Rheinland-Pfalz (SB 2014a and b).

1.1 Problem statement

With the CAP reform of 2008, a new approach in regulating the EU wine sector was introduced. Following the goal of increasing the competitiveness of the EU wine producers on the world market, planting rights were set to be liberalized by 2018 the latest (EC 2008). Among other changes of the CMO with regard to wine, this was the most debated. Many wine producers, experts, policy makers, and other interested parties have expressed doubts about the efficiency of the reform. The main arguments were related to possible excess supply, decrease of producers' income, allocation of plantations to more productive regions and loss of identity for rural areas (HLG 2013, Agra-Europe 2012a-c and Copa-Cogeca 2012).

For Rheinland-Pfalz the effects of the reform could be substantial due to the system of planting rights adopted there and specific characteristics of its wine sector. It is argued that the reform could lead to increased volume of wine production in the EU and, consequently, lower market prices of wine. This would leave smaller and less cost-efficient wine farms in Rheinland-Pfalz under the risk of negative profits (experts' opinion[3]).

As a result of intensive discussions at the EU level, liberalization of the planting rights regime was postponed. Instead, the system was set to be converted into a scheme of authorizations for vine plantings from 2016. This scheme limits the annual number of allowances that can be granted for vine planting, and thus ensures a gradual increase of the total acreage of vineyards in the EU (EU 2013).

1.2 Scope and objectives

This dissertation focuses on the wine sector in Rheinland-Pfalz, Germany. In particular, the analysis has been carried out with respect to production quantity of wine must[4] and acreage of vine plantings.

The main objective of this dissertation is to support the key players in the public sector of Rheinland-Pfalz in making informed decisions on the implementation of reforms with regard to the planting rights regime in this region. Moreover, it provides a source of information on the trends and developments in the wine sector in Rheinland-Pfalz that can be useful for a number of organizations and individuals.

The specific aims of this study are to analyze the effects of continuation and liberalization of planting rights regime, and conversion of planting rights into a scheme of authorizations for vine plantings[5] on

- production quantities of standard and basic quality wine must, and
- total acreage of vineyards and their distribution among wine farm groups according to size classes and area type in Rheinland-Pfalz.

[3] See References.
[4] Wine must is a freshly pressed grape juice. It is turned into wine during the fermentation process (Hornsey 2007).
[5] Since a scheme of authorizations for vine plantings has not been adopted in Rheinland-Pfalz by the time of completion of this dissertation, provisions of the EU Regulation No 1308/2013 (EU 2013) are considered herein.

CHAPTER 2

Agricultural policy of the European Union in the wine sector, and its implementation in Rheinland-Pfalz

Production and marketing of wine in the EU have been governed by a number of regulations. Through the years, these regulations have been repealed and amended. Thus, in 2008 Council Regulation (EC) No 479/2008 on the CMO in wine entered into force repealing older regulations, (EEC) No 2392/86 and (EC) No 1493/1999 (EC 2008, EC 1999 and EEC 1986)[6]. Some of its most important aspects included financial support programs for the purpose of structural improvement of the wine sector, gradual abolishment of distillation subsidies, voluntary three-year (i.e., till the end of the wine year 2010/2011) grubbing-up scheme[7], change of wine classification from quality wine and table wine to wine with and without protected indication of origin and liberalization of restriction on planting of vines which had been valid since 1976 (EEC 1976). The latter was set to be abolished from January 2016.

In January 2014 Regulation (EU) No 1308/2013 entered into force. Like the preceding regulation, it provides rules on financial support programs in the wine sector[8], enological practices, indications of origin, labeling and marketing of wine, etc. It, however, repeals the liberalization of planting rights presented in (EC) No 479/2008, and introduces a conversion of plating rights into a scheme of authorizations for vine plantings (EU 2013 and EC 2008).

In Germany, the EU wine law is adopted via Weinverordnung 1995, Weingesetz 1994 and Wein-Vergüngstigungsverordnung 1976 (WeinV 1995, WeinG 1994 and WeinVergV 1976). Because member states of the EU are granted certain flexibility in the implementation of the Union’s regulations, the specificities of legislation with regard to labeling of wine, planting of vines and support programs in the wine sector in Rheinland-Pfalz merit further examination.

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[6] A detailed overview of the EU regulations on the CMO in wine is presented in Meloni and Swinnen (2012).

[7] According to this scheme, farmers are offered premium for grubbing-up their vineyards.

[8] Support programs may contain measures such as promotion, restructuring and conversion of vineyards, green harvesting, harvest insurance, mutual funds, investments, innovation and by-product distillation (EU 2013).

2.1 Wine labeling

Labeling of wine with protected indication of origin includes Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) labels (AID 2011). In Germany, these markings are accompanied by German wine quality labels. Currently, there are four main quality categories of wine defined in Germany: Grundwein, Deutscher Wein, Landwein and Qualitätswein bestimmter Anbaugebiete (QbA). Grundwein and Deutscher Wein wine are not marked with any indication of origin. Landwein wine is labeled with PGI. QbA wine is the highest quality category among the aforementioned ones and bears the label of PDO (WeinG 1994).

2.2 System of planting rights

From 1976 and until the end of 2015, quantity of wine production in Rheinland-Pfalz has been regulated by planting rights and per hectare production quota. Planting rights are permissions to plant vines for wine production. They include new planting rights and replanting rights. New planting rights are granted for production of PDO and PGI wine with respect to vineyard areas that are temporarily not planted, under measures of land consolidation and reorganization of land ownership, and that are situated close to already established vine plantations (WeinG 1994). Replanting rights represent a possibility to transfer planting rights between the holdings.

Replanting rights are not transferable between areas of more and less than 30% slope. An exemption can be made only if a vineyard is to be established in close proximity to another vine garden for production of PDO wine. Transfers between the production regions in Rheinland-Pfalz (i.e., Ahr, Mittelrhein, Mosel, Nahe, Pfalz and Rheinhessen) are restricted as well. Planting rights that are not exercised for 13 years after they have been granted are extinguished.

PDO and PGI wine can be produced only in specified production regions. Therefore, planting rights cannot be awarded for vine planting in areas outside such regions. Permissions cannot be used for cultivation of vines which are not included in the list of allowed cultivars. Another restriction on the use of planting rights considers parcel productivity and marketing channels. Planting or replanting rights may only be granted if parcel productivity is proved, and marketing channels are established. This does not concern vineyards that are intended for experimental or nursery purposes (experts' opinion, MJVRP 2012, Frantz 2003, WeinV 1995 and WeinG 1994).

2.3 Yield restriction

In Rheinland-Pfalz, in addition to restriction on vine planting, there exists a quota on the production of wine per hectare. This per hectare production quota varies within the quality categories of wine and the wine production regions. There are six production regions in Rheinland-Pfalz (i.e., Anbaugebiete): Ahr, Mittelrhein, Mosel, Nahe, Pfalz and Rheinhessen. In Mosel, Nahe, Rheinhessen, and Pfalz, the quota for QbA wine is 105 hectoliters (hl) per hectare, for Landwein wine 125 hl/ha, for Deutscher Wein wine 150 hl/ha and for Grundwein 200 hl/ha. The quota for QbA wine produced from vineyards situated in areas with steeper slope in Mosel is 130 hl/ha. In Ahr and Mittelrhein, the quotas for any kind of wine are 100 hl/ha and 105 hl/ha, respectively (LWKRP 2012 and AID 2011)[9].

2.4 Scheme of authorizations for vine plantings

According to Regulation (EU) No 1308/2013, the system of rights is converted into a scheme of authorizations for vine plantings from 2016. This scheme allows an annual increase in the acreage of vineyards for production of PDO and PGI wine by maximum 1% of the total area actually planted with vines, as measured on 31 July of the previous year. This scheme is valid till 2030. Because the pattern of adoption of the scheme in the wine sector in Rheinland-Pfalz has not been developed by the time of completion of this dissertation, only general and most relevant provisions of the new system are described herein. In particular, rules on granting of authorizations are reviewed.

The authorizations are granted to vine growers without a fee and can be used within the next three years from the date of issue. If a producer possesses planting rights that have not been used until 2016 and are still valid by that time, these planting rights may be converted into the authorizations.

If the total area covered by the applications for authorizations for vine plantings exceeds the area made available for plantings in a given year, the authorizations are subject to specific eligibility criteria. If the total area covered by the eligible applications still exceeds the area made available for vine plantings, the authorizations shall be granted according to a pro-rata distribution of hectares to all applicants on the basis of the area for which they have requested the authorization. The authorizations shall be granted

[9] The influence of this policy regime on production decisions is analyzed in Dabbert and Oberhofer (1990).

automatically to producers who have grubbed up area planted with vines, and not included in the acreage made available for plantings in a given year (EU 2013).

2.5 Support measures

In accordance with (EC) No 479/2008, a support program for wine sector in Germany, namely "Nationales Stützungsprogramm der Bundesrepublik Deutschland gemäß der Verordnung (EG) Nr. 479/2008 über die gemeinsame Marktorganisation für Wein", is carried out on the national and regional levels. On the national level, only promotion of third-country markets is supported. In Rheinland-Pfalz, measures such as the support of restructuring and conversion of vineyards, harvest insurance and of investments are implemented as well (BMELV 2011 and EC 2008). Support of harvest insurance is the annual per hectare payment to farmers who have closed their previous insurances due to yield losses (MJVRP 2010). Subsidization of investments is provided to undertakings involved in processing and marketing of grapevine products[10], and those who purchase new technology for the purpose of modernization of harvesting, storage, cooling, sorting, preparation for marketing, packaging, labeling, processing or marketing of these products (DLRRP 2010).

Wine producers, whose vineyards are situated in areas with steeper slopes, are, in addition, subsidized via the regional support program for promotion of organic and ecological farming, Programm Agrar-Umwelt-Landschaft (PAULa). In 2009, for example, the annual premium was 765 euro (EUR) per hectare (MWVLWRP 2010).

[10] According to Annex IV of (EC) No 479/2008 grapevine products include: wine, new wine still in fermentation, liqueur wine, sparkling wine, quality sparkling wine, quality aromatic sparkling wine, aerated sparkling wine, semi-sparkling wine, aerated semi-sparkling wine, grape (wine) must, partially fermented grape must, partially fermented grape must extracted from raisined grapes, concentrated grape must, rectified concentrated grape must, wine of overripe grapes, wine vinegar (EC 2008).

CHAPTER 3

Wine sector in Rheinland-Pfalz and Germany

This chapter describes the wine production sector in Rheinland-Pfalz and Germany. It provides information on general characteristics of the sector and the evolution of size and structure of wine farms.

3.1 General characteristics

In Rheinland-Pfalz, wine production constitutes the largest share of the total agricultural production value: about 34%. In 2010, there were 63,350 ha of vineyards, and registered viticulture farms constituted about 42% of the total amount of farms number in the region. Cultivation of white wine grape varieties prevails. In 2010, about 70% of vineyards were white and 30% of vineyards red wine grape varieties (SLRP 2013). Maximum average yield of grape must observed throughout 1999-2013 was 123 hl/ha, and minimum 74 hl/ha (SLRP 2011b). Wine producers are focused on production of QbA wine. Throughout 2000-2009, average production quantity of QbA wine was 5.9 million hl. This constituted about 93% of the total amount of wine produced in the region (SLRP 2011a). About 29% of this wine was the so-called top-premium wine (LWKRP 2014). Whereas average shelf price of QbA wine of standard quality is around 3-5 EUR per bottle, average shelf price of QbA wine of top-premium quality is around 5-10 EUR per bottle (LWKRP 2014 and Hoffmann 2011).

Ahr and Mittelrhein are the smallest wine production regions. Their total production area constitutes about 2% of the total acreage of vine plantings in this federal state. There are about 300 viticulture farms in these two regions. Total area of vineyards in Mosel is almost 9 thousand ha, and number of wine farms is more than 2.6 thousands. Average size of wine farms in Ahr, Mittelrhein and Mosel is about 3 ha.

Total area of vineyards in Nahe is about 4 thousand ha, and there are about 570 wine farms. Average size of these farms is about 7.3 ha. Pfalz and Rheinhessen are the largest wine producing regions in Rheinland-Pfalz. They share about 50 thousand ha of vineyards that constitute around 80% of the total area of vineyards in the state. Average size of wine farms in Pfalz and Rheinhessen is about 9 ha (SLRP 2011a). In general, size of vineyards in Rheinland-Pfalz ranges from less than 1 ha to more than 50 ha. In 2010, for example, 77% of the total number of wine farms in this federal state constituted farms smaller than 10 ha; the size of 17% of wine farms was 10-20 ha; and there were 6% of wine farms larger than 20 ha (based on data presented in Chapter 6).

For more than 55% of wine farms wine grape cultivation is the main agricultural activity. About 56% of wine farms (about 16% of the total vineyards area) are members of producer organizations. In 2009, there were 48 registered producer organizations[11] in Rheinland-Pfalz (MWVLWRP 2010). Family enterprise is a common characteristic of wine farms. Almost half of the required labor work is performed by the family members (DLRRP 2005a-d).

Average profitability of wine farms in Rheinland-Pfalz differs with respect to size and type of area where vineyards are situated. In particular, the steeper the slope of a vineyard the higher the cost of wine grapes production. Shares of vineyards situated in areas with steeper slopes differ within the production regions. Thus, in 2010, around 69% of the total acreage of vineyards in Ahr, 83% in Mittelrhein, 42% in Mosel, 16% in Nahe, 0.2% in Pfalz and 0.1% in Rheinhessen were situated in areas of more than 30% slope (based on data presented in Chapter 6).

3.2 Location and size structure of wine farms: overview of development

In this section, historical acreage, number and structure[12] of wine farms are presented in detail. Because the data available are not complete, some calculations are performed to generate the necessary numbers. These calculations are described in Chapter 6.

In the last decades the number of wine farms in Rheinland-Pfalz has declined markedly. In 1989 there were almost 34 thousand wine farms, while by 2010 more than two thirds of them had gone out of business. Although the drop in the number of farms has been dramatic, total acreage of vineyards has decreased by about 5% only (Table A-3.1 in Annex to Chapter 3). A graphical illustration of the evolution of acreage of vineyards of farms situated in areas of more and less than 30% slope is presented in Figure 3.1.

[11] On German wine cooperatives see Hanf and Schweickert (2007).

[12] The definition of farm structure is heterogeneous (Stanton 1991). In this study, farm structure (and structural change) is defined as the number of farms in different farm types (change of the number of farms in different farm types).

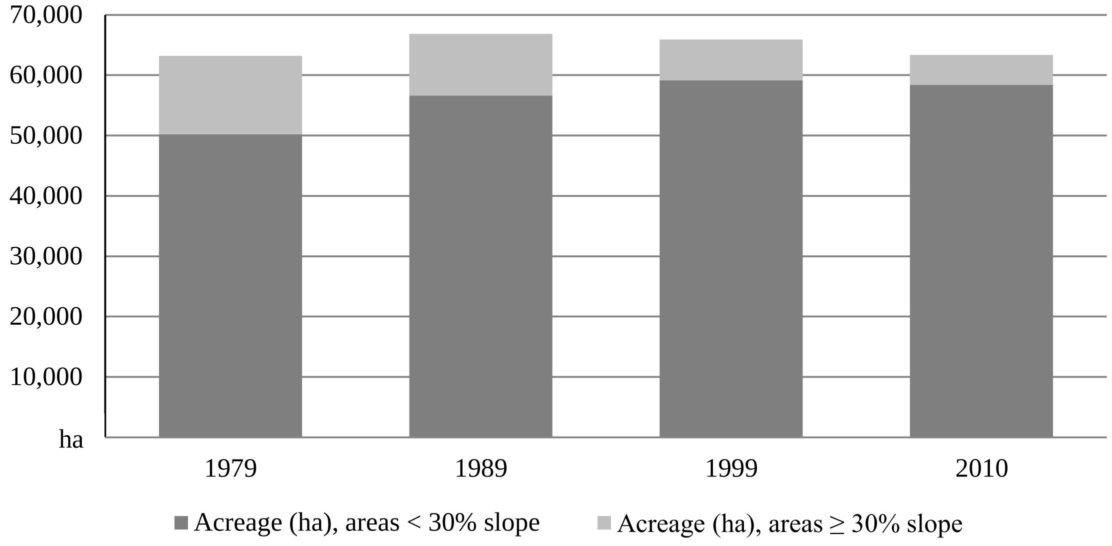

Figure 3.1: Total acreage of vineyards and acreage of vineyards in areas of more and less than 30% slope in Rheinland-Pfalz in 1979-2010
Note: Acreage (ha), areas <30% slope indicates total acreage of vineyards situated in areas of less than 30% slope.
Source: Based on data presented in Chapter 6

In spite of the increase in the total acreage of vineyards from about 63 thousand ha in 1979 to almost 67 thousand ha in 1989, the acreage of vines planted in areas of more than 30% slope dropped by 21.5%. This indicates that planting of new vineyards (presumably red wine grape varieties; and replacement of white with red wine grape varieties due to the red wine boom[13]) took place mostly in areas with flatter slope.

Throughout 1989-2010, the total area of vineyards decreased to 63,350 ha. Whereas acreage of vineyards in areas of more than 30% slope gradually decreased from about 10 thousand ha in 1989 to about 5 thousand ha in 2010, the acreage of vines planted in areas of less than 30% slope first increased from almost 57 thousand ha in 1989 to about 59 thousand ha in 1999, and then declined to about 58 thousand ha in 2010.

The distribution of vineyards and wine farms within five farm size classes and areas of more and less than 30% slope is presented in Figures 3.2-3.5. The size classes represent farms with <5, 5-10, 10-20, 20-50 and >50 ha of cultivation area.

[13] Replacement of white with red wine grape varieties, as well as increase of the total acreage of vineyards in Rheinland-Pfalz could result from the, so called, "red wine boom". The "red wine boom" refers to the increase in consumer demand for red wine in Germany. In Rheinland-Pfalz, for example, the share of red wine grape varieties in the total acreage of vineyards increased from about 5% in 1979 to about 30% in 2010 (Rheinschmidt 1999 and Table A-3.2 in Annex to Chapter 3).

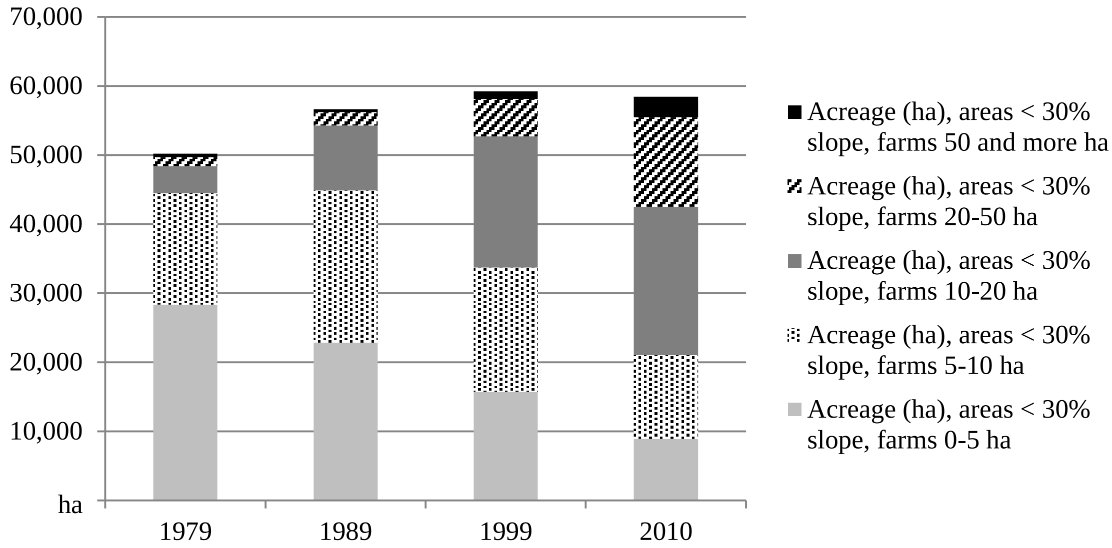

Figure 3.2: Distribution of vineyards in areas of less than 30% slope within farm size classes in Rheinland-Pfalz in 1979-2010
Note: Acreage (ha), areas <30% slope, farms 50 and more ha indicates total acreage of vineyards of wine farms of 50 and more ha and situated in areas of less than 30% slope.
Source: Based on data presented in Chapter 6

The distribution of acreage of vineyards and number of wine farms within the farm size classes in areas of less than 30% slope changed throughout 1979-2010. Thus, in 1979-1989, despite an increase in the total acreage of vine plantings in these areas, the share of vineyards in 0-5 ha farm group shrank from over 56% to 40%. Share of vineyards cultivated on farms larger than 5 ha, on the contrary, increased. In particular, the shares of vineyards cultivated on 1) 5-10 ha farms changed from 32% to 39%[14], 2) 10-20 ha farms more than doubled, and 3) farms larger than 20 ha increased from 3.6% to 4.2% (Figures 3.2 and 3.3).

In 1989-2010, the acreage of vineyards of farms smaller than 10 ha and situated in areas with flatter slope was decreasing and of farms larger than 10 ha increasing. In particular, in 1989-1999, the total acreage of vineyards of 10-20 ha farms increased by 102% and in 1999-2010 by 13%. The total acreage of vineyards of 20-50 ha farms increased by 180% in 1989-1999 and by 139% in 1999-2010. Likewise, in 1989-1999 the total acreage of vineyards of farms larger than 50 ha increased by 146% and in 1999-2010 by 173% (Figures 3.2 and 3.3).

[14] Increase in the total acreage of vineyards in 5-10 ha farm group throughout 1979-1989 was also due to the land consolidation measures (experts' opinion).

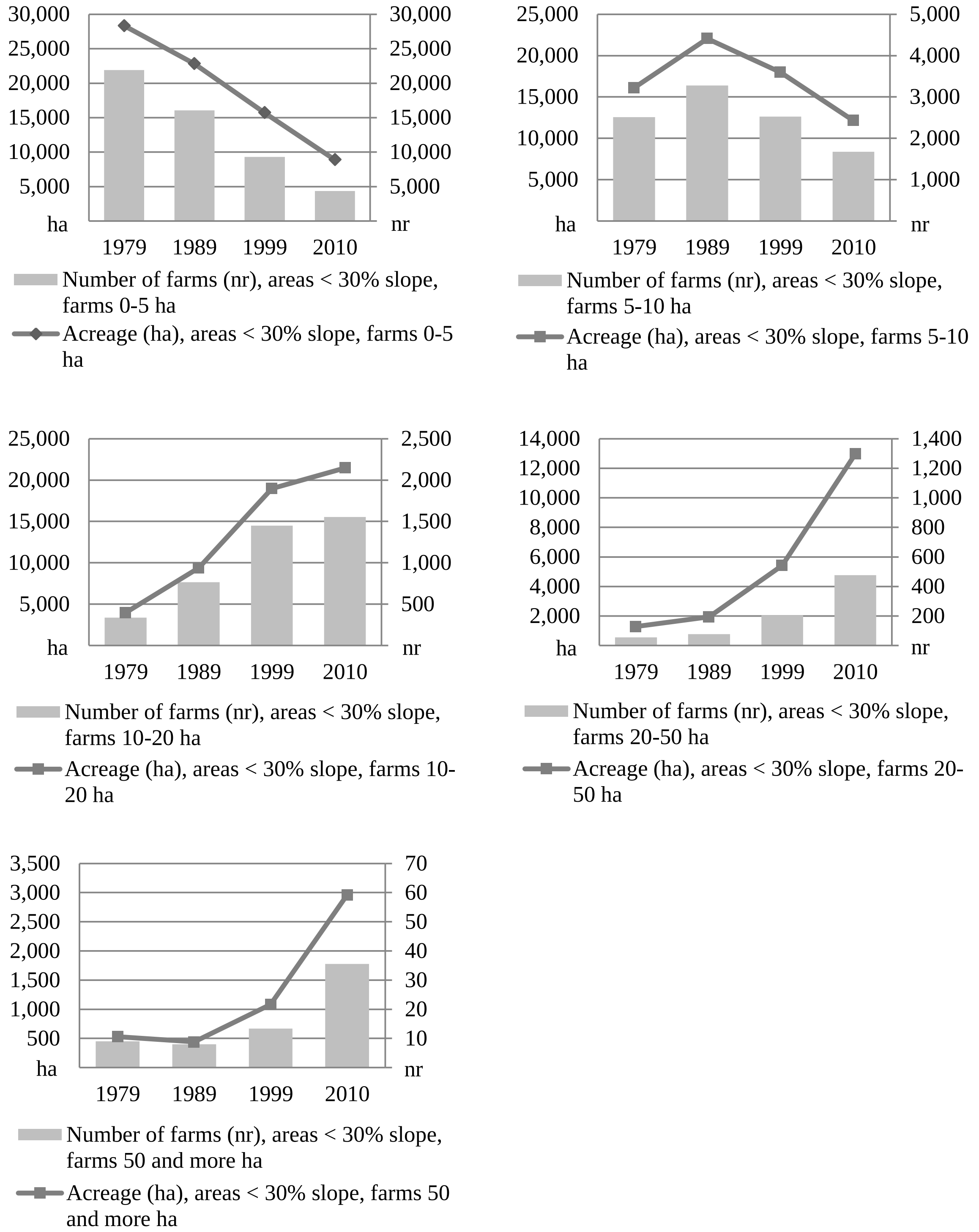

Figure 3.3: Distribution of vineyards and wine farms in areas of less than 30% slope within farm size classes in Rheinland-Pfalz in 1979-2010
Note: ha is hectares, and *nr* is number of farms; *Acreage (ha), areas <30% slope, farms 0-5 ha* indicates total acreage of vineyards of 0-5 ha farms situated in areas of less than 30% slope.
Source: Based on data presented in Chapter 6

In 1979-2010, the number of farms in the smallest farm size class in areas of less than 30% slope decreased from 22 thousands to 4.4 thousands. The number of 5-10 ha farms first increased from 2.5 thousands to 3.3 thousands, and then decreased to 1.7 thousands. The number of 10-20 ha farms increased from 336 to 1.6 thousands. The number of 20-50 ha farms increased from 55 to 477, and of farms larger than 50 ha increased from 9 to 36 (Figure 3.3).

Data on the distribution of vineyards and wine farms in areas of more than 30% slope within the farm size classes are not available for 1979 and 1989. Therefore, only records for 1999 and 2010 are analyzed (Figures 3.4 and 3.5).

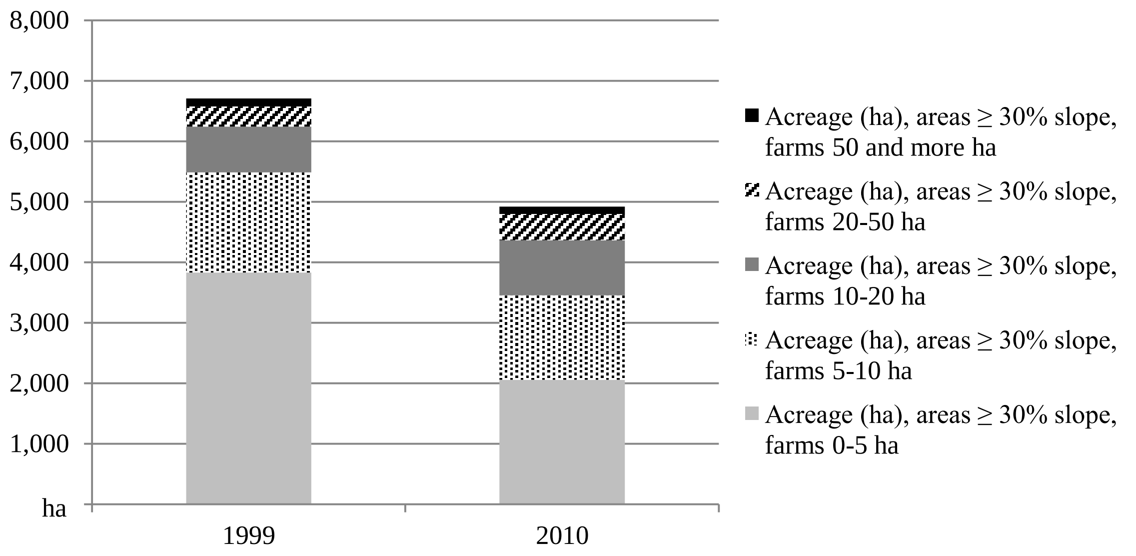

Figure 3.4: Distribution of vineyards in areas of more than 30% slope within farm size classes in Rheinland-Pfalz in 1999-2010
Note: Acreage (ha), areas ≥30% slope, farms 50 and more ha indicates total acreage of vineyards of wine farms of 50 and more ha and situated in areas of more than 30% slope.
Source: Based on data presented in Chapter 6

Although the total acreage of vineyards in areas with steeper slope decreased throughout 1999-2010, areas of vine plantings within some of the farm size classes increased. Thus, the total acreage of vineyards of 10-20 ha farms increased from 756 ha to 910 ha, and of 20-50 ha farms from 336 ha to 435 ha. The decrease of total acreage of vineyards of farms of the largest farm size class from 133 ha to 119 ha is most likely due to differences in the data collection approaches applied in 1999 and 2010 (experts' opinion).

Whereas throughout 1999-2010, the acreage of vineyards of farms larger than 10 ha increased, the acreage of vineyards of farms smaller than 10 ha decreased. In particular, the total acreage of vineyards of 0-5 ha farms decreased from about 4 thousand ha to about 2 thousand ha, and of 5-10 ha farms from 1.7 thousand ha to 1.4 thousand ha.

The distribution of wine farms in areas with steeper slope within farm size classes in 1999-2010 is quite similar to the distribution of vineyards acreage throughout this period (Figure 3.5). Thus, in 1999-2010, the number of 0-5 ha farms decreased from about 2 thousands to about 1 thousand, and of 5-10 ha farms from 232 to 192. On the contrary, the number of 10-20 ha farms increased from 58 to 66, and of 20-50 ha farms from 12 to

15. The change in the number of farms larger than 50 ha is rather marginal. In 1999 there were two of such farms and in 2010 only one. As in the case with acreage of vineyards in this farm size class, such a record is likely the result of differences in the data collection approaches applied in the two observation periods (experts' opinion).

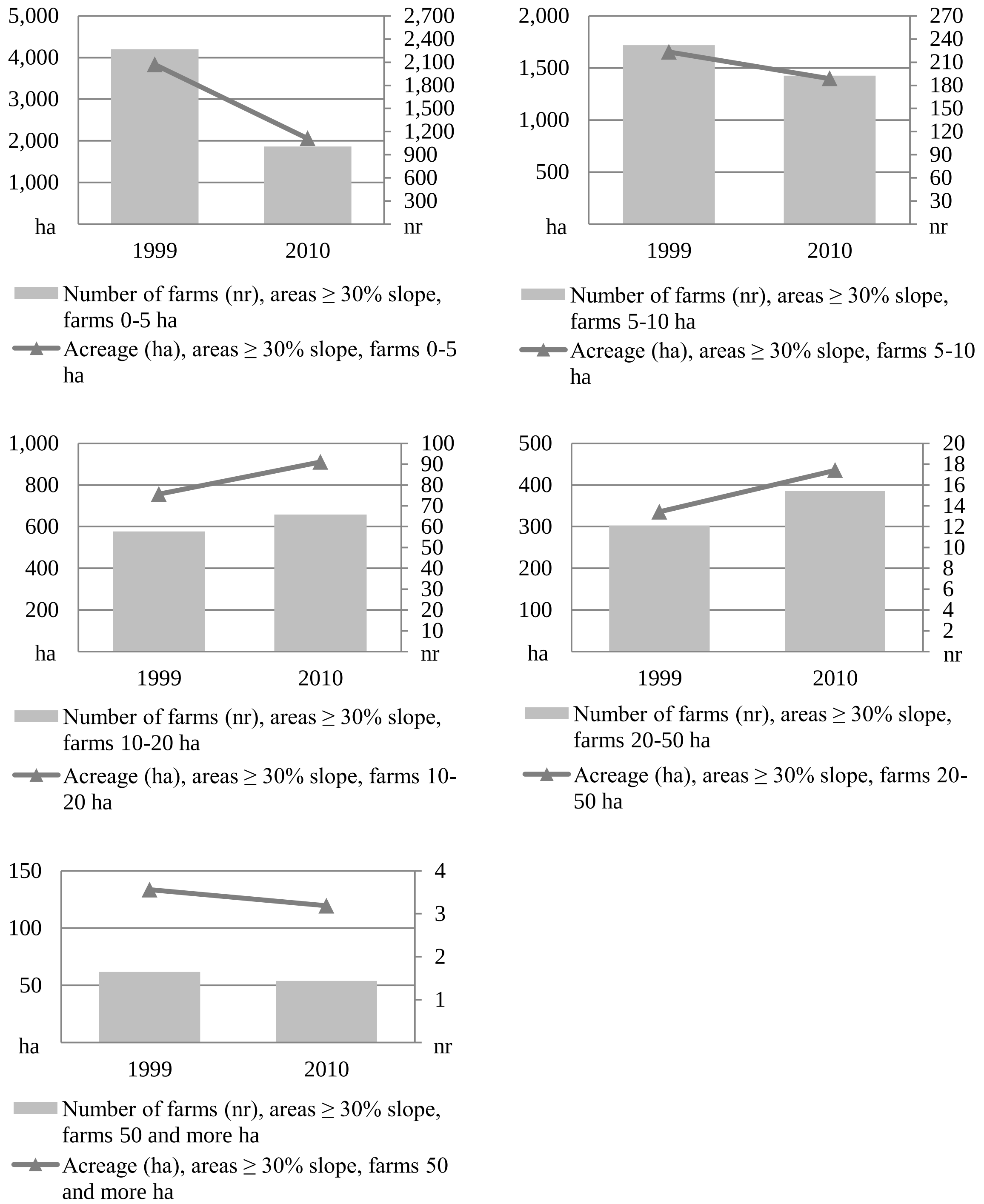

Figure 3.5: Distribution of vineyards and wine farms in areas of more than 30% slope within farm size classes in 1999-2010 in Rheinland-Pfalz
Note: ha is hectares, and *nr* is number of farms; *Acreage (ha), areas ≥30% slope, farms 0-5 ha* indicates total acreage of vineyards of 0-5 ha farms situated in areas of more than 30% slope.
Source: Based on data presented in Chapter 6

3.3 Production, consumption and stocks of wine in Germany

Because production, consumption and stocks of wine in Germany are considered by the market simulation model developed in this dissertation, they are described herein. Thus, in 2005-2010 Germany was producing about 9 million hl of wine annually. This constituted about 3% of the world wine production (about 270 million hl), and 6% of the EU wine production (about 160 million hl). Almost 90% of this wine was PDO wine (DWI 2013 and DWI 2008). The annual quantity of PDO wine of German and foreign origin in stocks was almost similar to its production (SB 2014c).

Total wine consumption in Germany is the fourth highest in the world (DWI 2013). Annual per capita consumption of still wine in this country is 20 liters, and of sparkling wine 4 liters. These correspond to about 32% and 9%, respectively, of private household expenditure on alcoholic beverages[15] (DWI 2013 and DWI 2008). Still and sparkling wine are consumed at least twice a month by, respectively, 30% and 15% of the population (MULEWFRP 2010).

About 39% of still wine is purchased in discount stores, 35% in supermarkets, 18% directly from producers and 8% in specialized shops. 44% of the wine purchased is of German origin. Wine from France, Italy, and Spain constitute about 37% of the total wine consumption quantity. 12% of the wine purchased is from the rest of the EU countries, and 7% from non-EU countries. Whereas red and white wine of German origin are consumed in equal shares, 60% of the consumed imported wine is red wine. Around 10% of wine of German and foreign origin are rose wine. About 60% of consumed German wine is produced in Rheinland-Pfalz (DWI 2013 and DWI 2008).

3.4 Export and import of wine in Germany

Germany imports wine from – and exports it to – other EU and non-EU countries. Whereas trade within the EU is free of border protection measures, imports from third countries are levied with import tariffs. The latter are applied in EUR per hectoliter of wine of fresh grapes, including fortified wines and wine must, vermouth and other flavored beverages, alcohol, vinegar and grape juice. The values of import tariffs on wine depend on alcoholic strength, container size and the import price of the beverage (EU 2009). In addition to border customs, imported wine is levied with value added tax (VAT).

[15] Total private household expenditure on alcoholic beverages in Germany is almost 11 billion EUR (DWI 2013 and DWI 2008).

There are no direct export refunds for wine or any other alcoholic drinks in the EU (EC 2010).

The main importers of wine in Germany are Italy, France and Spain. In 2005-2010, around 3 million hl of still PDO wine and 9 million hl of table wine, sparkling wine (excluding Champagne), aromatized wine and liquors were annually imported to Germany. The total quantity of wine imported from non-EU countries was relatively small: around 2.5 million hl. USA, Australia, Chile, South Africa and Argentina are the main non-EU wine importers in Germany. They import almost 90% of the total volume of non-EU wine.

The annual export quantity of wine from Germany is around 1.5 million hl. More than 80% is PDO wine. The product is mainly destined to Italy, Spain, France, Chile, Argentina, Australia, New Zeeland, USA, South Africa and Portugal (VDW 2011).

CHAPTER 4

Previous analytical work on the effects of abolishment of planting rights

Quota limits on agricultural produce in the EU such as sugar, milk and wine have been in place for decades. Whereas sugar and wine markets are still regulated by production quotas, milk quota regime has already come to an end. Assessment of its economic impact has, however, begun earlier. In 2008, for example, Zohra et al. (2008) presented a study on quantitative assessment of the effects of milk quota removal on the EU dairy sector, where spatial multi-periodic equilibrium model of the world dairy industry was applied. The analysis showed that phasing out milk quota would result in increase of milk supply and export and decline in milk price. A study by the European Commission, EC (2009), supported these results. For assessment of regional effects of the reform, an agricultural sector model, CAPRI (Common Agricultural Policy Regionalized Impact analysis model, Zintl and Kempen 2011), was applied. The key results of this analysis are increase in production of milk, cheese and butter at EU and EU member states levels and decline in the respective prices.

Possible future abolishment of the EU sugar quota has, as well, led to an extensive research on economic impacts of such a change. In Nolte et al. (2011), for example, the effects of phasing out of the EU sugar quota on the internal market are analyzed. The authors applied a spatial equilibrium model of the world sugar market. The results suggest increase in sugar production and decrease of its import. Burrell et al. (2014) applied the CAPRI model for simulation of the effects of the reform. The findings include increase in the EU production of sugar beet and sugar, and decrease of trade of sugar, prices and the beet sector income.

An importance of the reformation of planting rights system in the EU wine sector has also generated a number of studies. Thus, Deconinck and Swinnen (2015) developed a theoretical model for the analysis of effects of planting rights relaxation on the markets of land, planting rights and wine. Their main findings include lower market prices of wine, higher prices of land, greater production quantity of wine, positive welfare changes for the consumers and new entrants into the wine sector, and negative welfare changes for the owners of vineyards and current wine producers.

A study conducted by the request of the European Parliament's Committee on Agriculture and Rural Development (EP 2012) comprises: 1) the estimation of area planted with vines in response to market prices of wine (i.e., Nerlove model); 2) the exploration of income evolution and profitability of wine grapes growing with data from the Farm Accountancy Data Network (FADN) database; 3) a simulation of optimal distribution of agricultural land between agricultural activities with a positive mathematical programming model; and 4) a qualitative analysis of structural impact of the reform on wine industry in the EU member states. The study concludes that: 1) the harvested area of vineyards depends on fluctuations of prices of wine; 2) there is a possibility of pressure towards wine production after the liberalization due to higher profitability of grape production in comparison to the other crop-producing agricultural activities; and 3) a decrease in the number of producers of PDO wine and in the number of smaller farms might be expected.

Montaigne et al. (2012) analyzed socioeconomic impacts of the reform in several EU and non-EU wine producing regions in retrospective. The key results include change in distribution of vineyards, overproduction of wine and price pressure in case of liberalization of planting rights. In a study of Montaigne and Coelho (2006) it is concluded, that abolishment of planting rights regime might result in 1) distribution of vineyards to the areas where more cost-efficient production is possible, 2) a leading role for capital intensive production forms, 3) oversupply of wine, and 4) problems with quality labeling.

In EC (2012) a quantitative analysis of the effects of planting rights on different aspects of development of the EU wine sector was conducted. The authors concluded that planting rights limited the expansion of the wine-growing areas, disturbed the adjustment of the wine sector to the market conditions and limited the production of wine types other than PDO and PGI wines. An earlier research of the European Commission (i.e., EC 2004) emphasizes that planting rights penalize big and dynamic producers due to the limited possibilities of extending their business. Small and traditional producers are, on the contrary, enabled to continue their activities. It is also mentioned that planting rights play a role in keeping wine surplus at a low level but do not completely eliminate it.

Most of the aforementioned studies on planting rights agree that liberalization of planting rights might result in increased wine production, pressure towards production of other than PDO wine and an emphasis on more cost-effective forms of production. The extent of these effects, however, is not similar within these studies due to differences in the research methodologies, the data used and the regions studied.

CHAPTER 5

A model for simulation of the effects of abolishment of planting rights on the wine sector in Rheinland-Pfalz

There is a rich variety of concepts and approaches that are used in simulation of policy changes in the agricultural production sector. The modeling techniques are usually econometric, simulation and programming; the model may be static or dynamic, and may focus on single or several commodities; economic equilibrium may be partial or general, and the results aggregated to regional, national or multinational levels. Britz and Witzke (2013), Garforth and Rehman (2006), Balkhausen and Banse (2005) and Tongeren et al. (2001) provide extensive overview of agricultural policy simulation models and techniques developed in the last decades.

The objective and dataset of this dissertation, as well as the characteristics of wine production sector in Rheinland-Pfalz determine the choice of the modeling framework applied. In particular, a comparative static regional partial net-trade equilibrium model is developed. It consists of four simulation blocks: supply, demand, structural change of the sector and closure. An overview of the equations and parameters of the model is presented in Table A-5.1 of Annex to Chapter 5. The model simulates the distribution of vineyards in Rheinland-Pfalz according to their size class 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 in 2021. The model is run for scenarios of different levels of market prices of wine must and land rental prices, restricted and liberalized planting rights and a scheme of authorizations for vine plantings. The reform on liberalization of planting rights and their conversion into a scheme of authorizations for vine plantings is assumed to enter into force in 2016.

This chapter is organized as follows. The first section, describes the modeling approach with regard to characteristics of the wine sector in Rheinland-Pfalz. The remaining sections present a detailed description of every simulation block of the model and a review of the respective literature.

5.1 Description of the modeling approach with regard to characteristics of the wine sector in Rheinland-Pfalz

Modeling of the wine sector in Rheinland-Pfalz requires a sophisticated approach. The sector endows a variety of characteristics that complicate an approximation of the analyzed market by the model. Modeling complexity is posed by:

- Diversity of wine grapes processing outputs in terms of product types and wine quality levels;
- The 4-year maturation period of vines;
- The system of planting rights adopted in Rheinland-Pfalz;
- A quota on per hectare production of wine with respect to wine production regions and quality categories of wine;
- Industry heterogeneity with respect to cost-efficiency of wine farms (i.e., larger farms in areas with flatter slope produce wine grapes at lower costs than smaller units in areas with steeper slope); and
- Growth of average size of the wine farms observed in the last decades.

Starting from the very first step of the wine market simulation, a modeler must deal with the problem of multiple output. Output of wine producers in Rheinland-Pfalz might include several types of wine and wine must. Consequently, depending on the quantity and quality of grape yield and the current and expected market situations, one or more production options may be realized (on individual expectations in agriculture see Knapp 1987).

Standard and basic quality wine must are considered in this research. Standard quality wine must is used for production of QbA wine, and basic quality wine must is Grundwein. Grundwein is further processed into table wine, sparkling wine, liquors, wine beverages and traditional drinks such as Glühwein (experts' opinion). An important advantage of such a disaggregation level is relative homogeneity of production costs and of market prices of these products.

There are three main characteristics of wine grapes growing that distinguish this type of agricultural activity from annual crops production. First, as many other perennial crops, grapevines are characterized by three basic stages of development: maturation, maturity (when yields are the highest) and decline. With regard to these growth stages, supply of wine must can be modeled in three ways. The first way is to model the acreage of only wine bearing plants. The second way is to model new plantings by using the maturation-period lag. And the third option is to model new and grubbed up plantings

(Cutts et al. 2007). The second characteristic of wine grapes growing is that changes in the area under grapevines and age-composition of a vineyard from one year to the next represent the effect of farmers' decisions upon new plantings, uprooting and replanting. The third and last characteristic is that both current and past levels of inputs influence the current and future yields (Bellman and Hartley 1985). The aforementioned three features result in dynamic nature of wine grapes and wine must production functions. In this dissertation a static function of wine must production is used, and total acreage of vineyards is modeled as wine bearing plants.

The wine sector in Rheinland-Pfalz is characterized by decreasing average total production costs throughout the range of observed production scales. Ten mutually exclusive groups of wine farms are included in this study. These groups are differentiated according to the acreage of vineyards of the farms and type of area where the vineyards are situated. The groups are presented in Table 5.1.

Table 5.1: Groups of wine farms included in the analysis

Wine farms situated in areas of more than 30% slope:	Wine farms situated in areas of less than 30% slope:
1) wine farms of <5 ha	6) wine farms of <5 ha
2) wine farms of 5-10 ha	7) wine farms of 5-10 ha
3) wine farms of 10-20 ha	8) wine farms of 10-20 ha
4) wine farms of 20-50 ha	9) wine farms of 20-50 ha
5) wine farms of >50 ha	10) wine farms of >50 ha

Source: Author's presentation, based on data presented in Chapter 6

Starting from the smallest farm group that is 0-5 ha, average production costs of wine must decrease with increase of the farm size. As a 60-ha farm is already a large unit for the wine sector in Rheinland-Pfalz, it makes sense to neglect the possibility of farm growth beyond this size in the study. Wine must production costs also decrease with decreasing slope of the area where a vineyard is situated. Thus, production costs of a wine farm larger than 50 ha and situated in area of less than 30% slope represent the lowest costs of wine must production in Rheinland-Pfalz.

In the simulation model developed in this dissertation, total possible acreage of vineyards is limited by the projection of AgroScience (2012). That projection takes into account environmental (temperature, sunshine hours, areas with possibility of extremely low temperatures, areas with cold air flow, precipitation, and areas where wine grapes cultivation is not possible due to the small parcels) and anthropogenic (program Natura 2000, nature protection areas and permanent pastures) limits to planting of vines (Table 5.2).

Table 5.2: Maximum acreage of land suitable for vine growing in Rheinland-Pfalz

Slope of area, %	Maximum acreage of vineyards, ha
<10%	152,397
10% – 20%	39,186
20% – 30%	4,726
>30%	5,319
Sum	201,628

Source: Based on AgroScience (2012)

The total acreage of land suitable for vine planting in Rheinland-Pfalz amounts to slightly over 200,000 ha. About 76% (3%) of these hectares are found in areas of less than 10% (more than 30%) slope. The remaining hectares are found in areas between 10% and 30% slope.

Those farms that produce top-premium wine[16] in Rheinland-Pfalz are not considered in this study. Since production of this quality category of wine must requires much higher production costs in comparison to the production of standard quality wine must (experts' opinion), quantity of top-premium wine must produced in Rheinland-Pfalz, as well as the acreage of vineyards for production of this product are excluded from the calculations.

Per hectare production quota and characteristics of production of standard and basic quality wine must define a decision-making process of a wine must producer: "what quantity of standard and basic quality wine must should be produced, since it is possible to market some of the standard quality wine must as basic quality category?" (Figure 5.1).

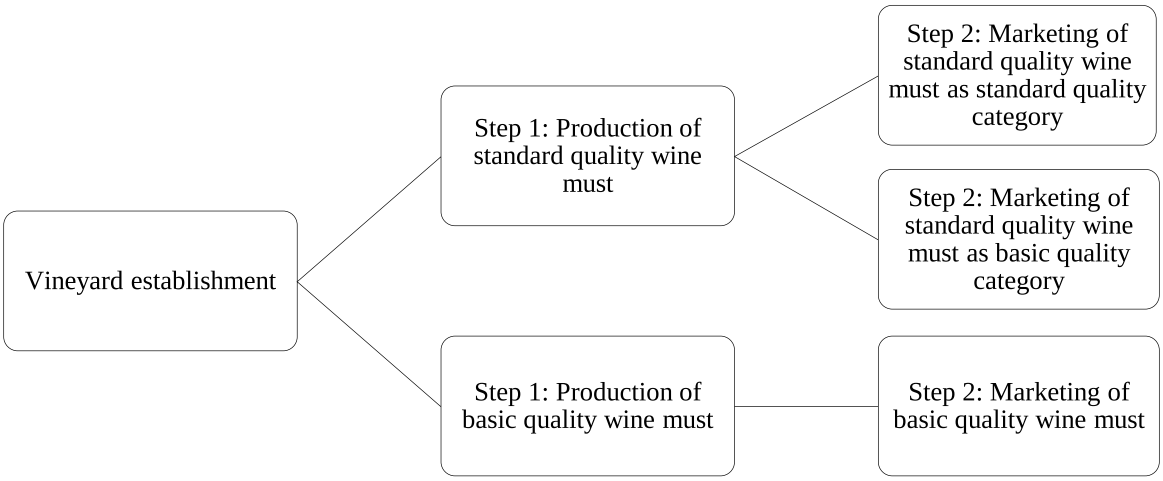

Figure 5.1: Decision-making process of a farmer with regard to wine must production and marketing
Source: Author's presentation, based on experts' opinion

[16] Top-premium wine belongs to QbA quality category of wine. See Section 3.1 on production quantity of top-premium wine in Rheinland-Pfalz.

As Figure 5.1 shows, if basic quality wine must is produced, the output can be marketed only as basic quality category, whereas if standard quality wine must is produced, the output can be sold as basic quality category as well. Thus, three types of output are simulated: standard quality wine must sold as standard quality category, standard quality wine must sold as basic quality category, and basic quality wine must sold as basic quality category.

Currently, wine must producers in Rheinland-Pfalz aim at production of standard quality wine must. Their target yield is about 120 hl/ha. This yield is somewhat higher than the respective production quota. This is the so-called “security yield”. It means that wine producers aim at production and marketing of standard quality wine must but secure themselves against poor and low quality yields. Thus, if yield happens to be greater than the production quota, then with regard to the market prices of standard and basic quality wine must, producers might opt for selling some of their standard quality wine must as basic quality category (experts’ opinion).

In the model developed in this dissertation, if a new vineyard is being established, the farmer may choose between all the aforementioned production options. Since a vast majority of vineyards in Rheinland-Pfalz are focused on production of standard quality wine must (experts’ opinion), there are only two production and marketing options defined in the model for already established vineyards: production of standard quality wine must and selling it as standard quality category, and production of standard quality wine must and selling it as basic quality category.

In Rheinland-Pfalz the number of smaller wine farms eventually decreases, while that of larger farms increases. This is included in the policy model. In particular, future wine farms distribution is projected by using historical growth rates of the farms and applying conditions of the economic theory for entrance into – and exit from – the sector.

A feature of the wine sector which is particularly relevant for specification of the demand for wine is the imperfect substitution between wine of different origin, quality categories, types (e.g., color and grape variety) and their possible combinations (e.g., red wine from Spain and white wine from Germany). With regard to studies on demand for wine in Germany (i.e., MULEWFRP 2010 and MWVLWRP 2006), wine of German origin is likely to be substitutable by imported wine. However, because the model developed in this dissertation is of net-trade type, wine produced in Germany and Rheinland-Pfalz and imported wine are assumed to be perfect substitutes.

5.2 Supply model

The following two sections provide a review of the literature on modeling the supply response of wine and wine grapes, and a description of modeling of wine must supply in Rheinland-Pfalz.

5.2.1 State of the art: modeling of supply of wine and wine grapes

There are a number of studies which analyze the supply response of perennial crops. Some of them comprise extensions to the model of annual crop supply by Nerlove (1956)[17] (French and Mathews 1971, Hartley et al. 1987, Mitra et al. 1991, etc.). Such models are most frequently estimated econometrically. The estimators include ordinary, unrestricted, generalized, non-linear and multi-stage least squares estimator (LSE), maximum likelihood and generalized method of moments. The other studies apply approaches of mathematical programming, equilibrium modeling and Monte Carlo simulation. Selected studies that apply the aforementioned simulation techniques are presented in Table A-5.2 of Annex to Chapter 5. Here, only the studies that analyze the supply response of wine and wine grapes are reviewed.

Among the first research on supply of wine is Wohlgenant (1982). In this work, equations of processing demand, production, price and inventory of wine in California (USA) are estimated with three-stage LSE. The equations are represented by the functions of expected prices of inputs, index of expected marketing prices and expected level of all wine shipments.

In 1987, Szidarovszky and Szenteleki developed a multi-objective dynamic programming model for wine grapes in Hungary. Two linear objective functions are defined in this model. The first function is the net profit from wine production, and the second function is the manpower demand. The constraints include land areas, technological constraints on wine production and balance equations for volumes of grape juice and wine. The model is solved by the methods of sequential optimization, weighting method, goal programming, compromise programming and ε-constraint (Szidarovszky and Szenteleki 1987).

In Kaine and Gow (1994), supply response in grape production to a vine pull scheme is analyzed. The model developed is based on microeconomic investment theory. In particular, optimal commercial life of vines is estimated as a function of salvage value

[17] The Nerlove model is estimated as a reduced form econometric model in which area cultivated is a function of past crop areas and prices.

of the grape enterprise. The salvage value of the enterprise is a function of present value of investment into wine grapes production. The authors conclude that assistance for removing vines (i.e., vine pull scheme) increases the salvage value of the enterprise that, in turn, decreases the commercial life of a vineyard (i.e., producers are encouraged to remove vines).

In 2001, Wittwer et al. developed a partial equilibrium model for wine production in Australia. In this model, wine producers' selection process between intermediate inputs from domestic and import sources and between primary production factors is modeled with constant elasticity of substitution production functions. The relationship between inputs and output is represented by a Leontieff production function (Wittwer et al. 2001).

In Cutts et al. (2007), grape production is estimated as a function of total vine numbers and five year moving average yield. Total vine numbers are modeled as a function of the total vine numbers in period t-1, the real price of competing crops lagged four years and weighted sum of all the varietals' expected real gross returns.

Franklin et al. (2012) developed an econometric dynamic model which included age composition of vineyards, crop establishment period, input use and age-dependent yields. In Oczkowski (2014), equations of quantity transacted, of demand and supply of wine grapes in Australia are estimated with maximum likelihood estimator. Tozer et al. (2014) present an econometric model where wine grape growers optimize their portfolio by balancing planting and removal decisions. These decisions are the functions of expected returns from wine grape production and from production of their substitutes.

5.2.2 Modeling of supply of wine must

The supply response model developed in this dissertation combines three simulation techniques: partial equilibrium modeling, mathematical programming and Markov chain (MC). The model of supply of standard and basic quality wine must consists of two functions presented in equations (5.1) and (5.2).

$$
\begin{aligned}
(5.1)\quad Qs\_q = \text{sum}\,\{&(0, \text{if } AVC\_hl\_q\_N10 < P\_q),\\
&(N10\_q, \text{if } AVC\_hl\_q\_N10 \leq P\_q < AVC\_hl\_q\_N9),\\
&(N10\_q + N9\_q, \text{if } AVC\_hl\_q\_N9 \leq P\_q < AVC\_hl\_q\_N8),\\
&(N10\_q + ,\ldots, N1\_q, \text{if } AVC\_hl\_q\_N1 \leq P\_q)\}
\end{aligned}
$$

(5.2) $Qs\_g = \text{sum}\,\{(0, \text{if } AVC\_hl\_g\_N10 < P\_g),$

$(N10\_g, \text{if } AVC\_hl\_g\_N10 \le P\_g < AVC\_hl\_g\_N9),$

$(N10\_g + N9\_g, \text{if } AVC\_hl\_g\_N9 \le P\_g < AVC\_hl\_g\_N8),$

$(N10\_g + ,\ldots, N1\_g, \text{if } AVC\_hl\_g\_N1 \le P\_g)\}$

where

- Qs_q and Qs_g are, respectively, quantities of standard and basic quality wine must production in Rheinland-Pfalz; and *(in alphabetical order)*
- AVC_hl_g_N1 – AVC_hl_g_N10 are average (per hectoliter) variable costs of production and marketing of basic quality wine must of the wine farm groups (wine must can be produced either as standard or basic quality wine must);
- AVC_hl_q_N1 – AVC_hl_q_N10 are average (per hectoliter) variable costs of production of standard quality wine must of the wine farm groups;
- N1_g – N10_g are marketing of basic quality wine must by the wine farm groups (wine must can be produced either as standard or basic quality wine must);
- N1_q – N10_q are production of standard quality wine must by the wine farm groups;
- N1 – N5 are farm groups: <5 ha, 5-10 ha, 10-20 ha, 20-50 ha and >50 ha situated in areas of more than 30% slope (see Table 5.1);
- N6 – N10 are farm groups: <5 ha, 5-10 ha, 10-20 ha, 20-50 ha and >50 ha situated in areas of less than 30% slope;
- P_q (P_g) is price of standard (basic) quality wine must.

In the model, producers of wine must are represented by ten mutually exclusive farm groups (see Table 5.1 in Section 5.1). Standard quality wine must can be produced from vineyards situated in areas of less and more than 30% slope (i.e., by farms of N1 – N10 groups), and basic quality wine must only from vineyards situated in areas of less than 30% slope (i.e., by farms of N6 – N10 groups) (see also Section 5.1). It is, however, possible to market standard quality wine must as a basic quality category.

It is assumed that:

- An increase in wine must yield results from a proportional increase of production inputs;
- Land quality within regions of more and less than 30% slope is homogeneous;
- Prices of agricultural production inputs (including prices of agricultural land) do not change when the wine must production sector in Rheinland-Pfalz expands or shrinks; and

- The profitability of wine must production exceeds the profitability of production of the rest of agricultural crops in the region.

In the model, marginal and average variable costs of wine must production are equal and constant. Respectively, the short-run supply functions of standard and basic quality wine must of the farm groups are perfectly elastic. The second and third assumptions result in perfectly elastic demand for agricultural production inputs including agricultural land. The aforementioned leads to perfect elasticity of the long-run supply functions of the farm groups. Since short- and long-run supply functions of the wine farm groups are perfectly elastic, the aggregated short- and long-run supply functions of standard and basic quality wine must are stepwise curves. In combination with the other three assumptions, the fourth assumption results in a situation where, if market prices of wine must are higher than – or equal to – the average total costs of wine must production, the acreage of vineyards will increase until the demand for wine must is satisfied and/or the limit of land available for vine planting is reached.

The functions of standard and basic quality wine must production of the farm groups are presented in equations (5.3) and (5.4).

$$\text{(5.3)} \quad N\_q = M\_ha\_q\_cnst\_n \times N\_cnstvrd\_n(Status\_n) + M\_ha\_q\_rllc\_n \times N\_rllcvrd\_n(Status\_n)$$

$$\text{(5.4)} \quad N\_g = M\_ha\_q\_g\_cnst\_n \times N\_cnstvrd\_n(Status\_n) + M\_ha\_q\_g\_rllc\_n \times \times N\_rllcvrd\_n(Status\_n) + M\_ha\_g\_rllc\_n \times N\_rllcvrd\_n(Status\_n)$$

where

- N_q and N_g are, respectively, standard and basic quality wine must production by the farm groups; and *(in alphabetical order)*
- M_ha_g_rllc_n is optimal per hectare production of basic quality wine must of a farm group, from vineyards established after the calibration year;
- M_ha_q_g_rllc_n is optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established after the calibration year;
- M_ha_q_rllc_n is optimal per hectare production of standard quality wine must of a farm group, from vineyards established after the calibration year;
- M_ha_q_g_cnst_n is optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established before the calibration year;

– $M\_ha\_q\_cnst\_n$ is optimal per hectare production of standard quality wine must of a farm group, from vineyards established before the calibration year;
– $N\_cnstvrd\_n(Status\_n)$ is acreage of vineyards of a farm group that have been established before the calibration year and depend on the status of the farm group ($Status\_n$);
– $N\_rllcvrd\_n(Status\_n)$ is acreage of vineyards of a farm group that have been established after the calibration year and depend on the status of the farm group ($Status\_n$);
– $Status\_n$ defines 1) whether a farm group grows, 2) whether acreage of vineyards of a farm group remains constant or declines and 3) whether a farm group exits the sector. If a farm group grows, acreage of vineyards established before and after the calibration year is not zero. If acreage of vineyards of a farm group remains constant or declines, acreage of vineyards established after the calibration year is zero, and of vineyards established before the calibration year is not zero. And if a farm group exits the sector, total acreage of vineyards of a farm group is zero (see Section 5.4).

Standard (basic) quality wine must production of a farm group is a function of 1) optimal per hectare production of standard (basic) quality wine must of a farm group (equations (5.5)-(5.7)), and 2) acreage of vineyards of a farm group that have been established before and after the calibration year (equations (5.8) and (5.9)) and that depend on the status of the farm group (see Section 5.4.2).

Optimal per hectare production of standard and basic quality wine must of the farm groups is estimated with mathematical programming models presented in equations (5.5)-(5.7).

(5.5)
$$\max \{P\_g - ATC\_hl\_g\_n\} \times M\_ha\_g\_rllc\_n + \{P\_q - ATC\_hl\_q\_n\} \times M\_ha\_q\_rllc\_n + \{P\_g - ATC\_hl\_q\_n\} \times M\_ha\_q\_g\_rllc\_n$$
subject to
$$M\_ha\_g\_rllc\_n/HE\_g + M\_ha\_q\_rllc\_n/HE\_q + M\_ha\_q\_g\_rllc\_n/max\_q \leq 1 \text{ and}$$
$$M\_ha\_g\_rllc\_n,\ M\_ha\_q\_rllc\_n,\ M\_ha\_q\_g\_rllc\_n \geq 0$$

(5.6)
$$\max \{P\_q - ATC\_hl\_q\_n\} \times M\_ha\_q\_rllc\_n + \{P\_g - ATC\_hl\_q\_n\} \times M\_ha\_q\_g\_rllc\_n$$
subject to
$$M\_ha\_q\_rllc\_n/HE\_q + M\_ha\_q\_g\_rllc\_n/max\_q \leq 1 \text{ and}$$
$$M\_ha\_g\_rllc\_n,\ M\_ha\_q\_rllc\_n,\ M\_ha\_q\_g\_rllc\_n \geq 0$$

$$(5.7)\quad \max \{P\_q - AVC\_hl\_q\_n\} \times M\_ha\_q\_cnst\_n + \{P\_g - AVC\_hl\_q\_n\} \times$$
$$\times M\_ha\_q\_g\_cnst\_n$$
$$\text{subject to}$$
$$M\_ha\_q\_cnst\_n/HE\_q + M\_ha\_q\_g\_cnst\_n/max\_q \leq 1 \text{ and}$$
$$M\_ha\_q\_cnst\_n, M\_ha\_q\_g\_cnst\_n \geq 0$$

where *(in alphabetical order)*

- ATC_hl_q_n (ATC_hl_g_n) is average (per hectoliter) total costs of production of standard (basic) quality wine must of the farm groups;
- AVC_hl_q_n (AVC_hl_g_n) is average (per hectoliter) variable costs of production of standard (basic) quality wine must of the farm groups;
- HE_q (HE_g) is per hectare production quota of standard (basic) quality wine must;
- M_ha_g_rllc_n is optimal per hectare production of basic quality wine must of a farm group, from vineyards established after the calibration year;
- M_ha_q_g_rllc_n is optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established after the calibration year;
- M_ha_q_rllc_n is optimal per hectare production of standard quality wine must of a farm group, from vineyards established after the calibration year;
- M_ha_q_g_cnst_n is optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established before the calibration year;
- M_ha_q_cnst_n is optimal per hectare production of standard quality wine must of a farm group, from vineyards established before the calibration year;
- max_q is maximum yield of standard quality wine must;
- P_q (P_g) is price of standard (basic) quality wine must.

Models (5.5)-(5.7) are run for each of the wine farm groups separately, and based on the assumption that the quantity produced equals the quantity sold. Model (5.5) estimates the optimal production and marketing quantities of standard and basic quality wine must of farms, vineyards of which are situated in areas of less than 30% slope and have been established after the calibration year. Model (5.6) estimates the optimal production and marketing quantities of standard and basic quality wine must of farms, vineyards of which are situated in areas of more than 30% slope and have been established after the calibration year. And model (5.7) estimates the optimal production and marketing quantities of standard and basic quality wine must of farms, vineyards of which are situated in areas of more and less than 30% slope and have been established before the calibration year.

There are two reasons for distinguishing vineyards established before and after the calibration year and vineyards situated in areas of more and less than 30% slope. The first is that vineyards that have been established before the calibration year produce only standard quality wine must, and vineyards established after the calibration year may produce basic quality wine must as well. The second is that vineyards in areas with steeper slope do not produce wine must of basic quality (experts' opinion).

Objective functions of models (5.5)-(5.7) are net benefits (i.e., total revenue from wine must production minus total/variable costs of wine must production). Total costs of wine must production include expenditures for labor, machinery, plant protection and fertilization measures, buildings, vineyard development, bookkeeping, costs to process grapes into wine must and rental prices of land. Variable costs of wine must production include expenditures for labor, machinery, plant protection and fertilization measures, costs to process grapes into wine must and land rental prices. Direct payments within PAULa support program are included into the variable costs category (see Section 2.5 and Chapter 6).

Models (5.5) and (5.6) take into account total production costs, because they estimate optimal production quantities from vineyards that are to be established (i.e., after the calibration year). Model (5.7) takes into account variable production costs because it estimates optimal production from vineyards that have already been established (i.e., before the calibration year).

The objective functions of the models are maximized subject to per hectare production quotas, maximum yield of standard quality wine must (see Sections 2.3 and 5.1) and non-negativity constraints. 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 that is 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. Maximum yield of standard quality wine must is 120 hl/ha. The unknown parameters of the models are per hectare optimal production and marketing of standard and basic quality wine must (i.e., M_ha_q_cnst_n, M_ha_q_rllc_n and M_ha_g_rllc_n) and per hectare optimal production of standard quality wine must sold as basic quality category (i.e., M_ha_q_g_rllc_n and M_ha_q_g_cnst_n). Yields of standard and basic quality wine must which are produced from vineyards established after liberalization of planting rights are not estimated with models (5.5)-(5.7). They equal the respective production quotas.

Functions for estimation of acreage of vineyards established before and after the calibration year are presented in equations (5.8) and (5.9).

(5.8) If Distr_n_prj – Distr_n_rf > 0, then Distr_n_prj – Distr_n_rf = N_rllcvrd and Distr_n_rf = N_cnstvrd

(5.9) If Distr_n_prj – Distr_n_rf ≤ 0, then Distr_n_prj = N_cnstvrd

where *(in alphabetical order)*

– Distr_n_prj is acreage of vineyards of a farm group projected by MC (see Section 5.4);
– Distr_n_rf is acreage of vineyards of a farm group in the calibration year (i.e., in 2009);
– N_cnstvrd is acreage of vineyards of a farm group that have been established before the calibration year; and
– N_rllcvrd is acreage of vineyards of a farm group that have been established after the calibration year.

Equations (5.8) and (5.9) are run for every farm group. If the difference between the acreage of vineyards projected (Distr_n_prj) and the acreage of vineyards in the calibration year (Distr_n_rf) is positive, this difference corresponds to the area of vineyards which have been established after the calibration year (N_rllcvrd). If the difference between the acreage projected and the acreage in the calibration year is not positive, it corresponds to the vineyards that have been established before the calibration year (N_cnstvrd). The approach used for the projection of the acreage of vineyards is described in Section 5.4.

5.3 Demand model

The following section presents a review of the literature on modeling of demand for wine, and models of demand for standard and basic quality wine must developed in this dissertation.

5.3.1 Literature review on demand for wine

A number of studies are dedicated to the estimation of demand for wine and other alcoholic beverages. Some of them are listed and briefly reviewed in Table A-5.3 in Annex to Chapter 5. Subjects and regions of study, data used and estimation approaches vary widely among these studies. For example, the subjects include alcohol in general, spirits, soft drinks, ready-to-drink alcoholic beverages, wine grapes, liquor, beer and wine of different brands, quality levels, wine grape varieties and type of packaging. The regions of study include Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Federative Republic of Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, UK, USA, etc. The data used include annual, triannual, quarterly, bimonthly and monthly time series, individual and aggregated cross sections, longitudinal data, pooled time series, pooled cross sections and panel data. The models are of dynamic and static nature and, in many cases, estimated within the frameworks of Rotterdam, Almost Ideal Demand System (AIDS), Central Bureau of Statistics (CBS) and National Bureau of Research (NBR)[18] demand models. The estimation approaches include ordinary, generalized, multi-stage, quadratic, weighted and indirect LSE, maximum likelihood, quasi maximum likelihood, full information maximum likelihood, pooled mean group estimators, etc.

Fogarty (2010), Wagenaar et al. (2009), Gallet (2007), Fogarty (2004) and Customs Associated Ltd. (2001) provide an extensive review and analysis of studies on demand for alcohol. Fogarty (2004) considers 64 studies across countries published between 1945 and 1993; Gallet (2007) takes into account 132 studies published throughout 1942-2002; Wagenaar et al. (2009) analyses 112 studies from 1972 to 2007; and Fogarty (2010) reviews 141 studies that analyze data from the period 1911-2000. These four studies suggest that price and income elasticity estimates of demand for alcohol including wine are influenced by estimation techniques and data characteristics. It is also found that wine and alcohol, as commodities, are rather necessities, than luxury goods.

Despite a large number of studies on elasticity of demand for wine around the world, the research for Germany is limited to the work of Labys published in 1976. In this study, income and own-price elasticities of consumer demand for wine are estimated for the Federative Republic of Germany. They equal, respectively, 0.508 and -0.379 (Labys 1976).

[18] Detailed description of Rotterdam demand model is presented in Theil (1965), of AIDS demand model in Deaton and Muellbauer (1980), of CBS demand model in Keller and van Driel (1985) and of NBR demand model in Neves (1987).

5.3.2 Model of demand for wine must

The demand model developed in the current study takes the position that demand for wine must is derived from consumer demand for wine. Respectively, the volumes of wine must demanded by wine processors are represented by the volumes of wine demanded by consumers[19]. The demand functions are described in equations (5.10) and (5.11).

(5.10) $Qd\_q = const\_Qd\_q \times P\_q^{e\_opd\_q} \times P\_g^{e\_cpd\_qg} \times Inc^{e\_id\_q} \times \ Pop$

(5.11) $Qd\_g = const\_Qd\_g \times P\_g^{e\_opd\_g} \times P\_q^{e\_cpd\_qg} \times Inc^{e\_id\_g} \times \ Pop$

where

- Qd_q and Qd_g are, respectively, demand for standard and basic quality wine must in Germany; and *(in alphabetical order)*
- const_Qd_q (const_Qd_g) is constant term in the demand function for standard (basic) quality wine must;
- e_cpd_qg is cross-price elasticity of demand for standard quality wine must with respect to price of basic quality wine must;
- e_id_q (e_id_g) is income elasticity of demand for standard (basic) quality wine must;
- e_opd_q (e_opd_g) is own-price elasticity of demand for standard (basic) quality wine must;
- Inc is real per capita Gross Domestic Product (GDP) growth rate;
- P_q (P_g) is price of standard (basic) quality wine must;
- Pop is population growth rate in Germany.

In this study, wine is modeled as normal good and a necessity[20] (Fogarty 2010 and Labys 1976). The functions of demand for standard and basic quality wine must estimated are constant elasticity demand functions. Among the main disadvantages of such functions is that price and income elasticities are constant over all time and over all levels of the respective variables (Vazquez 1998 and Evans 1994)[21]. Since, however, iso-elastic demand functions are frequently utilized when estimating single equations of demand (Alston et al. 2002, see also Table A-5.3 of Annex to Chapter 5), such functional form is used in the current study as well.

The variables included in the demand functions are own prices, prices of products substitutes, and a proxy for consumer income. Because prices of wine at the retailers' level

[19] Processing ratio of wine must into wine is 1:1 (see also Chapter 6).

[20] One of the main features of "normal" goods is: demand for "normal" goods increases as their market price decreases. A good is a necessity when its income elasticity of demand is less than one.

[21] See also Alston et al. 2002, LaFrance 1986, Deaton and Muelbauer 1980 and Willig 1976a and b.

are not available at the necessary disaggregation level, producer prices of wine must are used in the demand model. Respectively, it is assumed that 1) changes in producer and retail prices are proportional, and 2) the ratio of consumer prices of standard and basic quality wine equals the ratio of producer prices of standard and basic quality wine must[22].

5.4 Sector restructuring model

In the following section, simulation of wine sector restructuring in Rheinland-Pfalz is described. In Section 5.4.1, the approach used for estimation of growth rates of wine farms and the review of the respective studies are presented. Section 5.4.2 describes the method used for modeling of vineyards distribution within the partial equilibrium framework.

5.4.1 Estimation of growth rates of wine farms

This section provides a review of selected studies on the causes and modeling approaches of farms entry, exit and growth. It also presents the two models used in this dissertation for estimation of growth rates of wine farms.

5.4.1.1 Causes and modeling approaches of farms entry, exit and growth

Causes of structural change in agriculture are complex and interrelated. They include economies of scale, farm characteristics, personal features of farmers and general environmental factors (see also Boehlje 1992). Economies of scale imply a decrease of average total production costs with an increase of the production scale. In presence of such, larger farms are more profitable than smaller ones, and every farm aims at growing (see also Dabbert and Braun 2006). Farm characteristics that encourage or depress farm growth comprise location (e.g. better climatic conditions), organizational structure such as off-farm employment and initial ability of farm to accumulate investment capital. Personal features of farmers are, among else, ability to follow technical change in farming (Berenstein et al. 1997), managerial skills and education (Yee and Ahearn 2005). General environmental factors include changes in farm and non-farm markets, in government policies, technological progress and structure of the sector.

The economic literature suggests different possible theoretical and empirical models for analyzing industry dynamics in general, and farmer choices on farm size, entry, and exit in particular (e.g., Hallam 1991). There are studies that are based on competitive

[22] Price elasticities of consumer demand for wine equal elasticities of processor demand for wine must, if changes in producer and retailer prices are proportional (Asche et al. 2002).

equilibrium theory (e.g., Hopenhayn 1992 and Jovanovic 1982), Gibrat's law[23] (e.g., Kostov et al. 2006 and Mansfield 1962) and Cochrane's hypothesis[24] (Cochrane 1958). And there are studies that draw on combinations of these theories. Modeling approaches often applied for the analysis of structural change in agriculture include mathematical programming models, multi-agent systems, econometric models and MC (Zimmermann et al. 2006).

Mathematical programming models simulate farmer decisions based on the optimization procedure[25]. Agent-based systems are based on the optimization procedure as well, but comprise interactions between the units (e.g., Kellermann et al. 2008) in addition. Johnson et al. (1967), for example, applied stochastic linear programming technique for modeling of farm growth. The results show that farm growth, defined in terms of asset accumulation, is influenced by the initial asset position, the investment policy, and crop yield variability. Modified Vickers programming model used in Lowenberg-DeBoer and Boehlje (1986) shows that farmland capital gains encourage growth of farm acreage and extensive farming.

Econometric models are frequently used to identify factors that affect structural change and measure their impact[26]. Glauben et al. (2003), for example, applied econometric estimators to county-level data for regions in western Germany. The results show that farm exit rates are 1) higher in regions with smaller farms, 2) closely related to retirement and succession considerations, and 3) lower in regions with high share of part-time farms.

In Foltz (2004), estimation results of the econometric model of sunk costs and farm capital investment present evidence that (dairy) farm entries and growth[27] are:

- Increasing in the expected prices and farm productivity (and technical sophistication) levels; and
- Decreasing in price variances and the values of returns to alternative uses of agricultural land.

Yee and Ahearn (2005) used panel data from USA farms. They found that public agricultural research and development and extension programs, as well as government payments have positive effects on the farm size. Hüttel et al. (2011) developed a

[23] Gibrat's law states that the proportional change in the size of a firm and its absolute size are independent (Samuels 1965).
[24] Cochrane's hypothesis is based on the idea that as adoption of technological innovation which reduces real per unit output cost at the farm level becomes widespread, commodity prices fall differentially among the farms, initiating structural change (Cochrane 1958).
[25] See also Hennessy and Rehman 2006.
[26] See also Weiss 1999.
[27] In this study, farm size measure is number of cows.

theoretical model for the analysis of impacts of the initial farm size on the exit decision of farms and the distribution of newly available land to the remaining farms. That model was applied to the farm-level data of western Germany. The econometric estimation results revealed that:

- Small farms tend to increasingly leave the market in the presence of many large farms; and
- Large farms tend to grow, because they benefit from lower production costs and, consequently, have higher valuation of additional land resources.

The MC approach uses historical data to uncover patterns of structural change and applies these results for future projection. Since data available for this study are restricted to the records on the distribution of wine farms within farm size classes and type of area, first-order[28] stationary[29] MC is the best suited approach for estimation of their growth rates.

5.4.1.2 Markov chain selected studies

From the plethora of studies on different types of MC (see Zimmermann et al. 2009) that are worth the attention otherwise, only those directly related to the methodological scope of the present analysis are reviewed here.

The application of MC for projection of structural changes in the agricultural production sector has been extremely popular throughout the last sixty years. Judge and Swanson (1961) were the first who suggested applying this approach in analyzing the distribution of agricultural production units. Their idea gave rise to a great number of studies on the theme. Up to 1964, however, only micro-data were used. By dealing with total farm numbers per class per period, Krenz (1964) introduced a new scope for the methodological investigation in this field: the estimation of transition probabilities from an aggregated dataset. Krenz (1964) followed by Keane (1976 and 1991) applied maximum likelihood estimation to assess the transition probability matrix and developed restrictive assumptions on farm growth. The latter was necessary, since this estimator produced a great number of allowed combinations of individual routs when applied to the aggregated sample. Because of strong criticism of the estimation methodology used in these studies (Plas 1983, Stavins and Stanton 1980 and MacRae 1977), the era of search for more accurate methods of estimation of the MC transition probabilities when only macro-data are at hand had begun.

[28] First-order MC implies that the probability of a farm to move from class i to class j in period t depends only on the class i that it occupied in period t-1.
[29] Stationary MC implies that the probability of a farm to move from class i to class j is the same at all time periods.

In 1965, Lee, Judge and Takayama presented a comparative study on the efficiency of unrestricted LSE[30], inequality restricted LSE and minimum absolute deviations estimator in assessing the transition probability matrix for stationary first-order MC from the aggregated dataset (Lee et al. 1965). It was concluded that restricted LSE yields the most accurate probability matrix. In Lee et al. (1969), in order to tackle the heteroscedasticity problem due to application of inequality restricted LSE, weighted restricted LSE[31] was applied. The latter method appeared to be superior over the aforementioned three.

A study by McGuire (1969) stresses the deficiency of weighted restricted LSE[32] and suggests estimation of the MC probability matrix with generalized LSE. Efficiency of this estimator is discussed in Lawless and McLeish (1984) as well. In 1984, Kalbfleisch and Lawless suggested a modified version of the weighted LSE for estimation of the MC transition probabilities. Although this estimator is less efficient than the weighted LSE, it functionally facilitates the independent estimation (Kalbfleisch and Lawless 1984).

In 1996, Lee and Judge presented maximum entropy (ME) and minimum (generalized) cross-entropy principles for estimation of the MC probability matrix (Lee and Judge 1996). The latter principle is applied for estimation of the parameters of non-stationary MC (see Zimmermann and Heckelei 2012, Jongeneel and Tonini 2008, Tonini and Jongeneel 2007 and Karantininis 2002), and the former for estimation of the parameters of stationary MC. It is shown that quality of the ME estimates increases with the number of the transition periods (Golan et al. 1996).

Another methodology suggested for estimation of the MC parameters is based on the estimation of probability generating functions (Crowder and Stephens 2011). The approach in Piet (2011) is referred to as the parametric MC model. Instead of dealing with defined states, the author treats the categories of farms as intervals. This allows deriving MC parameters from probability distribution of the relative change in size farms. The model is then estimated with seemingly unrelated regression equations.

5.4.1.3 Markov chain models for estimation of growth rates of wine farms

In order to determine patterns of structural change in the wine sector in Rheinland-Pfalz, first-order stationary discrete time with exit possibilities MC models are applied. Given that MC is a finite stochastic process, the aforementioned means that:

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[30] See also Goodman (1953), Kao (1953) and Miller (1952).
[31] Proposed by Madansky (1959).
[32] This deficiency lies in ignorance of the covariance among the error terms incorporated into the estimation procedure.

- The probability of a farm to move from class i to class j in period t depends only on the class i that it occupied in period t-1 (i.e., first-order MC);
- This probability is the same at all time periods (i.e., stationary MC);
- Time parameter is discrete or countable[33] (i.e., discrete MC); and
- Any farm can exit the sector (i.e., MC with exit possibilities) (Golan et al. 1996).

MC parameters are estimated with two methods. The first is based on Keane (1991), and the second on Lee and Judge (1996). Selection of such type of MC and of methods of its estimation is determined by characteristics of the data available[34]. The results of estimation of the MC transition probability matrices by the two methods are examined and compared. The probability matrix obtained from application of only one of the approaches is introduced into the policy simulation model.

The probability matrices are estimated for the transition of vineyards within the farm size classes. Movement of vineyards between the areas of more and less than 30% slope is restricted. Thus, vineyards may move only within the farm size classes of area with flatter slope or within the farm size classes of area with steeper slope. Such a limitation is due to the difference in wine must production technology by farms situated in areas of more and less than 30% slope.

Markov chain model based on Keane (1991)

Following Keane (1991), the estimation of MC transition probability matrices is based on a set of assumptions. These assumptions are:

- Increase in a farm size class comes from the next smallest farm size class;
- Farms in the largest farm size group do not enter any other group;
- Decrease in farm size can result only in exit from the sector[35]; and
- Total acreage of vineyards in the previous period equals the total acreage of vineyards in the next period, plus acreage that exit.[36]

As stated in Keane (1991, p. 179), although the MC technique loses some of its usefulness as an analytical tool when the aforementioned assumptions are applied, it

[33] The smallest time step exists.
[34] Data for estimation of non-stationary MC and for examination of order of the process (Sirdari et al. 2013 and Anderson and Goodman 1957) are not available for this research; and the vast majority of methods for estimation of parameters of MC require more data than are available for this study.
[35] This assumption is supported by the fact that decrease in farm size has not been characteristic to the wine sector in Rheinland-Pfalz (experts' opinion).
[36] These assumptions define the MC model applied as reducable and irreversable. The first term implies that it is not possible for a vineyard to move from every state to every state (not necessarily in one move). The second term means that probabilities of transition between states i and j are not equal (Grinstead and Snell 2000).

would nevertheless appear applicable in the case, *“where there has been a consistent movement over time towards fewer and larger numbers”*.

This method requires the use of records on distribution of vineyards in one transition period only. The probability matrix is estimated as presented in equation (5.12):

$$(5.12)\quad p_{ij} = \frac{M_{ij}^{t}}{M_{i}^{t-1}} : j = 1, \dots, r; t = 2, \dots, T$$

where

- p_{ij} is transition probability from state i to state j; and *(in alphabetical order)*
- M_{ij}^{t} is acreage of vineyards moving from state i to state j at time t;
- M_{i}^{t-1} is acreage of vineyards in state i at time t-1;
- r represents farm size classes;
- T-1 is number of time periods.

Markov chain model based on Lee and Judge (1996)

Following Lee and Judge (1996), probabilities of transition of vineyards within the farm size classes are estimated as presented in equation (5.13):

$$(5.13)\quad \max H(p) = -p \times \ln(p) = \sum_i \sum_j p_{ij} \times \ln(p_{ij})$$

subject to

$$(I_k \otimes X_T) \times p = y_T,$$

$$(1 \otimes I_K) \times p = 1 \text{ and}$$

$$p \geq 0$$

where

- p_{ij} is transition probability from state i to state j; and *(in alphabetical order)*
- H is normalized entropy measure;
- $(I_k \otimes X_T)$ is $(TK \times K^2)$ matrix of vineyards distribution in T periods (where $\otimes$ denotes Kronecker product);
- K is number of states;
- p is $(K^2 \times 1)$ vector of transition probabilities;
- T is number of data transition periods;
- X_T is $(TK \times K^2)$ matrix of state outcomes for T transitions;
- y_T is $(TK \times 1)$ vector of state outcomes for T transitions;
- 1 is $(K \times 1)$ vector of ones.

The first constraint is the first-order MC condition. It implies that the probability of a vineyard to move from class i to class j in period t depends only on the class i that it occupied in period t-1. The second constraint represents the condition that the probabilities of movement of a vineyard from state i sum up to one.

The ME concept is quite straightforward. The sum of products of the probabilities and their natural logarithms reaches the maximum when the probabilities are uniform. Uniformity implies the absence of information for estimation of the transition probabilities. Thus, the higher the entropy measure, the higher the uncertainty about occurrence of events.

The ME principle can be applied for at least one transition period. If the MC process is stationary, the use of records for more transition periods results in improved estimates of the transition probabilities. This is demonstrated by a lower normalized entropy measure and increased variability of the estimates. If the MC process is not stationary, the estimates of the transition probabilities shall not improve (Golan et al. 1996).

5.4.2 Modeling of structural change of the wine sector

Results of projection of the vineyards distribution by the MC model, in particular, probabilities of vineyards distribution, are introduced into the policy simulation model via a set of rules. These rules are presented in Table 5.3.

Table 5.3: Rules for simulation of distribution of vineyards among wine farm groups by the policy simulation model

Increasing, constant or decreasing acreage of vineyards according to the projection by Markov chain	Total revenues minus total costs	Total revenues minus variable costs	Status of the farm group
increasing	positive	positive	new entrants
	zero or negative	positive or zero	constant acreage of vineyards
constant or decreasing	positive, zero or negative	positive or zero	if there is at least one farm group of similar location which can absorb additional vineyards, then acreage of vineyards declines as projected. Otherwise, constant
increasing, constant or decreasing	negative	negative	exits the sector

Source: Author's presentation

As presented in Table 5.3, the policy simulation model takes into account trend of movement of vineyards within the farm size classes and profitability of wine must production. In particular:

1) If a farm group is characterized by 1) increasing acreage of vineyards according to the projection by MC, and 2) positive difference between total revenues from – and total costs of – wine must production, then this farm group may absorb new entrants and vineyards that from the other farm groups.
2) If a farm group is characterized by 1) increasing acreage of vineyards according to the projection by MC, 2) zero or negative difference between total revenues from – and total costs of – wine must production, and 3) positive or zero difference between total revenues from – and variable costs of – wine must production, then the acreage of vineyards in this farm group equals to the acreage of vineyards in the calibration year.
3) If a farm group is characterized by 1) constant or decreasing acreage of vineyards according to the projection by MC, 2) positive or zero difference between total revenues from – and variable costs of – wine must production, and 3) there is no farm group situated in same area type (i.e., areas of more or less than 30% slope) that can absorb additional vineyards, then acreage of vineyards in this farm group equals the acreage of vineyards in the calibration year.
4) If a farm group is characterized by 1) constant or decreasing acreage of vineyards according to the projection by MC, 2) positive or zero difference between total revenues from – and variable costs of – wine must production, and 3) there is at least one farm group situated in same area type (i.e., areas of more or less than 30% slope) that can absorb additional vineyards, then acreage of vineyards in this farm group declines as projected by MC.
5) If a farm group is characterized by negative difference between total revenues from – and variable costs of – wine must production, then this farm group exits the sector.

Vineyards that move within the wine farm groups and new entrants draw their distribution from the distribution of vineyards projected by MC. If planting rights are liberalized or converted into a scheme of authorizations for vine plantings, the vineyards draw their distribution from the distribution of vineyards at the end of 2015. The latter is estimated by application of the rules of Table 5.3 to (5.14):

$$(5.14)\ \text{Distr\_n\_2015} = \frac{\text{Distr\_n\_2021} + \text{Distr\_n\_ref}}{2}$$

where

- Distr_n_2015 is acreage of vineyards in a farm group at the end of 2015;
- Distr_n_2021 is acreage of vineyards in a farm group in 2021 projected by MC; and
- Distr_n_ref is acreage of vineyards in a farm group in the calibration year.

5.5 Market clearance and structural change in equilibrium

The following chapter presents a review of selected studies on firm dynamics and market equilibrium, as well as equations for closing of the policy simulation model developed in this dissertation.

5.5.1 Literature review on firm dynamics and market equilibrium

There are a number of equilibrium models that deal with simulation of the effects of policy changes in agriculture. For example: ESIM – European Simulation Model (Grethe et al. 2012), CAPRI (Zintl and Kempen 2011), AGMEMOD – Agricultural Member States Modeling (AGMEMOD Partnership 2008), AGLINK – partial equilibrium model of the world agriculture developed by the OECD (Conforti and Londero 2001), CAPSIM – Common Agricultural Policy Simulation Model (Witzke and Zintl 2005), FAPRI – model of Food and Agriculture Policy Research Institute (Devadoss et al. 1989), etc. There are also equilibrium models that integrate industry dynamics. In 1982, for example, Jovanovic presented a model of industry with homogeneous product but heterogeneous firms in terms of their cost efficiency. In the study, it is assumed that firms are not aware of their productivity levels unless they enter the industry. At entrance, they draw their initial productivity from industry's productivity distribution. A firm takes the decision to exit, if its productivity level is below a certain minimum productivity threshold. In equilibrium, number of firms in the industry is constant (Jovanovic 1982).

Based on the study of Jovanovic (1982), Hopenhayn (1992) developed a dynamic stochastic long-run equilibrium model for competitive industry. This model allows endogenous entry and exit of firms that are induced by exogenous shocks. Entering firms draw their initial productivity from common productivity distribution in the industry, and upon entrance, might face bankruptcy as a result of exogenous shock.

Most of the later studies rest on the theory of Jovanovic (1982) and Hopenhayn (1992). Bernard et al. (2002), for example, presented a theoretical model of endogenous product choice and entry and exit of heterogeneous firms in a closed economy. In the model, firms choose which product to produce by maximizing their profitability. Entry and exit of firms is modeled as in Hopenhayn (1992). In equilibrium, 1) none of the firms receive negative profits, 2) firms are indifferent between producing any of the products, 3) expected firm value equals its entry costs, 4) marginal product values of inputs equal their market prices, and 5) consumer utility is maximized.

Melitz (2003) developed a model of dynamic industry with firms characterized by heterogeneous productivity levels that produce one good. The model analyzes the effects of trade on such an economy. In his model, simulation of entrance and exit of firms follows Hopenhayn (1992). Entry into the export market, however, occurs after firms become aware of their productivity. They take the decision of exporting their output, only if their productivity is higher than a certain threshold (i.e., exporting is profitable). Exposure to trade induces more productive firms to engage in exporting and less productive exit the industry. Consequently, aggregate industry productivity and total welfare increase.

Yeaple (2005) developed a general equilibrium model where firms were characterized by heterogeneous technology, and labor force was characterized by heterogeneous skill. The study extended the work of Melitz (2003) and Hopenhayn (1992). It discovered that firms that engaged in international trade were more productive than those that did not, and that in comparison to the closed economy, in the conditions of open economy revenues per worker and industry productivity rose.

Bernard et al. (2007) developed a general equilibrium model to examine how trade liberalization affects a country's industry and firm characteristics. In the model, in equilibrium, price of a good equals to a mark-up over marginal production costs; expected firm value equals its entry costs; marginal product values of inputs equal their market prices; consumers and producers maximize their utility and profits; and the share of a good in the value of the world's revenue equals the share of a good in the value of the world's expenditure. The study found that when countries liberalized trade, increase in aggregate productivity and loss of rent of scarce resources slowed down.

Demidova and Rodríguez-Clare (2009) presented a model of firm heterogeneity and monopolistic competition, and investigated the effects of trade policy on productivity and welfare. Chavas (2010) developed a model of long-run equilibrium in an industry with heterogeneous firms. He examined implications of cost structure of firms on market equilibrium price, firms' markup and entry and exit of firms. Balistery et al. (2011) applied the theory of Melitz (2003), and developed a general equilibrium model with heterogeneous firms. The model indicated welfare gains from trade liberalization, and greater effect of policy measures on the costs of engagement of a firm in international trade in comparison to tariff barriers.

Kersting et al. (2013) developed a dynamic model of equilibrium in an industry with limited resources and undergoing structural change. In the model, firms produce a homogeneous good and differ with respect to their productivity. They have perfect foresight on market equilibrium prices and choose their optimal production output. Firms that enter the industry or grow pay entry costs (i.e., investment into production capacity). If expected discounted future profits are lower than these entry costs, firms do not enter. If expected discounted future profits are lower than the minimum productivity threshold, firms exit the industry. When the resources are restricted, entry costs grow along with the number of firms. In the model, every period output and input equilibrium prices are adjusted with respect to the number of firms in the industry.

5.5.2 Closure of the model

Market clearing condition for the simulation model is presented in equations (5.15) and (5.16).

(5.15) $\mathrm{Qd\_q} = \mathrm{Qs\_q} + \mathrm{Qs\_q\_RoG} - \mathrm{NT\_q}$

(5.16) $\mathrm{Qd\_g} = \mathrm{Qs\_g} + \mathrm{Qs\_g\_RoG} - \mathrm{NT\_g}$

where

- Qd_q and Qd_g are, respectively, quantities of standard and basic quality wine must demanded in Germany; and *(in alphabetical order)*
- NT_q (NT_g) is difference between quantities of standard (basic) quality wine must exported from – and imported to – Germany;
- Qs_q (Qs_g) is quantity of standard (basic) quality wine must produced in Rheinland-Pfalz; and
- Qs_q_RoG (Qs_g_RoG) is quantity of standard (basic) quality wine must produced in the rest of wine production regions in Germany.

The German wine market is modeled as open and small[37]. Because the main trading partners of Germany in the wine sector are the EU member states (VDW 2011) and the transaction costs associated with importing and exporting wine must are considered equal, domestic market prices of standard and basic quality wine must without the value-added tax represent the import and export prices in the model. The prices are exogenous to the model.

The market of standard (basic) quality wine must is cleared when quantity of standard (basic) quality wine must demanded equals the sum of:

- Production of standard (basic) quality wine must in Rheinland-Pfalz;

[37] 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 do not influence the world market price of wine must.

- Production of standard (basic) quality wine must in the rest of Germany (kept constant); and
- Net-trade quantity of standard (basic) quality wine must in Germany.

In equilibrium, quantity of wine must production in Rheinland-Pfalz depends on the quantity of wine must demanded in Germany and profitability of wine farms. That is, if quantity of wine must demanded exceeds quantity supplied, then new vineyards will be established. The total acreage of vineyards will increase until the quantity of wine must demanded is satisfied or maximum acreage of land available for vine growing is planted with vines. If under certain market prices, demand for wine must in Germany is lower than the quantity of wine must produced from vineyards that have already been established, there will be export of wine must.

CHAPTER 6

Data set and behavioral parameters

This study uses data from the publicly available statistical sources, data provided by the national bureau of statistics of Rheinland-Pfalz and Verband Deutscher Weinexporteure e.V. (VDW 2011), and relies on experts' opinion. The records include values on wine production, consumption, stocks, trade and prices throughout 2005-2010, as well as on the wine farms distribution in Rheinland-Pfalz within the farm size classes and two types of area in 1979, 1989, 1999, 2007 and 2010. Wine must production costs used in this study are differentiated between the production costs of the wine farm groups.

The volumes of wine must production in Germany and Rheinland-Pfalz are differentiated between standard and basic quality wine must. Wine is translated into wine must with a processing ratio of 1:1 (experts' opinion). Since the market of top-premium wine must is not modeled, this type of wine must and the respective acreage of vineyards are excluded from the records.

Available data on consumption of wine in Germany are limited to aggregate records: total and per capita consumption. Thus, per capita standard and basic quality wine consumption in Germany is calculated as presented in formulae (6.1) and (6.2).

(6.1) $Qd\_q = \frac{prod\_q - NT\_q + \Delta stock\_q}{Pop}$

(6.2) $Qd\_g = \frac{prod\_g - NT\_g + \Delta stock\_g - dist\_g}{Pop}$

where

- Qd_q and Qd_g are, respectively, per capita consumption of standard and basic quality wine in Germany; and *(in alphabetical order)*
- prod_q (prod_g) is production of standard (basic) quality wine in Germany excluding top-premium wine from Rheinland-Pfalz;
- NT_q (NT_g) is net-trade quantity of standard (basic) quality wine;
- Δstock_q (Δstock_g) is level of depletion of stocks of standard (basic) quality wine must;
- dist_g is quantity of distilled basic quality wine must;
- Pop is population number in Germany.

In (6.1) and (6.2), standard quality category of wine includes QbA wine. Basic quality category includes Grundwein, and wine of Deutscher Wein and Landwein quality categories. The quantity of standard quality wine in stocks is the sum of quantities of QbA wine of German and foreign origin. The quantity of basic quality wine in stocks is the sum of volumes of all the rest quality categories of wine and wine must. Levels of depletion of wine stocks are calculated as the difference between quantities of standard (basic) quality wine must in stocks in periods t-1 and t. Because distilled wine is not differentiated within quality categories of wine in the original records, the entire quantity of distilled wine is assumed to be of basic quality category. It is also assumed that wine stocks are depleted for domestic consumption only.

Original records on wine trade between Germany and other countries are differentiated between red and white wine, liquors, aromatized wines, sparkling wines, and wine in barrels and in bottles. For modeling purposes, standard quality wine corresponds to the QbA quality category, and basic quality wine corresponds to the sum of table wine, sparkling wines including Perl- and Schaumwein (apart from Champagne), aromatized wine and liquors. Because the share of wine imported to Germany from the EU is more than 80% (VDW 2011), it is assumed that the whole wine import in Germany originates from the EU. Both, goods in bulk and bottles are considered. The difference between quantities of wine exported (including re-export) and imported is the net-trade balance.

As it has already been mentioned in Section 5.1 (Table 5.1), data on distribution of wine farms[38] used in this study comprise records on number of farms and acreage of vineyards within five farm size classes and two types of area. The original records include:

- Total acreage of vineyards and number of wine farms in Rheinland-Pfalz in 1979, 1989, 1999, 2007 and 2010;
- Distribution of vineyards and of number of farms within five farm size classes (i.e., 0-5 ha, 5-10 ha, 10-20 ha, 20-50 ha and 50 and more ha) in areas of less than 30% slope in 1979 and 1989[39];
- Distribution of vineyards and of number of wine farms within nine farm size classes (i.e., 0.3-1 ha, 1-2 ha, 2-3 ha, 3-5 ha, 5-10 ha, 10-20 ha, 20-30 ha, 30-50 ha and 50 and more ha) in the wine production regions in Rheinland-Pfalz (i.e, Ahr, Mittelrhein, Mosel, Nahe, Rheinhessen and Pfalz) in 1999, 2007 and 2010; and

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[38] The records include wine farms with at least 0.3 ha vineyards.

[39] The data on distribution of vineyards and wine farms in areas of more than 30% slope within the farm size classes in 1979-1989 are not available.

- Total acreage of vineyards in areas of more than 30% slope in the wine production regions in Rheinland-Pfalz in 1999, 2007 and 2010.

Because data on the distribution of vineyards and wine farms between the areas of more and less than 30% slope in 1999-2010 are not available, the following calculations are performed. First, data on acreage of vineyards and number of wine farms in the four smallest farm size classes (i.e., 0.3-1 ha, 1-2 ha, 2-3 ha and 3-5 ha) and in the two middle farm size classes (i.e., 20-30 ha and 30-50 ha) are aggregated into farm size classes 0-5 ha and 20-50 ha, respectively. Second, the share of vineyards situated in areas with steeper slope in the total area of vine plantings in Rheinland-Pfalz is calculated for 1999, 2007 and 2010. In particular, the acreage of vineyards in areas with steeper slope in Ahr, Mittelrhein, Mosel and Nahe is divided by the total acreage of vineyards in Rheinland-Pfalz. In Rheinhessen and Pfalz, vineyards in areas with steeper slope constitute less than 1% of the total acreage of vine plantings in these regions. Consequently, Rheinhessen and Pfalz are not taken into account in this calculation.

At the third step, the distribution of vineyards and wine farms within the five farm size classes and two types of area in 1999, 2007 and 2010 is calculated. In particular, the total acreage of vineyards in every farm size class excluding vineyards in Rheinhessen and Pfalz is multiplied by the share of vineyards in areas of more than 30% slope. The acreage of vineyards in areas of less than 30% slope in the farm size classes is, then, calculated as the difference between the total acreage of vineyards and acreage of vineyards in areas with steeper slope. The number of wine farms in the farm groups is calculated as the ratio of acreage of vineyards and average sizes of farms in each of the farm groups.

As has already been mentioned in Section 5.2, wine must production costs include per hectare expenditures for labor, machinery, plant protection and fertilization measures, buildings, vineyard development, bookkeeping, costs to process grapes into wine must and rental prices of land. They correspond to the farms whose vineyards are situated within 3 km distance, and to the reference year of 2009. Farms situated in areas of more than 30% slope receive annual support payments from the PAULa programme. These payments are taken into account when estimating profitability of farms in areas with steeper slope.

The fiscal year of wine industry starts on September 1st and ends on August 31st (EU 2013). Respectively, all the original records, as well as the simulations, refer to this time period. Other parameters included in the model are elasticity values of demand for wine, real GDP and population growth rates in Germany. They are presented in Table 6.1.

Table 6.1: Elasticities of demand for wine and growth rates of population and of per capita real GDP in Germany

Parameter	Value	Source
Own-price elasticity of demand for standard quality wine must	-0.379	based on Labys (1976)
Own-price elasticity of demand for basic quality wine must	-0.900	based on Zhao et al. (2003)
Cross-price elasticity of demand for standard quality wine must with respect to price of basic quality wine must	0.339	based on Gruenewald et al. (2006)
Income elasticity of demand for standard quality wine must	0.508	based on Labys (1976)
Income elasticity of demand for basic quality wine must	0.508	assumed[a)]
Real per capita GDP growth rate in 2007 with respect to per capita GDP in 2009	1.038	author's calculations based on USDA 2014a
Projected real per capita GDP growth rate in 2021 with respect to per capita GDP in 2009	1.266	author's calculations based on USDA 2014a
Population growth rate in Germany in 2007 with respect to population in 2009	1.005	author's calculations based on USDA 2014b
Projected population growth rate in Germany in 2021 with respect to population in 2009	0.977	author's calculations based on USDA 2014b

Note: GDP is Gross Domestic Product.

[a)] Income elasticities of demand for standard and basic quality wine must are equal in the model, because no information is available on the difference between these elasticities.

Source: Author's presentation

Prices

Prices used in the model are prices received by producers of standard and basic quality wine must in Rheinland-Pfalz. They are represented by the wholesale market prices of QbA and Grundwein wines in Rheinland-Pfalz for the period of September to November, and are increased by 10.7% VAT (DLRRP 2009). The wholesale prices of wine from September to November represent the prices of wine must, because in Rheinland-Pfalz the wine grapes are harvested in autumn. The original records on prices are disaggregated according to wine grape varieties and wine production regions. Thus, prices employed in this analysis correspond to weighted averages, the weights being quantities of the wine varieties produced in the production regions of Rheinland-Pfalz.

Because records on consumer prices are not available, prices included in the demand models are producer prices. It is, thus, assumed that, as it has already been mentioned in Section 5.3, 1) changes in producer and retail prices are proportional, and 2) the ratio of consumer prices of standard and basic quality wine equals the ratio of producer prices of standard and basic quality wine must.

CHAPTER 7

Calibration and validation of the model

This chapter describes the results of the model calibration, validation and estimation of growth rates of wine farm groups. The policy simulation model is calibrated to 2009. The General Algebraic Modeling System (GAMS) 23.7 (GAMS Development Corporation, Washington, DC 20007, USA) software package is used to calibrate and estimate the model. Estimation of growth rates of wine farm groups based on Keane (1991) is performed in Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA 98052-6399, USA).

Section 7.1 presents the results of calibration of the demand model. Section 7.2, describes the results of estimation of growth rates of wine farm groups. Section 7.3 presents the results of model validation.

7.1 Calibration of the demand model

The results of calibration of the demand model are presented in equations (7.1) and (7.2).

(7.1) $\mathrm{Qd\_q} = 14{,}219{,}500 \times \mathrm{P\_q}^{-0.379} \times \mathrm{P\_g}^{0.339} \times \mathrm{Inc}^{0.508} \times \mathrm{Pop}$

(7.2) $\mathrm{Qd\_g} = 57{,}689{,}140 \times \mathrm{P\_g}^{-0.900} \times \mathrm{P\_q}^{0.339} \times \mathrm{Inc}^{0.508} \times \mathrm{Pop}$

where

- Qd_q and Qd_g are, respectively, demand for standard and basic quality wine must in Germany; and *(in alphabetical order)*
- Inc is real per capita GDP growth rate;
- P_q (P_g) is price of standard (basic) quality wine must;
- Pop is population growth rate in Germany.

The powers are 0.508, –0.379, –0.900 and 0.339 are values of income, own- and cross-price elasticities of demand. They are also presented in Table 6.1.

The constant terms (const_Qd_g and const_Qd_q) are calibrated in order to set quantities of standard and basic quality wine must consumption in Germany at their base period values. The models are solved separately as equations with one unknown.

7.2 Results of estimation of growth rates of wine farms

The next three sections present the results of estimation of growth rates of wine farms. Sections 7.2.1 and 7.2.2 provide estimates of the MC models based on Keane (1991) and Lee and Judge (1996). Section 7.2.3 provides a comparison of these estimates and concludes the analysis.

7.2.1 Estimates of the Markov chain model based on Keane (1991)

Because estimation of the MC transition probability matrix based on Keane (1991) requires the use of only one transition period, the most recent records on vineyards distribution available are used herein. The records comprise the distribution of vineyards within farm size classes and types of area in 1999 and 2010. The results are presented in Tables 7.1 and 7.2.

Table 7.1: Markov chain probability matrix of transition of vineyards within farm size classes in areas of more than 30% slope; the estimation is based on Keane (1991)

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 ha and more
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.464	0.536	0.000	0.000	0.000	0.000
	5-10 ha	0.000	0.000	0.846	0.155	0.000	0.000
	10-20 ha	0.000	0.000	0.000	0.866	0.134	0.000
	20-50 ha	0.000	0.000	0.000	0.000	0.996	0.004
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
Source: Author’s calculations

Table 7.2: Markov chain probability matrix of transition of vineyards within farm size classes in areas of less than 30% slope; the estimation is based on Keane (1991)

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 ha and more
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.048	0.566	0.387	0.000	0.000	0.000
	5-10 ha	0.000	0.000	0.338	0.662	0.000	0.000
	10-20 ha	0.000	0.000	0.000	0.503	0.497	0.000
	20-50 ha	0.000	0.000	0.000	0.000	0.654	0.346
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
Source: Author’s calculations

The transition probabilities represent the shares of total acreage of vineyards that move from class i to class j in period t of the total acreage of vineyards in class i in period t-1. As presented in Table 7.1, of the vineyards situated in areas of more than 30% slope only those smaller than 5 ha exit the sector. In particular, about 53.6% of total acreage of such vineyards remain in the sector, and 46.4% exit. 15.5% of vineyards of 5-10 ha farms move to the next farm size class (i.e., 10-20 ha farms), and about 84.6% remain in the same farm size class. 13.4% of vineyards of 10-20 ha farms enter the next farm size class (i.e., 20-50 ha farms), and the rest of these vineyards remain in the same farm size class. The largest farm size class (i.e., 50 and more ha) absorbs vineyards from the farm size class of 20-50 ha. In particular, 0.4% of vineyards of 20-50 ha farms move to the largest farm size class.

As presented in Table 7.2, vineyards in areas of less than 30% slope exit the sector only if they are smaller than 5 ha. In particular, by period t, 4.8% of acreage of 0-5 ha farms is expected to exit the sector. At the same time, 38.7% of acreage of 0-5 ha farms, 66.2% of acreage of 5-10 ha farms, 49.7% of acreage of 10-20 ha farms and 34.6% of acreage of 20-50 ha farms are expected to move to the next largest farm size classes.

7.2.2 Estimates of the Markov chain model based on Lee and Judge (1996)

Because total acreage of vineyards in areas of less than 30% slope increases in 1979-1999, and decreases in 1999-2010, the transition probability matrix is estimated for the period 1999-2010 only. Because data on distribution of vineyards in areas of more than 30% slope in 1979-1989 are not available, the transition probability matrix for such vineyards is estimated only for the period 1999-2010 as well.

In this analysis, estimation of transition probabilities is based on one common and four exclusive assumptions. The common assumption is that a decrease in farm size results in exit from the sector[40]. The four exclusive assumptions are:

1) Vineyards from any farm size class can exit the sector;
2) Vineyards of farms larger than 50 ha do not exit the sector;
3) Vineyards of farms larger than 20 ha do not exit the sector; and
4) Vineyards of farms larger than 10 ha do not exit the sector.

If assumptions 1)-3) are applied, the model produces rather unrealistic results. In particular, if assumptions 1) and 2) are applied, 100% of vineyards of 10-20 ha farms in areas with steeper slope and 0% of vineyards of farms smaller than 20 ha in areas with flatter slope exit the sector. If assumption 3) is applied, vineyards of the three smallest farm size classes in areas with steeper slope exit the sector, and vineyards of 0-5 ha farms in areas with flatter slope move to the third and fourth largest farm size classes (Tables A-7.1-7.6 in Annex to Chapter 7). More trustworthy transition probability matrices are produced, if assumption 4) is applied (Tables 7.3 and 7.4).

[40] This assumption defines the MC model applied as reducible and irreversible (Grinstead and Snell 2000).

Table 7.3: Markov chain probability matrix of transition of vineyards within farm size classes in areas of more than 30% slope; the estimation is based on Lee and Judge (1996)[a)]

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.409	0.536	0.055	0.000	0.000	0.000
	5-10 ha	0.128	0.000	0.719	0.154	0.000	0.000
	10-20 ha	0.000	0.000	0.000	0.868	0.132	0.000
	20-50 ha	0.000	0.000	0.000	0.000	0.997	0.003
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumptions are: 1) decrease in farm size results in exit from the sector; and 2) vineyards of farms larger than 10 ha do not exit the sector.
Source: Author's calculations

Table 7.4: Markov chain probability matrix of transition of vineyards within farm size classes in areas of less than 30% slope; the estimation is based on Lee and Judge (1996)[a)]

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.048	0.566	0.000	0.289	0.098	0.000
	5-10 ha	0.000	0.000	0.675	0.318	0.000	0.006
	10-20 ha	0.000	0.000	0.000	0.590	0.317	0.093
	20-50 ha	0.000	0.000	0.000	0.000	1.000	0.000
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumptions are: 1) decrease in farm size results in exit from the sector; and 2) vineyards of farms larger than 10 ha do not exit the sector.
Source: Author's calculations

As presented in Table 7.3, of the vineyards situated in areas of more than 30% slope only those smaller than 10 ha exit the sector. At the same time, 5.5% of the total acreage of 0-5 ha farms move to the next largest farm size class, and 53.6% remain in the initial farm size class. Similarly, 15.4% of the total acreage of 5-10 ha farms move to the next largest farm size class, and 71.9% remain in initial farm size class. 13.2% of acreage of 10-20 ha farms enter the next largest farm size class. Farms larger than 50 ha absorb vineyards from 20-50 ha farms only. In particular, 0.3% of the latter move to the largest farm size class.

As presented in Table 7.4, vineyards in areas with flatter slope exit the sector only if they belong to farms smaller than 5 ha. 4.8% of the acreage of 0-5 ha farms exit the sector, 56.6% remain in the group, 28.9% move to 10-20 ha farm size class, and 9.8% move to 20-50 ha farm size class. Vineyards of 5-10 ha farms move to 10-20 ha farms and to the largest size class. In particular, 31.8% of acreage of these vineyards move to 10-20 ha farms, and 0.6% to the largest farm size class. 31.7% of acreage of vineyards of 10-20 ha farms move to 20-50 ha farms, and 9.3% to the largest farm size class.

7.2.3 Concluding remarks and selection of transition probability matrices

Probability matrices of transition of vineyards within the farm size classes in areas of more and less than 30% slope estimated by the methods proposed in Keane (1991) (Tables 7.1 and 7.2) and Lee and Judge (1996) (Tables 7.3 and 7.4) are rather similar[41]. There are, however, some differences between them:

1) Whereas vineyards of 0-5 ha farms in areas with steeper slope do not move to larger farm size classes in the estimation based on Keane (1991), 5.5% of the acreage of such vineyards move to the next largest farm size class in the estimation based on Lee and Judge (1996);
2) The exit rate of vineyards of 5-10 ha farms in areas with steeper slope in estimation based on Keane (1991) is zero, whereas in the estimation based on Lee and Judge (1996) is 12.8%;
3) In the estimation based on Keane (1991), vineyards of 0-5 ha farms in areas with flatter slope move to 5-10 ha farms, and in the estimation based on Lee and Judge (1996) to 10-20 ha and 20-50 ha farms;
4) In the estimation based on Keane (1991), vineyards of 10-20 ha farms in areas with flatter slope move to 20-50 ha farms, and in the estimation based on Lee and Judge (1996) to 20-50 ha and larger than 50 ha farms; and
5) In the estimation based on Keane (1991), vineyards of 20-50 ha farms in areas with flatter slope move to the next largest farm size class, and in the estimation based on Lee and Judge (1996) they do not leave their size class.

The two MC models applied can be identified as the most suitable to predict the future vineyards distribution in this study, because they are less demanding in terms of data and offer straightforward approaches of handling the problem. While the MC model based on Keane (1991) uses a set of realistic assumptions for the estimation of the transition probability matrix, the MC model based on Lee and Judge (1996) derives maximum information on the movement of vineyards from the available data.

The results from both models indicate that the acreage of vineyards in smaller farm size classes may continue to decline, and in larger ones to increase. These trends will occur, however, if factors which have been affecting the sector so far will continue to influence it to the same extent in the future.

[41] One of the main reasons of their similarity is restrictiveness of the assumptions applied in the MC model based on Lee and Judge (1996).

For further use in the policy simulation model, the estimates of the MC model based on Keane (1991) are selected. Although these estimates are in close proximity to the estimates of the MC model based on Lee and Judge (1996), the former approach makes more use of the expert knowledge which, in the case of limited data, adds reliability to the estimation outcome.

7.3 Results of model validation

Overview of the validation output of the simulation model is presented in Table 7.5. The model simulates general patterns and trends of development of the wine must market in Rheinland-Pfalz and Germany in 2007. The total area of vineyards for production of standard and basic quality wine must in Rheinland-Pfalz is estimated to equal 47,946 ha. It is by about 6% less than that observed in 2007. Farms that are larger than 5 ha and situated in areas with flatter slope are simulated to receive positive economic profits. Their optimal long- and short- run production choice is standard quality wine must. Farm groups "≥30% slope, <5", "≥30% slope, 5-10" and "≥30% slope, 10-20" are simulated to exit the sector. The simulated distribution of acreage of vineyards within the farm groups is quite close to that observed in 2007[42].

[42] One of the reasons for such a result is that the MC transition probability matrices are estimated for the period 1999-2010.

Table 7.5: Results of simulation of markets for standard and basic quality wine must in 2007 and values observed in 2007

Parameter	Units of measure	Observed in 2007	Output of validation to 2007
Standard quality wine must			
Price[a)]	EUR/hl	98.16	-
Demand in Germany	1,000 hl	10,978	8,795
Production in Rheinland-Pfalz	1,000 hl	4,991	5,182
Net-trade in Germany	1,000 hl	-1,919	-284
Basic quality wine must			
Price	EUR/hl	38.09	-
Demand in Germany	1,000 hl	10,928	10,568
Production in Rheinland-Pfalz	1,000 hl	546	0
Net-trade in Germany	1,000 hl	-11,060	-10,548
Average wine must yield in Rheinland-Pfalz	hl/ha	109	-
Yield of standard quality wine must in Rheinland-Pfalz	hl/ha	-	108.07
Yield of basic quality wine must in Rheinland-Pfalz	hl/ha	-	200
Total acreage of vineyards in Rheinland-Pfalz for production of standard and basic quality wine must	ha	50,791	47,946
Distribution of vineyards and profitability of wine farm groups in Rheinland-Pfalz			
≥30% slope, <5[b)]	ha	1,911	0[c)]
≥30% slope, 5-10		1,104	0[c)]
≥30% slope, 10-20		697	0[c)]
≥30% slope, 20-50		341	251[d)]
≥30% slope, >50		96	94[d)]
<30% slope, <5		8,087	8,744[d)]
<30% slope, 5-10		10,493	11,143[e)]
<30% slope, 10-20		17,019	16,555[e)]
<30% slope, 20-50		8,973	9,242[e)]
<30% slope, >50		2,071	1,915[e)]

[a)] Prices of wine must are exogenous to the model. [b)] *≥30% slope, <5* is farm group, vineyards of which are not larger than 5 ha and are situated in areas with more than 30% slope. [c)] indicates that total revenues from – are smaller than variable costs of – wine must production. [d)] indicates that total revenues from wine must production are greater than variable costs but not greater than total costs of wine must production. [e)] indicates that total revenues from – are greater than total costs of – wine must production.
Source: Author's calculations, data presented in Chapter 6

Standard quality wine must production in Rheinland-Pfalz is simulated to equal 5,182 thousand hl. Its optimal per hectare production quantity is 108.07 hl/ha. Quantity of standard quality wine must demanded equals 8,795 thousand hl. It is by almost 20% less than the observed in 2007. Due to the underestimated quantity demanded, net-trade increases from -1,919 thousand hl to -284 thousand hl. Although production of basic quality wine must in Rheinland-Pfalz is simulated to equal zero, its net-trade increases due to the underestimated quantity demanded.

CHAPTER 8

Results of policy simulations

This chapter describes the simulation scenarios and the output of the policy simulation model. Section 8.1 presents the scenarios and Sections 8.2 and 8.3 the simulation results.

8.1 Modeling scenarios

Markets of standard and basic quality wine must are simulated for 2021 using the baseline and ten simulation scenarios:

- 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 of wine must and of land";
- Scenario IX "Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must"; and
- Scenario X "Authorizations, 2009 price of basic quality wine must and lower price of 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 a scheme of authorizations for vine plantings (i.e., "authorizations"). They are also differentiated with respect to the prices of 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 planting rights regime and market prices of standard and basic quality wine must agree with those of 2009 (i.e., "2009 prices"). "Higher prices" correspond to the prices of standard and basic quality wine must that allow farms smaller than 5 ha and situated in areas of less than 30% slope covering their total costs of production of both types of wine must. “Lower prices” represent market prices of standard and basic quality wine must that allow only the farms that are larger than 50 ha and situated in areas of less than 30% slope covering their total costs of production of both types of wine must.

In Scenario VIII “Liberalization, lower prices of wine must and of land“, land rental prices paid by the wine farmers in Rheinland-Pfalz are reduced in order to consider possible decrease of prices of land for vine growing after liberalization of planting rights. For areas of less than 30% slope these prices decrease from 900 EUR/ha to 400 EUR/ha, and for areas of more than 30% slope from 459 EUR/ha to 204 EUR/ha. The reduction rate is based on expected future prices of land suitable for wine grapes cultivation after the liberalization of planting rights (experts’ opinion).

In scenario IX “Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must” price of basic quality wine must corresponds to the price observed in 2009, and price of standard quality wine must to the price that allows the most cost-efficient wine farm group covering their total production costs.

8.2 Simulation results

Modeling output and state of the markets of standard and basic quality wine must observed in 2009 are presented in Table 8.1.

Table 8.1: Situations observed in 2009 and simulated for 2021 regarding markets of standard and basic quality wine must in Germany and Rheinland-Pfalz

Parameter	Units	Observed in 2009	Baseline	Scenarios I, II	Scenario III	Scenario IV	Scenario V	Scenario VI	Scenario VII	Scenario VIII	Scenario IX	Scenario X
Market of standard quality wine must												
Price[a]	EUR/hl	74.27	74.27	74.27	106.63	106.63	106.63	83.59	83.59	78.97	83.59	83.59
Demand[b]	1,000 hl	9,217	10,151	10,151	10,916	10,916	10,916	11,121	11,121	11,173	9,706	9,706
Production[c]	1,000 hl	4,425	4,120	4,120	3,837	7,867	3,837	8,073	3,715	8,124	6,658	5,158
Net-trade[d]	1,000 hl	-2,065	-2,983	-2,983	-4,030	0	-4,030	0	-4,358	0	0	-1,499
Market of basic quality wine must												
Price[a]	EUR/hl	34.36	34.36	34.36	63.79	63.79	63.79	51.34	51.34	48.84	34.36	34.36
Demand[b]	1,000 hl	10,300	11,344	11,344	7,349	7,349	7,349	8,227	8,227	8,441	11,808	11,808
Production[c]	1,000 hl	316	0	0	2,117	7,346	2,670	8,225	2,670	8,438	0	0
Net-trade[d]	1,000 hl	-10,619[l]	-11,341	-11,341	-5,229	0	-4,676	0	-5,554	0	-11,805	-11,805
Total acreage of vineyards in Rheinland-Pfalz for production of standard and basic quality wine must, ha												
		48,744	38,122	38,122	46,089	109,528	48,855	115,822	47,727	117,370	61,604	47,727
Distribution of vineyards and profitability of wine farm groups in Rheinland-Pfalz												
≥30%, <5[e]	ha	1,581	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, 5-10		1,076	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, 10-20		701	0[f]	0[f]	701[g]	701[g]	701[g]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, 20-50		335	0[f]	0[f]	335[g]	335[g]	335[g]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, >50		92	0[f]	0[f]	92[g]	92[g]	92[g]	0[f]	0[f]	0[f]	0[f]	0[f]
<30%, <5		6,838	0[f]	0[f]	3,086[h]	3,086[h]	3,086[h]	3,086[g]	3,086[g]	3,086[g]	3,086[g]	3,086[g]
<30%, 5-10		9,348	9,348[g]	9,348[g]	4,888[h]	4,888[h]	4,888[h]	4,888[g]	4,888[g]	4,888[g]	4,888[g]	4,888[g]
<30%, 10-20		16,515	16,516[g]	16,516[g]	14,144[h]	14,144[h]	14,144[h]	14,144[g]	14,144[g]	14,144[g]	14,144[g]	14,144[g]
<30%, 20-50		9,982	9,982[g]	9,982[g]	17,454[h]	64,718[h]	19,855[h]	9,982[g]	9,982[g]	9,982[g]	9,982[g]	9,982[g]
<30%, >50		2,276	2,276[g]	2,276[g]	5,389[h]	21,564[h]	5,755[h]	83,722[h]	15,627[h]	85,270[h]	29,504[h]	15,627[h]

Note: 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 of wine must and of land", Scenario IX "Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must", Scenario X "Authorizations, 2009 price of basic quality wine must and lower price of standard quality wine must"
[a] Prices of wine must are exogenous to the model. [b] Demand in Germany. [c] Production in Rheinland-Pfalz. [d] Net-trade in Germany. [e] *≥30% slope, <5* is a farm group, units of which are not larger than 5 ha and situated in areas of more than 30% slope. [f] indicates that total revenues from – are smaller than variable costs of – wine must production. [g] indicates that total revenues from wine must production are greater than variable costs but not greater than total costs of wine must production. [h] indicates that total revenues from – are greater than total costs of – wine must production.
Source: Author's calculations, data presented in Chapter 6

8.2.1 Baseline “Planting rights, 2009 prices”, scenario I “Liberalization, 2009 prices” and scenario II “Authorizations, 2009 prices”

If prices of standard and basic quality wine must remain at the 2009 rate (i.e., price of standard quality wine must is 74.27 EUR/hl and of basic quality wine must is 34.36 EUR/hl), the total acreage of vineyards cultivated in Rheinland-Pfalz will be 38,122 ha, irrespective of whether planting rights are retained, liberalized or converted into the scheme of authorizations. This is 22% less than the acreage observed in 2009. Such a decrease results from the exit of farms situated in areas with steeper slope and farms smaller than 5 ha situated in areas with flatter slope. At the prices of 2009, variable production costs of these farms exceed revenues. Although most farms that are situated in areas with flatter slopes remain, their total production costs are greater than the revenues, and consequently an incentive to invest in the establishment of new wine must production capacity is 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. Although there is an option to sell standard quality wine must as a basic quality category, it is not profitable to do so at the prices of 2009. Due to the increased demand for – and decreased supply of – standard quality wine must in comparison to the situation observed in 2009, net-trade quantity of this type of wine must decreases from -2,065 thousand hl in 2009 to -2,983 thousand hl in 2021. Zero production of basic quality wine must and greater demand for it result in an increase in the import of this product.

8.2.2 Scenario III “Planting rights, higher prices”, scenario IV “Liberalization, higher prices” and scenario V “Authorizations, higher prices”

If the prices of standard and basic quality wine must increase to, respectively, 106.63 EUR/hl and 63.79 EUR/hl, farms situated in areas with flatter slope will be able to cover their total production costs. This will result in a change of distribution of vineyards among the farm groups in these areas. In particular, farms smaller than 20 ha will move to farm groups “<30% slope, 20-50” and “<30% slope, >50”. Farms larger than 10 ha and situated in areas with steeper slope will be able to cover only their variable production costs, and, therefore, neither exit the industry nor grow. Their distribution will correspond to the one observed in 2009. Farms smaller than 10 ha and situated in these areas will exit the sector, because they do not cover their variable production costs.

If planting rights are restricted, the total area of vineyards will be 46,089 ha, if they are converted into the scheme of authorizations, 48,855 ha, and if they are liberalized, it will be 109,528 ha. In the first case, the total acreage of vineyards is smaller than the observed in 2009 by the acreage of farm groups that exit the industry. Acreage of vineyards under the regime of authorizations is the maximum that can be planted according to the limitation of 1% of annual increase starting from 2016. If planting rights are liberalized or converted into authorizations for vine plantings, there are new entrants into the industry. They are distributed between the farm groups that are profitable and were growing in 1999-2010 (i.e., farm groups "<30% slope, 20-50" and "<30% slope, >50").

Under the regimes of restricted planting rights and authorizations for vine plantings, production of standard quality wine must will decrease by 7% in comparison to the baseline. If planting rights are restricted, production of basic quality wine must will reach 2,117 thousand hl, and if they are converted into a scheme of authorizations for vine plantings, 2,670 thousand hl. The yield of standard quality wine must will be 108.07 hl/ha and of basic quality wine must 200 hl/ha. Basic quality wine must is produced from the vineyards established after 2009. This is motivated by higher per hectare profitability of basic quality wine must production in comparison to per hectare profitability of standard quality wine must production. In particular, because per hectoliter profitability of basic and standard quality wine must production in Scenarios III and V is equal (i.e., due to the prices of wine must), and yield of basic quality wine must is greater than of standard quality wine must, production of basic quality wine must in these two scenarios is more profitable than of standard quality wine must.

Under the regime of planting rights, net-trade quantity of standard quality wine must is -4,030 thousand hl, and of basic quality wine must -5,229 thousand hl. Under the regime of authorizations for vine plantings, net-trade quantity of standard quality wine must is -4,030 thousand hl, and of basic quality wine must -4,676 thousand hl.

Under the regime of liberalized planting rights, domestic demand for standard and basic quality wine must is satisfied by the domestic production. Respectively, production of standard quality wine must in Rheinland-Pfalz is 7,867 thousand hl, and of basic quality wine must 7,346 thousand hl. The net-trade quantities of these two types of wine must are zero.

8.2.3 Scenario VI “Liberalization, lower prices” and scenario VII “Authorizations, lower prices”

If prices of standard and basic quality wine must are, respectively, 83.59 EUR/hl and 51.34 EUR/hl, the total acreage of vineyards in Rheinland-Pfalz will be 115,822 ha under the regime of liberalized planting rights and 47,727 ha under the regime of authorizations for vine plantings. Farms situated in areas with steeper slope will exit the sector, because they do not cover their variable production costs. Farms situated in areas with flatter slope and smaller than 50 ha cover only their variable production costs and, thus, remain in the industry. Only farms larger than 50 ha are profitable under such market prices. Consequently, they absorb vineyards that move from smaller farm size groups and the new entrants. Thus, acreage of vineyards in farm group “<30% slope, >50” is 83,722 ha under the liberalized planting rights, and 15,627 ha under a scheme of authorizations for vine plantings.

If planting rights are liberalized, production of standard and basic quality wine must satisfy the respective domestic demand. In particular, quantity of standard quality wine must production in Rheinland-Pfalz increases from 4,120 thousand hl in the baseline to 8,073 thousand hl, and of basic quality wine must from zero in the baseline to 8,225 thousand hl. If planting rights are converted into a scheme of authorizations for vine plantings, production of standard quality wine must in Rheinland-Pfalz decreases from 4,120 thousand hl in the baseline to 3,715 thousand hl, and of basic quality wine must from zero to 2,670 thousand hl. The yield of standard quality wine must is 108.07 hl/ha, and of basic quality wine must 200 hl/ha. As in Scenarios III and V, per hectare profitability of basic quality wine must production is greater than of standard quality wine must (i.e., due to the prices of wine must). Therefore, basic quality wine must is produced from vineyards established after 2009.

With respect to the changes in quantities of wine must demanded and produced in comparison to the baseline, net-trade quantities change as well. Thus, if planting rights are liberalized, net-trade quantities of standard and basic quality wine must are zero, because domestic production satisfies the domestic demand. If planting rights are converted into a scheme of authorizations for vine plantings, the net-trade quantity of standard quality wine must changes from -2,983 thousand hl in the baseline to -4,358 thousand hl. Net-trade quantity of basic quality wine must changes from -11,341 thousand hl in the baseline to -5,554 thousand hl.

8.2.4 Scenario VIII “Liberalization, lower prices of wine must and of land”

If rental prices of land are reduced, then 78.97 EUR/hl and 48.84 EUR/hl are, respectively, the prices of standard and basic quality wine must that allow only the most cost-efficient farm group (i.e., “<30% slope, >50”) covering their total production costs. In this case, and if planting rights are liberalized, the total acreage of vineyards in Rheinland-Pfalz in 2021 will increase to 117,370 ha in comparison to 38,122 ha in the baseline. Only “<30% slope, >50” farm group will expand: it will absorb new entrants and vineyards that move from the smaller wine farm groups.

Production of standard quality wine must will reach 8,124 thousand hl, and of basic quality wine must 8,438 thousand hl. The yield of standard quality wine must is 108.07 hl/ha, and of basic quality wine must 200 hl/ha. Because production of standard and basic quality wine must satisfies the domestic demand, the respective net-trade quantities will be zero.

8.2.5 Scenario IX “Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must” and scenario X “Authorizations, 2009 price of basic quality wine must and lower price of standard quality wine must”

If prices of standard and basic quality wine must are, respectively, 83.59 EUR/hl and 34.36 EUR/hl, and planting rights are liberalized, total acreage of vineyards in Rheinland-Pfalz will increase to 61,604 ha in comparison to 38,122 ha in the baseline. If planting rights are converted into a scheme of authorizations for vine plantings, the total acreage of vineyards in Rheinland-Pfalz will increase to 47,727 ha. Farms situated in areas with steeper slope will exit the sector, because their variable production costs exceed revenues. Because the farm group “<30% slope, >50” is the only one with positive economic profits, they will accommodate vineyards that move from the other wine farm groups and the new entrants.

Because the price of basic quality wine must does not allow covering variable costs of production of this type of wine must, only standard quality wine must will be produced. If planting rights are liberalized, the domestic demand for standard quality wine must will be satisfied by the domestic production. In particular, 6,658 thousand hl of standard quality wine must will be produced. The net-trade quantity of this type of wine must will be zero. If planting rights are converted into the scheme of authorizations, 5,158 thousand hl of standard quality wine must will be produced, and net-trade of quantity of this type of wine must will be -1,499 thousand hl. In both scenarios, net-trade of basic quality wine must equals -11,805 thousand hl.

8.3 Summary of impacts

Figure 8.1 provides an overview of the effects of the three policy options analyzed. It presents the results of simulation of the distribution of vineyards in Rheinland-Pfalz among wine farm groups according to size classes and area type, the demand for standard and basic quality wine must in Germany and production of standard and basic quality wine must in Rheinland-Pfalz.

The study finds that if prices of standard and basic quality wine must allow profitable production of these two types of wine must, and planting rights are liberalized, the total acreage of vineyards in Rheinland-Pfalz will increase with respect to the quantities of standard and basic quality wine must demanded and availability of land suitable for vine growing. Respectively, net-trade quantity of wine must in Germany might become zero (Scenarios IV “Liberalization, higher prices”, VI “Liberalization, lower prices” and VIII “Liberalization, lower prices of wine must and of land). If production of only one of the two types of wine must is profitable, only this type of wine must will be produced (Scenario IX “Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must”).

If production of basic and standard quality wine must is profitable and planting rights are retained or converted into a scheme of authorizations for vine plantings, the acreage of vineyards in Rheinland-Pfalz might reach the maximum defined by the policy regime. In addition, newly established vineyards will be used for production of either standard or basic quality wine must depending on which type is more profitable (Scenarios III “Planting rights, higher prices”, V “Authorizations, higher prices”, VII “Authorizations, lower prices” and X “Authorizations, 2009 price of basic quality wine must and lower price of standard quality wine must”).

Movement of vineyards from less to more cost-efficient wine farm groups will take place if at least one of the wine farm groups receives positive economic profits. In particular, land for vine growing will be distributed to the farm groups which are profitable and characterized by positive growth rates in the past. If planting rights are liberalized or converted into a scheme of authorizations of vine plantings, additional land for cultivation of vines will also be distributed to such wine farm groups.

If prices of standard and basic quality wine must remain at the 2009 rate or fall, the liberalization of planting rights and their conversion into a scheme of authorizations for vine plantings will have minor or no effects on the wine sector in Rheinland-Pfalz. In particular, if none of the wine farm groups receive positive economic profits, an incentive to invest into wine must production will be absent, and acreage of vineyards in Rheinland-Pfalz will eventually decline (baseline and Scenarios I “Liberalization, 2009 prices” and II “Authorization, 2009 prices”).

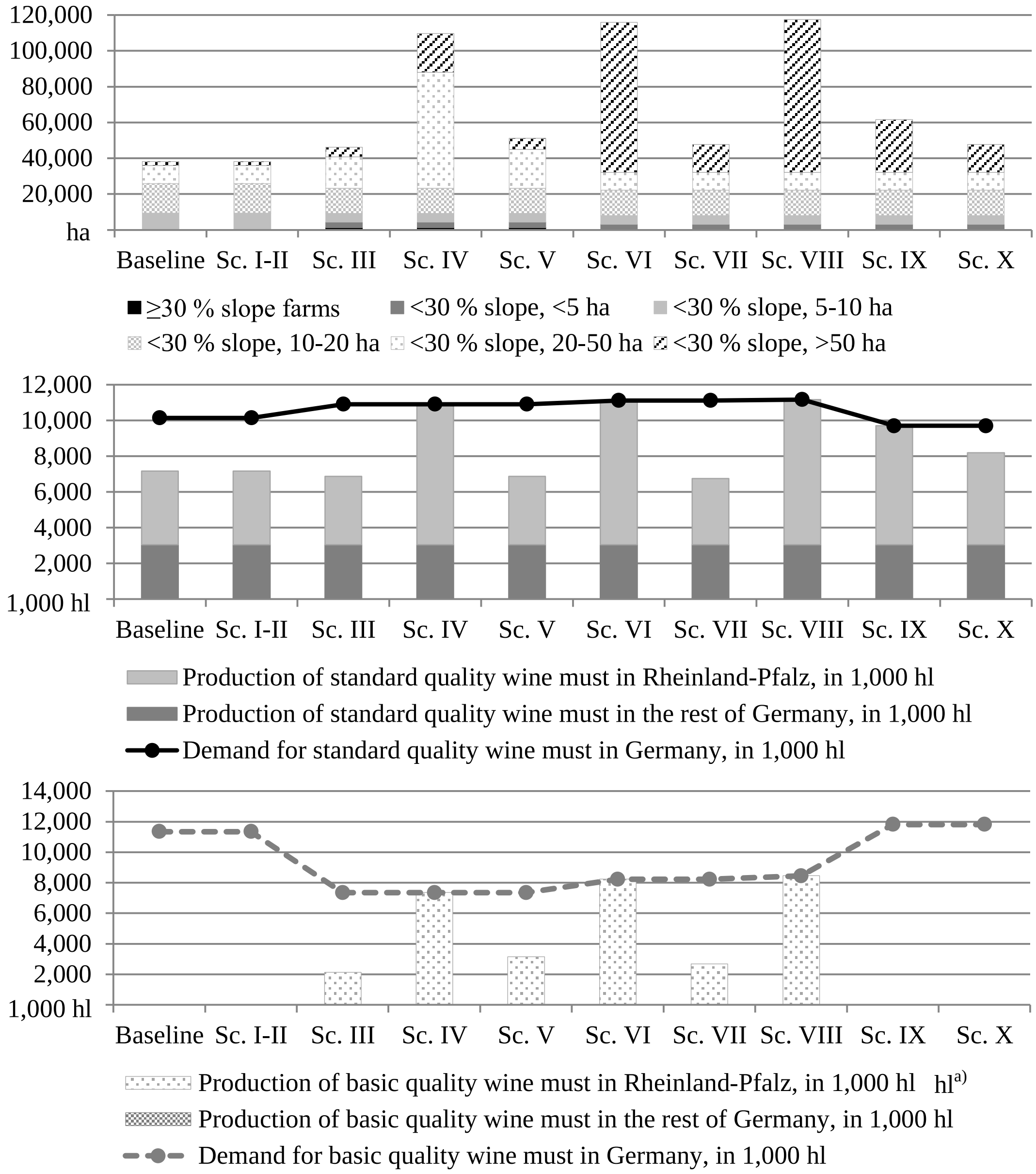

Figure 8.1: The results of simulation of total acreage of vineyards and their distribution among wine farm groups according to size classes and area type, of the demand for standard and basic quality wine must in Germany and production of standard and basic quality wine must in Rheinland-Pfalz in 2021

[a)] Production of basic quality wine must in the rest of Germany is 2,640 hl.

Note:

<30% slope, <5 ha is a farm group, vineyards of which are not larger than 5 ha and situated in areas with less than 30% slope.

Baseline "Planting rights, 2009 prices"

Sc. I-II are Scenario I "Liberalization, 2009 prices" and Scenario II "Authorizations, 2009 prices"

Sc. III is Scenario III "Planting rights, higher prices"

Sc. IV is Scenario IV "Liberalization, higher prices"

Sc. V is Scenario V "Authorizations, higher prices"

Sc. VI is Scenario VI "Liberalization, lower prices"

Sc. VII is Scenario VII "Authorizations, lower prices"

Sc. VIII is Scenario VIII "Liberalization, lower prices of wine must and of land"

Sc. IX is Scenario IX "Liberalization, 2009 price of basic quality wine must and lower price of standard quality wine must"

Sc. X is Scenario X "Authorizations, 2009 price of basic quality wine must and lower price of standard quality wine must"

Source: Author's presentation

CHAPTER 9

Sensitivity analysis of the model

This chapter presents the results of sensitivity analysis of the model. In particular, changes in the modeling output with respect to the changes in one of the modeling parameters are analyzed. The current sensitivity analysis is conducted with respect to the values of elasticities of demand for standard and basic quality wine must. The values of these parameters are doubled, and compared to the original output of the model under Scenario IV "Liberalization, higher prices". This scenario corresponds to a situation when planting rights are liberalized and prices of standard and basic quality wine must allow farms smaller than 5 ha and situated in areas of less than 30% slope covering their total costs of production of both types of wine must. The output of the analysis is presented in Table 9.1.

If the value of own-price elasticity of demand for standard quality wine must changes from -0.379 to -0.758, then the quantities of this product demanded and produced decrease by, respectively, 13% and 18%, in comparison to the original simulation output. The total area of vineyards in Rheinland-Pfalz decreases by 12%. If the value of own-price elasticity of demand for basic quality wine must changes from -0.9 to -1.8, then the quantities of basic quality wine must demanded and produced decrease by 43%, in comparison to the original simulation output. The total area of vineyards in Rheinland-Pfalz decreases by 14%.

Changes in income elasticities of demand for standard and basic quality wine must have opposite impacts on the modeling outcome in comparison to the impacts of changes in own-price elasticities. Thus, if income elasticity of demand for standard quality wine must doubles, then quantities of this product demanded and produced increase by, respectively, 13% and 18%, in comparison to the original simulation output. If the income elasticity of demand for basic quality wine must is doubled, the quantity of this product demanded and produced increases by 13%. Due to the difference in yields of standard and basic quality wine must, the total acreage of vineyards in Rheinland-Pfalz increases by 12%, if the income elasticity of demand for standard quality wine must is doubled, and by 4%, if the income elasticity of demand for basic quality wine must is doubled.

Table 9.1: Simulation output of scenario IV "Liberalization, higher prices" and results of sensitivity analysis of the model

Parameter	Units	Scenario IV "Liberalization, higher prices"	Own-price elasticity of demand for standard quality wine must doubles: -0.379 → -0.758	Own-price elasticity of demand for basic quality wine must doubles: -0.9 → -1.8	Income elasticity of demand for standard quality wine must doubles: 0.508 → 1.016	Income elasticity of demand for basic quality wine must doubles: 0.508 → 1. 016	Cross-price elasticity of demand for standard quality wine must with respect to price of basic quality wine must doubles: 0.339 → 0.678
Market of standard quality wine must							
Price[a]	EUR/hl	106.63	106.63	106.63	106.63	106.63	106.63
Demand[b]	1,000 hl	10,916	9,517	10,916	12,305	10,916	13,462
Production[c]	1,000 hl	7,867	6,469	7,867	9,257	7,867	10,414
Net-trade[d]	1,000 hl	0	0	0	0	0	0
Market of basic quality wine must							
Price[a]	EUR/hl	63.79	63.79	63.79	63.79	63.79	63.79
Demand[b]	1,000 hl	7,349	7,349	4,212	7,349	8,285	8,308
Production[c]	1,000 hl	7,346	7,346	4,209	7,346	8,282	8,305
Net-trade[d]	1,000 hl	0	0	0	0	0	0
Total acreage of vineyards in Rheinland-Pfalz for production of standard and basic quality wine must, ha							
		109,528	96,589	93,841	122,385	114,206	137,887
Distribution of vineyards and profitability of wine farm groups in Rheinland-Pfalz							
≥30%, <5[e]	ha	0[f]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, 5-10		0[f]	0[f]	0[f]	0[f]	0[f]	0[f]
≥30%, 10-20		701[g]	701[g]	701[g]	701[g]	701[g]	701[g]
≥30%, 20-50		335[g]	335[g]	335[g]	335[g]	335[g]	335[g]
≥30%, >50		92[g]	92[g]	92[g]	92[g]	92[g]	92[g]
<30%, <5		3,086[h]	3,086[h]	3,086[h]	3,086[h]	3,086[h]	3,086[h]
<30%, 5-10		4,888[h]	4,888[h]	4,888[h]	4,888[h]	4,888[h]	4,888[h]
<30%, 10-20		14,144[h]	14,144[h]	14,144[h]	14,144[h]	14,144[h]	14,144[h]
<30%, 20-50		64,718[h]	55,150[h]	53,118[h]	74,225[h]	68,177[h]	85,687[h]
<30%, >50		21,564[h]	18,193[h]	17,477[h]	24,915[h]	22,784[h]	28,954[h]

[a] Prices of wine must are exogenous to the model. [b] Demand in Germany. [c] Production in Rheinland-Pfalz. [d] Net-trade in Germany. [e] *≥30% slope, <5* is a farm group, vineyards of which are not larger than 5 ha and situated in areas of more than 30% slope. [f] indicates that total revenues from – are smaller than variable costs of – wine must production. [g] indicates that total revenues from wine must production are greater than variable costs but not greater than total costs of wine must production. [h] indicates that total revenues from – are greater than total costs of – wine must production.

Source: Author's calculations, data presented in Chapter 6

Impacts of change of cross-price elasticity of demand for standard with respect to basic quality wine must on the simulation output are greater than the impacts of change of own-price and income elasticities. Thus, if the cross-price elasticity increases from 0.339 to 0.678, then, in comparison to the original simulation output, the quantities of standard quality wine must demanded and produced increase by 23% and 32%, respectively, and of basic quality wine must by 13%. The total acreage of vineyards in Rheinland-Pfalz increases by 26%.

Because in the sensitivity analysis prices of wine must do not change, profitability of wine farms remains similar to the original simulation output. Consequently, the distribution of vineyards among the wine farm groups that do not receive positive economic profits, and are not characterized by positive growth rates in the past (i.e., farms situated in areas of more than 30% slope and farms smaller than 20 ha and situated in areas of less than 30% slope) is not different from the simulation output. On the contrary, acreage of vineyards of wine farm groups with positive economic profitability and positive growth rates in 1999-2010 changes throughout the analysis. Such wine farm groups absorb vineyards that move from the other farm groups and vineyards established in response to the abolishment of planting rights regime.

CHAPTER 10

Discussion and conclusions

This dissertation analyzed the effects of continuation and abolishment of the planting rights regime on the wine sector in Rheinland-Pfalz, Germany. In particular, we examined the effects of planting rights (EEC 1976), liberalized planting rights (EC 2008) and a scheme of authorizations for vine plantings (EU 2013) on production of basic and standard quality wine must in Rheinland-Pfalz, the demand for – and net-trade of – these products in Germany, and the distribution of vineyards among wine farm groups according to size classes and area type in Rheinland-Pfalz.

In 2008, Council Regulation (EC) No 479/2008 which included the ending of restriction on planting of new vineyards in the EU from 2018 the latest was adopted (EC 2008). Because more than 65% of wine in Germany is produced in Rheinland-Pfalz (SB 2014a), and around 42% of the total number of farms in this region are wine farms (SLRP 2013), such a sweeping change of more than three-decade-old policy could not have left the community of wine producers and other stakeholders unalarmed. Discussions on the pros and cons of the reform with regard to its impacts on the wine sector had, therefore, begun. The main argument of the advocates of the reform was that planting rights had created an obstacle for competitive producers to benefit from economies of scale and respond flexibly to changes in demand for wine on the world market. Opponents of the new policy argued that liberalization of planting rights would result in increased wine production in the EU and, thus, a fall of prices of wine. The latter could lead to the bankruptcy of smaller and less cost-efficient wine farms, the loss of identity of wine production regions, and the orientation of the industry to production of lower instead of higher quality wine (Agra-Europe 2012a-c and Copa-Cogeca 2012).

After a considerable debate on the EU and member state levels (HLG 2013 and Bogonos et al. 2012), a decision was made to withhold the liberalization of planting rights until 2030. Instead, it was decided to adopt a scheme of authorizations for vine plantings for the period 2016-2030. This scheme allows an annual increase in the acreage of vineyards by maximum 1% of the total area actually planted with vines, as measured in the previous year. The adoption of this new system has given rise to speculation on the maximum rate of growth of vineyards that shall be established in Rheinland-Pfalz. The suggestions include a range from 0.1% to 1%, as well as retaining of the planting rights system in some wine production regions (MULEWFRP 2015, Roebel 2015 and Yumda 2015).

Absence of quantitative assessment of the effects of abolishment of planting rights on the wine sector in Rheinland-Pfalz and heated discussions on both reforms is the main motivation for this dissertation. The current work offers contributions to the scientific community and to stakeholders of agricultural policy in the wine sector. The contributions and limitations of this study, suggestions for further research and policy implications are described below.

10.1 Contributions and advantages of the presented work

For the purposes of this dissertation a comparative static regional partial net-trade equilibrium model with nested MC output was used. The model examines two markets: markets of standard and basic quality wine must. This allows analyzing the effects of the policy reform with respect to quantity and quality of wine must production. The effects of the policy reforms on production of higher and basic quality wine is among the main concerns in the community of wine producers, experts and other interested parties in Rheinland-Pfalz.

Not only takes the model into account two different types of wine must, but also ten different groups of wine farms. Because heterogeneity of wine farms is observed in Rheinland-Pfalz, taking it into account when simulating effects of policy reforms improves the reliability of the output. In addition, this allows performing specific-to-general analysis. In particular, the effects of abolishment of planting rights on the wine sector in Rheinland-Pfalz are simulated by modeling the effects of the reforms on separate groups of wine farms.

For simulation of the effects of abolishment of planting rights on the distribution of vineyards within the wine farm groups, two types of MC models were used. The first is based on Keane (1991) and the second on Lee and Judge (1996). The performance of both was compared and the output of the better suited one was then introduced into the policy simulation model. The comparison of the two MC approaches has provided relevant conclusions on performance of both methods in conditions of restricted information and uncertainty with regard to stationarity of the process. In particular, it was found that the MC model based on maximization of the entropy measure (Lee and Judge 1996) might deliver unreliable results, if data for one transition period are used and no additional constraints on movement of the units included. Upon adding information on patterns of movement of vineyards in the form of transition constraints, the transition probability matrix estimated by the MC model based on Lee and Judge (1996) converges to the one of the MC model based on Keane (1991). Consequently, the latter is preferred when data only on few transition periods are available. Using the MC model based on Lee and Judge (1996) in addition to the MC model based on Keane (1991) is, however, recommended, because it provides information on the extent of uncertainty of the movement of the units.

Growth rates of wine farms estimated by MC are introduced into the policy simulation model with a set of rules. These rules allow simulating the effects of the policy regimes on distribution of vineyards within wine farm groups with regard to the cost-efficiency and growth trends observed of these wine farm groups. Respectively, the modeling output provides analytical information on the issue that has raised concerns in the community of wine producers in Rheinland-Pfalz, and with a simulation approach that is not common in equilibrium modeling.

The current research incorporates affluent specific information on functioning and characteristics of the wine must production in Rheinland-Pfalz. It includes aspects such as the orientation of wine producers towards production of standard quality wine must, planting of vines for production of only standard quality wine must in areas with steeper slope and the possibility of selling of standard quality wine must as basic quality category. This enabled the policy simulation model portraying the wine sector in Rheinland-Pfalz more accurately, and improved the reliability of the simulation output.

The policy simulation model presented in this dissertation is developed to fit the purposes of the current research. Therefore, it can be used for simulating the effects of policy changes with regard to planting rights on the wine sector in Rheinland-Pfalz under other scenarios as well. In addition, the modeling framework developed herein can be modified and used for simulation of these effects in other federal states or countries.

10.2 Limitations and future research

Although findings of the current research support the conclusions presented in the literature, some limitations should be considered when interpreting the results. The first limitation is that the analysis is based on the net-trade approach. Although it allows estimating maximum extent of the effects of the policy reform on the wine sector, it precludes a possibility of imperfect substitution between wine must of different origin[43] and varieties.

The second limitation of the analysis is that the farmers' decisions to establish vineyards are not based on discounted net profits but on current profits. The investment decision on planting of a permanent crop requires commitment of resources today for a purpose which is based on expectation of future outcome. Respectively, an investment decision should be undertaken when the discounted value of expected cash flows of a unit of capital is not less, than the purchase price and installation cost of the capital. Because the model considers undiscounted net profits, the profitability of vineyards may be overestimated.

The third limitation of the current analysis is that proportional transmission of prices from producers to retailers is assumed. Whereas barely any empirical research on vertical price transmission in the wine sector has been conducted in the last decades, the literature on estimation and analysis of farm-to-retail price transmission in the food and agricultural sector is rather substantial[44]. Since most studies agree on imperfect pass-through of prices along the food supply chain (see, for example, Agra CEAS Consulting 2007 and Vavra and Goodwin 2005), such a phenomenon may exist in the wine sector as well. Thus, the assumption on symmetric price transmission may lead to certain inexactness of the simulation outcome.

Another aspect to be considered when interpreting the simulation outcome is that due to data limitations, the examination of stationarity and order of the process of structural change in the wine sector (Sirdari et al. 2013 and Anderson and Goodman 1957) could not be conducted. Therefore, the current analysis could be further elaborated with respect to testing for possible features of the structural change, application of non-stationary MC model and identification of factors that affect size structure of the wine farms.

A final note worth to be mentioned pertains to farmland prices. In the current analysis, the functions of demand for agricultural land for vine growing and for cultivation of competing crops are perfectly elastic. Production of wine must is assumed to be more profitable than the rest of the crops. These result to preferring cultivation of vines over the other crops, and in constant land rental prices. Respectively, if restriction on planting of vineyards in the form of planting rights is absent or not binding, increase in area planted with vines is only limited by factors such as demand for wine must and acreage of land

[43] More on the theory of demand for products of different origin see Armington (1969).
[44] More on price transmission see Meyer and von Cramon-Taubadel (2004).

suitable for vine growing. If demand for land for vine growing or for at least one of the competing agricultural crops were imperfectly elastic, an increase in the area planted with vines would be limited by the profitability of wine must production relative to the rest of the competing crops[45] as well. Respectively, changes in total acreage of vineyards and total acreage of the competing crops would induce changes in land rental prices. The equilibrium land rental price would be established at the point where marginal productivity of land is equal among all the considered crops. Thus, future studies on the effects of policy changes with regard to planting rights on the wine sector in the EU could address the aspects of land allocation and change in land rental prices in more detail.

10.3 Policy implications

Positive and negative impacts of planting rights, liberalized planting rights and a scheme of authorizations for vine plantings are generalized and discussed herein. Because demand for land for vine growing exceeds the supply, the rental price of land for vine growing is considerably higher than the rental prices of land for other agricultural purposes (SLRP 2012b). Thus, planting rights regime benefits land owners, but penalizes those vine growers who rent the land. They pay a rental price that could have been lower in the case of absence of restriction on planting of vines.

Another possible negative effect of the planting rights regime concerns market prices of wine must and profitability of wine farms. In particular, if the system of planting rights in the EU is valid, and cost-efficiency of non-EU wine producers increases, the world market price of wine (and wine must) will decrease. Lower world market price of wine (and wine must) will lead to decrease in price of wine (and wine must) produced in Rheinland-Pfalz. This would result in lower profitability of wine farms in Rheinland-Pfalz.

The effects of liberalization of planting rights would be somewhat opposite to the effects of planting rights. In particular, the liberalization would result in establishment of true (i.e., lower) market values of land rental prices. Wine farms would be able to benefit from economies of scale and lower land rental prices, and the wine sector in Rheinland-Pfalz could increase its production capacity in response to the world demand for wine (and wine must)[46].

[45] See also Deconinck and Swinnen (2013).
[46] On demand for wine on the world market see (Anderson and Nelgen 2011).

The effects of a scheme of authorizations for vine plantings on the wine sector in Rheinland-Pfalz will be more moderate in comparison to the effects of liberalized planting rights regime. Thus, although planting rights will be abolished, demand for land will continue to exceed its supply, and high land rental prices will remain. These prices will, however, gradually decrease, because the supply of land for vine growing will be increasing[47]. On the one hand, a gradual increase of area of vineyards will allow avoiding drastic changes in the supply of wine (and wine must) and, thus, possibly, in the market prices of wine (and wine must). And on the other hand, a scheme of authorizations for vine plantings may still hinder responding of wine (and wine must) production potential in Rheinland-Pfalz to the demand for wine (and wine must) on the world market.

Under the planting rights regime, the trend towards production of standard quality wine must will most likely continue. Because of the difference in prices of basic and standard quality wine must, this will most likely be the profit maximizing choice of the wine producers. As response to demand for basic quality wine must and if planting rights are liberalized or converted into a scheme of authorizations for vine plantings, more of basic quality wine must will be produced in Rheinland-Pfalz.

10.4 Epilogue

This dissertation took up a twofold challenge. On the one hand, it supplements the literature on how policy reforms with regard to limitation of the use of agricultural production input for controlling of the output affect the agricultural production sector. And on the other hand, it provides an analysis and expertise on politically and socially sensitive issue in Rheinland-Pfalz. Therefore, it is hoped that this work will provide stakeholders of the policy reform analyzed with valuable insights and motivate future research on simulation of the effects of policy reforms with regard to limitation of the production output on the agricultural production sector.

[47] According to a scheme of authorizations for vine plantings, total acreage of vineyards may increase annually by 1% maximum, as measured on 31 July of the previous year (EU 2013).

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A N N E X

Annex to Chapter 3

Table A-3.1: Distribution of vineyards and of wine farms within farm size classes and type of area in 1979-2010 in Rheinland-Pfalz

Size class of wine farms (ha)	1979		1989		1999		2007		2010	
	Farms (units)	Area (ha)	Farms (units)	Area (ha)	Farms (units)	Area (ha)	Farms (units)	Area (ha)	Farms (units)	Area (ha)
Areas of less than 30% slope (<30%)										
<5[a]	21,903	28,321	16,049	22,812	9,300	15,711	5,637	10,095	4,361	8,888
5-10	2,510	16,094	3,277	22,052	2,527	17,986	1,803	13,098	1,673	12,149
10-20	336	3,973	767	9,377	1,448	18,982	1,547	21,244	1,553	21,465
20-50	55	1,277	77	1,937	204	5,419	416	11,201	477	12,973
>50	9	530	8	441	13	1,083	13	2,586	36	2,958
Sum	24,813	50,195	20,178	56,618	13,493	59,181	9,434	58,223	8,098	58,431
Areas of more than 30% slope (≥30%)										
<5	-	-	-	-	2,269	3,832	1,332	2,385	1,008	2,055
5-10	-	-	-	-	232	1,653	190	1,378	192	1,398
10-20	-	-	-	-	58	756	63	870	66	910
20-50	-	-	-	-	12	336	16	425	15	435
>50	-	-	-	-	2	133	1	119	1	119
Sum	-	-	-	-	2,572	6,710	1,603	5,178	1,284	4,919
Sum										
0-5	-	-	-	-	11,569	19,543	6,969	12,480	5,369	10,943
5-10	-	-	-	-	2,759	19,639	1,993	14,476	1,865	13,547
10-20	-	-	-	-	1,506	19,738	1,610	22,114	1,619	22,375
20-50	-	-	-	-	216	5,755	432	11,626	492	13,408
>50	-	-	-	-	15	1,216	33	2,705	37	3,077
Sum	44,509	63,202	33,894	66,831	16,065	65,891	110,37	63,401	9,382	63,350

[a] *<5* is a farm group, units of which are not larger than 5 ha.

Source: Based on data presented in Chapter 6

Table A-3.2: Total acreage of white and red wine grape varieties in production regions in Rheinland-Pfalz in 1979-2010

	Acreage (ha)			
	1979	1989	1999	2010
Ahr				
white wine grapes varieties	150	107	89	83
red wine grapes varieties	259	372	431	476
Mittelrhein				
white wine grapes varieties	739	655	503	370
red wine grapes varieties	8	27	49	66
Mosel				
white wine grapes varieties	12,210	12,467	11,016	7,959
red wine grapes varieties	2	42	421	809
Nahe				
white wine grapes varieties	4,436	4,404	4,017	3,119
red wine grapes varieties	50	232	586	1,036
Rheinhessen				
white wine grapes varieties	22,516	23,106	22,106	18,352
red wine grapes varieties	983	2,356	4,274	8,171
Pfalz				
white wine grapes varieties	19,821	19,485	17,481	14,466
red wine grapes varieties	2,010	3,561	5,857	8,979
Rheinland-Pfalz				
white wine grapes varieties	59,872	60,223	55,213	44,350
red wine grapes varieties	3,312	6,589	11,618	19,536

Note: Data presented herein may not coincide with the data presented in Section 3.2 because they are collected from different sources.
Source: Based on SLRP 2003 and SLRP 2012a

Annex to Chapter 5

Table A-5.1: Overview of equations of the simulation model

1. Demand for wine must in Germany

Function of demand for standard quality wine must:

$$\text{Qd\_q} = \text{const\_Qd\_q} \times \text{P\_q}^{\text{e\_opd\_q}} \times \text{P\_g}^{\text{e\_cpd\_qg}} \times \text{Inc}^{\text{e\_id\_q}} \times \text{Pop}$$

Function of demand for basic quality wine must:

$$\text{Qd\_g} = \text{const\_Qd\_g} \times \text{P\_g}^{\text{e\_opd\_g}} \times \text{P\_q}^{\text{e\_cpd\_qg}} \times \text{Inc}^{\text{e\_id\_g}} \times \text{Pop}$$

Qd_q (Qd_g)	demand for standard (basic) quality wine must in Germany
(in alphabetical order)	
const_Qd_q (const_Qd_g)	constant term in the demand function for standard (basic) quality wine must
e_cpd_qg	cross-price elasticity of demand for standard quality wine must with respect to price of basic quality wine must
e_id_q (e_id_g)	income elasticity of demand for standard (basic) quality wine must
e_opd_q (e_opd_g)	own-price elasticity of demand for standard (basic) quality wine must
Inc	real per capita Gross Domestic Product (GDP)
P_q (P_g)	price of standard (basic) quality wine must
Pop	population growth rate in Germany

2. Supply of wine must in Rheinland-Pfalz

A) *Functions for estimation of optimal per hectare production quantity of wine must by farm groups*

Function for estimation of optimal production quantity of wine must by farms, vineyards of which are situated in areas of less than 30% slope and have been established after the calibration year:

$$\max \{\text{P\_g} - \text{ATC\_ha\_g\_n/HE\_g}\} \times \text{M\_ha\_g\_rllc\_n} + \{\text{P\_q} - \text{ATC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_rllc\_n} + \{\text{P\_g} - \text{ATC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_g\_rllc\_n}$$

subject to

$$\text{M\_ha\_g\_rllc\_n/HE\_g} + \text{M\_ha\_q\_rllc\_n/HE\_q} + \text{M\_ha\_q\_g\_rllc\_n/max\_q} \leq 1 \text{ and}$$

$$\text{M\_ha\_g\_rllc\_n, M\_ha\_q\_rllc\_n, M\_ha\_q\_g\_rllc\_n} \geq 0$$

Function for estimation of optimal production quantity of wine must by farms, vineyards of which are situated in areas of more than 30% slope and have been established after the calibration year:

$$\max \{\text{P\_q} - \text{ATC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_rllc\_n} + \{\text{P\_g} - \text{ATC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_g\_rllc\_n}$$

subject to

$$\text{M\_ha\_g\_rllc\_n/HE\_g} + \text{M\_ha\_q\_n/HE\_q} + \text{M\_ha\_q\_g\_rllc\_n/max\_q} \leq 1 \text{ and}$$

$$\text{M\_ha\_g\_rllc\_n, M\_ha\_q\_rllc\_n, M\_ha\_q\_g\_rllc\_n} \geq 0$$

Function for estimation of optimal production quantity of wine must by farms, vineyards of which are situated in areas of more and less than 30% slope and have been established before the calibration year:

$$\max \{\text{P\_q} - \text{AVC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_cnst\_n} + \{\text{P\_g} - \text{AVC\_ha\_q\_n/HE\_q}\} \times \text{M\_ha\_q\_g\_cnst\_n}$$

subject to

$$\text{M\_ha\_q\_cnst\_n/HE\_q} + \text{M\_ha\_q\_g\_cnst\_n/max\_q} \leq 1 \text{ and}$$

$$\text{M\_ha\_q\_cnst\_n, M\_ha\_q\_g\_cnst\_n} \geq 0$$

(in alphabetical order)	
ATC_hl_q_n (ATC_hl_g_n)	average (per hectoliter) total costs of production of standard (basic) quality wine must of the farm groups
AVC_hl_q_n (AVC_hl_g_n)	average (per hectoliter) variable costs of production of standard (basic) quality wine must of the farm groups

Table A-5.1: Overview of equations of the simulation model (cont.)

HE_q (HE_g)	per hectare production quota of standard (basic) quality wine must
M_ha_g_rllc_n	optimal per hectare production of basic quality wine must of a farm group, from vineyards established after the calibration year
M_ha_q_g_rllc_n	optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established after the calibration year
M_ha_q_rllc_n	optimal per hectare production of standard quality wine must of a farm group, from vineyards established after the calibration year
M_ ha_q_g_cnst_n	optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established before the calibration year
M_ha_q_cnst_n	optimal per hectare production of standard quality wine must of a farm group, from vineyards established before the calibration year
max_q	maximum yield of standard quality wine must
P_q (P_g)	price of standard (basic) quality wine must

B) *Functions for estimation of acreage of vineyards of farm groups*

If $\text{Distr\_n\_prj} - \text{Distr\_n\_rf} > 0$, then $\text{Distr\_n\_prj} - \text{Distr\_n\_rf} = \text{N\_rllcvrd}$ and $\text{Distr\_n\_rf} = \text{N\_cnstvrd}$

If $\text{Distr\_n\_prj} - \text{Distr\_ n\_rf} \leq 0$, then $\text{Distr\_n\_prj} = \text{N\_cnstvrd}$

(in alphabetical order)

Distr_n_prj	acreage of vineyards of a farm group projected by Markov chain (see Section 5.4)
Distr_n_rf	acreage of vineyards of a farm group in the calibration year (i.e., in 2009)
N_cnstvrd	acreage of vineyards of a farm group that have been established before the calibration year
N_rllcvrd	acreage of vineyards of a farm group that have been established after the calibration year

C) *Functions for estimation of wine must production quantities of farm groups*

Production of standard quality wine must of a farm group:

$$\text{N\_q} = \text{M\_ha\_q\_cnst\_n} \times \text{N\_cnstvrd\_n}(\text{Status\_n}) + \text{M\_ha\_q\_rllc\_n} \times \text{N\_rllcvrd\_n}(\text{Status\_n})$$

Production of basic quality wine must of a farm group:

$$\text{N\_g} = \text{M\_ha\_q\_g\_cnst\_n} \times \text{N\_cnstvrd\_n}(\text{Status\_n}) + \text{M\_ha\_q\_g\_rllc\_n} \times \text{N\_rllcvrd\_n}(\text{Status\_n}) + \text{M\_ha\_g\_rllc\_n} \times \text{N\_rllcvrd\_n}(\text{Status\_n})$$

N_q	standard quality wine must production by the farm groups
N_g	basic quality wine must production by the farm groups (wine must can be produced either as standard or basic quality wine must)

(in alphabetical order)

M_ha_g_rllc_n	optimal per hectare production of basic quality wine must of a farm group, from vineyards established after the calibration year
M_ha_q_g_rllc_n	optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established after the calibration year
M_ha_q_rllc_n	optimal per hectare production of standard quality wine must of a farm group, from vineyards established after the calibration year
M_ha_q_g_cnst_n	optimal per hectare production of standard quality wine must sold as basic quality category of a farm group, from vineyards established before the calibration year
M_ha_q_cnst_n	optimal per hectare production of standard quality wine must of a farm group, from vineyards established before the calibration year

Table A-5.1: Overview of equations of the simulation model (cont.)

N_cnstvrd_n(Status_n)	acreage of vineyards of a farm group that have been established before the calibration year and depend on the status of the farm group (Status_n)
N_rllcvrd_n(Status_n)	acreage of vineyards of a farm group that have been established after the calibration year and depend on the status of the farm group (Status_n)
Status_n	defines 1) whether farm group grows, 2) whether acreage of vineyards of a farm group remains constant or declines and 3) whether farm group exits the sector. If 1), acreage of vineyards established before and after the calibration year is not zero. If 2), acreage of vineyards established after the calibration year is zero, and of vineyards established before the calibration year is not zero. And if 3), total acreage of vineyards of a farm group is zero.

D) *Functions of supply of wine must in Rheinland-Pfalz*

Function of supply of standard quality wine must:

Qs_q = sum {(0, if AVC_hl_q_N10 < P_q), (N10_q, if AVC_hl_q_N10 ≤ P_q < AVC_hl_q_N9),
(N10_q + N9_q, if AVC_hl_q_N9 ≤ P_q < AVC_hl_q_N8),
(N10_q + ,..., N1_q, if AVC_hl_q_N1 ≤ P_q)}

Function of supply of basic quality wine must:

Qs_g = sum {(0, if AVC_hl_g_N10 < P_g), (N10_g, if AVC_hl_g_N10 ≤ P_g < AVC_hl_g_N9),
(N10_g + N9_g, if AVC_hl_g_N9 ≤ P_g < AVC_hl_g_N8),
(N10_g + ,..., N1_g, if AVC_hl_g_N1 ≤ P_g)}

Qs_q (Qs_g)	quantity of standard (basic) quality wine must supplied by Rheinland-Pfalz
(in alphabetical order)	
from AVC_hl_g_N1 to AVC_hl_g_N10	average (per hectoliter) variable costs of production and marketing of basic quality wine must of the farm groups (wine must can be produced either as standard or basic quality wine must)
from AVC_hl_q_N1 to AVC_hl_q_N10	average (per hectoliter) variable costs of production of standard quality wine must of the farm groups
from N1_g to N10_g	marketing of basic quality wine must by the farm groups (wine must can be produced either as standard or basic quality wine must)
from N1_q to N10_q	production of standard quality wine must by the farm groups
N1	farm group: wine farms of <5 ha situated in areas of more than 30% slope
N2	farm group: wine farms of 5-10 ha situated in areas of more than 30% slope
N3	farm group: wine farms of 10-20 ha situated in areas of more than 30% slope
N4	farm group: wine farms of 20-50 ha situated in areas of more than 30% slope
N5	farm group: wine farms of >50 ha situated in areas of more than 30% slope
N6	farm group: wine farms of <5 ha situated in areas of less than 30% slope
N7	farm group: wine farms of 5-10 ha situated in areas of less than 30% slope
N8	farm group: wine farms of 10-20 ha situated in areas of less than 30% slope
N9	farm group: wine farms of 20-50 ha situated in areas of less than 30% slope
N10	farm group: wine farms of >50 ha situated in areas of less than 30% slope
P_q (P_g)	price of standard (basic) quality wine must

3. Growth rates of wine farms

Markov chain model based on Keane (1991):

$$p_{ij} = \frac{M_{ij}^{t}}{M_{i}^{t-1}} : j = 1, \ldots, r; t = 2, \ldots, T$$

Markov chain model based on Lee and Judge (1996):

$$\max H(p) = -p \times \ln(p) = \sum_{i} \sum_{j} p_{ij} \times \ln(p_{ij})$$

Table A-5.1: Overview of equations of the simulation model (cont.)

subject to

$(I_k \otimes X_T) \times p = y_T$, $(1 \otimes I_K) \times p = 1$ and $p \geq 0$

p_{ij}	probability of transition from farm group i to farm group j
H	normalized entropy measure
p	$(K^2 \times 1)$ vector of transition probabilities
(in alphabetical order)	
1	$(K \times 1)$ vector of ones
$(I_k \otimes X_T)$	$(TK \times K^2)$ matrix of wine farms distribution in T periods (where $\otimes$ denotes Kronecker product)
K	number of states
M_{ij}^t	number of farms that move from group i to group j at time t
M_i^{t-1}	number of farms in group i at time t-1
T	number of data transition periods
t-1	number of time periods (from 1 to T)
X_T	$(TK \times K^2)$ matrix of state outcomes for T transitions
y_T	$(TK \times 1)$ vector of state outcomes for T transitions

4. Distribution of vineyards within farm groups at the end of 2015

$$Distr\_n\_2015 = \frac{Distr\_n\_2021 + Distr\_n\_ref}{2}$$

(in alphabetical order)	
Distr_n_2015	acreage of vineyards of a farm group at the end of 2015
Distr_n_2021	acreage of vineyards of a farm group in 2021 projected Markov chain (see point 3. of this table)
Distr_n_ref	acreage of vineyards of a farm group in the calibration year

5. Model closure

Equations that close the model:

$Qd\_q = Qs\_q + Qs\_q\_RoG - NT\_q$ and $Qd\_g = Qs\_g + Qs\_g\_RoG - NT\_g$

(in alphabetical order)	
NT_q (NT_g)	difference between quantities of standard (basic) quality wine must exported from – and imported to – Germany
Qd_q (Qd_g)	quantity of standard (basic) quality wine must demanded in Germany
Qs_q (Qs_g)	quantity of standard (basic) quality wine must supplied by Rheinland-Pfalz
Qs_q_RoG (Qs_g_RoG)	quantity of standard (basic) quality wine must supplied by the rest of wine production regions in Germany

Source: Author's presentation

Table A-5.2: Selected studies on supply response of perennial crops

Alston, J. M., J. W. Freebairn and J. J. Quilkey (1980): A model of supply response in the Australian orange growing industry. In: Australian Journal of Agricultural Economics 24 (3): 248-267.
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Askari, H. and J. T. Cummings (1977): Estimating supply response with Nerlove model: A survey. In: International Economic Review 18 (2): 257-292.
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Bazen, E., R. K. Roberts, J. Travis and J. A. Larson (2008): Factors affecting hay supply and demand in Tennessee. Paper presented at the Southern Agricultural Economics Association annual meeting, 2.-5.02.2008, Dallas, Texas. In: http://purl.umn.edu/6889. Accessed on 25.04.2015.
Dorfman, J. H. and D. Heien (1989): The effects of uncertainty and adjustment costs on investment in the almond industry. In: The review of Economics and Statistics 71 (2): 263-274.
Elnagheeb, A. H. and W. J. Florkowski (1993): Modeling perennial crop supply: An illustration from the pecan industry. In: Journal of Agricultural and Applied Economics 25 (1): 187-196.
French, B. C., A. K. Gordon and D. D. Minami (1985): Planting and removal relationships for perennial crops: An application to Cling peaches. In: American Journal of Agricultural Economics 67 (2): 215-223.
Kalaitzandonakes, N. G. and J. S. Shonkwiler (1992): A state-space approach to perennial crop supply analysis. In: American Journal of Agricultural Economics 74 (2): 343-352.
Konyar, K. and K. Knapp (1991): Perennial crop supply response: A Kalman filter approach. In: American Journal of agricultural Economics 73 (3): 841-849.
Konyar, K. and K. Knapp (1988): Market analysis of alfalfa hay: California case. In: Agribusiness 4 (3): 271-284.
Marques, G. F., J. R. Lund and R. E. Howitt (2005): Modeling irrigated agricultural production and water use decisions under water supply uncertainty. In: Water Resources Research 41 (8): 1-11.
Nerlove, M. (1979): The dynamics of supply: Retrospect and prospect. In: American Journal of Agricultural Economics 61 (5): 874-888, proceedings issue.
Rae, A. N. and H. F. Carman (1975): A model of New Zealand apple supply response to technological change. In: Australian Journal of Agricultural Economics 19 (1): 39-51.
Roosen, J. (1999): A regional econometric model of U.S. apple production. Paper presented at American Agricultural Economics Association annual meeting, 8.-11.08.1999, Nashville, NT. In: http://purl.umn.edu/21663. Accessed on 27.04.2015.
Stern, R. M. (1965): Malayan production, inventory holdings, and the elasticity of export supply. In: Southern Economic Journal 31 (4): 314-323.
Weisong, M., Z. Xiaoshuan, Z. Lingxian and F. Zettan (2007): A structural model for analysis of fruit supply and demand applied to grapes in China. In: New Zealand Journal of Agricultural Research 50 (5): 1359-1365.
Wickens, M. R. and J. N. Greenfield (1973): The econometrics of agricultural supply: An application to the world coffee market. In: The Review of Economics and Statistics 55 (4): 433-440.
Willet, L. S. (1993): The U.S. apple industry: Econometric model and projections. In: Agricultural and Resource Economics Review 22 (2): 137-149.

Source: Author’s presentation

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages

Study, Model, Dependent variables, Data
Adrian, M. and B. S. Ferguson (1987): Demand for domestic and imported alcohol in Canada. In: Applied Economics 19 (4): 531-540. Model: Double-logarithmic models; ordinary least squares estimator (LSE). Dependent variables: Per capita consumption of beer, wine and spirits. Data: Canada, annual records across seven states for 1968-81.
Aepli, M. (2014): Consumer demand for alcoholic beverages in Switzerland: A two-stage Quadratic Almost Ideal Demand System for low, moderate, and heavy drinking households. In: Agricultural and Food Economics 2:15. Framework/Estimation method: Two-stage budgeting quadratic Quadratic Almost Ideal Demand System (QUAIDS) model. Dependent variables: Shares of expenditure on wine, beer, spirits and alcohol in total. Data: Switzerland, annual records across 34,000 households for 2000-2009.
Andrikopoulos A. A. and Loizides J. (2000): The demand for home-produced and imported alcoholic beverages in Cyprus: The AIDS approach. In: Applied economics 32 (9): 1111-1119. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on domestic and imported alcoholic beverages, wine, beer, spirits and alcoholic beverages in total. Data: Cyprus, annual records for 1970-1992.
Andrikopoulos, A. A., A. James, B. Carvalho and E. Carvalho (1997): The demand for domestic and imported alcoholic beverages in Ontario, Canada: A dynamic simultaneous equation approach. In: Applied Economics 29 (7): 945-953. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Expenditures on imported and domestically produced spirits, wine and beer. Data: Ontario (Canada), annual records for 1958-1987.
Angulo, A. M., J. M. Gil and A. Gracia (2001): The demand for alcoholic beverages in Spain. In: Agricultural Economics 26 (1): 71-83. Model: Double-Hurdle model; maximum likelihood estimator. Dependent variables: Shares of total beverage expenditure on wine, beer, spirits, cava and other alcoholic beverages. Data: Spain, annual records across 21,155 households for 1990-1991.
Atkinson, A. B., J. Gomulka and N. H. Stern (1990): Spending on alcohol: Evidence from the family expenditure survey 1970-1983. In: The Economic Journal 100 (402): 808-827. Model: Gamma-Tobit and Tobit models; maximum likelihood estimator. Dependent variables: Household’s share of expenditure on alcohol. Data: UK, annual records across 68,854 households for 1970-1983.
Ayyagari, P., P. Deb, J. Fletcher, W. Gallo and J. L. Sindelar (2013): Understanding heterogeneity in price elasticities in the demand for alcohol for older individuals. In: Health Economics 22 (1): 89-105. Framework/Estimation method: Finite mixture models. Dependent variables: Positive/negative choice upon alcohol consumption, per capita consumption of alcohol. Data: USA, records across 12,562 individuals for 1992.
Baltagi, B. H. and D. Li (2006): Prediction in the panel data model with spatial correlation: The case of liquor. Center for policy research. Paper 81. In: http://surface.syr.edu/cpr/81. Accessed on 19.03.2015. Model: Double logarithmic model; ordinary LSE, random effects generalized LSE. Dependent variables: Per capita consumption of liquor. Data: USA, annual records across 43 states for 1965-1994.
Baltagi, B. H. and J. M. Griffin (1995): A dynamic demand model for liquor: The case for pooling. In: The Review of Economics and Statistics 77 (3): 545-554. Model: Log-linear model; ordinary, within, generalized, modified two-stage and within two-stage LSE. Dependent variables: Per capita consumption of liquor. Data: USA, annual records for 1959-1982, and annual records across 43 states for 1959-1982.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Blake, D. and A. Nied (1997): The demand for alcohol in the United Kingdom. In: Applied Economics 29 (12): 1655-1672. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on beer, cider, spirits and wine. Data: UK, annual records for 1952-1991.
Blake, D. and S. Boyle (1992): The demand for cider in the United Kingdom. In: Oxford Bulletin of Economics and Statistics 54 (2): 73-87. Model: Log-linear models; ordinary LSE. Dependent variables: Per capita consumption of cider, share of cider in the total consumption of long drinks. Data: UK, annual records for 1952-1986.
Blaylock, J. R. and W. N. Blisard (1993): Women and the demand for alcohol: Estimating participation and consumption. In: The Journal of Consumer Affairs 27 (2): 319-334. Model: Dependent Craag model, independent Craag model, dominance (Heckmann) model, complete dominance model and Tobit model; maximum likelihood estimator. Dependent variables: Positive/negative choice upon alcohol consumption, per capita consumption of alcoholic beverages. Data: USA, national household survey for 1987.
Blaylock, J. R. and W. N. Blisard (1993): Wine consumption by US men. In: Applied Economics 25 (5): 645-651. Model: Double-Hurdle model; maximum likelihood estimator. Dependent variables: Positive/negative choice upon alcohol consumption, per capita consumption of alcoholic beverages. Data: USA, national household survey for 1987.
Buccola, S. T. and L. VanderZanden (1997): Wine demand, price strategy and tax policy. In: Review of Agricultural Economics 19 (2): 428-440. Model: Rotterdam model. Dependent variables: Sales of wine. Data: USA, monthly records for 1993-1994.
Carew, R., W. J. Florkowski and S. He (2004): Demand for domestic and imported table wine in British Columbia: A source-differentiated Almost Ideal Demand System approach. In: Canadian Journal of Agricultural Economics 52 (2) 183–199. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on imported and domestically produced wine of different varieties. Data: Canada, monthly records for 1990-2000.
Chang, H.-S. and N. Bettington (2001): Demand for wine in Australia: Systems versus single equation approaches. Working Paper 2001-5. School of Economics, University of New England. Armidale. In: http://purl.umn.edu/12923. Accessed on 19.03.2015. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on beer, wine and spirits. Data: Australia, annual records for 1975-1999 (time series data).
Clements K. W., W. Yang and S. W. Zheng (1997): Is utility additive? The case of alcohol. In: Applied Economics 29 (9): 1163-1167. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits. Data: Annual records for 1955-1989 in Australia, 1953-1982 in Canada, 1970-1983 in Finland, 1965-1982 in New Zealand, 1960-1986 in Norway, 1967-1984 in Sweden and 1955-1985 in the UK.
Clements and Selvanathan (1991): The economic determinants of alcohol consumption. In: Australian Journal of Agricultural Economics 35 (2): 209-231. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Data: Australia, annual records for 1955-1986.
Clements, K.W., P.B. McLeod and E.A. Selvanathan (1985): Does advertising affect drinking and smoking? Discussion Paper 85.02. University of Western Australia. In: https://ecompapers.biz.uwa.edu.au/paper/PDF%20of%20Discussion%20Papers/1985/85-02.pdf. Accessed on 19.03.2015. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits. Data: Australia, annual records for 1955-1975.
Clements, K. W. and L. W. Johnson (1983): The demand for beer, wine, and spirits: A system wide analysis. In: The Journal of Business 56 (3): 273-304. Model: Rotterdam model. Dependent variables: Total consumption of beer, wine and spirits. Data: Australia, annual records for 1955-1977.
Collis, J., A. Grayson and S. Johal (2010): Econometric analysis of alcohol consumption in the UK. HMRC Working Paper 10. HM Revenue & Customs 100 Parliament Street, London. In: https://www.gov.uk/government/publications/econometric-analysis-of-alcohol-consumption-in-the-uk. Accessed on 19.03.2015. Model: Tobit model. Dependent variables: Sales of – and expenditure shares on – beer, wine, spirits, cider and ready-to-drink beverages. Data: UK, records across 1,750 households for 2001-2006.
Cook, P. J. and G. Tauchen (1982): The effect of liquor taxes on heavy drinking. In: The Bell Journal of Economics 13 (2): 379-390. Model: Log-linear models; two-stage LSE. Dependent variables: Per capita consumption of liquor. Data: USA, annual records across 30 states for 1962-1977.
Crawford, I. and S. Tanner (1995): Bringing it all back home: Alcohol taxation and cross-border shopping. In: Fiscal Studies 16 (2): 94-114. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Household's expenditure share on beer, wine and spirits. Data: UK, annual records across 150,000 households for 1973-1993.
Cuellar, S. S., T. Colgan, H. Hunnicutt and G. Ransom (2009): The demand for wine in the USA. In: International Journal of Wine Business Research 22 (2): 178-190. Model: Fixed effect instrumental variable model. Dependent variables: Sales of wine bottles. Data: USA, monthly records across retail stores for 2002-2005.
Davis, T., F. Ahmadi-Esfahani and S. Iranzo (2007): Demand under product differentiation: An empirical analysis of the US wine market. Paper prepared for 51st annual conference of the Australian Agricultural and Resource Economics Society. In: http://purl.umn.edu/161896. Accessed on 19.03.2015. Model: Discrete choice model of product differentiation. Dependent variables: Sales of different brands of wine. Data: USA, annual records across sales in grocery and drug stores for 2003-2005.
Duffy, M. H. (2003): Advertising and food, drink and tobacco consumption in the United Kingdom: A dynamic demand system. In: Agricultural Economics 28 (1): 51-70. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Share of expenditure on on alcoholic drinks. Data: UK, quarterly records for 1963-1996.
Duffy, M. H. (2002): On the estimation of an advertising-augmented, cointegrating demand system. In: Economic Modelling 20 (1): 181–206. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on beer, wine and spirits. Data: UK, quarterly records for 1963-1999.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Duffy, M. (2001): Advertising in consumer allocation models: Choice of functional form. In: Applied Economics 33 (4): 437-456. Model: Rotterdam, Almost Ideal Demand System (AIDS), Central Bureau of Statistics (CBS) and National Bureau (NBR) models. Dependent variables: Conditional shares of expenditure on beer, wine and spirits. Data: UK, quarterly records for 1963-1996.
Duffy, M.H. (1987): Advertising and the inter-product distribution of demand: A Rotterdam model approach. In: European Economic Review 31 (5): 1051-1070. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, annual records for 1963-1983.
Duffy, M. H. (1983): The demand for alcohol drink in the United Kingdom, 1963-1978. In: Applied Economics 15 (1): 125-140. Model: Log-linear and linear models; simultaneous equations model, two-stage LSE. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, annual records for 1963-1978.
Duffy, M. H. (1982): A case study in econometric forecasting for alcoholic drinks. In: Omega 10 (6): 597-611. Model: Double-logarithmic, semi-logarithmic and linear models; ordinary LSE. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, quarterly records for 1963-1978.
Duffy, M. H. (1981): The influence of prices, consumer incomes and advertising upon the demand for alcoholic drink in the United Kingdom: An econometric study. In: British Journal on Alcohol and Alcoholism 16 (4): 200-209. Model: Double logarithmic models; ordinary LSE. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, quarterly records for 1963-1979.
Dyak, B. and E. Goddard (2001): The rise of red and the wane of white: wine demand in Ontario Canada. 2001 Conference (45th), January 23-25, 2001, Adelaide. In: http://purl.umn.edu/125617. Accessed on 19.03.2015. Model: Two-stage translog demand system; maximum likelihood estimator. Dependent variables: Share of expenditure on wine. Data: Ontario (Canada), monthly records for 1985-1998.
Eakins, J. M. and Gallagher L. M. (2003): Dynamic Almost Ideal Demand Systems: An empirical analysis of alcohol expenditure in Ireland. In: Applied Economics 35 (9): 1025-1036. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Share of expenditure on alcoholic drinks. Data: Ireland, annual records for 1960-1998.
Faroque, A. (2008): An investigation into the demand for alcoholic beverages in Canada: A choice between the Almost Ideal Demand System and the Rotterdam models. In: Applied Economics 40 (16): 2045-2054. Model: Almost Ideal Demand System (AIDS) and Rotterdam models. Dependent variables: Per capita sales of beer, wine and spirits. Data: Canada, annual records for 1950-2003.
Florkowski, W. J. and K. T. McNamara (1992): Policy implications of alcohol and tobacco demand in Poland. In: Journal of Policy Modelling 14 (1): 93-98. Model: Linear models; ordinary LSE. Dependent variables: Per capita consumption of vodka, beer and wine. Data: Poland, annual records for 1959-1985.
Folwell, R. J. and J. L. Baritelle (1978): The U.S. wine market: Economics, statistics, and cooperatives service. U.S. Department of Agriculture. Agricultural Economic Report No. 417.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Model: Linear and logarithmic models; ordinary LSE. Dependent variables: Per household purchase of wine. Data: USA, monthly records across 7,000 households for 1975-1976.
Franke, G. and G. Wilcox (1987): Alcoholic beverage advertising and consumption in the United States, 1964-1984. In: Journal of Advertising 16 (3): 22-30. Model: Linear model; generalized LSE and maximum likelihood estimators. Dependent variables: Per capita consumption of beer, wine and spirits. Data: USA, quarterly records for 1964-1984.
Franses, P. H. (1991): Primary demand for beer in the Netherlands: An application of ARMAX model specification In: Journal of Marketing Research 28 (2): 240-245. Model: ARMAX model. Dependent variables: Per capita consumption of beer. Data: Netherlands, bimonthly records for 1978-1984.
Freeman, D. G. (2000): Alternative panel estimates of alcohol demand, taxation, and the business cycle. In: Southern Economic Journal 67 (2): 325-344. Model: Linear model; pooled mean group estimator. Dependent variables: Per capita consumption of beer. Data: Canada, annual records across 50 states for 1961-1995.
Fuller, K. B. and J. M. Alston (2012): The demand for California wine grapes. In: Journal of Wine Economics 7 (2): 192–212. Model: Flexible form inverse demand system model. Dependent variables: Price of wine grapes. Data: California (USA), annual records across 3 grape growing regions for 1985-2009.
Gallet, G. A. (1999): Gradual switching regression estimates of alcohol demand elasticities. In: Applied Economics Letters 6 (6): 377-379. Model: Double logarithmic gradual switching regression model; ordinary LSE. Dependent variables: Per capita consumption of spirits. Data: USA, annual records for 1964-92.
Gallet, C. A. and J. A. List (1998): Elasticities of beer demand revisited. In: Economics Letters 61 (1): 67-71. Model: Gradual switching regression model; ordinary LSE. Dependent variables: Per capita consumption of beer. Data: USA, annual records for 1964-1992.
Gao, X. M., E. J. Wailes and G. L. Cramer (1995): A microeconometric model analysis of US consumer demand for alcoholic beverages. In: Applied Economics 27 (1): 59-69. Model: Two-stage budgeting model (first stage – Gamma-tobit model, second stage – normalized linear combination of Rotterdam, Central Bureau of Statistics (CBS) and Almost Ideal Demand System (AIDS) models. Dependent variables: Per capita consumption of beer, wine and spirits. Data: USA, records across 1,152 households and 4,640 individuals for 1987-1988.
Gerolimetto, M., C. Mauracher and I. Procidano (2005): Analysing wine demand with artificial neural networks. European Association of Agricultural Economists 2005, International Congress, August 23-27, 2005, Copenhagen, Denmark. In: http://purl.umn.edu/24753. Accessed on 19.03.2015. Model: Neural networks. Dependent variables: Per capita consumption of wine. Data: Italy, records across 4,245 households for 2003.
Hausman, J., G. Leonard and J. Douglas (1994): Competitive analysis with differentiated products. In: Annals of Economics and Statistics 34: 159-180. Model: Three-stage double logarithmic model; maximum likelihood estimator. Dependent variables: Per capita consumption of beer. Data: Canada, monthly records for 5 years, monthly records for 16 years.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Heien, D. and E. N. Sims (2000): The impact of the Canada-United States free trade agreement on U.S. wine exports. In: American Journal of Agricultural Economics 82 (1): 173-182. Model: Linear model; ordinary LSE. Dependent variables: Per capita quantity of imported wine. Data: USA, annual records for 1978-1994.
Heien, D. and G. Pompelli (1989): The demand for alcoholic beverages: Economic and demographic effects. In: Southern economic journal 55 (3): 759-770. Model: Almost Ideal Demand System (AIDS) model with two-stage budgeting process. Dependent variables: Per household consumption of alcoholic beverages. Data: USA, survey of 14,000 households for 1977-78.
Hogarty, T. H. and K. G. Elzinga (1972): The demand for beer. In: The Review of Economics and Statistics 54 (2): 195-198. Model: Log-linear model; ordinary LSE. Dependent variables: Per capita consumption of beer. Data: USA, annual records across 49 states for 1956-1959.
Holm, P. (1995): Alcohol content and demand for alcoholic beverages: A system approach. In: Empirical Economics 20 (1): 75-92. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Shares of expenditure on four groups of beverages: 1) vodka, gin and aquavit, 2) other distilled spirits, 3) wine and 4) beer. Data: Finland, annual records across 12 provinces for 1965-1987.
Holm, P. and I. Suoniemi (1992): Empirical application of optimal commodity tax theory to taxation of alcoholic beverages. In: The Scandinavian Journal of Economics 94 (1): 85-101. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Share of expenditure on alcoholic drinks. Data: Finland, triannual records for 1968-1973.
Holmes, J., Y. Meng, P. S. Meier, A. Brennan, C. Angus, A. Campbell-Burton, Y. Guo, D. Hill-McManus, R. (2014): Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: A modelling study. In: The Lancet 383 (9929): 1655-1664. Framework/Estimation method: Sheffield Alcohol Policy Model. Dependent variables: Off- and on-trade per capita consumption of beer, cider, wine, spirits and ready-to-drink beverages. Data: UK, records across 10,588 individuals for 2009.
Horowitz, I. and A. R. Horowitz (1965): Firms in a declining market: The brewing case. In: The Journal of Industrial Economics 13 (2): 129-153. Model: System of simultaneous linear equations; indirect LSE. Dependent variables: Per capita consumption of beer. Data: USA, annual records across 49 states for 1949-1961.
Jada, K., J. Mikolášek and M. Netuka (2010): Complete Almost Ideal Demand System approach to Czech alcohol demand. Department of Microeconomics and Mathematical Methods, Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague, Czech Republic. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Share of expenditure on wine. Data: Czech Republic, records across 3,000 households for 2007.
Jithitikulchai, T. (2010): U.S. alcohol consumption: ´Tax instrumental variables in Quadratic Almost Ideal Demand System (QUAIDS). Selected paper prepared for presentation at the Agricultural and Applied Economics Association and Northeastern Agricultural Economics Association joint annual meeting 2011, Pittsburgh, Pennsylvania, July 24-26, 2011. In: http://purl.umn.edu/112670. Accessed on 19.03.2015. Model: Quadratic Almost Ideal Demand System (QUAIDS) model. Dependent variables: Shares of expenditure on beer, wine and spirits. Data: USA, annual records across 51 states for 1985-2002.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Johnson, J. A., E. H. Oksanen, M. R. Veall and D. Fretz (1992): Short-run and long-run elasticities for Canadian consumption of alcoholic beverages: An error-correction mechanism/cointegration approach. In: The Review of Economics and Statistics 74 (1): 64-74. Model: Unrestricted dynamic models, the error-correction mechanism. Dependent variables: Per capita consumption of beer, wine and spirits. Data: Canada, annual records across 10 states for 1956-1983.
Johnson, J. A. and E. H. Oksanen (1977): Estimation of demand for alcoholic beverages in Canada from pooled time series and cross sections. In: The Review of Economics and Statistics 59 (1): 113-118. Johnson, J. A. and E. H. Oksanen (1974) Socio-economic determinants of the consumption of alcoholic beverages. In: Applied Economics 6 (4): 293-302. Model: Logarithmic and linear models; ordinary and generalized LSE. Dependent variables: Per capita consumption of beer, wine, and spirits. Data: Canada, annual records across 10 states for 1955-1971.
Kioulafas, K. E. (1985): An application of multiple regression analysis to the Greek beer market. In: The Journal of the Operational Research Society 36 (8): 689-696. Model: Linear models; quadratic ordinary LSE, Cochrane-Orcutt iterative technique. Dependent variables: Sales of beer. Data: Greece, monthly records across five firms for 1980-1982.
Koksalan, M., N. Erkip and H. Moskowitz (1999): Explaining beer demand: A residual modeling regression approach using statistical process control. In: International Journal of Production Economics 58 (3): 265-276. Model: Residual modeling regression approach. Dependent variables: Per capita sales of beer. Data: Turkey, annual records across 42 cities for 1989-1991.
Lariviere, E., B. Larue and J. Chalfant (2000): Modeling the demand for alcoholic beverages and advertising specifications. In: Agricultural Economics 22 (2): 147-162. Model: Dynamic Almost Ideal Demand System (AIDS) model. Dependent variables: Per capita expenditure on alcoholic beverages and soft drinks. Data: Ontario (Canada), monthly records for 1979-1987.
Larue, B., A. Ker and L. MacKinnon (1991): The demand for wine in Ontario and the phasing-out of discriminatory mark-ups. In: Agribusiness 7 (5): 475-488. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Household's share of expenditure on wine. Data: Canada, annual records for 1978-1987.
Lee, B. and V. J. Tremblay (1992): Advertising and the US market demand for beer. In: Applied Economics 24 (1): 69-76. Model: Double logarithmic model; ordinary LSE. Dependent variables: Per capita consumption of beer. Data: USA, annual record for 1953-1983.
Lenten, L. J. A. and I. A. Moosa (1999): Modelling the trend and seasonality in the consumption of alcoholic beverages in the United Kingdom. In: Applied Economics 31 (7): 795-804. Model: Double-logarithmic time series model; maximum likelihood estimator. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, quarterly records for 1964–1995.
Leppänen, K., R. Sullström and I. Suoniemi (2001): Effects of economic factors on alcohol consumption in 14 European countries. In: Nordisk Alkohol & Narkotikatidskrift 18: 100-116 (English supplement). Model: Linear-logarithmic system of equations; ordinary LSE. Dependent variables: Per capita consumption of alcoholic beverages. Data: Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, and the UK, annual records for 1970-1996.
Levy, A. E. and R. J. Folwell (1995): U.S. demand for imported wines. In: Journal of International Food and Agribusiness Marketing 7 (1): 79-91.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Model: Linear model; two-stage LSE. Dependent variables: Per capita consumption of wine. Data: USA, annual records for 1964-1991 and 1970-1991.
Levy, D. and N. Sheflin (1985): The demand for alcoholic beverages: An aggregate time-series analysis. In: Journal of Public Policy and Marketing 4 (1): 47-54. Model: Double-logarithmic models; ordinary LSE. Dependent variables: Per capita consumption of alcoholic beverages. Data: USA, annual records for 1940-1980.
MacGuinness, T. (1980): An econometric analysis of total demand for alcoholic beverages in the U.K., 1956-75. In: The Journal of Industrial Economics 29 (1): 85-109. Model: Linear and semi-logarithmic models; LSE. Dependent variables: Per capita consumption of alcoholic beverages. Data: UK, annual records for 1956-1975.
Mangeloja, E. and J. Pehkonen (2009): Availability and consumption of alcoholic beverages: Evidence from Finland. In: Applied Economics Letters 16 (4): 425-429. Model: Log-linear models, seemingly unrelated regression equations. Dependent variables: Per capita consumption of wine, beer and spirits. Data: Finland, annual records for 1960-2004.
Manning, W. G., L. Blumberg and L. H. Moulton (1995): The demand for alcohol: The differential response to price. In: Journal of Health Economics 14 (2): 123-148. Model: Logit and logarithmic models; ordinary LSE. Dependent variables: Positive/negative choice upon alcohol consumption, per capita consumption of alcohol. Data: USA, records across 22,418 individuals for 1983.
Mazzocchi, M. (2005): Time patterns in UK demand for alcohol and tobacco: An application of the EM algorithm. In: Computational Statistics and Data Analysis 50 (9): 2191-2205. Model: Almost Ideal Demand System (AIDS) model. Dependent variables: Per capita consumption of alcohol. Data: UK, quarterly records for 1963-2003.
Menga, Y., A. Brennana, R. Purshouseb, D. Hill-McManusa, C. Angusa, J. Holmesa and P. S. Meier (2014): Estimation of own- and cross-price elasticities of alcohol demand in the UK: A pseudo-panel approach using the Living costs and food survey 2001-2009. In: Journal of Health Economics 34 (1): 96-103. Dependent variables: Off- and on-trade per capita consumption of beer, cider, wine, spirits and ready-to-drink beverages. Data: UK, annual records across 107,763 individuals for 2001-2009.
Meyerhoefer, C. D., C. K. Ranney and D. E. Sahn (2005): Consistent estimation of censored demand systems using panel data. In: American Journal of Agricultural Economics 87 (3): 660-672. Model: Joint continuous/censored commodity demand system with correlated random effects specification; generalized method of moments estimator. Dependent variables: Per capita consumption of alcohol. Data: Romania, annual records across 24,553 households for 1994-1996.
Miravete, E. J., K. Seim and J. Waldfogel (2012): Complexity, efficiency, and fairness in multiproduct liquor pricing. The Wharton School Research Paper No. 74. University of Minnesota - Twin Cities – Carlson School of Management; National Bureau of Economic Research (NBER). In: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2553143. Accessed on 19.03.2015. Model: Multi-product discrete choice model of demand; generalized method of moments estimator. Dependent variables: Sales of spirits and wine. Data: Pennsylvania (USA), records across 459 markets for 2005.
Muhammad, A. (2011): Wine demand in the United Kingdom and New World structural change: A source-disaggregated analysis. In: Agribusiness 27 (1): 82-98. Model: Rotterdam model.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Dependent variables: Imports of wine. Data: UK, monthly records for 1995-2009.
Nelson J. P. (2008): Alcohol advertising bans, consumption, and control policies in seventeen OECD countries, 1975-2000. Pennsylvania State University – College of the Liberal Arts – Department of Economics. In: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=942647. Accessed on 19.03.2015. Model: Double logarithmic model; weighted generalized and unweighted ordinary LSE. Dependent variables: Per capita consumption of alcohol. Data: Austria, Belgium, Denmark, France, Italy, New Zealand, Portugal, Spain, Australia, Canada, Finland, Ireland, Netherlands, Norway, Sweden, United Kingdom, and the United States, annual records for 1975-2000.
Nelson, J. P. (2003): Advertising bans, monopoly, and alcohol demand: Testing for substitution effects using state panel data. In: Review of Industrial Organization 22 (1): 1-25. Model: Double-logarithmic fixed effects models; generalized LSE. Dependent variables: Per capita consumption of alcohol, beer, wine and spirits. Data: USA, annual records across 45 states for 1982-1997.
Nelson, J. P. (1999): Broadcast advertising and U. S. demand for alcoholic beverages. In: Southern Economic Journal 65 (4): 774-790. Model: Rotterdam model. Dependent variables: Shares of expenditure on wine, beer and spirits. Data: USA, quarterly records for 1977-1994.
Nelson, J. P. (1997): Economic and demographic factors in U.S. alcohol demand: A growth-accounting analysis. In: Empirical Economics 22 (1): 83-102. Model: Rotterdam model. Dependent variables: Share of expenditure on ethanol. Data: USA, quarterly records for 1974-1990.
Nelson, J. P. (1990): State monopolies and alcoholic beverage consumption. In: Journal of Regulatory Economics 2 (1):83-98. Model: Double logarithmic demand model; ordinary LSE. Dependent variables: Per capita consumption of beer, wine and spirits. Data: USA, records across 15 states for 1982.
Nerlove, M. and W. Addison (1958): Statistical estimation of long-run elasticities of supply and demand. In: Journal of Farm Economics 40 (4): 861-880. Model: Distributed lag linear model; ordinary LSE. Dependent variables: Per capita consumption of alcoholic drinks. Data: UK, annual records for 1921-1938.
Niskanen, W. A. (1962): The demand for alcoholic beverages: an experiment in econometric method. University of Chicago. In: www.prgs.edu/content/dam/rand/pubs/papers/2008/P2583.pdf. Accessed on 19.03.2015. Model: Linear, logarithmic and linear-logarithmic models; ordinary least squares estimator. System of simultaneous linear equations; three-stage LSE. Dependent variables: Per capita consumption of beer, wine and spirits. Data: USA, annual records for 1934-1941 and 1947-1960.
Norströhm, T. (2005): The price elasticity of alcohol in Sweden 1984-2003. In: Nordisk Alkohol & Narkotikatidskrift 22: 87-101 (English supplement). Model: Double logarithmic function, Box-Jenkins technique. Dependent variables: Sales of beer, wine and spirits. Data: Sweden, quarterly records for 1984-2004.
Ogwang, T. and D. I. Cho (2009): Economic determinants of the consumption of alcoholic beverages in Canada: A panel data analysis. In: Empirical Economic 37 (3): 599-613. Model: Fixed effects panel regression model. Dependent variables: Per capita consumption of wine, beer and spirits. Data: Canada, annual records across 10 states for 1981-2004.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data

Ornstein, S. I. and D. M. Hassens (1985): Alcohol control laws and the consumption of distilled spirits and beer. In: The Journal of Consumer Research 12 (2): 200-213.
Model: Multiplicative demand model.
Dependent variables: Per capita consumption of spirits.
Data: USA, annual records across 51 states for 1974-1978.

Pan, S., C. Fang and J. Malaga (2006): Alcoholic beverage consumption in China: A censored demand system approach. In: Applied Economics Letters 13 (15): 975-979.
Model: Probit model, Almost Ideal Demand System (AIDS) model.
Dependent variables: Per capita expenditure on wine, beer and alcoholic beverages.
Data: China, annual records across 2,298 households for 1993 and 1998.

Penm, J. H. (1988): An econometric study of the demand for bottled, canned and bulk beer. In: Economic Record 64 (4): 268-274.
Model: Rotterdam model; full information maximum likelihood estimator.
Dependent variables: Per capita consumption of bottled, canned and bulk beer.
Data: Australia, annual records for 1968-1984.

Pompelli, G. and D. Heien (1991): Discrete/continuous consumer demand choices: An application to the U.S. domestic and imported white wine markets. In: European Review of Agricultural Economics 18 (1): 117-130.
Model: Linear functions of demand, Heckman's two-step method.
Dependent variables: Per capita white wine consumption.
Data: USA, records across 13,000 households for 1980.

Prest, A. R. (1949): Some experiments in demand analysis. In: The Review of Economics and Statistics 31 (1): 33-49.
Model: Linear and logarithmic models; ordinary LSE.
Dependent variables: Per capita consumption of beer and spirits.
Data: UK, annual records for 1870-1938.

Sabuhoro, J. B., B. Larue and E. Larivière (1997): Advertising expenditures and the consumption of alcoholic beverages. In: Journal of International Food and Agribusiness Marketing 8 (3): 37-54.
Model: Almost Ideal Demand System (AIDS) model.
Dependent variables: Budget shares of off- and on-trade consumption of beer, liquor, wine and soft drinks.
Data: Canada, monthly records for 1979-1987.

Sam, A. G. and S. R. Thompson (2012): Country of origin advertising and US demand of imported wine: An empirical analysis. In: Applied economics letters 19 (18): 1871-1877.
Framework/Estimation method: Double logarithmic function of demand, instrumental variables technique.
Dependent variables: Per capita import of wine.
Data: USA, annual records across main importers for 1994-2008.

Seale, J. L., M. A. Marchant and A. Basso (2003): Imports versus domestic production: A demand system analysis of the U.S. red wine market. In: Review of Agricultural Economics 25 (1): 187-202.
Model: Almost Ideal Demand System (AIDS) model.
Dependent variables: Import quantity of red wine.
Data: USA, monthly records for 1990-1999.

Selvanathan, E. A. and S. Selvanathan (2009): An econometric analysis of wine consumption in Australia. Paper prepared for the Australian Agricultural and Resource Economics Society conference workshop on "The world's wine markets by 2030: Terroir, climate change, R&D and globalization". Adelaide Convention Centre, Adelaide, South Australia, 7-9 February. In: https://www.adelaide.edu.au/wine-econ/events/2030workshop/pubs/Selvanathan_WC0210.pdf. Accessed on 19.03.2015.
Model: Rotterdam model.
Dependent variables: Per capita consumption of beer, wine and spirits.
Data: Australia, annual records for 1955-2005.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Selvanathan, E. A. and S. Selvanathan (2004): Economic and demographic factors in Australian alcohol demand. In: Applied Economics 36 (21): 2405-2417. Model: Linear conditional and conditional demand equations; maximum likelihood estimator. Dependent variables: Per capita consumption of pure alcohol, wine, beer and spirits. Data: Australia, annual records for 1956-1999.
Selvanathan, E. A. (1991): Cross-country alcohol consumption comparison: An application of the Rotterdam demand system. In: Applied Economics 23 (10): 1613-1622. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits. Data: Annual records for 1955-1985 in Australia, 1953-1982 in Canada, 1969-1983 in Finland, 1964-1 983 in Japan, 1965-1982 in New Zealand, 1960-1986 in Norway, 1960-1986 in Sweden, 1955-1985 in the UK, and 1949-1982 in the USA.
Selvanathan, A. E. (1989): Advertising and alcohol demand in the UK: Further results. In: International Journal of Advertising: The Review of Marketing Communications 8 (2): 181-188. Model: Rotterdam model. Dependent variables: Per capita consumption of beer, wine and spirits. Data: UK, annual records for 1955-1975.
Shrestha, V. (2014): Estimating the price elasticity of demand for different levels of alcohol consumption among young adults. Department of Economics, Emory University, USA. In: http://economics.emory.edu/home/documents/documents/Shresthavinish_5.pdf. Accessed on 19.03.2015. Framework/Estimation method: Pooled quantile regression, quantile regression for panel data and finite mixture models. Dependent variables: Per capita consumption of alcohol. Data: USA, annual records across 9,022 individuals for 1997-2008.
Sousa, J. (2014): Estimation of price elasticities of demand for alcohol in the United Kingdom. HMRC (Her Majesty's Revenue and Customs) Working Paper 16. In: https://www.gov.uk/government/publications/estimation-of-price-elasticities-of-demand-for-alcohol-in-the-uk. Accessed on 19.03.2015. Framework/Estimation method: Heckman correction model. Dependent variables: Off- and on-trade per capita consumption of beer, cider, wine, spirits and ready-to-drink beverages. Data: UK, annual records across 34,326 individuals for 2007-2012.
Srivastava, P., K. R. McLaren, M. Wohlgenant and X. Zhao (2014): Econometric modelling of price response by alcohol types to inform alcohol tax policies. Working Paper 05/14, Department of econometrics and business statistics, Monasch University, Australia. In: http://www.buseco.monash.edu.au/ebs/pubs/wpapers/2014/wp05-14.pdf. Accessed on 19.03.2015. Framework/Estimation method: Semi-flexible Almost Ideal Demand System (AIDS) model. Dependent variables: Per capita consumption of premium beer, full strength beer, low alcohol beer, mid strength beer, red bottled wine, white bottled wine, sparkling wine, cask wine, dark and light ready-to-drink beverages, dark and light spirits. Data: Australia, monthly records for 2004-2010.
Stone, R. (1951): The demand for food in the United Kingdom before the war. In: Metroeconomica 3 (1): 8-27. Stone, R. (1945): The analysis of market demand. In: Journal of the Royal Statistical Society 108 (3/4): 286-391. Model: Logarithmic models; ordinary LSE. Dependent variables: Per capita consumption of barrels of beer and gallons of distilled spirits. Data: UK, annual records for 1920-1938.
Su, S.-J. B. and S. T. Yen (2000): A censored system of cigarette and alcohol consumption. In: Applied Economics 32 (6): 729-737. Model: System of linear equations; two-stage maximum likelihood estimator. Dependent variables: Per capita consumption of beer and wine. Data: USA, annual records across 7,823 individuals in 48 states for 1989-1991.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data

Tegene, A. (1990): The Kalman filter approach for testing structural change in the demand for alcoholic beverages in the US. In: Applied Economics 22 (10): 1407-1416.
Model: Double logarithmic models, seemingly unrelated regression equations.
Dependent variables: Per capita consumption of beer, wine and spirits.
Data: USA, annual records for 1954-1985.

Thom, R. (1984): The demand for alcohol in Ireland. UCD Centre for Economic Research Working paper series No. 24. School of Economics University College Dublin. In: http://researchrepository.ucd.ie/handle/10197/1413. Accessed on 19.03.2015.
Model: Almost Ideal Demand System (AIDS) model.
Dependent variables: Per capita consumption of wine, beer and spirits.
Data: Ireland, quarterly records for 1969-1980.

Tsolakis, D., P. Riethmuller and G. Watts (1983): The demand for wine and beer. In: Review of Marketing and Agricultural Economics 51 (2): 131-153.
Model: Log-linear models; ordinary LSE and maximum likelihood estimator.
Dependent variables: Per capita consumption of wine and beer.
Data: Australia, annual records for 1955-1979.

Uri, N. D. (1986): The demand for beverages and inter-beverage substitution in the United States. In: Bulletin of Economic Research 38 (1): 77-85.
Model: Double-logarithmic model; maximum likelihood estimator.
Dependent variables: Per capita consumption of alcoholic beverages.
Data: USA, records across 51 states for 1982.

Wall, M. W. and S. Casswell (2012): Affordability of alcohol as a key driver of alcohol demand in New Zealand: A co-integration analysis. In: Addiction 108 (1): 72–79.
Dependent variables: Per capita consumption of beer, wine, spirits and ready-to-drink beverages.
Data: New Zealand, quarterly records for 1988-2011.

Walsh, B. M., K. A. Kennedy, and L. P. Ebrill (1973): The demand for beer and spirits in Ireland. In: Proceedings of the Royal Irish Academy Section C, 73 (13): 699-711.
Model: Double-logarithmic, linear-logarithmic and linear models; ordinary LSE.
Dependent variables: Per capita consumption of beer and spirits.
Data: Ireland, annual records for 1950-1970.

Walsh, B. and D. Walsh (1970): Economic aspects of alcohol consumption in the republic of Ireland. In: Economic and Social Review 2: 115-138.
Model: Linear and logarithmic model; ordinary LSE.
Dependent variables: Per capita consumption of beer and spirits.
Data: Ireland, annual records for 1953-1968.

Wang, J., X. M. Gao, E. J. Wailes and L. Gail (1996): U.S. consumer demand for alcoholic beverages: Cross-section estimation of demographic and economic effects. In: Review of Agricultural Economics 18 (3): 477-489.
Model: Two-stage model (first stage – Double-Hurdle model, second stage – combination of Rotterdam, Almost Ideal Demand System (AIDS) and Central Bureau of Statistics (CBS) models).
Dependent variables: Per capita consumption beer, wine and spirits.
Data: USA, records across 1,152 households for 1987-1988.

Wette, H. C., J.-F. Zhang, R. J. Berg and S. Casswell (1993): The effect of prices on alcohol consumption in New Zealand 1983-1991. In: Drug and Alcohol Review 12 (2): 151-158.
Model: Multiple double logarithmic model; ordinary LSE.
Dependent variables: Per capita consumption of beer, wine, spirits, alcohol beverages in total and of pure alcohol.
Data: New Zealand, quarterly records for 1983-1991.

Yen, S. T. (1994): Cross-section estimation of US demand for alcoholic beverage. In: Applied Economics 26 (4): 381-392.
Model: Box-Cox Double-Hurdle model; maximum likelihood estimator.

Table A-5.3: Selected studies on demand for wine and other alcoholic beverages (cont.)

Study, Model, Dependent variables, Data
Dependent variables: Per capita consumption of alcohol. Data: USA, records across 4,245 households for 1987-1988.
Yuan, Y. and S. T, Yen (2012): Alcohol consumption by individuals in the United States: A sample selection approach. In: Applied Economics Letters 19 (14): 1353-1358. Framework/Estimation method: Log-transformed sample selection model and two-part model; maximum likelihood estimator. Dependent variables: Per capita consumption of alcohol. Data: USA, records across 3,839 individuals for 2003-2004.
Zhang, J. F. and S. Casswell (1999): The effects of real price and a change in the distribution system on alcohol consumption. In: Drug and Alcohol Review 18 (4): 371-378. Model: Box-Jenkins autoregressive-integrated moving average (ARIMA) model; unconditional-least-squares algorithm. Dependent variables: Per capita consumption of alcohol. Data: New Zealand, quarterly records for 1984-1997.

Note: LSE is least squares estimator.
Source: Author's presentation

Annex to Chapter 7

Table A-7.1: Markov chain probability matrix of transition of vineyards within farm size classes in areas of more than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of all groups of wine farms can exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.056	0.536	0.095	0.237	0.075	0.000
	5-10 ha	0.383	0.000	0.617	0.000	0.000	0.000
	10-20 ha	1.000	0.000	0.000	0.000	0.000	0.000
	20-50 ha	0.372	0.000	0.000	0.000	0.444	0.185
	50 and more ha	0.517	0.000	0.000	0.000	0.000	0.483

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Table A-7.2: Markov chain probability matrix of transition of vineyards within farm size classes in areas of more than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of farms larger than 50 ha do not exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.056	0.536	0.100	0.237	0.070	0.000
	5-10 ha	0.394	0.000	0.606	0.000	0.000	0.000
	10-20 ha	1.000	0.000	0.000	0.000	0.000	0.000
	20-50 ha	0.499	0.000	0.000	0.000	0.499	0.003
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Table A-7.3: Markov chain probability matrix of transition of vineyards within farm size classes in areas of more than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of farms larger than 20 ha do not exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.364	0.536	0.100	0.000	0.000	0.000
	5-10 ha	0.128	0.000	0.614	0.258	0.000	0.000
	10-20 ha	0.229	0.000	0.000	0.639	0.132	0.000
	20-50 ha	0.000	0.000	0.000	0.000	0.997	0.003
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Table A-7.4: Markov chain probability matrix of transition of vineyards within farm size classes in areas of less than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of all groups of wine farms can exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.000	0.566	0.059	0.269	0.106	0.000
	5-10 ha	0.000	0.000	0.624	0.308	0.068	0.000
	10-20 ha	0.000	0.000	0.000	0.615	0.385	0.000
	20-50 ha	0.138	0.000	0.000	0.000	0.516	0.346
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Table A-7.5: Markov chain probability matrix of transition of vineyards within farm size classes in areas of less than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of farms larger than 50 ha do not exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.000	0.566	0.033	0.303	0.099	0.000
	5-10 ha	0.000	0.000	0.647	0.353	0.000	0.000
	10-20 ha	0.000	0.000	0.000	0.546	0.454	0.000
	20-50 ha	0.138	0.000	0.000	0.000	0.516	0.346
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Table A-7.6: Markov chain probability matrix of transition of vineyards within farm size classes in areas of less than 30% slope; the estimation is based on Lee and Judge (1996)[a)] and on assumption that vineyards of farms larger than 20 ha do not exit the sector

Percentage of vineyards that exit from – and remain in – the farm size classes		period t					
		exit	0-5 ha	5-10 ha	10-20 ha	20-50 ha	50 and more ha
period t-1	exit	1.000	0.000	0.000	0.000	0.000	0.000
	0-5 ha	0.048	0.566	0.000	0.289	0.098	0.000
	5-10 ha	0.000	0.000	0.675	0.319	0.005	0.000
	10-20 ha	0.000	0.000	0.000	0.589	0.312	0.099
	20-50 ha	0.000	0.000	0.000	0.000	1.000	0.000
	50 and more ha	0.000	0.000	0.000	0.000	0.000	1.000

Note: The estimation is conducted for 1999-2010.
[a)] The assumption that a decrease in farm size results in exit from the sector is included.
Source: Author's calculations

Author's declaration

I hereby declare that this doctoral dissertation is a result of my own work, and that no other than the indicated aids have been used for its completion. All quotations and statements that have been used are indicated. Furthermore, I assure that the work has not been used, neither completely nor in parts, for achieving any other academic degree.

Mariia Bogonos
Stuttgart-Hohenheim, 2015

Curriculum vitae

Personal information

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Working experience

10/2011 – 03/2015	Institute of production theory and resource economics (410a) Universität Hohenheim, Stuttgart (GER) Position: research associate, DLR project *Scenarien weinbaulicher Flächenausweitung* (see https://www.uni-hohenheim.de/projekt/szenarien-weinbaulicher-flaechenausweitung) Teaching and assistance: course *Socioeconomics of organic farming* (within module 3405-450 *Problems and perspectives of organic farming*), 32 academic hours B.Sc. thesis *Investitionsrechnung anhand eines Beispiels einer Weinbergneuanlage für Qualitäts- und Grundwein in der Region Rheinland-Pfalz* (D. Hagmann, 2013)
Intern: 05/2011 – 07/2011	Teekenner GmbH, Munich Place: Germany and China Tasks: (1) improvement of quality management on organic tea farms in China, (2) written report *Organic tea production rules and guidelines*; (3) photos and blog (see http://www.teekenner.de/de/aktuelles/mariias-blog/)

Educational background

PhD candidate: 10/2011 – 10/2015	Institute of production theory and resource economics (410a) Universität Hohenheim, Stuttgart (GER) Dissertation: *Analysis of the effects of abolishment of planting rights in the European Union on the wine sector in Rheinland-Pfalz, Germany*
M.Sc. studies: 10/2008 – 01/2011	Universität Hohenheim, Stuttgart (GER) Agricultural Economics (grade 3.3/B+) Thesis: *Determinants of non-compliance of organic operators with the organic standards: a binary choice analysis for Germany* (grade 4.0/A)
B.Sc. studies: 09/2004 – 06/2008	Taras Shevchenko National University of Kyiv (UKR) Economic Cybernetics

Competences

Computer literacy: GAMS, Stata, MS Office

Languages: Ukrainian and Russian: native, English: fluent, German: good, Spanish: average

Academic publishing

Bogonos M., B. Engler, M. Dreßler, J. Oberhofer and S. Dabbert (2015): Planting rights liberalization in the European Union: an analysis of the possible effects on the wine sector in Rheinland-Pfalz, Germany. In: German Journal of Agricultural Economics (forthcoming).

Bogonos M., B. Engler and S. Dabbert (2013): Modeling of the effects of planting rights liberalization on the wine sector of Rheinland-Pfalz: a partial equilibrium analysis. Proceedings of the 5th EAAE PhD Workshop, pp. 607-620. May 29-31. Leuven.

Bogonos M., B. Engler and S. Dabbert (2012): A Markov chain analysis for the growth of wine farms in Rheinland-Pfalz. Proceedings of the 22. Jahrestagung der Österreichischen Gesellschaft für Agrarökonomie „Ökosystemdienstleistungen und Landwirtschaft: Herausforderungen und Konsequenzen für Forschung und Praxis", pp.77-78. September 20-21. Universität für Bodenkultur, Wien.

Bogonos M., B. Engler and S. Dabbert (2012): Auswirkungen der Liberalisierung der Pflanzrechte auf den Weinsektor in Rheinland-Pfalz. Presentation held at the internal discussion at the Deutscher Bundestag „Auswirkungen der Liberalisierung des Pflanzrechtesystems auf den Öko-Weinsektor". December 12. Berlin.

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Bogonos M., A. Zorn and C. Lippert (2010): Determinants of non-compliance of organic operators with the organic standards in Germany. Poster presented at the ELLS Scientific Student Conference 'Food and the Environment'. November 12-13. Copenhagen.

Non-academic publishing

Bogonos M. (2011): Organic market development: the German approach. In: BIOLan Ukraine 7, pp.10-11 (in Ukrainian).