**Departamento de Economía Agraria, Estadística
y Gestión de Empresas**

**Escuela Técnica Superior de Ingeniería Agronómica,
Alimentaria y de Biosistemas**

Universidad Politécnica de Madrid

Regional Competitiveness and Future Perspectives of Wine Production in China

Tesis Doctoral

Autor

Yuanbo Li

Máster en Economía Agraria, Alimentaria y de los Recursos
Naturales

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Directora

Isabel Bardají De Azcarate

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Sólo Las Formas Son Diferentes”**

Lord Chesterreld

“De Quien Más Aprende Es De Quien No Sale Nada De Lo Mío”

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SUMMARY

China has a long history of grape cultivating and wine making, which can be tracked back to thousand years ago. Nowadays, after a rapid economic growth of thirty years, China has become one of the world's largest wine-consuming markets with great growth potential. At the same time, we cannot ignore the fact that China is an important wine producer as well. In recent years, both the vineyard area and wine production have increased dramatically in China owing to the increasing domestic demand, improved life-standard and improved technologies and matured management experience in the area of viticulture. In the meantime, the international wine market is vigorously competitive. Hence, there is a need to consider the potential of China's domestic production to satisfy domestic demand and even the competitiveness in the international market.

With this goal, this Thesis provides four questions: 1. What is the competitiveness of Chinese wine industry compared to the main wine producing countries in the world and how has it evolved historically? 2. Considering the huge size as a country and local diversity, what are the main factors of regional competitiveness and how is the regional competitiveness of wine production in different wine regions in China? 3. Facing the influence of climate change of both challenges and opportunities, what are the possible effects on regional competitiveness and adequate adaptive measures? 4. What are the internal and external factors which shape the wine industry and wine market in China and what kinds of strategies can contribute to the further development of the wine industry in China?

To answers these four questions, the specific objectives of this thesis are as following: 1. To analyze and determine competitiveness of Chinese wines in a global scenario. 2. To analyze the regional competitiveness of local wine industries and factors which contribute to its determination. 3. To study the impacts of climate change on the wine production in China and provide adaptation strategies. 4. To analyze determining factors and provide adequate strategies for the development of the Chinese wine industry.

To support this study, several methods have been adopted like literature review, statistical analysis, market competitiveness analysis, Porter's Diamond Model and industry competitiveness

analysis, climate change scenario analysis, climate change adaptive capacity analysis, and SWOT and SWOT Matrix analysis.

Overall, the results of this study provide scientific implication on the research of evolution and perspectives of China's wine industry from several aspects like historical, social, industrial, commercial and cultural variables. Even though China has dramatic expansion in domestic vineyard and increase in grape and wine production, compared with other countries, the competitiveness of Chinese wine production is still low with small export wine value and volume but the competitiveness general has been improved in a small scale in recent years.

Wine producing regions are across the whole nation with diverse natural and social conditions. According to the Porter's Diamond Model and the theory of industry competitiveness, Xinjiang has the highest competitiveness of Factor Condition; Beijing possesses the strongest competitiveness of Demand Conditions; Xinjiang ranks the first of Related and Supporting Industries and Shandong is the first in relate to Firm Strategy, Structure and Rivalry. For the Total Competitiveness, Shandong has outstanding advantages.

For climate change, a general tendency of increasing temperatures and accumulated temperature, water scarcity with increasing number of frost-free days and higher frequency of extreme events, all of which will bring both challenges and opportunities to the young Chinese wine industry. Climate change adaptive capacity of Chinese wine industry is analyzed and adaptive strategies are provided at policy, financial, technical, institutional and collaborative level.

According to SWOT and SWOT Matrix theory, 6 internal factors for Strength, 9 internal factors for Weakness, 9 external factors for Opportunity and 7 external factors for Threat, considering both traditional conditions such as wine production, wine policies as well as new conditions such as e-commerce, climate change and domestic economy trend, have been achieved in four sectors- Grape Producing, Wine Processing, Wine Selling and Wine consuming- of wine industry in China. For the further development of Wine industry in China, 8 strategies such as government support and establishment of wine laws at governmental level, 5 strategies such as a diverse and sustainable development at industrial level and 4 strategies such as broadcast of wine knowledge at business level have been provided.

RESUMEN

China tiene una larga historia de cultivo de uva y de elaboración de vino, que tiene su origen hace mil años. Hoy en día, tras un crecimiento económico acelerado de treinta años, China se ha convertido en uno de los mayores mercados consumidores de vino, con un gran potencial de crecimiento. Al mismo tiempo, no podemos ignorar el hecho de que China también es un importante productor de vino. En los últimos años, tanto el área vitivinícola como la producción de vino han aumentado dramáticamente en China, debido a la creciente demanda interna, la mejora de la calidad de vida, además del desarrollo de tecnologías junto con experiencia adquiridas para alcanzar una madurez en la gestión del área de la viticultura. Al mismo tiempo, el mercado internacional del vino es fuertemente competitivo. Por lo tanto, es necesario considerar el potencial de la producción nacional de China para satisfacer la demanda interna e incluso la competitividad en el mercado internacional.

Con este objetivo, esta Tesis plantea cuatro preguntas: 1. ¿Cuál es la competitividad de la industria vitivinícola china, en comparación con los principales países productores de vino del mundo y cómo ha evolucionado históricamente? 2. Teniendo en cuenta el enorme tamaño del país y su diversidad local, ¿cuáles son los principales factores de la competitividad regional y que afronta China para la producción de vino y cómo es la competitividad regional en diferentes regiones vitivinícolas? 3. Considerar la influencia del cambio climático, tanto los desafíos como las oportunidades, ¿cuáles son los posibles efectos sobre la competitividad regional y las medidas de adaptación al cambio climático? 4. ¿Cuáles son los factores internos y externos que conforman la industria vitivinícola y el mercado del vino en China y qué tipos de estrategias pueden contribuir al desarrollo de la industria vinícola en China?

Para responder a estas cuatro preguntas, los objetivos específicos de esta tesis son los siguientes: 1. Analizar y determinar la competitividad de los vinos chinos en un escenario global. 2. Analizar la competitividad regional de las industrias vinícolas locales y los factores que contribuyen a su determinación. 3. Estudiar los impactos del cambio climático en la producción

de vino en China y proporcionar estrategias de adaptación. 4. Analizar factores determinantes y proporcionar estrategias adecuadas para el desarrollo de la industria vinícola china.

Para apoyar este estudio, se han adoptado varios métodos como revisión de literatura, análisis estadístico, análisis de competitividad de mercado, modelo de diamante de Porter y análisis de competitividad de la industria, análisis de escenarios de cambio climático, análisis de capacidad adaptativa de cambio climático y análisis SWOT y Matriz SWOT.

En general, los resultados de este estudio proporcionan un aporte científico en la investigación de la evolución y las perspectivas de la industria vitivinícola de China desde varios aspectos como las variables históricas, sociales, industriales, comerciales y culturales. Mientras tanto, se ha observado una evidente disminución tanto en el área vitivinícola como en la producción vinícola de la industria vitivinícola mundial, mientras que China tiene una expansión intensificada en viñedos nacionales y un aumento en la producción de uva y vino. En comparación con otros países, la competitividad de la producción de vino chino sigue siendo baja, con un valor y volumen de exportación de vino muy bajos, sin embargo, la competitividad general se ha mejorado a pequeña escala en los últimos años. Las regiones productoras de vino se encuentran a lo largo de todo el país, con diversas condiciones naturales y sociales. Según el modelo del diamante de Porter y la teoría de la competitividad de la industria, Xinjiang tiene el Factor de Condición de competitividad más alto; Beijing posee la competitividad más elevada de las Condiciones de Demanda; Xinjiang ocupa el primer lugar de las industrias relacionadas y de apoyo; y, Shandong es el primero en relacionarse con la estrategia de la empresa, la estructura y la competitividad. Para la competitividad total, Shandong tiene ventajas excepcionales. Con respecto al cambio climático, existe una tendencia general de aumento de las temperaturas y la temperatura acumulada, la escasez de agua, el aumento del número de días sin hielo permanente y los eventos extremos con mayor frecuencia traerán desafíos y oportunidades a la joven industria del vino chino. De hecho, se analiza la capacidad de adaptación al cambio climático de la industria del vino chino y se proporcionan estrategias adaptativas a nivel político, financiero, técnico, institucional y colaborativo. Según la teoría SWOT y Matriz SWOT, se presentan: 6 factores internos para la Fortalezas, 9 factores internos de Debilidades, 9 factores

externos de Oportunidades y 7 factores externos de Amenazas. En esta aspecto se consideran tanto las condiciones tradicionales, como la producción de vino, las políticas vitivinícolas, así como nuevas condiciones como e-commerce, el cambio climático y la tendencia de la economía nacional. Estos aspectos se han logrado en cuatro sectores-producción de uva, elaboración de vinos, venta de vino y el consumo de vino de la industria del vino en China. Adicionalmente, se observa para el desarrollo de la industria vitivinícola en China, 8 estrategias como el apoyo gubernamental y el establecimiento de leyes sobre el vino a nivel de gobierno, 5 estrategias como un desarrollo diverso y sostenible a nivel industrial y 4 estrategias como la difusión del conocimiento del vino que se otorgan a nivel empresarial.

论文摘要

中国有着数千年的葡萄栽种和葡萄酒酿造历史。近三十年，随着中国经济的快速增长，有着巨大消费潜力的中国已成为世界最大的葡萄酒消费市场之一。同时，我们不能忽略中国也是世界重要的葡萄酒生产国。近些年，随着国内需求的增长，生活水平的提高，葡萄种植技术的提高和管理经验的成熟，中国葡萄园的面积和葡萄酒产量都有了巨大增长。与此同时，国际葡萄酒市场竞争十分激烈。因此，有必要考虑国产葡萄酒满足日益增长的国内需求的能力和其在国际市场中的竞争力。

为了这个目标，该论文提出了四个问题：1. 中国葡萄酒产业的历史发展是什么，其与世界主要葡萄酒生产国相比的竞争力怎么样？2. 考虑到中国巨大的体量和地区的差异性，影响地区葡萄酒产业的竞争因素是什么，其地区之间的竞争力怎么样？3. 面对气候变化带来的挑战和机遇，其对葡萄酒产业可能的影响是什么，有什么可行的应对措施？4. 影响中国葡萄酒产业的内部和外部因素是什么，有什么可行的发展战略？

为了回答这四个问题，本文具体的四个目标是：1. 分析中国葡萄酒产业的发展历程并研究其在国际市场的竞争力。2. 分析中国葡萄酒产区的竞争力和影响其竞争力的影响因素。3. 研究气候变化对于中国葡萄酒产业的影响并建立相应的气候变化应对措施。4. 分析影响中国葡萄酒产业的内外因素并提出对于中国葡萄酒产业的发展战略。

为了支持研究，该工作采用了一些研究方法诸如文献综述，数据分析，市场竞争力研究，波特钻石模型理论和产业竞争力分析，气候变化模型分析，气候变化应对能力分析和SWOT及SWOT矩阵分析。

总体来说，研究结果为从历史，社会，产业，商业和文化方面研究中国葡萄酒产业的发展提供了科学参考。虽然中国的葡萄园和葡萄酒产量有了显著的增长，中国葡萄酒的竞争力还较低，其出口量和出口值不高，近些年的竞争力有些微提升。

中国的葡萄酒产区分布在全国各地，有着多样的自然和社会条件。根据波特钻石模型和产业竞争力分析，新疆在生产要素上有最强竞争力，北京在需求要素上有最强竞争力，新疆在相关产业和支持产业上有最强竞争力，山东在企业的战略、结构、竞争对手的表现上有最强竞争力。综合四个方面，山东总体竞争力最强。

对于气候变化，中国总体上面临温度和积温的上升，水资源的缺乏，无霜期的延长和更频繁的极端天气，这些都将对年轻的中国葡萄酒产业带来挑战和机遇。中国葡萄酒产业气候变化应对能力被分析并从政策，财政，科技，教育和国际合作方面提出了气候变化应对的措施。

根据 SWOT 分析，既考虑到传统影响因素诸如葡萄酒产量，葡萄酒政策，也考虑到新的影响因素诸如电子商务，气候变化和国内经济趋势，对于优势提出了 6 点内部因素，对于劣势提出了 9 点内部因素，对于机遇提出了 9 条外部因素，对于挑战提出了 7 条内部因素。这些因素被归类为葡萄酒产业中的葡萄生产，葡萄酒酿造，葡萄酒销售和葡萄酒消费。基于 SWOT Matrix 分析，随后对中国葡萄酒产业的未来发展从政府层面提出了 8 条措施，从产业层面提出了 5 条措施，从商业层面提出了 4 条措施。

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LIST OF ABBREVIATIONS

A.D.: anno Domini

AC: adaptive capacity

ADVID: Association for the Development of Viticulture in the Douro Region

ANR-TERVICLIM: Agence Nationale de la Recherche- « Observation et modélisation spatiale du climat à l'échelle des terroirs viticoles dans un contexte de changement climatique »

ASEAN: Association of Southeast Asian Nations

B.C.: Before Christ

BN: Bois Noir

CI: cool night index

CMIP: Coupled Model Inter-comparison Project

CNRS: National Center for Scientific Research

Cons: Wine Consuming

DI: dryness index

EAT: Effective Accumulated Temperature

EU: European Union

FAO: Food and Agriculture Organization of the United Nations

FFD: First Frost Day

FFP: Frost-Free Period

GCMs: Gas Chromatography Mass Spectrometry

GDD: Growing Degree Days

GDP: Gross domestic product

GICC-TERADCLIM: Gestion et impacts des changements climatiques- « Adaptation des terroirs viticoles au changement climatique »

GNP: Gross National Income

Ha: hectare

HDI: Human Development Index

Hg: Hectogrammo

HI: heliothermal index

HKQAA: Hong Kong Quality Assurance Agency

Hl: hectolitro

IMS: International Market Share Index

INRA: National Institute for Agricultural Research of France

IPCC: Intergovernmental Panel on Climate Change

km: kilometer

kW: Kilowatt

L: litro

LACCAVE: Long term Adaptation to Climate Change in Viticulture and Enology

LFD: Last Frost Day

MCC: Multicriteria Climatic Classification

Mhl: million hectoliters

NOAA: National Oceanic and Atmospheric Administration of the United States

OECD: The Organisation for Economic Co-operation and Development

OIV: International Organisation of Vine and Wine

pH: potential of hydrogen

Proc: Wine Processing

Prod: Grape Producing

RCA: Revealed Comparative Advantage Index

RMB: Yuan (Chinese Currency)

SAT: Sum of Average Temperature

Sell: Wine Selling

SO: Strength-Opportunity

ST: Strength-Threat

SWOT: strength, weakness, opportunity, threat

TC: Trade Competitive Advantage Index

TQM: Total Quality Management

UK: United Kingdom

UNCOMTRADE: United Nations International Trade Statistics Database

UNDP: The United Nations Development Programme

US: United States of America

USA: United States of America

WEADZ: wineries above designated size

WO: Weakness-Opportunity

WSET: Wine&Spirit Education Trust Organization

WSMS: Wine Storage Management System

WT: Weakness-Threat

WTO: World Trade Organization

CHAPTER 1. RESEARCH QUESTIONS AND OBJECTIVES

1.1 Introduction

In the Western World, wine is a symbol of culture, history and even religion. Wine and wine culture have cultivated in Europe for thousands of years and have been broadcasted the entire world. When we appreciate the brilliant wine culture and long wine history of Europe, we may not ignore the wine culture and history in China. In Hunan, Henan and Zhejiang of China, grape seeds in ancient ruins had been excavated by several archaeological excavations with a historical span from 8,000 B.C. to 3,000 B.C. (Lv and Zhang, 2013; Wang et al., 2016). In Han Dynasty (206 B.C.-220 A.D.) the Chinese Explorer Zhang Qian (164 B.C.-114 B.C.) introduced *Vitis vinifera* (common grape vine) and wine making technologies from Central Asian Region to China. After that, wine grape planting wine making and wine culture had been recorded in literature and art in several Chinese dynasties (Jenster and Cheng, 2008). The beginning of the modern Chinese wine industry was the establishment of the Changyu Company in 1892 by Zhang Bishi (1841-1916) in the coastal city of Yantai, Shandong (Mitry, Smith and Jenster, 2009).

After a rapid economic growth of thirty years, China has become the world's second largest economy with a vast market size with 1.36 billion people. The dramatic development of society stimulates the consumption of alcoholic beverage in China. It was hard to imagine that one day China would be one leading wine consumer. However, the fact is that in 2013, China had surpassed France as the world's largest red wine consumer with more than 1.8 billion bottles of red wines and in 2015 China had been ranked the world's fifth largest market for all kinds of wines with a total consumption of 16 million hl (Independent, 2014; OIV, 2016). When wine companies worldwide are excited to join the Chinese wine market, the industry in China is developing with fast pace in several regions all across China. In 2015, according to the International Organization of Vine and Wine the wine production in China occupied eighth place with a production of 11.5 million hl.

1.2 Research questions and objective

China has become one of the world's leading wine-consuming markets with great growth potential. Chinese wine production in recent years has increased but the volume is still very small and insufficient to cover the need of domestic market. Because of this, wine import to China is of importance in both volume and value. On the other hand, the global wine market is very competitive, with traditional and new emerging wine exporters that compete for scarce import markets. In this framework, the Chinese market is one of the most attractive because of its volume and above all its growth potential.

In this framework, it is relevant to consider the potential of China's domestic production to satisfy domestic demand. With this general objective, several questions could be asked: What is the competitiveness of the wine in China compared to the main countries and how has it evolved? Taking into account the huge size of one country like China, what are the main factors of regional competitiveness of wine production? Given the influence of climate change, what are the possible effects on regional competitiveness and the potential for growth? What are the strategies that can contribute to the development of the wine industry in China? To answer these questions, the specific objectives of this thesis are as following:

1. To determine the commercial competitiveness of wine production in China in a global context
2. To analyze the regional competitiveness of Chinese wine production and the factors which contribute to its determination
3. To study the effects of climate change on the growth potential of wine production in China
4. To establish the most adequate strategies for the development of the Chinese wine industry, taking into account the factors that affect its growth

1.3 Thesis outline

Figure 1.1 presents the outline of the thesis. Chapter 1 is one introduction of the thesis, which consists of introduction, research questions and objective, literature review of the Chinese wine industry and research methodology with a goal to give an investigation line to the whole thesis. Chapter 2 is a study of the world's wine industry including Old Wine World, New Wine World and China. In this chapter, we realize studies the Chinese wine industry, considering the wine history, wine culture and the development of the Chinese modern wine industry including traditional and new factors. In addition, this chapter gives an overview of the international wine industry and the role of Chinese wine industry on an international stage by both quantitative and qualitative analyses. In Chapter 3, we introduce current situation of wine producing regions in China. Additionally, we analyze factors, which may decide the industrial competitiveness and measure the competitiveness in different wine regions. In Chapter 4, there is an introduction of how climate change is affecting the global wine industry by affecting grape/wine quality and quantity, grape pests and diseases, vineyard location and wine oak worldwide. Climatic variables and relevance have been chosen to analyze possible benefits and harms to wine industry by climate change at national and regional level. Climate change adaptation strategies have been provided at political level, financial level, technical level, institutional level and collaborative level for the Chinese wine industry. In chapter 5, we make qualitative analyses of the Chinese wine industry considering both traditional and new conditions that target current situation and perspectives and provide certain strategies for the future development of the Chinese wine industry at governmental level, industrial level and enterprises level. In the end, this thesis provides general discussion and conclusion on the base of all the investigations conducted and gives its limits and future works.

Figure 1.1. Outline of Thesis.

1.4 Literature review

In our research, several aspects of the wine industry in China are taken into consideration such as situation and perspectives of wine industry, wine market trend, wine culture and wine demand. Hence, we conduct literature review of current studies of wine in China at industrial level, market level, trade level, cultural level and wine tourism to help us better understand the wine industry in China and what have been done in the scientific region. Through this literature review, we may find that there is a need to conduct research on the regional competitiveness and climate change issues for the Chinese wine industry.

At the industrial level, Jenster and Cheng, 2008 provided an evolutionary view of the emerging wine industry in China and major concerns and challenges. They found that top domestic wine producers such as ChangYu, Great Wall, and Dynasty dominated the majority wine production in China and the brand mark was important in wine market as the lack of wine culture. Mitry et al., 2009 conducted a profile analysis of the Chinese wine industry and market, making implications of China as hopeful wine market and creative wine producer. Thorpe, 2009 reviewed the possible opportunities as well as threats presented by China as a relatively new player in the market. Ma, 2013 made comments on the current wine production-consumption in China, addressing new market trend, sustainable development and environmental issues.

For the wine market and consumer preferences, traditional alcohols such as Baijiu (liquor of cereals) occupy the traditional alcohol market in China; however, Chinese people start to learn more about grape wines in the past decade (Lin and Tavoletti, 2013). China has already been the most important wine-consuming country in Asia with increase in both total wine importation and per capita wine consumption (Anderson and Wittwer, 2015). To enter the Chinese wine market, stakeholders need to understand the Chinese culture and some subtleties of it and specific relationship between wine sellers and buyers even cooperative relationships between wine competitors would contribute to market success (Bretherton and Carswell, 2001; Beverland, 2008). The Chinese wine market is on a changing point that large dealers get more market share and while domestic wine producers are promoting Chinese wine culture and improve wine

quality, foreign wine exporters are building their own distribution channels and catering the local market (Bouzdine-Chameeva et al., 2014).

In China, it is not normal to drink wines with traditional Chinese food; however, this pattern seems to be change with increasing trend of wine consumption (Dewald, 2003). Restaurants play a gatekeeper role in wine market as a major wine distribution channel (Lockshin et al., 2011). Chinese do drink wines for the celebration of important occasions such as the Chinese New Year and the Mid-autumn Festival when the Chinese lucky color red and the health benefit of wines are appreciated (Liu and Murphy, 2007; Muhammad et al., 2013). In addition, wine can play an important role in the social connections as gift or banquet drink and luxury and expensive wines can show the generosity and richness of the host which caters to the Chinese traditional value “Mian Zi (面子) (Liu and Murphy, 2007; Yu et al., 2009; Somogyi, 2011). While, huge wine consumption could be expected, generally Chinese customers do not have enough knowledge of wine which is highly connected with wine drinking behaviors (Liu and Murphy, 2007; Li et al., 2010). Hence, for wine market holders, it is necessary to develop and implement informational and educational marketing strategies in the Chinese wine market (Camillo, 2012). Origin, brand, label (name, design, color and image) are important when consumers purchase wines and French wines are considered as good wines with high quality (Wilson and Huang, 2003; Yu et al., 2009; Xu et al., 2014; Liu and Murphy, 2014; Tang et al., 2015). It seems that the country of origin (COO) of wines is more important when consumers purchase for special occasions such as gift giving and wine consuming in public than for private consumption (Balestrini and Gamble, 2006; Hu et al., 2008). In addition, Chinese customers’ preference of wine sensory of grape variety, color and aroma is important factor in wine purchase and relative market techniques could be implemented (Williamson et al., 2012; Qing et al., 2015; Lockshin et al., 2016). Education also affects Chinese customers’ wine purchase (Xu and Zeng, 2014). For the reason that Chinese consumers are becoming more experienced, intrinsic cues such as taste, quality, and value-for-money are more valued for regular consumption (Liu et al., 2014). Besides wines from Bordeaux, Chinese consumers are more inclined to go for excellent wines from other wine regions of the world and getting more information from wine courses and websites (Masset et al., 2016). Enhanced customers’ knowledge, product familiarity and emotional attachments to specific wine region could contribute to ethnocentrism of wine (Yang and Paladino, 2015).

For the wine import and trade in China, a great increase of foreign imported wines has been building thanks to the dramatically increasing market demand of wine and the China's entry into the World Trade Organization (WTO) which led to a reduction in import duties on wine (Atkin and Gurney, 2013). Certain certifications such as the certification of Wine Storage Management System (WSMS), which is an excellent mechanism in the establishment of Total Quality Management (TQM), implemented by the Hong Kong Quality Assurance Agency (HKQAA) can guarantee the shipped and storage foreign wines (Atkin and Gurney, 2013). Many wineries choose the first distributor or agent rather than planned and long-term approach to sell wine to China and there are several selling channels such as supermarkets, stores, restaurants, wine bars, karaoke and on-line retailers (Lockshin, 2014). Further research of wine market in China could consider designations of origin such as Protected Designation of Origin and Protected Geographical Indication to have a better understanding of the dynamics of Chinese consumers, other novice markets and export strategies by global players (Capitello et al., 2015).

For the Chinese wine history and culture, Gong, 1993 made historical study of wine culture in China, which illustrate that wine plays an important role in Chinese civilization with a historical span from 7,000 years ago to modern Chinese society. Wang, 2016 conducted research to explore the guiding principal for pairing common western wines made of Cabernet Sauvignon, Chardonnay, Riesling, and Merlot to traditional Chinese cuisines and found that Riesling wine was mostly preferred by Chinese consumers to pair with most of Chinese cuisines in his research.

For the Chinese wine tourism, Zhang Qiu et al., 2013 conducted a qualitative survey in Chateau Changyu-Castel and Chateau Junding in the Bohai Bay wine region in Shandong Province of China, finding that several facilitating and detrimental factors in the development of Chinese wine industry on people, promotion and place. Lirong, 2011 made descriptive analysis of wine tourism in China and the world about development issues (wine tourism brands, wine tourism industry standards, tourism product quality, cultural awareness and resources integration), development model (globalization, industry competition, improvement of service and construction) and financial crisis and made analysis of wine tourism in Shandong, China.

1.5 Contribution and publications

Publications

1. Li Y.B. and Bardají I. (2017, May). **Adapting the wine industry in China to climate change: Challenges and opportunities**. Volume 51, Number 2, 2017, P71-89; DOI:10.20870/oenone.2016.0.0.1184

Published by the French Journal, JCR, SCI, **OENO One (Journal International Des Sciences De La Vigne Et Du Vin)**.

2. Li Y.B. and Bardají I. (2016). **A new wine superpower? An analysis of the Chinese wine industry (2016-2017)**.

2.1 After review, Major Revision, French Journal, JCR, SCI, **Cahiers Agricultures** (2017, August)

2.2 Published in as the **No.198 Working Paper** of the American Association of Wine Economists (AAWE) (2016, June). http://www.wine-economics.org/dt_catalog/aawe-working-paper-no-198-business/

2.3 This Working Paper has been reprinted on the web site by the Observatorio Vitivinícola Argentino (Argentine Wine Observatory) as “¿Una nueva super potencia en el mundo del vino? Análisis de la industria vitivinícola china” (2016, June). <http://observatoriova.com/2016/06/una-nueva-super-potencia-en-el-mundo-del-vino-analisis-de-la-industria-vitivinicola-china/>

3. Li Y.B. (2015, May) **全球气候变化对于欧盟葡萄酒产业的影响和对中国的启示** (Impact of global climate change on European wine industry and the revelation to China, In Chinese). Number 5, 2015, P126-129; DOI: 10.13746/j.njkj.2014472

Published in the Chinese scientific journal, **LIQUOR-MAKING SCIENCE & TECHNOLOGY (酿酒科技)**.

Conferences

1. Li Y.B. and Bardají I. (2017, September). **A regional-level study on the competitiveness of the wine production industry in China.**

Published as Conference paper and presented as oral presentation in the XI Congress of the Spanish Association of Agricultural Economists, Oriuela-Elche, Spain. ISBN: 978-84-16024-62-9 , (2017, September).

2. Li Y.B. and Bardají I. (2017, June). **New wine world from Asia: Development, regional comparison and opportunities for the wine industry in China.**

Publishes as conference communication and presented as oral presentation in the XXIV European Association of Wine Economists Conference, Bologna, Italy (2017, June).

3. Li Y.B. and Bardají I. (2016, October). **New wine world from China: An analysis of competitiveness of the wine industry in Ningxia.**

Published as Conference Abstract in the XI Iberian Conference on Rural Studies, Vila Real, Portugal (2016, October).

4. Li Y.B. and Bardají I. (2016, June). **A new wine superpower? An analysis of the Chinese wine industry**

Presented as oral presentation in the 10th Annual Conference of the American Association of Wine Economist in Bordeaux, France (2016, June).

5. Li Y.B. and Bardají I. (2015, September). **Challenges of climate change and adaptation suggestions for the Chinese wine industry.**

Published as Conference paper and presented as oral presentation in the X Congress of the Spanish Association of Agricultural Economists, Cordoba, Spain. ISBN: 978-84-9048-383-1, (2015, September).

Monograph

Li Y.B. (2017, September). **China's Emerging Grape Wine Industry: History, Development, Perspectives, International and Regional Competitiveness**. Lambert Academic Publishing, Germany. ISBN (978-620-2-02878-3).

CHAPTER 2. WINE INDUSTRY: CHINESE AND GLOBAL TRENDS

2.1 Introduction

From the monopolization of wine culture through the nineteenth and much of the twentieth century by Europeans, to the emerging of New World wine producers, the world's wine industry now stands at a point of change (Aylward, 2005). Significant changes in the market such as decreases in consumption by traditional consuming countries and increasing market shares of New World including USA, Australia, Chile, South Africa, Argentina and New Zealand (Morrison and Rabellotti, 2017). Meanwhile Old World wine producers no longer dominant production, export and marketing of wine, New World wine producers such as California, South Africa, Australia and New Zealand have success in wine production, management, marketing and innovation (Aylward, 2003). The wine industry has become increasingly globalized over the last decades with structure changes in market (Thorpe, 2009). The globalization of wine production and consumption has aroused considerable academic interest in wine industry (Pinilla, 2013).

Over the past decade, China has become far more important to the world's wine markets (Anderson and Wittwer, 2015). Simultaneously, there has also been a significant growth in both wine production and wine marketing of wines made in China (Mitry et al., 2009). The Chinese wine industry emerges as a very unusual candidate for foreign direct investments, enterprising firms and eager capitalists (Jenster and Cheng, 2008). Now China is a major wine producer in world terms (Thorpe, 2009).

In this chapter, we study the changes in the world's wine industry. In addition, we analyze the role of the Chinese wine industry in the world and measure its competitiveness through the assessment of the International Market Share, the Trade Competitive Advantage Index and the Revealed Comparative Advantage Index.

2.2 Methods and data source

In this Chapter, there are three main studies. The first study is to analyze the current situation and the perspectives of the wine industry in China considering both traditional and new conditions and with a goal to provide strategies. This part of research is mainly based on a literature review and secondary data collected from organizations such as FAO (Food and Agriculture Organization of the United Nations), OIV (International Organisation of Vine and Wine), UN COMTRADE (United Nations International Trade Statistics Database), National Bureau of Statistics of China; government reports such as Yearbook of China Alcoholic Drinks Industry, China Sugar&Liquor Yearbok; business reports; online resources and research papers. The second study is to analyze the new trends and dynamics of the global wine industry. We collected information from literature review and on-line resources. We used data from international organizations such as FAO (Food and Agriculture Organization of the United Nations), OIV (International Organisation of Vine and Wine), and UN COMTRADE. The third study is to analyze the role of the Chinese wine industry in the world. In this part, we conduct analyses based on the International Market Share Index (IMS), the Trade Competitive Advantage Index (TC) and the Revealed Comparative Advantage Index (RCA) and used data from UN COMTRADE.

Considering the importance of international competitiveness, several indices have been developed to assess it including the International Market Share (IMS)/ the Export Market Share (EMS), the Trade Competitiveness (TC) and the Revealed Comparative Advantage (RCA) (Cao et al., 2011; Maksymets and Lönnstedt, 2016). The competitiveness of Chinese service trade is measure by IMS, TC and RCA to conduct an empirical study on the determinant factors that affect the trade competitiveness after China entering WTO since 2002 (Wang, 2006). An investigation on the international competitiveness of computer and information service trade between China and India is conducted through indices of IMS, TC and RCA (Wang, 2013). A study of the trade structure, complementary advantages of China and ASEAN (Association of Southeast Asian Nations) is conducted applying TC (Yang, 2009). Maksymets and Lönnstedt, 2016 used IMS and RCA to assess changes in the international

competitiveness of forest products industries in Sweden, USA and Ukraine. Cao et al., 2011 used TC and RCA to analyze export competitiveness of agri-products between China and Central Asian countries. The Revealed Comparative Advantage (RCA) is commonly accepted in the international economic literature to measure the international competitiveness of countries that export the same commodity (Seleka and Kebakile, 2017). Remeikiene et al. 2015 used RCA to assess the industry competitiveness of the Baltic States during the period of economic recession. Ismail and Abdullah, 2013 applies the RCA to study the shrimp trade competitiveness of Malaysia and other four countries in ASEAN (Association of Southeast Asian Nations). Seleka and Kebakile, 2017, use RCA to investigate Botswana's beef export during the period 1961-2011. First, we analyze the dynamics of the world's wine industry in recent decades considering Old World, New World and China. Data of this part are collected from data resources such as OIV (International Organisation of Vine and Wine) FAO (Food and Agriculture Organization) and UN COMTRADE. Second, we apply these three indices - International Market Share (IMS), Trade Competitive Advantage Index (TC) and Revealed Comparative Advantage Index (RCA) to analysis the role of the Chinese wine industry in the world.

2.3 Historical perspectives in China

Although wine is not an essential agricultural product for survival, it is closely connected to human history and culture as a significant product of human creativity (Mozell and Thach, 2014). In Pre-history and Antiquity, Medieval Period and Modern Period, there are vast of wine producing and wine consuming records and wine culture is rooted in many cultures in the world. In Caucasus Region, Greece and Roman Empire, the broadcast of grape and wine technology brought religion and legends and changed the life of local people (Vinehoo, 2017).

China has a 6,000-year history of grape growing and a 2,000-year history of wine making (Zhang Qiu et al., 2013). In China, grape seeds in ancient ruins had been excavated by several archaeological excavations in Hunan, Henan and Zhejiang three Chinese provinces with a

historical span from 8,000 B.C. to 3,000 B.C. (Lv and Zhang, 2013; Wang et al., 2016). Alcohol drinking in China has a long history and it plays an important role in the life of Chinese people. The first Chinese literature record of grape appeared in the Classic of Poetry (Shijing) from 1100 B.C. to 700 B.C. and grape was called “𦰩𦰪 Ying Yu” at that period (Wang et al., 2016). The Chinese name of grape “葡萄 Pu Tao” can also represent the grape wine and in ancient Chinese “葡萄” could also be written as “蒲陶” which means “gathering together to drink and getting drunk” and the first literature record of “蒲陶” was in The Records of the Grand Historian (91 B.C.) by the Chinese Historian Sima Qian (145 or 135 B.C. -86 B.C.) (Wang and Huang, 2009; Wen, 2013). Although in China grape wine is not the most consumed liquor, the Chinese grape cultivation history spans more than 2000 years. During the Han Dynasty (206 B.C.-220 A.D.) *Vitis vinifera* was introduced by the Chinese Explorer Zhang Qian (164 B.C.-114 B.C.) from central Western Regions (current Xinjiang Autonomous Region and some part of Central Asian) from 138 B.C. to 119 B.C. (Wang and Huang, 2009). Wine grape cultivation and wine culture came to China along the Silk Road firstly in Xinjiang and then expanded to the rest of China. In the Yellow River region where the ancient Chinese civilization was nurtured, began the large-scale viticulture activities of wine grape planting and wine making (Liu and Murphy, 2007). During the Tang Dynasty (618 A.D.-907 A.D.), which was the largest and most powerful dynasty of China wine drinking and wine-culture had achieved great progress. For the wealth and stability of society, grape wine not only became a favorite drink of emperors and ministers but also was popular in folk (Su, 2005). During this period, wine drinking behavior and wine culture were gathered by Chinese poems. The most famous Chinese poet Li Bai (701 A.D.-762 A.D.) expressed his love for wine in many of his poems. In many dynasties of China, it is easy to find historical references of wine making and wine consumption (Jenster and Cheng, 2008).

2.4 The development of the modern wine industry

2.4.1 Wine production

Zhang Bishi (1841-1916) established the first Chinese wine company Changyu in 1892 in the coastal city of Yantai, Shandong (Mitry, Smith and Jenster, 2009). This marked the beginning of the Chinese wine industry. In 1949 when the People's Republic of China was established, there were only 6 wineries remained (Changyu of Shandong, Dragon Seal of Beijing, Tonghua and Changbaishan of Jilin, Dingdao of Shandong and Qingxu of Shanxi) for years of war (Vinehoo, 2017). Wine producing regions are widely distributed in China from the east coastal areas to the west desert areas where distinct geographical and climatic conditions exist.

The domestic wine industry has developed significantly since the “Reform and Opening Up” policy in 1978. In the period of 1980-1990, the Chinese vineyard areas developed very slowly based on around 30,000 ha with a small production of grape below 900,000 tons (Li, Li and Yang, 2009). During this period the “half-juice wine” which mixed grape juice with water, sugar and other fruit juice was the main wine product in the market, and several problems of food quality existed. In the period of 1991-2000, the Chinese wine industry had a period of regulation and adjustment. In 1994, the production of certain “half-juice wine” containing less than 50% grape juice was permanently prohibited. By 2000, the vineyard area was 282,970 ha and the wine production was 2.02 million hectoliters. In the 21st century, due to the fast growing economy and increasing market demand, the Chinese wine industry has experienced rapid growth and both the yield and quality have been improved. The encouragement of government, the development of society and the advancement of technology have facilitated this growth. In 2004, the production of all kinds of “half-juice wine” was totally forbidden which encouraged the production of fine wines containing 100% of grape juice.

Figure 2.1. The wine region and wine production in China.

Source: Yearbook of China Alcoholic Drinks Industry (2001); China Sugar&Liquor Yearbok (2011); National Bureau of Statistics of China, 2016; ASKCI, 2016; OIV (2016).

Since 2001 when China entered the World Trade Organization (WTO), a large number of foreign wines have entered China bringing competition, new technology and management experience. As showed in **Figure 2.1**, the domestic wine production increased from 0.78 million hectoliters to 11.50 million hectoliters and the total vineyard area scaled up from 31,600 ha to 830,000 ha. Even though tremendous expansion of vineyard has been achieved in China, only approximately 10% of the total vineyards are for wine grape and Cabernet Sauvignon is the most widely planted wine grape variety (Li, Li and Yang, 2009; Li, 2016). Internationally, China plays an important role in wine production. In 2015 China was the 8th largest world wine producer with a volume of 11.5 million hectoliters (Mhl) after Italia (50.0 Mhl), France (47.4 Mhl), Spain (37.3 Mhl), USA (22.1 Mhl), Argentina (13.4 Mhl), Chile (12.9 Mhl) and Australia (11.9 Mhl) (**Figure 2.2**) (OIV, 2016).

Figure 2.2. World Wine Production, 2008-2014.

Source: OIV, 2016.

In spite of the significant development of the Chinese wine industry, there are many challenges to be addressed. Problems such as low yield and poor quality, homogeneity of products, and inconsistent standards, are hindering the development of Chinese vineries (Wang, Zhao, Liu and Fu, 2010). The development of wine cluster needs several necessary supports such as a favorable development environment, good cooperation among enterprises and adequate talent resources (Ma and Qiao, 2009). Improved regulations and legislations are necessary to solve the existing confusion and irregularity in the whole process from wine grape planting to wine making (Li, Li and Yang, 2009).

2.4.2 Government support

In recent decades, the Chinese wine industry has achieved great developments. Wine industry has been one of the most rapidly growing and promising light industries in China. The “12th Five-Year (2011-2015) Plan” for the Chinese wine industry released in 2012 by the Ministry of Industry and Information Technology of China highlights the importance of government guidance and support to the Chinese wine industry especially in the improvement of wine producing regions, the adjustment of industrial structure, the development of science and technology, the assurance of product quality and the combination of wine culture and Chinese wine brands.

To guide and support the domestic wine industry China has released several national legislations and policies (**Table 2.1**) but in comparison with other wine producing countries, which have a complete legal system, China still, has a long way to go. There is a great need for a complete legal system such as the wine classification system for the domestic wines. In the approach to a complete wine legal system the small in-land province Ningxia that has become the first Chinese province to be accepted as an official observer of the OIV in 2012 has one-step further (**Table 2.2**).

- The Ningxia Government promulgated the first Chinese protection regulation for wine region —“Regulation” on the protection of Eastern Foot of Helan Mountain Wine Region in 2012.
- In 2013, the first regional winery classification system was released in Ningxia and this system has been further completed in 2016 as the —“Ningxia Winery Classification System”.

In addition, several wine producing provinces have launched policies to guide the development of local wine industries such as the —“Development Plan for The Wine Industry (2015-2025)” of Xinjiang, the —“Suggestions for the promotion of the development of food industry” of Hebei, and the —“Wine industry development plan (2010 ~ 2020)” of Gansu.

Table 2.1. Main Chinese Legislations and Policies for the Wine Industry.

National legislations and policies for the wine industry of China			
Name	Year	Area	Target
Hygiene Regulation of Factory for Wine GB 12696-90	1990	Industry	To regulate hygiene practices for food production
National Standard Wine (Old) GB/T 15037-1994	1994	Industry	To regulate the term of wine name, classification, technology, inspection, signs, packaging, transportation and storage
Analytical Methods of Wine and Fruit-wine (Old) GB/T 15038-94	1994	Industry	To offer principles for wine and fruit-wine quality monitoring
Standard Half-juice Wine GB/T1980-1994 Standard Hill Wine QB/T1982-94	1994	Industry	To offer food standard and abolish the production of wine that contains less than 50% of grape juice
National Standard Wine (New) GB15037-2006	2006	Industry	A revision of the old standard. To offer new standards which cover all processes from grape planting, wine production to transportation
Analytical Methods of Wine and Fruit Wine (New)	2006	Industry	To offer principles for wine and fruit-wine quality monitoring
Measures for the Administration of Consumption Tax on Grape Wine (for Trial Implementation)	2006	Industry	To avoid double taxation in wine production and reduce the production cost of wine enterprises
Cleaner Production Standard — Wine Industry HJ452-2008	2008	Environment	To provide the general requirements for the wine producers to have cleaner products meeting the national and local emission standards
China's Wine Industry Twelfth Five-Year Development Plan	2012	Industry	To support and regulate the development of the Chinese wine industry (2011-2015)
MOFCOM Announcement No.36 of 2013on Case-filing for Anti-dumping Investigation Against Wines	2013	Commerce	To initiate anti-dumping investigation against wine imports originated in the European Union (EU)
MOFCOM Announcement No.37 of 2013 on Case-filing for Countervailing Investigation Against Wines	2013	Commerce	To initiate countervailing investigation against wine imports originated in the European Union (EU)
MOFCOM Announcement No.19 of 2014 on Termination of Anti-dumping and Countervailing Investigations Against Imports of Wines from the European Union (EU)	2014	Commerce	To terminate the anti-dumping and countervailing investigations against the wine imports originated in the European Union (EU)

Revising the —Measure for the Administration of Consumption Tax on Grape Wine (for Trial Implementation)”	2015	Industry	Revision for the old edition of 2006
China's Wine Industry Thirteenth Five-Year Development Guiding Opinion	2016	Industry	To support and regulate the development of the Chinese wine industry (2016-2020)

Table 2.2. Regulations for the Wine Industry of Ningxia.

Regional regulations for the wine industry of Ningxia		
Name	Year	Target
Regulation on the protection of Eastern Foot of Helan Mountain Wine Region	2012	The first protection regulation for wine region in China
—Ningxia Classification System” for wineries	2013	The first winery classification system in China
Regulation on the protection of the geographical mark —Eastern Foot of Helan Mountain”	2014	Regulation to protect the geographic mark of wine region
“Ningxia Classification System” for wineries (new edition)	2016	Classification system for wineries of Ningxia

2.4.3 Institutional support

Institutionally, the grape and wine education is of great importance for the development of Chinese wine industry, and talents with professional knowledge of grape cultivation, wine making, wine culture, wine tasting and wine business are more and more being welcomed in China. The need to develop the Chinese domestic wine industry urges the expansion of a high-level education of wine. Until 2015, China had above 16 universities or institutes offering the major —Viticulture and Enology Engineering” in the bachelor education and this number will keep rising (**Table 2.3**). Among them, the —Northwest Agriculture and Forest University” and —China Agricultural University” are universities in the “211” project and “985” project, which means they not only have a good reputation but also advanced technologies and national support.

Meanwhile, several advances in studies and technologies of grape and wine such as viticulture zoning, grape breeding, grape production have been achieved in China (Li, Li and Yang, 2009).

Table 2.3. Major “Viticulture and Enology Engineering” in Chinese Universities.

University	Province	University	Province
Northwest Agriculture and Forest University	Shaanxi	Shenyang Pharmaceutical University	Liaoning
China Agricultural University	Beijing	Dalian Polytechnic University	Liaoning
Beijing University of Agriculture	Beijing	Gansu Agricultural University	Gansu
Shandong Agricultural University	Shandong	He Xi University	Gansu
Taishan University	Shandong	Shanxi Agricultural University	Shanxi
Binzhou Medical University	Shandong	Ningxia University	Ningxia
Ludong University	Shandong	Chuxiong Normal University	Yunnan
Qingdao Agricultural University	Shandong	Xinjiang Agricultural University	Xinjiang

In the meantime, a growing interest of professional wine knowledge and culture has been observed. China has been one of the most important markets for the Wine&Spirit Education Trust (WSET) Organization that specializes in wine education (WSET, 2015). In big cities such as Beijing and Shanghai among people from a middle-class and business background there is a common belief that a good knowledge of wine can improve their self-cultivation and help their personal career.

2.5 Wine demand and trade

2.5.1 Wine demand

Due to the economy’s expansion, the improved living standard and the growing middle class, there was a rising trend in both the total alcohol consumption and the per capita wine

consumption of China from 2005 to 2012 (**Figure 2.3**). China was the fifth largest global wine market in 2015 with a consumption of 16 million hectoliters (Mhl) after USA (31Mhl), France (27 Mhl), Italy (21 Mhl) and Germany (20 Mhl) (OIV, 2016). In 2013, China surpassed France as the largest global red wine market (Independent, 2014). Even though the total national wine consumption is huge, the per capita wine consumption is still small with only 1.18 liters in 2014 representing only 11.5% of the United States of America (USA) and 2.4% of French (Table 2.4).

Figure 2.3. Wine Consumption in China. Source: ASKCI, 2015; National Bureau of Statistics of China, 2015; OIV, 2016 and calculated by author.

Table 2.4. Total and per capita wine consumption of main wine consuming countries.

Source: OIV, 2015; WINEINSTITUTE, 2015.

Country	Total consumption,2014 (million hectoliters)	Wine consumption per capita,2014 (liters)
USA	31	10.25
France	28	42.51
Italy	20	33.30
Germany	20	24.84
China	16	1.18
UK	13	21.99
Spain	10	21.26
Argentina	10	23.46
Russia	10	6.95
World	240	3.56

2.5.2 Wine commerce

However, the Chinese annual GDP growth rate of 2015 has been announced officially to be 6.9 % with 0.4% less compared to 2014. The slowdown of the economic growth rate or the “new normality” of the Chinese economy affects both the consumption of wine and the production of wine in China. At the same time, the “anti-corruption” campaign by the new Chinese government to some extent leads to a decrease in wine selling. This especially affects imported luxury wines that are often given as gifts to government officials or businesspersons. From 2012 to 2013, the wine consumption dropped from 17.48 million hectoliters to 16.82 million hectoliters with a rate of 3.8% and the wine consumption decreased to 15.80 million hectoliters in 2014 with a rate of 6.1% (**Figure 2.4**). The wine production decreased more sharply from 13.82 million hectoliters to 11.78 million hectoliters with a rate of 14.7% in 2013 and further decreased to 11.50 million hectoliters in 2015 (OIV, 2016; ASKCI, 2016). This trend affects the domestic wine industry and foreign wine companies. For wines from Bordeaux region the sales volume decreased by 9% and the sales value decreased by 17% in 2014 (Eads, 2015).

Figure 2.4. Wine Consumption and Production of China. Source: OIV, 2015, 2016; ASKCI, 2015.

Even though the Chinese wine market has some volatility, there is an opportunity to further explore the domestic market of China. It is worth noting the dramatic development of e-commerce. Even since 2008 China has surpassed the United States as the country with the largest number of Internet users, the number of Internet shoppers keeps growing with dramatic pace and the size of e-commerce is enlarging with a high speed. In 2014 the total number of Chinese on-line shoppers was 361.42 million (614.6 million Internet users) and the total e-commerce market size in 2018 is predicted to increase from 784.5 billion Yuan (RMB) in 2014 to 7,300 billion Yuan (RMB) (**Table 2.5**) (Internet Live Stats, 2015; Statista, 2015; IResearch, 2015). Several wine suppliers have participated in e-commerce which offers a new market channel for wine companies and a new shopping platform for wine consumers such as professional wine suppliers –Yesmywine”, –Winenice”, –Pinwine” and –WangJiuWang”; integrated alcohol suppliers –JiuXianWang”, –GouJiuWang” and –ZhongJiuWang”; E-platforms –JingDong” , –Tmall” and –YiHaoDian” (**Table 2.6**) .

Many Chinese wine enterprises possess vineyards in several parts of China to produce domestic wines. Several Chinese wine brands have good reputation among Chinese customers such as the “Great Wall” of “COFCO”, the “Changyu” of “Yantai Changyu Group” and the “Dynasty” of “DynastyWinery”. However, top Chinese wine companies are experiencing a market share decrease for the competition from both domestic and foreign wines (**Table 2.7**). However, top Chinese wine companies are experiencing a market share decrease for the competition from both domestic and foreign wines. Recently, some Chinese investment even flow into foreign wine industry to seek like acquisition of chateaux in France and vineyards in Australian to sell wines back to the Chinese huge market (Louise and Michael, 2015).

Table 2.5. E-commerce of China. Source: Internet Live Stats, 2015; Statista, 2015; IResearch, 2015. F: forest.

Year	Internet users (million)	Year	On-line shoppers (million)	Year	E-market size (billion RMB)
2000	22.74	2006	33.57	2011	784.5
2014	614.6	2014	361.42	2018f	7300

Table 2.6. Main Wine E-commerce Suppliers in China. Source: WINECHINA, 2014a and calculated by author.

Type	Name	Founded time	Business Model	% of Chinese wine (1 Oct. 2015)
Professional wine supplier	Yesmywine	2008	O2O,B2C	1%
	Winenice	2008	O2O,B2C	4%
	Pinwine	2009	O2O,B2C	0
	WangJiuWang	2011	O2O,B2C	0
Integrated alcohol supplier	JiuXianWang	2009	O2O,B2C	16%
	GouJiuWang	2011	B2C	22%
	ZhongJiuWang	2012	O2O	14%
E-Platform	JingDong	1998	B2C	
	Tmall	2003	B2C	
	Yihaodian	2008	B2C	

Table 2.7. Market Share of in China. Source: Euromonito International, 2014 and calculated by author.

Market Share (%) by Volume of Chinese Wine Enterprises						
Enterprise	Headquarters	2009	2010	2011	2012	2013
COFCO	Beijing	9.9	6.9	5.7	4.8	3
Yantai Changyu Group Co Ltd	Yantai, Shandong	5.6	5.3	5.1	4.1	3
Dynasty Winery Co Ltd	Tianjin	3.6	3.3	2.2	1.4	0.9
Yantai Weilong Grape Wine Co Ltd	Yantai, Shandong	3.1	2.8	2	1.3	0.9
Citic Guoan Group	Beijing	/	0.7	0.8	0.9	0.9
Vats Group	Beijing	1.2	1.2	1	0.8	0.7
Castel Groupe (China)	Shanghai	0.8	0.7	0.7	0.6	0.6
Macrolink Group	Beijing	0.8	0.8	0.7	0.6	0.6
China Tontine Wines Group Ltd	Hongkong	1.5	1.4	1.3	1.1	0.5
Yantai Pengzhu Winery Co Ltd	Yantai, Shandong	0.8	0.7	0.6	0.5	0.5
Total		27.3	23.8	20.1	16.1	11.6
Rest Enterprises		72.7	76.2	79.9	83.9	88.4

2.5.3 Wine tourism

Chinese people do appreciate travelling with the purpose of relaxing and acquiring new knowledge (**Figure 2.5**). As a response to the interest of wine and the desire of leisure, wine tourism has developed in China (Zhang Qiu et al., 2013). The wine tourism includes visiting in wineries where the visitors may engage in several activities such as wine and food tasting, grape picking and learning about wine culture. Many local governments intend to develop the wine tourism to support the local wine industries and to attract investment. The Ningxia Government issued a plan to develop the —Helan Mountain Grape Culture Corridor” in 2011 (Song, 2016). By 2020, there will be a total number of 1 million acres of vineyards, one wine culture development center, three wine cities, 10 wine towns and more than 100 wineries (Chateaus) which will make this area an excellent wine and tourism region. Tourism industry will be developed based on natural sceneries (deserts, Yellow River etc.), ecological sceneries (theme park of ecological

restoration of mining and industrial areas etc.), historical and cultural landscapes (local ethnic history etc.) and wine culture (wineries, wine museums, wine festivals etc.). Related industries such as real estate industry, food industry and film industry will also be developed.

Figure 2.5. Wine tourism structure. Source: Own drawn.

2.5.4 Wine trade

Since 2001 when China became a member of the World Trade Organization (WTO), the imported wine tariff fell from 65% to 14% (bottled wine) and 20% (bulk wine). Foreign wines began to enter the Chinese market at a fast pace. The import volume increased from 29.23 thousand tons to 552.09 thousand tons from 2001 to 2015. The import value increased from 23.60 million US dollars to 2,039.82 million US dollars from 2001 to 2015. For the Chinese market, approximately 30 % of the whole wine consumed in China is imported wine. France, Australia, Chile, Spain, Italia are main wine exporters of China. French wines occupy the largest sale volume and the largest sale value of bottled wine in China. For Chinese customers, France culture and food bring a good image to French wines and contribute heavily to the sale success (Yu, Sun, Goodman, Chen and Ma, 2009). New Zealand and Chile have the zero-tariff to enter

the Chinese market in 2012 and 2015 separately whereas Australia will get totally zero-tariff in 2019. Along with the lower- priced wines such as Spanish wines, the Chinese wine which mainly has price advantage in the lower- priced wine market will face a big challenge.

- In 2013 an decrease both in import volume (decreased from 391.37 thousand tons in 2012 to 373.98 thousand tons in 2013) and import value (decreased from 1,581.02 million US dollars in 2012 to 1,554.62 million US dollars in 2013 and further to 1,503.34 million US dollars in 2014) had been observed for several domestic reasons such as the “—slowdown of economic growth rate” and the “—anticorruption” campaign (UN COMTRADE, 2015) (**Figure 2.6** and **Figure 2.7**).
- However, a dramatic increase in both the import volume (43.99%) and the import value (35.69%) had been observed in 2015 compared to 2014 with 552.09 thousand tons and 2,039.82 million US dollars. The import volume of bottled wine and bulk wine increased 36.99% and 78.28% separately and the import value of bottled wine and bulk wine increased 37.11% and 41.64% separately compared to 2014 (GACC, 2016).
- More consumption of low-end wines of Chinese customers, import tariff adjustment for wines from Australia, New Zealand and Chile, wine import for stock by wine suppliers after the “—hard period” of sale may contribute to this phenomenon.

Figure 2.6. Wine Imports of China, 2008-2015. Source: UN COMTRADE, 2015.

Figure 2.7. Wine Import of China by Country, 2001-2015.

Source: Caculated by Data from UN COMTRADE, 2015

2.6 New trends and dynamics

According to data of FAO, a general decreasing trend of vineyard area has been observed from 1961 to 2014 (**Figure 2.8**). The world's total vineyard area was 9.33 million ha in 1961 and this amount fell down to 8.86 million ha in 1983 (-5.04 %) and further fell down to 7.97 million ha in 1990 (-10.00%) and 7.12 million ha in 2014 (-8.60%). Compared with 1961, the world's total vineyard area decreased 23.69% in 2014. In recent decade, the world's total vineyard surface area is decreasing, mainly for the reduction of vineyards in Europe (OIV, 2016). In France, the total vineyard area decreased from 1.42 million ha in 1961 to 0.76 million ha in 2014 (-46.48%). In Spain, this data shifted from 1.74 million ha in 1961 to 0.93 million ha in 2014 (-46.55%). Meanwhile in Italy, the total vineyard decreased from 1.69 million in 1961 ha to 0.70 million ha in 2014 (-58.58%) (**Figure 2.9**). However, at the same time, dramatic increase of vineyard area occurs in China (**Figure 2.10**). According to FAO, vineyard area in China grew from 0.10 million ha in 1961 to 0.77 million ha in 2014 (+ 670%).

Figure 2.8. World vineyard area 1961-2014. Source: FAO, 2016.

Figure 2.9. Vineyard area of France, Italy and Spain, 1961-2014. Source: FAO, 2016

Figure 2.10. Vineyard area by country, 1961-2014. Source: FAO, 2016

For the wine production in the world, turbulence is being observed and compared with the 1970's, current wine production is lower (**Figure 2.11**). According to FAO, in 1979, the world wine production was 37.54 million T (tons) which is the highest during the period of 1961-2014 and in 2014, this number shirked to 29.11 million T (-22.46%). In 2016, world wine production (juice and musts are not included) decreased by almost 15 mhl (million hectoliters) with 259 mhl compared with 2015, which is one of the most lowest during the last 20 years (OIV, 2016). In France the wine production decreased from 4.86 mhl in 1961 to 4.29 mhl in 2014 (-11.73%). During the same period, in Italy the wine volume decreased from 5.25 mhl in 1961 to 4.80 mhl in 2014 (-8.57%). However, in Spain this figure increased from 2.02 mhl in 1961 to 4.61 mhl in 2014 (+128%) and in USA the wine production grew from 0.64 mhl in 1961 to 3.3 mhl in 2014 (+416%). Meanwhile in China, the total wine production grew dramatically from 0.015 mhl in 1978 to 1.7 mhl in 2014 (113 times) (**Figure 2.12 and 2.13**).

Figure 2.11. World wine production 1961-2014. Source: FAO, 2016.

Figure 2.12. Wine product of France, Italy and Spain, 1961-2014. Source: FAO, 2016.

Figure 2.13. Wine product by country, 1961-2014. Source: FAO, 2016.

China's domestic wine production has grown dramatically since the 'reform and opening up' policy in 1978. According to the OIV, in 2014 China had the eighth largest global wine grape production and the largest global grape production. China has overtaken France as the country with the second largest vineyard area (table grape, wine grape and dried grape) after Spain. In 2015, China had the world's second largest vineyard area (table grape, wine grape and dried grape) and the world's eighth largest wine production (**Table 2.8**) (OIV, 2016). Even though the total vineyard area of China is now the second largest in the world, only 10% are for wine production. Hence, further vineyard expansion for wine grape could be expected considering the huge market demand and the vast suitable territory of China (Decanterchina, 2016).

Table 2.8. World's grape and wine. Source: OIV, 2016.

Ranking	Country	Wine (2015) million hectoliters	Country	Vineyard (2015) thousand hectares	Country	Wine grape (2014) million tons
1	Italy	50.0	Spain	1,021	France	6.04
2	France	47.4	China	830	Italy	5.87
3	Spain	37.3	France	786	Spain	5.19
4	USA	22.1	Italy	682	USA	3.20
5	Argentina	13.4	Turkey	497	Argentina	2.03
6	Chile	12.9	USA	419	Australia	1.56
7	Australia	11.9	Argentina	225	China	1.48
8	China	11.5	Iran	225	South Africa	1.46
9	South Africa	11.2	Portugal	217	Chile	1.37
Total	World	274.0	World	7,511	World	36.10

Even though the wine industry of China has achieved great advance with dramatic increase in both vineyard area and wine production, currently China is not a serious global wine player. Compared with other main wine countries, no matter the wine export by value (**Figure 2.14**)

or the wine export by quantity (**Figure 2.15**) wines from China do not occupy an importance place. In long period, France has the largest wine export by value. Recently, Spain has surpassed France as the country with the largest wine export by quantity since 2014.

In **Figure 2.16**, compared with the world's price of wine, the wine export price of China has dramatic growth since 2009, which may mean an increasing cost (material, labor force etc.), improved wine quality and management experience in the domestic wine industry of China.

Figure 2.14. Wine export by value. Source: UN COMTRADE, 2016.

Figure 2.15. Wine export by quantity. Source: UN COMTRADE, 2016.

Figure 2.16. Wine export price in China and the world (\$/L). Source: UN COMTRADE 2016 and calculated by author.

2.7 The competitiveness of the Chinese wine industry

2.7.1 International Market Share (IMS) of the Chinese wine industry

The IMS (International Market Share) is a very simple and direct index to reflect the international market competitiveness. The IMS Indicator represents the ratio of the export value/volume of one product/ service of one country/ region in the international market to the total export value/volume of this product/service of the world. The IMS indicator could indicate the competitiveness possessed by the goods of one certain country or region in the domestic or international market and the degree of international competitiveness (Yu et al., 2015). IMS_{ab} refers to the international market share of one product/service b of one country of one region a, X_{ab} refers to the total export value/volume of product/service b of one country of one region a, X_{bn} refers to the total export value/volume of product b in the world. Bigger market share means stronger competitiveness; on the other hand, it will indicate weaker competitiveness while an improvement of this ratio indicates a rising competitiveness of export. The variation of IMS reflects the change of the international market competitiveness and comparative status of one product/service in one certain country or region.

$$IMS_{ab} = \frac{X_{ab}}{X_{bn}}$$

We selected 11 main wine producing countries worldwide to compare with China. First, we calculate the index of International Market Share (IMS) by value (%) for the period 1999/2015 from UN COMTRADE data. The results are in **Table 2.9**, **Figure 2.17** and **2.18**. Second, the index of International Market Share (IMS) by volume (%) is calculated in **Table 2.10**, **Figure 2.19**, **2.20**. For the IMS by value, France, Italy and Spain have the highest IMS while the IMS of France has a declining trend and the IMS of Italy and Spain keeps stable. Compared with other main wine producing countries, the IMS of China by both value and volume is sharply tiny. The IMS of China by value researched the highest point with 1.28% in 2015 meanwhile the IMS by volume fell from 0.2% in 1993 to 0.07% in 2015 for the increasing price of Chinese wines.

Table 2.9. International Market Share (IMS) by value of main wine countries. Source: UN COMTRADE and calculated by author.

Year	Argentina	Australia	Chile	China	France	Germany	Italy	Portugal	South Africa	Spain	USA	New Zealand
1994	0.40%	3.28%	1.66%	0.10%	45.61%	5.19%	19.49%	5.17%		9.37%	2.13%	0.31%
1995	0.75%	2.96%	1.75%	0.04%	43.90%	4.80%	19.53%	4.76%		9.16%	2.21%	0.31%
1996	0.71%	3.70%	2.51%	0.05%	40.85%	4.33%	18.90%	4.59%		9.52%	2.66%	0.39%
1997	1.05%	4.29%	3.40%	0.05%	41.51%	3.48%	17.13%	4.18%		9.70%	3.26%	0.48%
1998	1.19%	4.36%	3.77%	0.04%	42.10%	3.22%	17.15%	3.77%		9.46%	3.70%	0.45%
1999	1.00%	5.50%	3.71%	0.04%	42.14%	3.07%	17.71%	3.63%		9.86%	3.64%	0.53%
2000	1.24%	6.99%	4.52%	0.04%	39.13%	2.72%	17.80%	3.64%	1.89%	8.86%	4.23%	0.71%
2001	1.20%	7.74%	5.01%	0.04%	37.08%	2.88%	18.14%	3.36%	1.78%	9.37%	4.08%	0.76%
2002	0.91%	8.85%	4.23%	0.03%	37.49%	2.93%	18.30%	3.34%	1.99%	8.98%	3.73%	0.89%
2003	0.99%	8.78%	3.87%	0.02%	37.65%	3.10%	17.43%	3.44%	2.39%	9.36%	3.55%	0.91%
2004	1.14%	10.01%	4.23%	0.02%	34.67%	2.98%	17.85%	3.33%	2.68%	9.60%	3.81%	1.23%
2005	1.49%	10.17%	4.26%	0.02%	33.59%	3.33%	18.00%	3.22%	2.87%	9.30%	3.06%	1.61%
2006	1.70%	9.17%	4.26%	0.05%	34.52%	3.60%	17.88%	3.08%	2.30%	8.83%	3.83%	1.75%
2007	1.81%	8.99%	4.54%	0.10%	33.47%	3.59%	17.52%	3.08%	2.42%	9.00%	3.42%	2.02%
2008	2.16%	7.03%	4.59%	0.07%	33.49%	3.75%	17.95%	2.99%	2.52%	9.61%	3.36%	2.15%
2009	2.47%	7.00%	5.36%	0.03%	29.84%	3.97%	18.98%	3.15%	2.76%	10.26%	3.61%	2.49%
2010	2.64%	6.92%	5.47%	0.09%	29.68%	4.03%	18.36%	2.88%	2.95%	8.83%	4.19%	2.75%
2011	2.56%	5.96%	5.09%	0.07%	30.04%	4.08%	18.39%	2.74%	2.42%	9.27%	4.34%	2.70%
2012	2.77%	5.83%	5.35%	0.23%	30.06%	3.78%	17.97%	2.69%	2.30%	9.82%	4.40%	2.95%
2013	2.52%	5.05%	5.58%	0.11%	29.47%	3.88%	18.98%	2.71%	2.46%	9.72%	4.59%	2.94%
2014	2.38%	4.75%	5.25%	0.37%	29.05%	3.72%	19.22%	2.73%	2.22%	9.63%	4.33%	3.19%
2015	2.52%	5.02%	5.68%	1.28%	28.29%	3.31%	18.42%	2.53%	2.06%	9.13%	4.89%	3.36%

Table 2.10. International Market Share (IMS) by volume of main wine countries. Source: UN COMTRADE and calculated by author.

Year	Argentina	Australia	Chile	China	France	Germany	Italy	Portugal	South Africa	Spain	USA	New Zealand
1994	0.61%	3.41%	2.17%	0.19%	22.95%	5.34%	32.39%	3.49%		14.31%	2.26%	0.15%
1995	2.57%	2.06%	1.59%	0.03%	13.74%	2.96%	20.36%	1.88%		7.00%	1.54%	0.10%
1996	1.45%	2.42%	2.09%	0.03%	14.04%	2.63%	14.96%	2.01%		7.10%	1.73%	0.12%
1997	1.72%	3.28%	3.90%	0.03%	19.93%	2.80%	17.99%	3.03%		12.06%	2.59%	0.18%
1998	1.86%	4.54%	4.03%	0.05%	25.08%	3.27%	23.30%	3.25%		16.25%	3.72%	0.43%
1999	1.72%	7.08%	/	0.08%	29.23%	4.02%	33.91%	/		5.82%	4.64%	0.59%
2000	1.36%	5.11%	4.96%	0.07%	24.53%	3.97%	30.28%	3.10%	2.54%	14.20%	4.76%	0.34%
2001	1.20%	5.59%	4.92%	0.04%	23.54%	3.59%	24.76%	2.38%	2.45%	14.98%	4.35%	0.59%
2002	0.86%	6.03%	3.63%	0.03%	19.80%	3.15%	21.31%	2.71%	2.69%	12.91%	3.52%	0.60%
2003	2.06%	5.52%	4.13%	0.02%	15.50%	2.79%	13.84%	3.23%	2.40%	12.83%	3.50%	0.53%
2004	1.08%	8.60%	6.31%	0.03%	19.01%	3.61%	19.04%	4.28%	3.48%	19.42%	5.34%	1.02%
2005	2.53%	7.97%	4.83%	0.03%	15.87%	3.33%	18.45%	3.01%	4.00%	16.25%	4.03%	0.66%
2006	3.55%	9.04%	5.65%	0.05%	17.41%	3.80%	22.32%	3.59%	3.24%	9.75%	4.57%	0.77%
2007	3.78%	8.14%	6.36%	0.10%	15.81%	3.59%	19.62%	3.86%	5.22%	16.08%	4.58%	0.88%
2008	4.16%	6.79%	5.71%	0.05%	13.25%	3.47%	17.49%	2.95%	4.19%	23.31%	4.65%	0.96%
2009	3.17%	8.28%	7.44%	0.02%	13.43%	3.76%	20.93%	2.73%	4.60%	16.01%	4.43%	1.38%
2010	2.86%	8.05%	7.37%	0.01%	13.58%	3.88%	21.62%	2.68%	4.24%	18.39%	4.14%	1.59%
2011	2.88%	6.51%	6.01%	0.02%	13.54%	3.75%	20.99%	2.79%	3.66%	22.05%	3.94%	1.52%
2012	3.41%	6.74%	6.89%	0.02%	13.76%	3.66%	19.55%	3.09%	4.10%	20.02%	3.85%	1.62%
2013	3.00%	6.66%	8.27%	0.02%	13.63%	3.79%	19.01%	2.90%	5.65%	17.52%	3.95%	1.65%
2014	2.55%	7.00%	7.72%	0.04%	13.76%	3.76%	19.64%	2.72%	4.59%	22.46%	0.00%	1.87%
2015	2.44%	6.72%	7.95%	0.07%	13.12%	3.30%	18.26%	2.53%	4.34%	22.32%	3.82%	1.98%

Figure 2.17. International Market Share (IMS) by value of main wine countries. Source: UN COMTRADE 2016 and calculated by author.

Figure 2.18. International Market Share (IMS) by value of China. Source: UN COMTRADE 2016 and calculated by author.

Figure 2.19. International Market Share (IMS) by volume of main wine countries. Source: UN COMTRADE 2016 and calculated by author.

Figure 2.20. International Market Share (IMS) by volume of China. Source: UN COMTRADE 2016 and calculated by author.

2.7.2 Trade Competitive Advantage Index (TC) of the Chinese wine industry

The Trade Competitive Index (TC) is commonly used to analyze international trade competitiveness, which is able to describe the international competitiveness of one specific product or industry in one country and reflect the comparable advantages situation (Wang, 2013). The TC is the ratio of the balance between the net exports of products –export - import” to the total value of export and import –export + import”. The TC rejects the effect of the macro-total fluctuation such as inflation in one certain country/region and can measure accurately the comparative advantage of one country/region.

$$TC_{ab} = (X_{ab} - M_{ab}) / (X_{ab} + M_{ab})$$

It is one of the common indexes to assess the international competitiveness of some exporting product in a country. Its calculation formula is: In the above formula, X_{ab} is the export volume of product/service b in country/region a; M_{ab} is the import volume of product/service b in country /region a. The value range of trade competitive index is (-1, 1). If $TC_{ab} = -1$, it means country/region a only imports good/service b but does not export and there is not any trade competitive advantage; if TC_{ab} is among the range of (-1, 0), it shows country/region a does not have competitiveness advantage in good/service b and the productivity of product/service b is lower than international level; if $TC_{ab} = 0$, indicates the good/service b in country/region a is belong to intra-industry trade and the competitiveness is equal to the international level (Yu et al., 2015); if TC_{ab} is among the range of (0,1), it shows that in country/region a the product/service b has competitiveness advantage and when the rate is larger the competitiveness advantage is larger; if $TC_{ab} = 1$, it means that country/region a only exports but not imports product/service b and the level of competitiveness advantage is the highest (Cao et al., 2011). The **Table 2.11** shows the results of the period 1994-2015 from data of UN COMTRADE.

Table 2.11. Trade Competitive Advantage Index (TC) of main wine countries. Source: UN COMTRADE and calculated by author.

Trade Competitive Advantage Index (TC) of main wine countries												
Year	Argentina	Australia	Chile	China	France	Germany	Italy	Portugal	South Africa	Spain	USA	New Zealand
1994	0.2837	0.7443	0.9918	0.8713	0.8059	-0.5137	0.8533	0.7459		0.8907	-0.7184	-0.2763
1995	0.7540	0.7118	0.9936	0.3407	0.7970	-0.5429	0.8519	0.7651		0.7612	-0.6905	-0.1584
1996	0.7927	0.7989	0.9944	-0.0425	0.8096	-0.5780	0.8689	0.8528		0.8807	-0.6615	-0.0655
1997	0.8186	0.7806	0.9636	-0.7116	0.8169	-0.6188	0.8495	0.8731		0.9393	-0.6358	0.0321
1998	0.8107	0.8043	0.9710	-0.7479	0.8354	-0.6413	0.8451	0.7098		0.8756	-0.5835	0.0714
1999	0.7870	0.8317	0.9807	-0.7231	0.8423	-0.6490	0.8459	0.5628		0.8601	-0.6278	0.0551
2000	0.8508	0.8609	0.9850	-0.6704	0.8333	-0.6534	0.8470	0.6509	0.9410	0.8821	-0.6229	0.2003
2001	0.8792	0.8946	0.9950	-0.6640	0.8217	-0.6495	0.8695	0.7167	0.9566	0.9081	-0.6343	0.2244
2002	0.9730	0.8824	0.9960	-0.7261	0.8356	-0.6199	0.8561	0.7637	0.9454	0.8990	-0.6786	0.2663
2003	0.9870	0.8762	0.9976	-0.8206	0.8386	-0.5812	0.8367	0.7728	0.9434	0.8899	-0.6914	0.2477
2004	0.9869	0.8699	0.9965	-0.8740	0.8277	-0.5896	0.8360	0.7607	0.9669	0.8802	-0.6496	0.4099
2005	0.9848	0.8481	0.9917	-0.8817	0.8272	-0.5505	0.8281	0.7683	0.9581	0.8701	-0.7230	0.5108
2006	0.9896	0.7996	0.9888	-0.8575	0.8361	-0.5068	0.8330	0.8151	0.9365	0.8342	-0.6681	0.5729
2007	0.9882	0.7579	0.9913	-0.8004	0.8301	-0.4628	0.8154	0.7978	0.9465	0.7877	-0.6736	0.6211
2008	0.9884	0.6380	0.9933	-0.8994	0.8327	-0.4540	0.8351	0.7191	0.9478	0.7906	-0.6551	0.6548
2009	0.9742	0.6530	0.9956	-0.9706	0.8021	-0.4613	0.8659	0.7022	0.9533	0.8752	-0.6365	0.7488
2010	0.9380	0.6154	0.9956	-0.9406	0.8283	-0.4057	0.8757	0.7464	0.9572	0.8751	-0.5803	0.7618
2011	0.9689	0.5770	0.9935	-0.9694	0.8211	-0.4132	0.8733	0.7761	0.9468	0.8903	-0.5543	0.7713
2012	0.9890	0.5315	0.9922	-0.9073	0.8345	-0.4245	0.8775	0.7799	0.9352	0.8862	-0.5640	0.7724
2013	0.9862	0.4722	0.9917	-0.9516	0.8347	-0.4343	0.8800	0.7096	0.9406	0.8682	-0.5447	0.7721
2014	0.9874	0.4661	0.9900	-0.8385	0.8388	-0.4448	0.8882	0.7061	0.9295	0.8910	-0.5705	0.7823
2015	0.9824	0.4923	0.9871	-0.6620	0.8372	-0.4394	0.8862	0.7213	0.9118	0.8774	-0.5598	0.7990

Figure 2.21. Trade Competitive Advantage Index (TC) of main wine countries. Source: UN COMTRADE 2016 and calculated by author.

By the application of the TC index, it is obvious that wines from Old World such as France, Italy, Spain and some New World countries such as Chile and Argentina have very strong competitiveness in the world wine market (**Figure 2.21**). Increasing trend of TC of wines from Argentina is obvious with 0.9824 in 2015 meanwhile wines from Australia lost the competitiveness of TC with 0.8946 in 2001 and 0.4923 in 2015. Wines from Chile keep very strong competitiveness with TC index above 0.9. In addition, wines from France, Italy and Spain hold strong competitiveness with TC index above 0.8. Compared with other main wine producing countries Wines from China, USA and Germany do not have competitiveness with -0.6620, -0.5598, and -0.4394 respectively in 2015. Before 1996, wines from China did have competitiveness showed by TC due to the small value of wine import compared with the value of Chinese wine export. After that, large number of foreign import wines came into the Chinese market especially since 2001 when China became a member of WTO. Recently, the competitiveness of Chinese wines is being improved thanks to the improved technology and management in domestic wine industry.

2.7.3 Revealed Comparative Advantage Index (RCA) of the Chinese wine industry

The Revealed Comparative Advantage Indicator (RCA Index) which is the ratio of the export of certain product/service to average export of world product/service is a useful tool to measure the industry competitiveness of a certain product/service in a country/region. The RCA Index was publicized by the Hungarian economist Béla Balassa in 1965 as the RCA index can greatly reduce the influence of total export volume between countries and the world (Cao et al., 2011). The RCA indicates whether a country/region is in the process of extending the products with a trade potential and provide useful information about potential trade prospects with new partners (World Bank, 2016).

$$RCA_{ab} = \left(\frac{X_{ab}}{X_{tb}} \right) / \left(\frac{X_{aW}}{X_{tW}} \right)$$

RCA_{ab} stands for the revealed comparative advantage of the product/service b in country/region a. X_{ab} represents the export of product/service b in country/region a; X_{tb} is the total export value of all products/services in the period of t for certain country/region a; X_{aW} is the total export value of product/service b of the world; X_{tW} is the total export value of all products/services in the period of t in the world. Generally, the RCA is positive. If $RCA_{ab} > 2.5$, it means the product/service b of certain country/region a has very strong international competitiveness; if $1.25 \leq RCA_{ab} \leq 2.5$, it shows that the product/service of certain country/region a has a comparatively strong international competitiveness; if $0.8 \leq RCA_{ab} \leq 1.25$, it means the international competitiveness of the product/service b of certain country/region a is medium; if $RCA_{ab} < 0.8$, it indicates the competitiveness of the product/service b of certain country/region a is relatively low. Countries with similar RCA profiles are unlikely to have high bilateral trade intensities unless industry trade is involved. RCA measures, if estimated at high levels of product disaggregation, can focus attention on other nontraditional products that might be successfully exported (World Bank, 2016). The **Table 2.12** shows the results of the period 1994-2015 from data of UN COMTRADE.

Table 2.12. Revealed Comparative Advantage (RCA) of main wine producing countries. Source: UN COMTRADE and calculated by author.

Revealed comparative advantage of international trade (RCA) of main wine producing countries												
Year	Argentina	Australia	Chile	China	France	Germany	Italy	Portugal	South Africa	Spain	USA	New Zealand
1994	0.9928	2.5965	5.7287	0.0322	7.6562	0.4762	4.0172	11.2556		5.0159	0.1536	0.9671
1995	1.7485	2.5893	5.3618	0.0140	7.5260	0.4460	4.1263	9.9132		4.9791	0.1734	1.0684
1996	1.5515	3.0509	8.4718	0.0160	7.4794	0.4296	3.8964	10.2986		4.8703	0.2087	1.3612
1997	2.1639	3.5483	11.0688	0.0143	7.9643	0.3690	3.9074	9.6608		4.9632	0.2421	1.8133
1998	2.4632	4.0605	13.8882	0.0116	7.6666	0.3245	3.8770	8.5171		4.7418	0.2787	2.0373
1999	2.4454	5.3895	13.5046	0.0111	8.0944	0.3220	4.2854	8.4332		5.0281	0.2784	2.4362
2000	3.0842	7.1877	16.2697	0.0114	8.6821	0.3247	4.8622	9.8071	4.7207	5.1201	0.3270	3.3444
2001	2.8388	7.6978	16.8029	0.0087	8.0532	0.3168	4.6705	8.7642	4.3141	5.0755	0.3224	3.3597
2002	2.3499	9.0121	16.0601	0.0052	8.1360	0.3147	4.7615	8.5441	5.7029	4.7203	0.3260	3.9310
2003	2.5496	9.6338	13.7831	0.0033	8.1121	0.3191	4.4902	8.3278	5.8220	4.6277	0.3438	4.0750
2004	3.0846	10.8565	12.0109	0.0028	7.8641	0.3062	4.7368	7.0552	6.2527	4.9318	0.3937	5.4775
2005	3.9249	10.1536	10.7359	0.0032	8.1803	0.3607	5.1053	8.8169	6.4686	5.1043	0.3222	7.5149
2006	4.5190	9.1777	8.8499	0.0060	8.8921	0.3962	5.2877	8.4933	5.3870	5.0900	0.4132	9.1371
2007	4.5684	8.9864	9.3415	0.0119	8.7545	0.3813	4.9445	8.2901	5.3422	5.0068	0.3772	10.1881
2008	5.0031	6.1113	11.5431	0.0076	9.1461	0.4148	5.3793	8.4854	5.5326	5.5875	0.3813	10.9948
2009	5.6642	5.8000	12.3225	0.0028	8.1998	0.4488	5.9551	9.0848	6.5325	5.8673	0.3913	12.1329
2010	6.0657	5.1150	12.0715	0.0086	9.0948	0.4977	6.4426	9.1460	5.5972	5.6209	0.4585	13.4162
2011	5.7375	4.1109	11.6186	0.0065	9.5372	0.5120	6.5362	8.5583	4.1648	5.7785	0.4854	12.8949
2012	6.4824	4.2629	12.8685	0.0209	10.0906	0.5023	6.4603	8.6821	4.3570	6.4403	0.4751	14.2910
2013	6.4462	3.8930	14.1623	0.0096	10.0968	0.5204	6.9178	8.4060	5.0375	6.0847	0.5007	13.9908
2014	6.7492	3.8243	13.2790	0.0309	9.9304	0.4814	6.8372	8.2879	4.7565	5.8530	0.4560	14.3442
2015	7.1932	4.3320	14.5295	0.0908	9.2824	0.4034	6.2911	7.4008	4.7840	5.3201	0.4610	15.1872

Figure 2.22. Revealed Competitiveness Advantage of international trade (RCA) of main wine counties. Source: UN COMTRADE 2016 and calculated by author.

Figure 2.23. Revealed Competitiveness Advantage of international trade (RCA) of China, Germany and USA. Source: UN COMTRADE 2016 and calculated by author.

When we use the RCA index to examine the trade competitiveness of wine, wines from Argentina, Australia, Chile, France, Italy, Portugal, South Africa, Spain and New Zealand have strong competitiveness with RCA above 2.5 (**Figure 2.22**). Among them, New Zealand had the strongest competitiveness with 15.1872 followed by Chile with 14.5295 in 2015. For wines from Argentina, Chile and New Zealand, dramatic increase of TC (trade competitiveness) had been observed during the period of 1994 and 2015. For the Old World, French wine has the strongest competitiveness with 9.2824 in 2015 followed by Italy 6.2911 and Spain 5.3201. In addition, wines from USA and Germany have very weak competitiveness (RCA below 0.8) with 0.4610 and 0.4034 in 2015. Wines from China even have lower competitiveness compared with USA and Germany with only 0.0908 in 2015, which is the highest during the period of 1994 to 2015. The RCA of China increased during the period 2013 and 2015 (**Figure 2.23**).

CHAPTER 3. COMPETITIVENESS OF THE REGIONAL WINE PRODUCTION

3.1 Introduction

In Chapter 3, we conduct an introduction and analyses of main wine producing provinces of China. With a goal to set up the potential, the perspectives and the development of wine industry, we make analyses from geographical distribution, vineyard area, wine production and wineries (above designated size¹). Further, we conduct an analysis of regional competitiveness based on the four determinant factors- Factor Conditions, Demand Conditions, Related and Supporting Industries and Firm Strategy, Structure and Rivalry and two variables- Government and Chance according to the Porter's Diamond Model. Finally, we conduct a competitive analysis of regional wine industries applying a 100 scores system of indices of four determinant factors of Single Diamond Model.

3.2 Methods and data source

In this Chapter, there are three studies. Firstly, there is an introduction of the situation and perspectives of main wine provinces of China (Shandong, Ningxia, Henan, Xinjiang, Hebei, Tianjin, Beijing, Gansu, Shaanxi, Jilin, Liaoning, Heilongjiang and Yunnan). Data were mainly collected from National Bureau of Statistics of China and Yearbook of China Alcoholic Drinks

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¹ 1996-2007 non-state-owned enterprises with annual revenue ≥ 5 million Yuan (RMB) and all state owned enterprises

2007-2011 enterprises with annual revenue ≥ 5 million Yuan (RMB)

since 2011 enterprises with annual revenue ≥ 20 million Yuan (RMB)

Industry. Secondly, an analysis according to the Porter's Diamond Model is conducted based on the four determinant factors-Factor Conditions, Demand Conditions, Firm Strategy, Structure and Rivalry, Related and Supporting Industries and two variables- Government and Chance. In this part, data were collected from organizations such as UNDP (The United Nations Development Programme), National Bureau of Statistics of China; reports such as Yearbook of China Alcoholic Drinks Industry; on-line resources. Thirdly, to study the competitiveness of Chinese wine provinces, we select several indices related to the four determinant factors –Factor Conditions, Demand Conditions, Related and Supporting Industries and Firm Strategy, Structure and Rivalry to apply for a quantitative system of 100 scores to measure the competitiveness of each wine province both in each determinant factor and the total competitiveness.

In this Chapter, we conduct research based on Porter's Diamond Model and Industry Competitiveness Analysis. According to Porter, there is a combination of the ability to innovate, to improve processes and products and to compete for the competitive advantage in a given industry (Dögl et al, 2010). Michael Porter had articulated his extensive empirical studies of distinct nations and distinct sectors in a simple, yet highly influential model known as the "Diamond Model" (Fig.3) in 1990 in his book "The Competitiveness Advantage of Nations (CAN)" (Chobanyan and Leigh, 2006). An excellent analyze framework has been provided by Diamond Model to analyze the competitiveness of a particular industry in one certain country which provides implications for marketers, policy makers and the government (Mann and Byun, 2011). Porter's model analyzes the phenomena under six broad factors, which has been a key tool for the analysis of competitiveness (Jarungkitkul and Sukcharoensin, 2016). The essential innovation in Porter's model is to translate ideas and concepts from different fields into an accessible framework to business researchers from different disciplines, which present a dynamic and evolutionary view of firm advantage. This model has been used in various ways including the study of competitiveness within the wine industry. The cluster evolution is influenced by factors from Porter's Diamond model also. They are interconnected and influencing each other with a positive result of innovation and improved competitiveness.

The Diamond Model of Porter has been applied in several academic studies of wine and wine industry. The Porter's Diamond Model has been applied in a study of trade competitiveness of wines of Argentina in the UK market (Cetrángolo et al., 2007). A study of the competitiveness of

the Bulgarian wine industry was conducted based on the Diamond Model in Strategy, Demand, Related and Supporting Industries and Factor Conditions (Georgiev, 2007). According to the Diamond Model, Chang et al. (2007) have assessed the potential of a proposed Geographical Indication for New England Wines in New South Wales in Australia. The competitive performance was measured and analyzed by a four-step framework based on the Porter's Diamond Model theory considering the Four Determinant Factors and Chance and Government Policies (Rooyen et al., 2011). In addition, an analysis of the competitiveness of the French wine industry using the Diamond Model was presented in the work of Michael Porter and Hirotaka Takeuchi of the Harvard Business School in 2013 (Porter and Takeuchi, 2013). The Diamond Model was applied to the study the competitiveness of wines of Georgia in wine market (Kharashvili et al., 2014).

According to the Diamond Model (*The Competitive Advantage of Nations*, Porter M.E. 1990), there are four factors, which determine the competitiveness of industry, and they have mutual interactions (**Figure 3.1**):

Figure 3.1. Four factors of the Porter's Diamond Model. Source: Porter, 1990.

Factor Conditions

Factor conditions refers to factors that are used in the production process, such as natural resources, land, capital, knowledge resource, infrastructure and labor. Factor Conditions provide initial advantages on which the organization can build to produce competition that is more advanced. In addition, quality of research, natural resources, technological process, social-cultural changes and political developments are also included, which could affect the economic condition of one country (Porter, 1990; Toolshero, 2016).

Demand Conditions

Demand conditions from the home country provide the foundation upon which the characteristics of the industry are shaped. Demand conditions can affect the pace and direction of innovation and development of products. A mature and sophisticated domestic market is of importance in generating global competitiveness (Porter, 1990).

Related and Supporting Industries

A set of strong related and supporting industries is important to global competitive advantage. Competitive suppliers reinforce innovation and internationalization. If one domestic industry is strong, it may enhance the competitive advantage in related or supporting industries. In return, related and supporting industries can use and coordinate particular activities and complementary products (Porter, 1990; Toolshero, 2016).

Firm strategy, structure and rivalry

These factors refer to domestic conditions, which determine how the industry is established, organized and managed, and how the goal is set. Cultural aspects, management structures, interactions between companies are different which provide advantages or disadvantages for particular industries. These factors also determine the characteristics of domestic competition. On an international scale, domestic rivalry and continuous research for competitive advantage can contribute to advantages (Porter, 1990; Themanager, 2015; Toolshero, 2016).

Apart from these Four Determining Factors (Factor Conditions, Demand Condition, Related and Supporting Industries and Firm strategy, structure and rivalry), there are two variables (**Figure 3.2**): Government and Chance (Porter, 1990).

Government

All the four factors above can be influenced by government, which can foster global advantages at a national level by concrete policies and supports and encourage the development of industries and companies at both domestic and international level. In addition, government can have influence on each of the five factors. It can affect the supply conditions, domestic demand conditions and competition between firms. Government interventions can occur at local, regional, national and international level (Porter, 1990; Marketing-Insider, 2016; Toolshero, 2016).

Chance

Chance is random events that can also influence these four factors but cannot be controlled by firms. Many events such as technology innovation increase of cost and government actions could lead to chance. While some firm gains competitive position by chance, some firm loses (Porter, 1990; Marketing-Insider, 2016).

Figure 3.2. Diamond Model of Porter. Source: Porter, 1990.

Based on descriptive data for each of the four determinant of the Double Diamond Model (**Figure 3.3**), which considers both the domestic environment and international environment, Sardy and Fetscherin (2009) and Liu and Hsu (2009) used a value system of 100 scores to value the competitiveness for each of the four determinant factors of the Diamond Model. They applied this system to explore make comparison of the Automotive Industry of China, India and South Korea and one comparison between Taiwan and Korea.

Figure 3.3. Structure of Double Diamond Model.

Source: Sardy and Fetscherin, 2009 and Liu and Hsu, 2009.

To explore and measure the competitiveness of wine regions of China, a similar system of indices for four determinant factors (Factor Condition, Demand Conditions, Related and Supporting Industries and Firm Strategy Structure and Rivalry) of Single Diamond Model, using a value system of 100 scores to value the competitiveness has been established in the Chapter 3.

3.3 The regional wine production in China: location and tendency

China has a large geographical size and distinct topographic situations including grassland areas and semi-arid plateau in the north, oasis and deserts in the northwest, semi-humid basin in the center, forests and plains in the northeast, high-altitude plateau in the southwest and humid coastal areas in the southeast. As consequence, there is a great variety of geographical and climatic conditions for wine production. In many provinces grape plantings are important to cover market demand of fruit consumption such as table grape and dried grape in Xinjiang, while in several provinces such as Shandong and Ningxia grape plantings mainly satisfy the need of local wine industries. In Xinjiang, which is the largest province (1.6 million square kilometers) occupying one-sixth of the Chinese territory vast lands are suitable for grape planting. Meanwhile, in densely populated metropolises such as Beijing and Tianjin grape and wine industry is also developed. Main Chinese wine producing regions are Xinjiang, Yunnan, Gansu, Shaanxi, Ningxia, Hebei, Beijing, Tianjin, Shandong, Henan, Liaoning, Jilin and Heilongjiang as the **Figure 3.4 and Appendix 1.** (Map and wine production/ vineyard by region) and **Appendix 2.** (Geographical, natural, social, historical and cultural conditions in wine regions).

Foreign wine grape varieties have been widely planted in different regions of China. Cabernet Sauvignon is the most widely planted wine grape with more than 20,000 ha and Chardonnay, Cabernet Franc, Syrah, Pinot Noir are main wine grape varieties as well (Li H. et al. 2009). In the Northeast China, local *Vitis Amurensis* and its hybrids are the main wine grape varieties and local wines made by them have special characteristics.

Figure 3.4. Main wine regions of China.

Tables 3.1, 3.2 and 3.3 show the evolution of vineyard area (1978/2014), wine production (2006/2014) and number of wineries above designated size² in each province. Even though data of vineyard area and grape production from of China do not distinguish table grape and wine grape, data do present the developing trend of grape planting, grape producing and viticulture activities which are administrated by the Ministry of Agriculture of China especially in wine producing regions while wine making is administrated by the China National Light Industry Council.

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² 1996-2007 non-state-owned enterprises with annual revenue ≥ 5 million Yuan (RMB) and all state owned enterprises

2007-2011 enterprises with annual revenue ≥ 5 million Yuan (RMB)

since 2011 enterprises with annual revenue ≥ 20 million Yuan (RMB)

Regarding the vineyard area and according to the International Organization of Vine and Wine (OIV), in 2014 China had the world's second largest vineyard (including table grape, wine grape and dried grape) with 799,000 ha after Spain (OIV, 2016). Of this area, only approximately 10% are for wine grape (Li H. et al, 2009). **Table 3.1** documents its significant global trend of growth. In 1978, the total vineyard area was only 26.33 thousand ha, of which 86.59% were located in the 13 main wine producing provinces. In 2014, this ratio fell to 67.09%, despite the increase of the area, as result of the tremendous expansion of vineyard area in other provinces. Xinjiang held the largest vineyard area with 9.60 thousand ha (36.46% of national area) in 1978 and 149.10 thousand ha (19.43%) in 2014. In Xinjiang, the majority of grape production is for table grapes and dried grapes. Compared with 1978, a dramatic trend of growth of vineyard area especially in the periods of 1996-2002 and 2008-2014 in Yunnan (508.57 times), Gansu (381.43 times) and Ningxia (261.54 times) has been observed.

Table 3.1. Vineyard areas of China by hectare. Source: National Bureau of Statistics, 2016.

Vineyard area 1978-2014 (1,000ha)								
Province	1978	1984	1990	1996	2002	2008	2014	2014/1978
1 Shandong	1.87	12.40	18.93	16.00	54.60	36.66	41.00	21.93
2 Ningxia	0.13	0.53	1.07	1.00	6.99	14.03	34.00	261.54
3 Henan	3.80	4.53	5.20	10.30	20.37	26.82	33.90	8.92
4 Xinjiang	9.60	18.27	37.93	29.10	87.94	108.76	149.10	15.53
5 Hebei	2.87	5.47	14.73	22.60	51.52	60.96	83.80	29.20
6 Tianjin	0.27	1.47	1.87	2.10	5.72	5.09	5.20	19.26
7 Beijing	0.33	1.67	1.53	1.10	4.81	2.98	3.20	9.70
8 Gansu	0.07	0.73	1.53	1.60	8.97	10.96	26.70	381.43
9 Shaanxi	0.60	3.47	3.47	5.00	10.28	17.67	46.60	77.76
10 Heilongjiang	0.13	0.73	1.00	2.00	1.59	2.73	4.90	37.69
11 Jilin	0.93	2.40	5.60	7.70	12.74	12.45	13.00	13.98
12 Liaoning	2.13	5.47	8.07	11.50	35.63	26.60	37.70	17.70
13 Yunnan	0.07	0.53	0.67	1.60	4.92	7.92	35.60	508.57
Total	22.80	57.67	101.60	111.60	306.08	333.63	514.70	22.57
China	26.33	64.20	122.60	153.50	392.33	451.22	767.20	29.14
Other provinces	3.53	6.53	21.00	41.90	86.25	117.59	252.50	71.53

Table 3.2 shows the development of wine production of China during the period 2006-2014. Data shows an increasing trend until 2012 where the production in almost all provinces starts to decrease. The total wine production of China increased from 495.10 million L in 2006 to 1381.60 million L in 2012, decreasing to 1124.90 in 2014. In the same period, the production of 13 main wine producing provinces grew from 484.30 million L (97.82% of total) in 2006 to 1349.30 in 2012 and to 124.90 million L (96.89 %). The trend of the last years is explained by the decrease of the GDP growth rate, which affects the domestic consumption.

Shandong, Henan and Jilin had the largest wine production while the wine production share of Shandong decreased from 46.37% in 2006 to 33.79% in 2014 and in Henan and Jilin the wine production share increased from 5.43%, 5.82 % in 2006 to 14.45%, and 14.26% separately. Apart from this, comparing the year 2014 with 2006, the wine production share in Gansu, Xinjiang, Shaanxi, Liaoning, Heilongjiang, Yunnan, and Ningxia had increased while in Hebei, Tianjin and Beijing had decreased.

Table 3.2. Wine production of China by volume. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016).

Wine production of China (Mhl)									
Province	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 Shandong	229.6	255.55	280.85	342.56	375.44	446.09	467.14	444.99	392.31
2 Ningxia	2.4	20.25	6.3	9.99	21.89	25.2	16.53	16.72	20.22
3 Henan	26.9	134.09	68.79	102.67	150.31	176.9	218.99	137.98	167.77
4 Xinjiang	5.7	9.18	17.28	10.94	33.47	16.26	31.58	29.96	54.32
5 Hebei	105.7	92.39	99.29	113.54	99.53	93.71	105.82	65.15	66.65
6 Tianjin	41.9	41.5	45.38	50.29	63.47	41.1	32.27	20.98	20.23
7 Beijing	15.6	17.74	15.87	12.76	10.19	12.17	9.27	8.32	7.01
8 Gansu	8.9	10.72	14.14	19.48	16.75	14.07	11.02	10.21	73.44
9 Shaanxi	5.5	5.37	7.04	13.14	15.06	15.29	30.22	41.27	54.05
10 Heilongjiang	3.4	1.74	1.13	5.27	13.09	21.49	37.94	49.18	38.22
11 Jilin	28.8	46.19	110.12	220.91	208.28	206.52	326.99	267.36	165.5
12 Liaoning	3.8	6.43	13.48	26.66	26.78	20.17	43.04	39.52	40.57
13 Yunnan	6.1	8.17	6.42	6.04	15.29	23.87	18.49	21.82	24.61
Total	484.30	649.32	686.09	934.25	1049.55	1112.84	1349.30	1153.46	1124.90
China	495.10	665.06	698.35	960.02	1088.80	1156.86	1381.61	1178.34	1160.99
Other provinces	10.80	15.74	12.26	25.77	39.25	44.02	32.31	24.88	36.09

According to **Table 3.3**, the number of wineries above designated size (WEADZ) in 2000 was 69 WEADZ, 60 of them located in the 13 main wine producing provinces. In 2010, this number increased to 248 among which 212 were situated in 13 wine producing provinces and 36 were situated in other provinces. In 2011, the total number of WEADZ of China decreased to 179, 69 less than 2010, and in 2013 this number rebounded to 218. An increase of the number of WEADZ could be observed in Shandong (14 to 59), Henan (4 to 24), Jilin (7 to 25), Liaoning (3 to 18), Hebei (13 to 20), Xinjiang (3 to 16), Liaoning (3 to 18) and Ningxia (1 to 6) from 2000 to 2013.

Table 3.3. Wineries above designated size in China.

Source: Yearbook of China Alcoholic Drinks Industry (2001, 2003, 2008-2013).

Province	Wineries above designated size*								
	2000	2002	2007	2008	2009	2010	2011	2012	2013
1 Shandong	14	17	40	51	65	68	52	54	59
2 Henan	4	8	18	18	24	26	25	26	24
3 Jilin	7	14	17	22	19	22	16	20	25
4 Gansu	1	2	6	6	7	7	7	7	6
5 Hebei	13	18	20	21	24	29	14	16	20
6 Xinjiang	3	7	7	7	8	15	9	13	16
7 Shaanxi	1	3	4	2	3	3	2	2	3
8 Liaoning	3	3	8	8	15	18	10	15	18
9 Heilongjiang	2	2	1	1	1	0	0	1	1
10 Yunnan	2	2	2	3	3	4	5	5	4
11 Tianjin	4	6	4	6	7	8	4	4	4
12 Ningxia	1	2	1	1	2	6	5	5	6
13 Beijing	5	5	3	3	5	6	4	4	4
Total	60	89	131	149	183	212	153	172	190
China	69	104	146	167	208	248	179	200	218
Other Provinces	9	15	15	18	25	36	26	28	28

*1996-2007 non-state-owned enterprises with annual revenue ≥ 5 million Yuan (RMB) and all state owned enterprises
2007-2011 enterprises with annual revenue ≥ 5 million Yuan (RMB)
since 2011 enterprises with annual revenue ≥ 20 million Yuan (RMB)

3.4 Factors of regional competitiveness of wine producing regions based on Porter's Diamond Model

3.4.1 Factor conditions

Indices for Factor Condition of each wine producing region (Table 3.4):

- Wine production by Mhl (million hectoliters, 2014) (*Source: CHYXX, 2016*)

Wine is one of the essential materials of production in wine industry. Based on Porter's Diamond Model, factor conditions in wine industry could be total wine production, total area of vineyard and the average per hectare yield of grapes (Škorpíková, 2002). In Europe, Factor Conditions in wine producing countries such as decline of vineyard areas and wine production lead to further decrease of EU wine market shares in the world (European Commission, 2014).

- Human Development Index (HDI), 2014 (*Source: UNDP, 2016*)

Human Development Index (HDI) is a summary measure of average scores of a long and healthy life, being knowledgeable and a decent standard of living, which are key dimensions of human development (UNDP, 2016). Higher HDI suggests that the performance of industrial development will have better opportunities and resources to improve the quality life of their population (UNDP, 2014).

- Education Index, 2014 (*Source: UNDP, 2016*)

Education and training can enhance the industry competitiveness (Svetličič, 2010). The Education Index is calculated by the mean years of schooling and expected years of schooling (UNDP, 2014). Even though the EI is included in the calculation of HDI, considering its importance, we list it as one individual index to analyze to competitiveness of Factor Conditions.

- Power of agricultural machinery per capita by kW, 2014 (*Source: National Bureau of Statistics, 2016*)

Farm machines can revolutionize agriculture, reduce the cost of labor force, and even contribute to an environmentally sustainable agriculture (FAO, 2014). Several farming activities in the wine industry such as grape harvest, grape and wine processing need the aid of farm machines (Airfield, 2010; Collopak, 2017).

- Vineyard area by 1000 ha, 2014 (*Source: National Bureau of Statistics, 2016*)

Since 2000, vineyard areas in Spain, France and Italy have decreased meanwhile; strong increasing of vineyard in China has been observed (OIV, 2016). In China, the vineyard areas in the majority of wine regions are increasing sharply in recent years. Total area of vineyard could be considered as one factor of Factor Conditions (Škorpíková, 2002; European Commission, 2014).

Table 3.4. Indices of Factor Conditions.

Indices of Factor Conditions					
Province	Wine production (Mhl, 2014)	Human Development Index (2014)	Education Index (2014)	Power of agricultural machinery per capita (kW, 2014)	Vineyard area (1,000 ha, 2014)
Shandong	392.31	0.77	0.69	1.34	41.00
Ningxia	20.22	0.73	0.67	1.23	34.00
Henan	167.77	0.73	0.67	1.22	33.90
Xinjiang	54.32	0.72	0.66	1.02	149.10
Hebei	66.65	0.74	0.68	1.48	83.80
Tianjin	20.23	0.84	0.79	0.36	5.20
Beijing	7.01	0.87	0.85	0.09	3.20
Gansu	73.44	0.69	0.64	0.98	26.70
Shaanxi	54.05	0.75	0.70	0.68	46.60
Heilongjiang	38.22	0.76	0.72	1.35	4.90
Jilin	165.50	0.77	0.72	1.06	13.00
Liaoning	40.57	0.80	0.76	0.62	37.70
Yunnan	24.61	0.67	0.61	0.68	35.60

3.4.2 Demand conditions

Indices for Demand Conditions of each wine producing region (Table 3.5):

- Revenue of wineries above designed size by 1000 RMB/Yuan, 2013 (*Source: Yearbook of China Alcoholic Drinks Industry, 2013*)

The revenue size of one firm is taken as a proxy measure of their overall global performance (Deloitte, 2016). Revenue was used together with wine export volumes and prices as variable in one model to measure the performance of wine industry (Fleming et al., 2014).

- GDP Per Capita by RMB/Yuan, 2014 (*Source: National Bureau of Statistics, 2016*)

GDP or GDP Per Capita is a common variable to measure market demand and a higher GDP Per Capita shows a larger local demand for more advanced goods with higher quality (Hacker et al., 2004).

- Household Final Consumption Expenditure by RMB/Yuan, 2014 (*Source: National Bureau of Statistics, 2016*)

The Household Final Consumption Expenditure is a transaction of the national account's use of income with representing consumer spending accounted by resident households on individual consumption goods and services (OECD, 2010). In China, the Household Final Consumption Expenditure in distinct regions can reflect somehow the economic development level and the purchase capacity of consumers (National Bureau of Statistics of China, 2012).

- Income Index, 2014(*Source: UNDP, 2016*)

The Income Index was measured by the Gross National Income (GNP) of Chinese regions (UNDP, 2016). The increase in per capita income is one of those factors, which led to an expansion of wine consumption in China (Muhammad et al., 2013).

- Urbanization rate, 2014 (*Source: National Bureau of Statistics, 2016 and calculated by author*)

Over the last three decades, China's urbanization has been unprecedented in human history resulting in 260 million migrants in cities and a rapid economic growth and development (Zheng and Saiz, 2016). Increasing urbanization, rising income and an uptake of wine culture will continue to propel the Chinese wine consumption (Wine Australia, 2017).

Table 3.5. Indices of Demand Conditions.

Indices of Demand Conditions					
Province	Revenue of wineries above designed size (1,000 Yuan, 2013)	GDP Per Capita (Yuan, 2014)	Household Final Consumption Expenditure (2014, Yuan)	Income Index (2014)	Urbanization rate (2014)
Shandong	24846145	60879	19184	0.74	0.55
Ningxia	2161996	41834	15193	0.68	0.51
Henan	4108445	37072	13078	0.66	0.45
Xinjiang	462944	40648	12435	0.68	0.46
Hebei	1267773	39984	12171	0.68	0.49
Tianjin	828270	105000	28492	0.81	0.82
Beijing	542791	100000	36057	0.81	0.86
Gansu	2181550	26433	10678	0.62	0.42
Shaanxi	226474	46929	14812	0.70	0.53
Heilongjiang	760398	39226	15215	0.67	0.58
Jilin	463540	50160	13663	0.71	0.42
Liaoning	315643	65201	22260	0.75	0.67
Yunnan	197858	27264	12235	0.62	0.42

3.4.3 Related and Supporting Industries

Indices for Related and Supporting Industries (Table 3.6):

- Percentage of Internet user, 2014 (*Source: National Bureau of Statistics, 2016 and calculated by author*)

More Chinese consumers are preferring to purchase wine products on-line considering there are more than half a billion mobile internet users in China (Jing Daily, 2014). There are approximately 21 million on-line wine buyers in which the majorities are urban middle-class (DrinksBusiness, 2016).

- Output value of agriculture per capita by RMB/Yuan, 2014 (*Source: National Bureau of Statistics, 2016*)

Output of agriculture per capita of rural population in one region shows the level of agricultural development and this is related to other indicators of agricultural development (Chand, 1997).

- Length of highways per capita by km, 2014 (*Source: National Bureau of Statistics, 2016 and calculated by author*)

Logistics links agricultural production with agricultural materials production companies and agricultural markets. The length of highways is one of the indicators of the infrastructure and basic conditions of logistics (Liu and Ouyang, 2014).

- Freight traffic per capita by tons, 2014 (*Source: National Bureau of Statistics, 2016*)

Freight traffic per capita was used as one of those indicators to measure the market-and supply-access conditions in the development of the west regions in China (Lu and Neilson, 2004).

Table 3.6. *Indices Related and Supporting Industries.*

Indices of Related and Supporting Industries				
Province	Percentage of Internet user (2014)	Output value of agriculture per capita (yuan, 2014)	Length of highways per capita (km, 2014)	Freight traffic per capita (tons, 2014)
Shandong	0.47	9396.53	2.65	27.02
Ningxia	0.45	6729.15	4.73	62.40
Henan	0.37	8000.33	2.65	21.28
Xinjiang	0.50	11940.86	7.64	31.40
Hebei	0.49	8118.62	2.43	28.43
Tianjin	0.60	2911.73	1.06	32.80
Beijing	0.74	1952.00	1.01	12.34
Gansu	0.37	6247.78	5.33	22.09
Shaanxi	0.46	7263.10	4.43	41.59
Heilongjiang	0.42	12770.15	4.24	15.71
Jilin	0.45	10040.01	3.49	17.55
Liaoning	0.59	10244.50	2.63	50.59
Yunnan	0.35	6922.68	4.89	23.03

3.4.4 Firm Strategy, Structure and Rivalry

Indices for Firm Strategy, Structure and Rivalry (Table 3.7):

- Number of wineries above designed size, 2013 (*Source: Yearbook of China Alcoholic Drinks Industry, 2013*)

Over the past decade, the Chinese wine industry has exploded with number of wineries more than doubling for the increasing market demand and suitable wine grape growing areas (Theconversation, 2014).

- Total number of universities and institutes, 2016
- Number of Universities with education of viticulture and enology, 2016 as **Appendix 2.**
(Universities and institutes for wine and grape education and research)
- Grape and wine research center, 2016

Technology and technical innovation have the power to significantly influence and to alter the industry's structure and are a highly important factor for wine industry (Del Valle Fernández Moreno et al., 2011). Collaborations with research institutes in regulation formation and participant education with a goal to improve the wine quality could be a key factor to improve the competitiveness of wine industry (Rendleman et al., 2016).

Table 3.7. Indices of Firm Strategy, Structure and Rivalry

Indices of Firm Strategy, Structure and Rivalry				
Province	Number of wineries above designed size (2013)	Total number of universities and institutes (2016)	Number of Universities with education of viticulture and enology (2016)	Grape and wine research center (2016)
Shandong	59	154	5	1
Ningxia	6	14	1	1
Henan	24	100	0	1
Xinjiang	16	32	1	1
Hebei	20	75	0	1
Tianjin	4	40	0	2
Beijing	4	79	2	2
Gansu	6	30	2	1
Shaanxi	3	96	1	1
Heilongjiang	1	69	0	0
Jilin	25	58	0	2
Liaoning	18	97	2	1
Yunnan	4	36	1	1

3.4.5 Government

As Table 2.1 in Chapter 2 shows, recently, China has promulgated a series of policies and regulations for wine industry at industrial level, commercial level and environmental level. In wine regions of China, local governments also have promulgated policies, regulations and taken actions to support local grape wine industries as **Table 3.8**.

Table 3.8. Government support.

Wine Region	Government Support
Shandong	Strong government support; vast inversion; wine education; wine forums China (China Yantai Vine and Wine Officer, 2016)
Ningxia	The Wine Institute of Ningxia and the Wine Industry Association of Ningxia (2012); the International Federation of Vine and Wine of Helan Mountain's East Foothill (2013); Ningxia Grape and Wine Industry Development Alliance (2015); Ningxia's Grape Industry Development Bureau (2015) Plan of —The Helan Mountain Grape Culture Corridor” (2015); —Regulation on the protection of Eastern Foot of Helan Mountain Wine Region” (2012); “Ningxia Classification System for wineries” (2013); —Regulation on the protection of the geographical mark Eastern Foot of Helan Mountain” (2014); —New Ningxia winery classification system” (2016)
Henan	Guidance opinions for the Alcohol Industry of Henan in the Period of the 12th Five-Year Plan (2010) which emphasizes the importance of rational development, industrial innovation, low-carbon economy, talent education and food safety for the wine industry during the period of 2011-2015 (CGNJ,2011)

Xinjiang	Development Plan for The Wine Industry of Xinjiang (2015-2025) in 2015 emphasizes the importance of policy support, market guidance, wine industry chain, sustainable development with chateau model, wine culture cultivation and tourism development in the further development in the wine industry (XJFTEC, 2015)
Hebei	Suggestions for the promotion of the development of food industry of Hebei Province (2014) highlights the importance of governmental support for the local wine industry's development especially in the area of food quality control and local wine brands promotion to revive the local wine industry (Winesinfo,2015)
Tianjin	—The Pilot Free Trade Zone of Tianjin” is the second pilot free trade zone of China after Yangshan of Shanghai and offers services such as international transit, international procurement, and international trade for wines; the wine warehousing and exhibition center
Beijing	Wine Industry Development Plan of Yanqing County (2016); —Platform for the Grape and Wine Industry of Yan-Huai Valley” which intends to cooperate with neighboring wine region Huailai of Hebei; the Yan-Huai Valley Grape and Wine Industry Federation (2014) (WINECHINA, 2014b); —Winery Administrative Measures” and —Intellectual Property Rights Implement of Wine of Yanqing County; —Development Plan for the Thirteen Five -Year” of Miyun County; —Guidance for Chateau Tourism” (2016) of FanShan County; despite this, there is a need for a leading policy and plan to regulate and guide the completely wine industry of Beijing (Ma J.Z., 2015)
Gansu	—Gansu wine industry development plan (2010 ~ 2020)” (2010); the Gansu Government had emphasized the importance to develop the local wine industry in the 11th five year-plan (2006-2011); —Opinions to further support the development of wine industry in the Hexi Corridor”

	Several grape and wine festivals such as the 6th China Hexi Corridor Organic Wine Festival (MOFCOM,2016) The Professional Committee of Gansu Wine Industrial Association had been found (CNWINENEWS , 2016c)
Shaanxi	—Shaanxi wine industry development plan (2014-2020)” (2016) intends to guide the development of local wine industry engaging climatic zoning of wine grape cultivation and enlargement of local wine grape producing bases (Nwsuaf, 2016); One committee of wine experts from government, universities, enterprises and media was established in 2016 by the —Chamber of Wine Commerce of Shaanxi” in order to investigate the development of local wine industry, offer technical and knowledge guidance and broadcast wine culture and knowledge (CNWINENEWS , 2016a)
Heilongjiang	The Dongning County of Heilongjiang intends to accelerate the local wine industry’s development by adequate industrial planning, foreign experiences of winery administration, policy support and governmental cooperation (WINECHINA, 2013)
Jilin	In Jilin, local governments spent a lot of effort to ensure the food safety and rebuild the reputation of —Hl Grape Wine (Wilding Grape Wine)” production among Chinese consumers (JiuQ, 2013). The government of Ji’an intends to improve the local hill grape wine industry by policy (priority of development) and financially support (subvention, tax reduction and reward, fund) (rensheng2, 2015)
Liaoning	In the ice-wine producing Hengren the local government makes a development strategy named —one route, one yard and one town” combining local tourism route with ice-wine grape producing yards and wineries and a ice-wine team town where tourists can experience 50

	wineries from different wine producing countries (Li and Zhao, 2014)
Yunnan	Plan of industrial chain of —Agriculture-Tourism-Culture” for red ice-wine of Mile (DQAGRI, 2016); —Wine Industry Development Plan (2015-2030) of Yunnan” (2015)

3.4.6 Chance

As a big country, owned to the local diversity, each wine region may have its own opportunity or chance for local wine industry, considering natural condition, alcohol drink condition, geographical location and national project for development as **Table 3.9**.

Table 3.9. Chance for local wine industries.

Wine Region	Chance for the development of local wine industries
Shandong	1. The liquor industry of Shandong including —Baiji” which is made of grain, beer and wine is in the leading position of China (CNWINENEWS, 2016b) 2. Shandong has a developed economy in the coastal area and a huge population of 97.89 million ; alcohol consuming tradition 3. Convenient geographical location in the eastern costal area of China near Korea and Japan
Ningxia	1. Excellent producing conditions (Helan Mountains East Piedmont Area) 2. International cooperation including with OIV 3. Leading position in winery development of China
Henan	1. Large population of 94.36 million and alcohol consuming tradition; 2. The China-Europe Railway for commerce

	3. E-commerce platforms
Xinjiang	1. Geographical location and international borders and commerce relationship with Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Pakistan, Mongolia, Indian and Afghanistan 2. Vast lands with 1.6 million square kilometers; excellent and diverse conditions for grape cultivation and wine making 3. —Silk Road Economic Belt” and the “21st-Century Maritime Silk Road”
Hebei	1. Highly developed wine clusters 2. —Beijing-Tianjin-Hebei Integrated Development” announced in 2015 targets to transfer non-essential functions of the Capital Beijing to neighboring areas in Tianjin and Hebei and to archive an integrated and coordinated development in the high populated and industrialized area in Beijing, Tianjin and Hebei 3. —2020 Winter Olympic Games”
Tianjin	1. Convenient geographical location for transport and commerce in the north center of China near Beijing and faces the Bohai Gulf which accesses to the Bohai Sea and Yellow Sea 2. Large size of high-income and well-educated consumers as one modernized municipal 3. —Beijing-Tianjin-Hebei Integrated Development Program”
Beijing	1. Cultural, economic and political center of China 2. Large size of high-income and well-educated consumers 3. —Beijing-Tianjin-Hebei Integrated Development Program” 4. —2020 Winter Olympic Games”
Gansu	1. Divers conditions for grape planting and wine making 2. —Silk Road Economic Belt” and —21st Century Maritime Silk Road” 3. The China-Europe Railway for commerce

Shaanxi	1. —Silk Road Economic Belt” and —21st Century Maritime Silk Road” 2. The China-Europe Railway for commerce
Heilongjiang	1. International borders and commerce relationship with Russian 2. —Northeast Area Revitalization Plan” released in 2006 intends to rejuvenate industrial areas in the Northeastern China including these three provinces. Many wineries got financial support (JiuQ, 2013)
Jilin	1. International borders and commerce relationship with Russian and North Korea 2. Northeast Area Revitalization Plan
Liaoning	1. Convenient geographical location for marine commerce 2. Northeast Area Revitalization Plan
Yunnan	1. International borders between China and ASEAN (Association of Southeast Asian Nations) countries and related international commerce

3.5 Analysis of competitiveness of Chinese wine provinces

Even though data of vineyard area and grape production do not distinguish table grape, wine grape and dried grape, considering the fact that in China viticulture activities are all administrated by the Ministry of Agriculture of China and modern Chinese wine industry is quickly development in current table grape and dried grape producing areas, they are taken as indices to measure the competitiveness of Factor Conditions as well.

Based on all the data of indices collected in **Table 3.4**, **Table 3.5**, **Table 3.6** and **Table 3.7**, we use Shandong Province as a comparative base. We use a score of 100 when referring to Shandong (as a point of reference) and the relative ratio and the average score are given for the rest 12 wine

producing provinces in **Table 3.10**, **Table 3.11**, **Table 3.12** and **Table 3.13**. For all the indices, the higher the number is, the more competitiveness has in this factor.

For example, in table 10 the Wine production of Shandong and Ningxia were 392.31 Mhl and 20.22 Mhl in 2014. We give Shandong a score of 100 in the table 11 and the score of Wine production of Ningxia in table 11 will be $100 * (20.22/392.31) = 5.15$. Hence, for the Factor Conditions of Ningxia the total score will be $100 * (20.22/392.31) + 100 * (0.73/0.77) + 100 * (0.67/0.69) + 100 * (1.23/1.34) + 100 * (34.00/41.00) = 5.15 + 94.81 + 97.10 + 91.79 + 82.93 = 371.78$ and the average score is $371.78/5 = 74.36$. In **Table 3.18**, we present the average score of four determinant factors of each province and calculate the total average score (Total Competitiveness). The total average score (Total Competitiveness) of Ningxia is $(74.36 + 68.43 + 144.20 + 34.82)/4 = 321.81$.

3.5.1 Competitiveness of Factor Conditions

In terms of Factor Conditions (**Table 3.10**), comparatively Shandong holds absolute advantage in the sector of Wine production followed by Henan and Jilin. Beijing and Tianjin have high scores of Human Development and Education Index as developed municipals but the score of Wine production and Vineyard area are not high for the limit of area. The score of Power of agricultural machinery per capita in Heilongjiang, Shandong, Ningxia and Henan have comparative advantage.

For the Total average score of Factor Conditions (**Figure 3.5**), Xinjiang has the highest score with 128.56 followed by Hebei 105.30 and Shandong 100.00 all of which are main grape and wine producing regions of China. Beijing and Tianjin fall behind mainly because of their area limitation for grape and wine production as municipals.

Table 3.10. Score of Factor Conditions.

Score of Factor Conditions						
Province	Wine production (Mhl, 2014)	Human Development Index (2014)	Education Index (2014)	Power of agricultural machinery per capita (kw,2014)	Vineyard area (1,000 ha, 2014)	Total average
Shandong	100.00	100.00	100.00	100.00	100.00	100.00
Ningxia	5.15	94.81	97.10	91.79	82.93	74.36
Henan	42.76	94.81	97.10	91.04	82.68	81.68
Xinjiang	13.85	93.51	95.65	76.12	363.66	128.56
Hebei	16.99	96.10	98.55	110.45	204.39	105.30
Tianjin	5.16	109.09	114.49	26.87	12.68	53.66
Beijing	1.79	112.99	123.19	6.72	7.80	50.50
Gansu	18.72	89.61	92.75	73.13	65.12	67.87
Shaanxi	13.78	97.40	101.45	50.75	113.66	75.41
Heilongjiang	9.74	98.70	104.35	100.75	11.95	65.10
Jilin	42.19	100.00	104.35	79.10	31.71	71.47
Liaoning	10.34	103.90	110.14	46.27	91.95	72.52
Yunnan	6.27	87.01	88.41	50.75	86.83	63.85

Figure 3.5. Score of Factor Conditions.

3.5.2 Competitiveness of Demand Conditions

In terms of Demand Conditions (**Table 3.11**), Beijing and Tianjin have high scores in all the indexes mainly for the high-developed economy and life standards in China as two of the four Municipalities (others two are Shanghai and Chongqing). By the same time, there is large number of high-income and well-educated population in these two areas. Foreign culture including wine culture is being popular.

For the Total average score of Demand Conditions (**Figure 3.6**), Beijing ranks the first with 124.08 and Tianjin ranks the second with 116.83. Yunnan and Gansu get lower scores than other provinces as these two provinces have less scores in economy and urbanization rate.

Table 3.11. Score of Demand Conditions.

Score of Demand Conditions						
Province	Revenue of wineries above designed size (1,000 Yuan, 2013)	GDP Per Capita (Yuan,2014)	Household Final Consumption Expenditure (2014, Yuan)	Income Index (2014)	Urbanization rate (2014)	Total average
Shandong	100.00	100.00	100.00	100.00	100.00	100.00
Ningxia	8.70	68.72	79.20	92.79	92.73	68.43
Henan	16.54	60.89	68.17	90.34	81.82	63.55
Xinjiang	1.86	66.77	64.82	92.11	83.64	61.84
Hebei	5.10	65.68	63.44	91.84	89.09	63.03
Tianjin	3.33	172.47	148.52	110.75	149.09	116.83
Beijing	2.18	164.26	187.95	109.66	156.36	124.08
Gansu	8.78	43.42	55.66	83.81	76.36	53.61
Shaanxi	0.91	77.09	77.21	94.97	96.36	69.31
Heilongjiang	3.06	64.43	79.31	91.43	105.45	68.74
Jilin	1.87	82.39	71.22	96.33	76.36	65.63
Liaoning	1.27	107.10	116.03	101.36	121.82	89.52
Yunnan	0.80	44.78	63.78	84.35	76.36	54.01

Figure 3.6. Score of Demand Conditions.

3.5.3 Competitiveness of Related and Supporting Industries

In terms of Related and Supporting Industries (**Table 3.12**), Beijing and Tianjin are in the leading position of Percentage of Internet user. Heilongjiang and Xinjiang have higher scores in Output value of agriculture per capita when these two provinces have large size of arable lands for agriculture and comparatively denser population. Xinjiang and Gansu get higher scores in length of highway per capita. Xinjiang and Ningxia pose higher scores in Freight traffic per capita.

For the Total average score of Related and Supporting Industries (**Figure 3.7**), Xinjiang ranks the first with 159.49 followed by Ningxia 144.20, Liaoning 130.26 and Shaanxi 124.07. Tianjin and Beijing get lower scores with 80.01 and 65.50.

Table 3.12 Score of Related and Supporting Industries.

Score of Related and Supporting Industries					
Province	Percentage of Internet user (2014)	Output value of agriculture per capita (yuan, 2014)	Length of highways per capita(km, 2014)	Freight traffic per capita(tons, 2014)	Average
Shandong	100	100	100	100	100.00
Ningxia	95.74	71.61	178.49	230.94	144.20
Henan	78.72	85.14	100.00	78.76	85.66
Xinjiang	106.38	127.08	288.30	116.21	159.49
Hebei	104.26	86.40	91.70	105.22	96.90
Tianjin	127.66	30.99	40.00	121.39	80.01
Beijing	157.45	20.77	38.11	45.67	65.50
Gansu	78.72	66.49	201.13	81.75	107.02
Shaanxi	97.87	77.30	167.17	153.92	124.07
Heilongjiang	89.36	135.90	160.00	58.14	110.85
Jilin	95.74	106.85	131.70	64.95	99.81
Liaoning	125.53	109.02	99.25	187.23	130.26
Yunnan	74.47	73.67	184.53	85.23	104.48

Figure 3.7. Score of Related and Supporting Industries

3.5.4 Competitiveness of Firm Strategy, Structure and Rivalry

For the Firm Strategy, Structure and Rivalry (**Table 3.13**) Shandong wins in the Number of wineries above designed size and in the number of Universities and institutes, Universities with education of viticulture and enology. Tianjin, Beijing and Jilin have more Grape and wine research centers.

For the Total average score of Firm Strategy, Structure and Rivalry (**Figure 3.8**), Shandong occupies the first place with 100.00. The first modern wine company of China Changyu was established in Yantai of Shandong and the researching level of grape and wine is higher. Beijing with 74.52 ranks the second thanks to its educational and scientific resources. The score of Heilongjiang is lower than others due to the lack of related education and scientific researching centers.

Table 3.13. Score of Firm Strategy, Structure and Rivalry.

Score of Firm Strategy, Structure and Rivalry					
Province	Number of wineries above designed size (2013)	Total number of universities and institutes (2016)	Number of Universities with education of viticulture and enology (2016)	Grape and wine research center (2016)	Total Average
Shandong	100.00	100.00	100.00	100	100.00
Ningxia	10.17	9.09	20.00	100	34.82
Henan	40.68	64.94	0.00	100	51.41
Xinjiang	27.12	20.78	20.00	100	41.97
Hebei	33.90	48.70	0.00	100	45.65
Tianjin	6.78	25.97	0.00	200	58.19
Beijing	6.78	51.30	40.00	200	74.52
Gansu	10.17	19.48	40.00	100	42.41
Shaanxi	5.08	62.34	20.00	100	46.86
Heilongjiang	1.69	44.81	0.00	0	11.63
Jilin	42.37	37.66	0.00	200	70.01
Liaoning	30.51	62.99	40.00	100	58.37
Yunnan	6.78	23.38	20.00	100	37.54

Figure 3.8. Score of Firm Strategy, Structure and Rivalry.

3.5.5 Total competitiveness

Table 3.14. Score of Total Competitiveness

Average Score of Competitiveness of Wine Regions					
Province	Factor Conditions	Demand Conditions	Related and Supporting Industries	Index of Firm Strategy, Structure and Rivalry	Total Score
Shandong	100.00	100.00	100.00	100.00	400.00
Ningxia	74.36	68.43	144.20	34.82	321.81
Henan	81.68	63.55	85.66	51.41	282.30
Xinjiang	128.56	61.84	159.49	41.97	391.86
Hebei	105.30	63.03	96.90	45.65	310.88
Tianjin	53.66	116.83	80.01	58.19	308.69
Beijing	50.50	124.08	65.50	74.52	314.60
Gansu	67.87	53.61	107.02	42.41	270.91
Shaanxi	75.41	69.31	124.07	46.86	315.65
Heilongjiang	65.10	68.74	110.85	11.63	256.32
Jilin	71.47	65.63	99.81	70.01	306.92
Liaoning	72.52	89.52	130.26	58.37	350.67
Yunnan	63.85	54.01	104.48	37.54	259.88

To better achieve the goal to make comparison and analysis of the competitiveness of wine producing regions of China, we summarize the Total average scores of Factor Conditions, Demand Conditions, Related and Supporting Industries and Firm Strategy, Structure and Rivalry in **Table 3.14** and figure scores of four determinate factors in **Figure 3.9** for each Chinese wine producing regions.

To achieve a conclusion, in **Table 3.14** we calculate Total Score of Competitiveness = Score of Factor Conditions+ Score of Demand Conditions +Score of Related and Supporting Industries + Score of Firm Strategy, Structure and Rivalry and they are figured in **Figure 3.10**. For example, the Total Score of Competitiveness of Shandong = 100.00+100.00+100.00+100.00 = 400.00. Shandong has the highest competitiveness with 400 followed by Xinjiang with 391.86. Ningxia ranks the fourth with 321.81. Heilongjiang is the last with 256.32.

Figure 3.9. Competitiveness of Diamond Factors.

Figure 3.10. Total Score of Competitiveness.

Competitiveness of Factor Conditions:

Xinjiang has the strongest advantage in Factor Conditions especially for its large scale of vineyard area. The ranking of competitiveness of Factor Conditions is as follows: 1.Xinjiang (128.56); 2. Hebei (105.30); 3. Shandong (100.00); 4. Henan (81.68); 5. Shaanxi (75.41); 6. Ningxia (74.36); 7. Liaoning (72.52); 8. Jilin (71.47); 9. Gansu (67.87); 10. Heilongjiang (65.10); 11. Yunnan (63.85); 12. Tianjin (53.66) and 13. Beijing (50.50).

Competitiveness of Demand Conditions:

Beijing has the strongest advantage in Demand Conditions for its high of GDP per capita, Household final consumption expenditure, and Income Index and Urbanization rate as the Capital

of China. The ranking of competitiveness of Demand Conditions is as follows: 1. Beijing (124.08); 2. Tianjin (116.83); 3. Shandong (100.00); 4. Liaoning (89.52); 5. Shaanxi (69.31); 6. Heilongjiang (68.74); 7. Ningxia (68.43); 8. Jilin (65.63); 9. Henan (63.55); 10. Hebei (63.03); 11. Xinjiang (61.84); 12. Yunnan (54.01) and 13. Gansu (53.61).

Competitiveness of Related and Supporting Industries:

Xinjiang has the strongest advantage in Related and Supporting Industries mainly for its high rate of Output value of agriculture per capita and Length of highways per capita. The ranking of competitiveness of Related and Supporting Industries is as follows: 1. Xinjiang (159.49); 2. Ningxia (144.20); 3. Liaoning (130.26); 4. Shaanxi (124.07); 5. Heilongjiang (110.85); 6. Gansu (107.02); 7. Yunnan (104.48); 8. Shandong (100.00); 9. Jilin (99.81); 10. Hebei (96.90); 11. Henan (85.66); 12. Tianjin (80.01) and 13. Beijing (65.50).

Competitiveness of Firm Strategy, Structure and Rivalry:

Shandong ranks the first of the competitiveness of Firm Strategy, Structure and Rivalry thanks to its Number of wineries above designed size, Total number of universities and institutes, and Number of universities with education of viticulture and enology. The ranking of competitiveness of Firm Strategy, Structure and Rivalry is as follows: 1. Shandong (100.00); 2. Beijing (74.52); 3. Jilin (70.01); 4. Liaoning (58.37); 5. Tianjin (58.19); 6. Henan (51.41); 7. Shaanxi (46.86); 8. Hebei (45.65); 9. Gansu (42.41); 10. Xinjiang (41.97); 11. Yunnan (37.54); 12. Ningxia (34.82) and 13. Heilongjiang (11.63).

For the total competitiveness of main wine producing provinces of China, the ranking presents as follows: 1. Shandong (400.00); 2. Xinjiang (391.86); 3. Liaoning (350.67); 4. Ningxia (321.81); 5. Shaanxi (315.65); 6. Beijing (314.60); 7. Hebei (310.88); 8. Tianjin (308.69); 9. Jilin (306.92); 10. Henan (282.30); 11. Gansu (270.91); 12. Yunnan (259.88) and 13. Heilongjiang (256.32).

CHAPTER 4. THE EFFECTS OF CLIMATE CHANGE IN THE CHINESE WINE INDUSTRY: CHALLENGES AND OPPORTUNITIES

4.1 Introduction

Recently, China has become an exciting wine consumer market, as well as one of the most important wine producers. Current studies of the Chinese wine industry are mostly focused on the wine market. However, global climate change, which affects the quantity, quality and distribution of wine, will have a strong impact on the Chinese domestic wine industry. In this paper, we analysis the impact of climate change in China and establish policy, financial, technical, institutional and collaborative adaptation strategies for the Chinese wine industry.

Global warming is a common challenge for society. The Intergovernmental Panel on Climate Change (IPCC) report shows that increasing mean surface air temperatures over oceans and land have been observed over the last century (IPCC, 2013). Additionally, in several regions of the world it is evident that climate change has affected both terrestrial food production and crop yields (IPCC, 2014b). Under climate change, especially in developing countries, such as China, agriculture is the most vulnerable economic sector (Chen et al., 2016).

In the Northern Hemisphere, the 3 decades between 1983 and 2012 were possibly the warmest period in the past 14 centuries (IPCC, 2013). According to the National Oceanic and Atmospheric Administration of the United States (NOAA), the average land temperature between April and September in the Northern Hemisphere (**Figure 4.1**) in 2012 had increased 1.64°C compared to 1880.

Although wine is not an essential agricultural product for survival, it is closely connected to human history and culture as a significant product of human ingenuity (Mozell and Thach 2014). Viticulture contributes to the local economy, tourism, industry and natural habitat (Resco et al., 2015; Duchene, 2016). In the Northern Hemisphere, the period between April and September is crucial for wine grape growth, during which time bulb breaking, flowering,

fruit setting, véraison and harvesting of wine grapes occur. A widespread observation is that climate change will affect both the geographical distribution of the wine industry and the quality of the product. In recent years China has joined the world's wine world presenting significant suitable regions and diverse climatic sites (De Orduña, 2010, Hannah et al., 2013). A great expansion of Chinese domestic wineries in new regions with increasing capability may be observed (Mozell and Thach, 2014). While there have been continued improvements in the wine industry, it is necessary to recognize the impact of global climate change, which will bring both challenges and opportunities to China.

Figure 4.1. Northern hemisphere land temperature anomalies from April to September, compared to 20th century average. Source: NOAA, 2015.

4.2 Methods and data source

In Chapter 4, we conduct 4 main studies. Firstly, to understand how climate change will affect the global wine industry, we explore the structural relationship between climate change and vineyards by literature review. We attempt to analyze the possible benefits (opportunities) and harms (challenges) of climate change for the Chinese wine industry based on a number of indicators of both climate variables (temperature, accumulated heat, precipitation and water resource, the frost free period) and climate events (drought, flood, extreme rainstorm, fog, and hail). For the whole country, secondary data are mainly obtained from three sources: 1. Literature review; 2. Institutes and organizations, such as the China Meteorological Administration, and the World Bank; 3. Government reports and bulletins, such the Ningxia Statistical Yearbook and the China Flood and Drought Management. For the primary wine-producing provinces, qualitative analyses were made by literature review. Secondly, in the part of scenarios study, we adopt gfdl_cm2 model of A2 scenario in the periods of 2046-2065 and 2081-2100 in comparison with the period of 1961-1990 from Climate Wizard of World Bank to predict possible changes in temperature, precipitation and Frost-Free Days in China. Thirdly, in the part of climate change adaptive capability of wine industry in the world, we collect data from World Bank, UDNP and FAO. Fourthly, in the final part of climate change adaptation strategies, we provide adaptation strategies at political level, financial level, technical level, institutional level and collaborative level based on current Chinese climate change policies such as China's Policies and Actions for Addressing Climate Change (2008) and China's Policies and Actions for Addressing Climate Change (2012) and studies of wine and adaptation such as the multidisciplinary LACCAGE project (long-term adaptation to climate change in viticulture and enology of France).

In this Chapter, we conduct research applying Climate Change Scenarios and Climate Change Adaptive Capacity. Scenarios are devices for analyzing situations where outcomes are uncertain. Scenarios describe plausible trajectories of climate conditions and other aspects of the future for climate change research-including processes, impacts (physical, ecological, and socioeconomic), and potential responses which are of importance for informing climate change analysis (IPCC,

2017). Different emission scenarios result in a range of potential changes in temperature and precipitation for the planet (Jones, 2007). Several studies of climate change and wine industry have been conducted applying climate change scenarios. Hannah et al., 2013 used the WorldClim global climate dataset for current climate and GCMs from the fifth phase of the Coupled Model Inter-comparison Project (CMIP5) for future climate to predict global change in viticulture suitability. In the Douro Valley of Portugal, the Association for the Development of Viticulture in the Douro Region (ADVID) cooperates with wine growers and producers to develop models to simulate the impact of climate change on this region to assess and plan for future climate change scenarios (Jones and Alves, 2011). Resco et al., 2016 estimated probabilistic projections across scenario, zone and sensitivity indices in the 56 Protected Designation of Origin wine areas of Spain to inform on the magnitude of the adaptation effort towards climate change. We adopt climate change scenarios from Climate Wizard of World Bank Group to predict possible changes of average annual temperature, average annual precipitation and average annual number of Frost Free Days in China. The results of scenarios show the possible changes under gfdl_cm2 model of A2 scenario in the periods of 2046-2065 and 2081-2100 in comparison with the period of 1961-1990.

Climate change adaptive capacity refers to the ability/potential of a system to respond to climate variability and change successfully, including adjustments in both behavior and resources and technologies (IPCC, 2007). There are several studies about the adaptive capacities of Climate Change (Iglesias et al., 2011). In the studies of Yohe and Tol (2002) and Ionescu et al. (2009), they defined eight determinants of adaptive capacity. These determinants include social, economic and institutional factors such as resources, institutions, human and social capital. In addition, in the research of Iglesias et al (2011), more determinant related to Natural capacity such as Total water use and Agricultural innovation such as Irrigation area are taken into consideration. In the research in Chapter 5, an adaptive capacity index (AC index) with a score range of 0-100 to measure the adaptive capacity is applied considering natural component, economic component, social component, technical component and viticulture component.

4.3 Impacts of climate change on Viticulture

Climate change can potentially affect almost every agricultural form especially for wine grapes, which is located in narrow climatic zones (Jones, 2007). Current world wine producing regions are mainly located in the temperate latitudes of 30°-50° in the north and south hemisphere. There are many types of climates throughout these mild latitudes including Mediterranean, Marine West Coast, Humid Subtropical and Semi-arid Continental Climates (Jones G.V., 2006). Main wine producing regions are located in European countries (such as France, Italy, and Spain Portugal), California of USA, Chile and Argentina, South Africa, South Australia (**Figure 4.2**). Temperature plays a key role in viticulture. Each specific wine grape has its own range of average growing season temperatures such as cold 13-15 °C , intermedia 15-17 °C, warm 17-19 °C and hot 19-24 °C which determine the climate-maturity ripening potential (**Figure 4.3**) (Jones 2006). While fine change of average growing season temperatures like 1 °C may let one grape growing region more conducive to ripening some grape varieties and less for others, larger magnitude of change such as 2 °C may conduct the shift of climate maturity type in one region (Jones 2007).

Figure 4.2. World viticulture zones. Source: Jones, 2006.

Figure 4.3. Grapevine Climate/Maturity Groupings. Source: Jones, 2007.

4.3.1 Grape/wine quality and quantity

Wine grapes require suitable climatic conditions such as a mild winter with little frost damage, a warm spring with budburst flowering and development, and a stable summer with low temperature change and optative maturation (Holland and Smit 2010). Previous Research indicates that temperatures of 30°C or above cause lower anthocyanin synthesis and reduced

grape color while this process will be completely inhibited at 37 °C (de Orduña, 2010). Abnormally colder temperatures can contribute to incomplete ripening of grapes with low sugar, high acid and immature flavors while excessively warm temperatures will bring over-ripened grapes with high sugar, low acid, high alcohol and cooked flavors (Mozell and Thach 2014). Some Studies show that in the south of France the potential alcohol level of all grape varieties had increased by 2% between 1980 to 2001 and the pH had increased from 3 to 3.3 while the acidity decreased (de Orduña, 2010). While in Napa, California, between 1971 and 2001 the average alcohol level had increased from 12.5% to 14.8%, but the degree of acidity fell (Jones 2007). The rising level of carbon dioxide will change grape and wine quality. High concentration of carbon dioxide will accelerate the ripening process and increase the accumulation of tannic resulting in higher sugar and alcohol level grapes (Holland and Smit 2010).

Wine production is particularly sensitive to climatic factors, which pose significant effects on yields. The influence of climatic factors will vary across different grape varieties given that each requires a different minimum temperature summation to reach maturity. A research of the grape yields and climate over 50 years in California shows that higher yields were associated with asymmetric warming which brought less frequency of frost, advanced initiation and longer growing period (Jones 2007). In California, excessive heat during the growing period especially in ripening was known to cause damage in both wine yields and quality as physiological ripening shut down (Nicholas and Durham 2012). Also, in California scientists predict that climate change with warming temperature and reducing fresh water may decrease the yield of several kinds of local planted grapes by 2050 (Lobell et al. 2006; Mozell and Thach 2014). An investigation of perception and impact of climate change among European winegrowers shows that most reductions of yield were caused by extreme weather such as drought, heavy rain and spring ice (Battaglini et al. 2009). Inland areas of Spain may experience changes in temperature and water availability, which may threat wine grapes' survival (Mozell and Thach 2014).

4.3.2 Grape pests and diseases

Warming temperature will increase the probability of grape pests and diseases as well as the vectors that are responsible for disease distribution (de Orduña, 2010). The grape pest Asian Lady Beetle (*Harmonia axyridis*) has been found in both Europe and North America; in northern Germany, the grape disease Bois Noir (BN) phytoplasma brought by the vector of *Hyalestes obsoletus* threatens the grape yield (Mozell and Thach 2014). Some pests or diseases will even as warming temperatures extend the survival range such as Pierce's disease, which restrains the water circulation of vine, which would be spread by its vector Glassy-winged sharpshooter (*Homalodisca vitripennis*). Therefore, more grape growing areas will be under the threat of grape pests and diseases (Galvez et al. 2014).

4.3.3 Location of vineyards

Quality wine vineyards are mainly located in relatively narrow geographical areas situated between 30° to 50° north and 30° to 40° south. The range of average growing season temperature which can define the climate-maturity ripening potential of wine grapes is 10°C and for some special grapes like Pinot noir, the range of average growing season temperature is as narrow as 2°C; therefore these grapes are more vulnerable under global climate change than other more broad acre crops (Jones 2007; Schultz and Jones 2010; Mozell and Thach 2014). Current vineyards may experience a location shift due to changing and varying climatic factors. Many European wine regions were predicted to witness shifts from their current climate zones and others even will have significant latitudinal shifts (Moriondo et al. 2013). As a consequence of climate change and the relative rising temperatures and melting glaciers the sea level rises, which can threaten many coastal areas including vineyards.

4.3.4 Impacts on the oak to make the barrels

Oak trees are important in the wine making process since oak is used for wine barrels, which affect the color, tannic and aromas of wine during the conservation period (de Orduña, 2010). In addition, oak is processed as wine corks. The changing weather as well as the increasing carbon dioxide level may accelerate the growing process of oak trees leading to an increasing size and number of conducting vessels in oak stem. This results in a weakening of the raw material used for barrels and corks. Simultaneously the concentration of both ellagitannin and tannic of oak will decrease and the wine quality will be influenced (Holland and Smit 2010).

4.3.5 Structural relationship between climate change and vineyards

The sensitivity of wine production to changing climate factors will pose significant effects on yields and quality, ultimately impacting prices and revenues (Bardaji and Iraizoz 2015). The decrease in suitable grape planting areas will adversely affect the quantity and quality of wine grapes produced (IPCC, 2014b). **Figure 4.4** illustrates the structural relationships between climate change and the wine production process. The vineyard location and climate variables have an immediate impact on grape quality and quantity produced. The effects of climate variables become apparent during the wine making and the wine storage period. Over the long term, vineyards could be relocated as owners seek more suitable climate conditions in order to maximize grape/wine quantity and quality.

Figure 4.4. Climate change and the wine production process. Source: Own drawn.

4.3.6 Climate variables and relevance on viticulture

Even though a multitude of individual climate factors has impacts on viticulture, temperature and water supply are the most important factors (Schultz and Jones, 2010).

Temperature plays a key role in viticulture. Each specific grape cultivar has its own range of optimal growing season temperatures, which determine the climate-maturity ripening potential (Table 2) (Jones, 2007). In North China, when the average annual minimum temperature is below -15°C , it is necessary to adopt the soil-burying method to prevent *Vitis vinifera* from the damage of winter frost, and approximately 90% of the current vineyards in China need soil-burying (Wang S. et al., 2015). The Soil-Burying Line of China indicating areas with average annual minimum temperature below -15°C and requiring soil-burying in winter includes

Shandong, Jiangsu, Henan, Shanxi, Shaanxi, Gansu, Sichuan, Yunnan and Tibet from east to west (Li H. et al., 2007b; Li H., Wang et al., 2007). Soil burying could lead to increased labor intensity and production cost (Zhang J. et al., 2013).

Grapevine growth is initiated by a prolonged temperature above 10°C in spring (Jones et al., 2005; Holland and Smit, 2014). The sum of mean daily temperature from 1st April to 31st October in the northern hemisphere is an indicator of heat available for wine grape growing defined as the Sum of Average Temperature over the same period (SAT) in viticulture (Jones and Davis, 2000; Szymanowski et al., 2007; Green and Szymanowski, 2012) (Table 2). Another indicator of heat available for viticulture is the Effective Accumulated Temperature (EAT) or the Growing Degree Days (GDD) which is the sum of the temperature value between mean daily temperature and 10°C from 1st April to 31st October in the northern hemisphere (Amerine and Winkler, 1944; Li H., Li and Yang, 2009; Green and Szymanowski, 2012) (Table 2). Currently in China, accumulated temperatures are mainly used in viticulture climatic zoning studies (Li H. et al., 2007b).

Water availability is a limiting factor for the development of viticulture (De la Fuente et al., 2016). Vine grapes need a suitable amount of water during the growing period. In some cases, excessive rainfall can damage vine roots and grapes and cause floods, while in dry areas additional water supply may be provided by irrigation.

Spring frost will damage the grape buds and affect grape yield and quality; autumn frost will affect carbohydrate synthesis and reduce the cold tolerance ability of grapevine in winter (Li H., Wang et al., 2007). The choice of wine grape planting area is also related to the Frost-Free Period (FFP), which is usually defined as the number of consecutive days between the last day with a temperature below 0°C in spring and the first day with a temperature below 0°C in autumn (Wolf and Boyer, 2003; Li H. et al., 2007b). The length of the FFP is often defined by the frost timing in the spring and fall and corresponds to approximately 160-200 days in the vast majority of the world's viticulture regions (Wolf and Boyer, 2003; Jones, 2005). Sufficient FFP is needed in the processes of budburst, flowering, grape ripening, nutrient accumulation and grape frost resistance in winter (Wolf and Boyer, 2003; Li H. et al., 2007b; Holland and Smit, 2014) (**Table 4.1**).

In viticulture, we should also consider climate events such as extreme rainstorms, flood, drought, fog and hail which will affect grapevine production. Droughts and extreme rainstorms will have negative impacts on wine grape yield (Castex et al., 2015); hail in summer will damage the shoots, leaves and fruits and affect the yield and quality (Li H. et al., 2007a).

Table 4.1. Climate variables for viticulture. Source: Amerine and Winkler, 1944; Jones and Davis, 2000; Jones, 2005; Jones, 2007; Szymanowski et al., 2007; Li H., Li and Yang, 2009; Li H., Wang et al., 2009; Green and Szymanowski, 2012.

Variable	Range of values		Class name or variety
Average Growing Season Temperature (°C) in viticulture (Jones, 2007)	13-15		Cool temperature
	15-17		Intermediate temperature
	17-19		Warm temperature
	19-24		Hot temperature
Sum of Active Temperature (SAT) from 1st April to 31st October in the northern hemisphere in viticulture (Jones and Davis, 2000; Szymanowski et al., 2007; Green and Szymanowski, 2012)	2000-2200		Very early ripening
	2200-2500		Early ripening
	2500-2700		Moderately early ripening
	2700-2900		Late ripening
	>2900		Very late ripening
Effective Accumulated Temperature (EAT)/ Growing Degree Days (GDD) from 1st April to 31st October in the northern hemisphere in viticulture (Amerine and Winkler, 1944; Li H., Li and Yang, 2009)	°C	°F	
	<1371	<2500	Very early maturing grape varieties
	1372-1649	2501-3000	Early maturing grape varieties
	1649-1927	3001-3500	Late maturing grape varieties
	1927-2204	3501-4000	Acid grape varieties
	>2205	>4001	Very acid grape varieties
Frost-Free Period (FFP) (days) in viticulture (Jones, 2005; Li H., Wang et al., 2009)	<160		Unsuitable region
	160-220		Suitable region
	>220		Suitable region but wine quality affected

4.4 Effects of climate change in the wine industry of China

4.4.1 Temperature and annual accumulated temperature

In the past century, China has experienced obvious impacts of global warming in annual mean temperature (10.1°C in 2014) (**Figure 4.5**). Data from 156 meteorological stations show that in 2010 the average temperature was 1.23°C higher than in 1950 (Li R.L. and Shu, 2013). The surface temperature in eastern China has increased by 1.52°C during 1909-2010 (Zhao P. et al., 2014). The temperature increase varied based on seasonal and geographical factors. The warming rate in winter was 0.04°C per year while it was 0.01°C per year in summer, and the north warmed more quickly than the south during 1960-2010 (Piao et al., 2010). According to data from 520 meteorological stations in China, during 1951-2005 both the accumulated temperature ($\geq 10^{\circ}\text{C}$, $\geq 0^{\circ}\text{C}$) and its value increased (Miao et al., 2009). The annual effective accumulated temperature ($\geq 10^{\circ}\text{C}$), which is the sum of the temperature value between mean daily temperature and 10°C for the whole year, generally has an increasing trend after 1985 (Liu S.H. et al., 2013). Since the 1990s, the whole Soil-Burying Line of China, which indicates areas with average annual minimum temperature below -15°C and with the necessity to have vine soil-burying in winter, has advanced northward, leaving vast areas (including some part of Xinjiang) suitable for viticulture without the necessity to have vine burying in winter (Li H., Wang et al., 2007).

From the literature review (**Table 4.2**), we can observe a trend of increasing temperature in eight wine-producing provinces (Ningxia, Xinjiang, Shandong, Tianjin, Jilin, Gansu, Hebei, Shaanxi) and an increasing number of days with specific annual active accumulated temperature ($\geq 0^{\circ}\text{C}$, $\geq 5^{\circ}\text{C}$, $\geq 10^{\circ}\text{C}$) in seven wine-producing provinces (Ningxia, Xinjiang, Shaanxi, Heilongjiang, Gansu, Hebei, Tianjin) over a long period (more than 40 years). Although the literature review does not cover all of the wine-producing provinces, we can see the correlation with the national trend of increasing annual mean temperature (**Figure 4.5**). These changes may have caused possible benefits such as an increase in the number of areas

suitable for wine grape planting and possible harms such as a reduction in grape and wine quality (Table 4.2).

Figure 4.5. Annual mean temperature of China. Source: China Meteorological Administration, 2015.

Table 4.2. Temperature change in Chinese wine-producing provinces.

Climate Variable	Period	Region	Tendency	References	Possible Benefits	Possible Harms
Temperature	1961-2004	Ningxia	Annual mean temperature ↑	Chen X.G. et al., 2008a	Current cold areas may be suitable to grow grapes that can only grow in warm areas (Moriondo et al., 2013).	The quality and yield of grape may be influenced (Fraga et al., 2012; Nicholas and Durham, 2012).
			Mean temperature of each season ↑			
	1960-2009	Xinjian	Frequency of extreme hot days ↑	Zhang M.J. et al., 2012	The ripening process accelerates (Holland and	The sugar content increases for
			Frequency of extreme cold days ↓			
	1961-	Xinjian	Degree of	Pu et al.,		

	2010	g	extreme cold days ↓ Mean temperature of January↑	2014	Smit, 2010). Less frost events (Jones, 2007).	some grape varieties in some regions (Mozell and Thach, 2014).
	1950-2009	Shandong	Annual mean temperature ↑	Zhang S.P. et al., 2011	The sugar content increases for some grape varieties in some regions (Mozell and Thach, 2014).	The acidity of grape decreases for some grape varieties in some regions (Mozell and Thach, 2014).
	1955-2007	Tianjin		Liu S.M. et al., 2009		
	1961-2010	Jilin		Shen et al., 2014		
	1961-2010 1961-2003	Gansu	Annual mean temperature increased 0.29°C per decade↑	Deng et al., 2012	The acidity of grape decreases for some grape varieties in some regions (Mozell and Thach, 2014).	The alcohol content increases for some grape varieties in some regions (Mozell and Thach, 2014).
	1956-2007	Hebei	Annual mean temperature ↑	Liu F.Y. et al., 2014	The alcohol content increases for some grape varieties in some regions (Mozell and Thach, 2014).	Higher risk of pests and diseases (De Orduña, 2010).
	1960-2013	Shaanxi	Mean temperature of each season↑	Wang Y.H., 2014		
						Impede photosynthesis and hence respiration process (Ashenfelter and Storchmann, 2016).
						Fruit burnt (De Orduña, 2010; Hadarits et

						al., 2010). Extreme heat threatens grape survival (Nicholas and Durham, 2012). Higher risk of fire (De Orduña, 2010).
Annual Active Accumulated Temperature	1961-2005	Ningxia	Annual number of days ($\geq 0^{\circ}\text{C}$, $\geq 10^{\circ}\text{C}$) $\uparrow$	Zhang Z. and Lin, 2008	Longer favorable growth period (Holland and Smit, 2014). More areas may be suitable for grape planting (Li H. et al., 2007a; Li H. et al., 2007b). The ripening process accelerates (Holland and Smit, 2010). Grape yield may be increased by suitable heat (Jones, 2007).	The quality of grape may be influenced (Jones, 2007; Holland and Smit, 2014). Grape yield may be decreased by excess heat (Jones, 2007). Extreme heat may damage the vine (Holland and Smit, 2014).
	1961-2010	Xinjiang	Annual number of days ($\geq 0^{\circ}\text{C}$) $\uparrow$	Pu et al., 2013		
	1961-2008	Shaanxi	Annual number of days ($\geq 5^{\circ}\text{C}$) $\uparrow$	Wang Y.R. et al., 2011		
	1961-2005	Heilongjiang	Annual number of days ($\geq 10^{\circ}\text{C}$) $\uparrow$	Ji et al., 2009		
	1961-2003	Gansu	Annual Active Accumulated Temperature ($\geq 0^{\circ}\text{C}$, $\geq 10^{\circ}\text{C}$) $\uparrow$	Liu D.X. et al., 2005		
	1956-2007	Hebei		Liu F.Y. et al., 2014		
	1955-2007	Tianjin		Liu S.M. et al., 2009		

4.4.2 Precipitation and water scarcity

The precipitation trends have shown distinctive regional and seasonal variations, but there has

been a general decreasing trend throughout the entire country. From 1960 to 2010, three periods of precipitation transitions occurred in the 1970s, 1980s and 1990s, and the increase and decrease of precipitation moved along with the latitude (Zhao H.R., 2013; Wang Y.J. and Yan, 2014). While southern China has experienced an increasing trend of rainfall in summer and winter, northeastern China has experienced a significant decrease of precipitation in summer and winter (Piao et al., 2010; Li R.L. and Shu, 2013).

Approximately 98% of the surface water in China is recharged by precipitation (Jiang, 2009). From precipitation data of the primary wine regions in 2010 (**Figure 4.6**), we can see that the majority of regions have lower precipitation amounts than the national level. In Ningxia, Gansu and Xinjiang, the annual mean precipitation is considerably less than the national level. Changes in precipitation have been observed over long periods (more than 40 years) in six wine-producing provinces (Ningxia, Tianjin, Shandong, Gansu, Shaanxi, Hebei) with decreasing annual amount of precipitation or decreasing annual precipitation days (**Table 4.3**). These changes may have positive impacts, such as fewer pests and diseases. However, the changes may also have negative impacts, such as increased drought frequency and increased irrigation cost (**Table 4.3**).

In 2013, China ranked 102nd of 176 nations and regions with 2083 cubic meter water resource per capita (World Bank, 2015). This ranking was lower than in many wine-producing countries (**Figure 4.6**). With the exception of Heilongjiang, Jilin, Xinjiang and Yunnan, the available water per capita in the other main wine-producing regions is lower than the national average. Xinjiang has vast amounts of water stored in glaciers. Yunnan has an uneven distribution of precipitation, and irrigation is difficult due to the obstruction of high mountains, all of which lead to water scarcity.

Table 4.3. Precipitation change in Chinese wine-producing provinces.

Climate Variable	Period	Region	Tendency	References	Possible Benefits	Possible Harms
Precipitation	1961-2005 1971-2011	Ningxia	Annual precipitation ↓ Annual days of precipitation ↓	Chen X.G. et al., 2008b; Tan et al., 2014	The grape growing condition over humid areas may be improved (Jones, 2007).	Higher frequency of drought disaster (Fraga et al., 2012).
	1958-2007	Tianjin		Li C. et al., 2010		
	1961-2010	Shandong	Annual days of precipitation ↓	Dong et al., 2014	Less pest and disease damages (Fraga et al., 2012).	Higher cost of irrigation and facilities (Jones, 2007).
	1961-2010	Gansu	Annual precipitation ↓	Deng et al., 2012		
	1960-2013	Shaanxi		Wang Y.H., 2014	The taste of some grapes may be improved (Fraga et al., 2012).	Grape yield decreases (Lereboullet et al., 2013).
	1961-2011 1956-2007	Hebei		Xiang et al., 2014; Liu F.Y. et al., 2014		
						Grape grows slowly (Fraga et al., 2012).
						Lower grape survival (Jones, 2007).

Figure 4.6. Annual mean precipitations and per capita water resource of China. Source: National Bureau of Statistics of China, 2015; World Bank, 2015.

4.4.3 Frost-free Period

Chinese studies indicate that between 1964 and 2003, in China, the acreage with a FFP above 160 increased significantly, especially between 1984 and 2003, while the First Frost Day (FFD) was delayed and the Last Frost Day (LFD) was advanced (Li H., Wang et al., 2007; Li H.,

Wang et al., 2009). The Yongning County, which is bordered by the Yellow River to the west and the Helan Mountain to the east, is one of the main wine-producing regions of Ningxia. Meteorological observations between 1952 and 2013 in Yongning County indicate that the FFP had an increasing trend (164 days in 1952 and 189 days in 2013) and the FFD was delayed (26th Sep in 1952 and 16th Oct in 2013) (**Figure 4.7**).

In eight wine-producing provinces (Shandong, Ningxia, Shaanxi, Xinjiang, Liaoning, Jilin, Heilongjiang, Tianjin), studies had indicated the increasing trend of FFP over 50 years, delayed FFD, and advanced LFD (**Table 4.4**). This finding may provide an opportunity for cultivation of more grape varieties and lead to more areas suitable for viticulture. However, grape quality and grape yield may be affected (Hadarits et al., 2010; Fraga et al., 2012) (**Table 4.4**).

Figure 4.7. Frost-Free Periods and First Frost Day change in Yongning County, Ningxia, 1952-2013. Source: Ningxia Statistical Yearbook, 1985-2013.

Table 4.4. Provincial Frost-Free Period change.

Climate Variable	Period	Region	Tendency	References	Possible Benefits	Possible Harms
Frost-Free Period	1961-2008	Shandong	Number of frost-free days ↑ FFD was delayed	Wang H.Y et al., 2011	More types of grape could be planted (Belliveau et al., 2006).	Grape quality may be affected (Fraga et al., 2012).
	1961-2010	Ningxia		Zhang L. et al., 2013		
	1961-2010	Shaanxi	LFD was advanced	Bai et al., 2013	More areas may be suitable for grapes (Belliveau et al., 2006).	Grape yield may be affected (Hadarits et al., 2010).
	1960-2011	Xinjiang		Pan et al., 2013		
	1957-2006 1961-2012	Liaoning		Li J. et al., 2010 Hu et al., 2015		
	1961-2012	Jilin		Hu et al., 2015		
	1961-2012	Heilongjiang		Hu et al., 2015		
	1955-2007	Tianjin		Liu S.M. et al., 2009	Less damage to buds and vine (Belliveau et al., 2006; Hadarits et al., 2010).	

4.4.4 Extreme climate events

With the changing climate, there has been an increasing trend in periods of remarkable drought and flood, leading to challenges to agriculture and the Chinese wine industry. The most significant droughts appeared in 1978 and 2000, strongly affecting the crop production in China. **Figure 4.8** indicates total agricultural crop area covered (crop yield loss >10%) and affected (crop yield loss >30%) by drought and flood in China from 1950 to 2014. In the 1990s and 2000s, strong floods caused by heavy rains affected the entire country. In 1991, 1998, 2003, and 2010, serious floods hit China, leaving vast crop areas affected by flood

(Figure 4.8).

Regionally, increased incidence of extreme rainstorms in Ningxia, Hebei and Xinjiang over a long period may have alleviated the drought problem but may have also increased the risk of flood damage and vineyard destruction (**Table 4.5**). Due to the increased severity of drought conditions in five wine-producing provinces (Ningxia, Liaoning, Shaanxi, Henan, Yunnan), an increased investment in irrigation infrastructure may be required.

In Ningxia, Xinjiang, Shaanxi and Yunnan, changes in the density and frequency of fog over more than 40 years may have affected the growth process of grapes. In Ningxia, Tianjin, Hebei and Yunnan, the decreasing frequency of hail may have reduced the damage to vineyards.

Figure 4.8. Crop area covered/affected by drought/flood in China. Source: China Flood and

Table 4.5. Provincial extreme climate events and effects on viticulture.

Climate Event	Period	Region	Tendency	References	Possible Benefits	Possible Harms
Extreme Rainstorm	1961-2005 1961-2010	Ningxia	Annual days of extreme rainstorm ↑ Intensity and amount ↑	Chen X.G. et al., 2008b; Li X. et al., 2013	Alleviated drought problem (Battaglini et al. 2009; Fraga et al., 2012).	Greater frequency of flood damage and loss of soil nutrition (Fraga et al., 2012).
	1961-2005	Hebei		Gao et al., 2009		Destruction of vineyards and more damaged roots and branches (Battaglini et al., 2009).
	1901-2010	Xinjiang	Annual frequency of rainstorm ↑	Sun et al., 2011		Damage to pollination and fruit set (Belliveau et al., 2006).
Drought	1951-2000	Ningxia	Frequency of drought ↑	Liang et al., 2007	The grape growing conditions over humid areas may be improved (Battaglini et al. 2009; Fraga et al., 2012; Holland and Smit, 2014).	Higher cost of irrigation and facilities (Battaglini et al., 2009; Fraga et al., 2012).
	1961-2004		Especially in winter frequency of drought ↑	Sang et al., 2007		Decreased grape yield (Hadarits et al., 2010; Ollat et al., 2016).
	1978-2010		Degree of drought ↑ Geographical distribution of drought ↑	Tan et al., 2014		Reduced grape growth (Fraga et al., 2012).
	1988-2007	Liaoning	Degree of drought ↑	Zhao X.L. et al., 2009	Less pest and disease damages (Holland and Smit, 2014). Improves the taste of some grapes (Holland and Smit, 2014).	Threat to grape survival (Holland and Smit, 2014).
	1961-2010	Shaanxi		Cai et al., 2013		
	1961-2008	Henan		Zhang H.W. et al., 2009		
	1961-2011	Yunnan	Degree and time duration of drought ↑	Zhang W.C. et al., 2013		
Fog	1961-	Ningxia	Annual frequency	Zhou et	Supplements	May impede the

	2009		in the north ↑	al., 2010	water and keeps ground heat (Calwineries, 2017). Moderate it can protect grapes from extreme heat (Wine-searcher, 2017).	photosynthesis process and hence respiration (Progressive viticulture, 2016).
	1961-2003	Xinjiang	Annual frequency after 1987↓	Ma et al., 2005	Fewer obstacles for photosynthesis and respiration (Progressive viticulture, 2016).	
	1960-2010	Shaanxi	Annual frequency after 2000↓	Zhang H.F. et al., 2013		
	1961-2008	Yunnan	Annual frequency↓	Tao et al., 2011b		
Hail	1961-2004 1961-2010	Ningxia	Annual frequency of hail ↓	Wu et al., 2008; Yang et al., 2012	Lower frequency of hail damage (Fraga et al., 2012).	
	1979-2008	Tianjin		Min et al., 2012		
	1979-2008	Hebei				
	1961-2008	Yunnan	Annual and seasonal frequency↓	Tao et al., 2011a		

4.4.5 Climate change scenarios

From climate change maps (**Figure 4.9** A1-A3), all across the territory the increasing trends of temperature can be seen in two future periods of 2046-2065 and 2081-2100 compared to historical period of 1961 - 1990. Comparing the future periods of 2046-2065 and 2081-2100, the increasing trend of temperature is obvious. Current main wine producing regions such as Xinjiang, Northeast Region, Bohai Bay Region, Yunnan and Henan all have significant temperature variations. The most violent variations will happen in Xinjiang, Yunnan, Henan, Hebei and Shandong. Cold areas in the north may have chance for wine grape planting but

some current wine producing regions may experience excessive heat.

For precipitation, the gfda_cm2_2.1 model under A2 scenario (**Figure 4.9 7-B**) shows that an increasing trend of precipitation from April to September can be seen. Some anomalies in April, May and September with decreasing trends of precipitation respectively in 2040-2059, 2080-2099 and 2060-2079 are predicted. However, climate change maps (**Figure 4.9 B1-B3**) present regionally converse trends of precipitation in China in the future. While the annual precipitation in some parts of Southern China and Yunnan will increase, current main wine producing regions Xinjiang and Central Region will have less precipitation, and existing drought problems may be more serious. In many parts of Southern China, the precipitation will decrease in the period of 2046-2065 and then increase in the period of 2081-2100.

The variation of Frost-free Days (FFD) will significantly affect the suitable variety of wine grape planting areas. Climate change maps (**Figure 4.9 C1-C30**) show the variation of frost days in China. The decreasing trend of frost days corresponds to an increasing trend of FFD. In Xinjiang and Yunnan obvious variations of increasing FFD is predicted in the period of 2081-2100. In Henan, Shandong and Hebei the continuously increasing trends of FFD will happen in the periods of 2046-2065 and 2081-2100. More areas may experience opportunities for wine grape growing.

Figure 4.9. Climate change scenarios of China. Source: Climate Wizard, World Bank Group, 2015

4.5 Adaptive capability

The future growth of the Chinese wine industry is highly dependent on the adaptive capacity i.e. the potential or ability of the industry to adapt to the effects of climate change. Adaptive capability will vary at the individual, community, regional, and national level depending on access to resources (Wall and Marzall 2006). By enhancing the climate change adaptive capacity, some potential impacts can be avoided and some vulnerability can be reduced so that a sustainable development can be promoted (IPCC, 2014a; Jones and Webb 2010). Potential climate change effects on the physical and biological fields of viticulture represent climate change risk or opportunity depending on the climate change capacity of grape growers, wine makers and vineyard owners (Holland and Smit 2010).

To measure the comparative climate change adaptive capability among main wine producing counties, we develop a measuring system (**Table 4.6**) for the wine industry using several indexes (**Table 4.7**), which include natural, economic, and social and viticulture components. Water is considered as an indispensable component as water resources are necessary for viticulture for both irrigation and production. A scarcity of water will limit the development of wineries and even cause a shift of location. Forestland with sustainable management can play a key role in the climate change adaptation and mitigation (FAO, 2010). For the economic sector, GDP, which measures the aggregate of economic activities, can be a reflection of the adaptive capability.

Table 4. 6. System to measure climate change adaptive capability of wine industry.

Components	Index	Score scope
Natural component	Forest area(%of land use)	0-6
	Arable land(hectare)per person	0-6
	Improved water source, rural (%of rural population with access)	0-6
	Renewable internal freshwater resources per capita (cubic meters)	0-6
Economic component	GDP per capita(current US\$)	0-6
Social component	Human Development Index	0-6
Technical component	Research and development expenditure (% of GDP)	0-6
	Internet users(per 100 people)	0-6
Viticulture component	Grape harvested area(hectares)	0-13
	Grape yield(Hg/Ha)	0-13
	Wine quantity(tons)	0-13
	Wine export value (1000US\$)	0-13
Wine industry adaptive capacity	Total score scope	0-100

The Human Development Index, which includes the three indices-life expectancy, education and income (calculated with GNP), can indicate the social potential to adapt to climate change. New technologies that improve irrigation and cultivation can be applied to the viticulture adaptation, thus the capability of agricultural and internet access become more widely available in Chinese rural areas new information resources and communication channels will increase the adaptive capability.

The total score is 100 and the score range is 0-100.Each natural, social and economic index has a score of 0-6 and each viticulture index has a score of 0-13. The scores are calculated as follows: in each component such as the natural component Forest area (% of land use), the score scope is 0-6. Spain, with the comparatively highest number 37.1 is assigned 6, the highest score. Other countries are scored relative to Spain. For China, the calculation is $\text{China Forest area (China) / Forest area (Spain)} * 6 = 22.6 / 37.1 * 6 = 3.6550$. Finally, all the scores will be summed to present the comparative climate change adaptive capability of the wine industry for each country. We get the scores of main wine producing countries in **Table 4.8**.

Table 4.7. Index data of main wine producing countries. Source: World Bank 2015. HDI data is from UNDP, 2015; FAO, 2015

Grape harvested area and grape yield include vineyards for table grape, wine grape and dried grape

Index	Country								
	China	Italy	France	Spain	USA	Australia	Argentina	Chile	South Africa
Forest area (%of land use) (2012)	22.6	31.6	29.3	37.1	33.3	19.2	10.6	21.9	7.6
Arable land (hectare) per person (2012)	0.08	0.12	0.28	0.27	0.49	2.07	0.96	0.08	0.23
Improved water source, rural (%of rural population with access) (2012)	85	100	100	100	98	100	95	91	88
Renewable internal freshwater resources per capita (1000 cubic meters) (2012)	2.08	3.07	3.05	2.38	8.98	21.65	7.11	50.68	0.86
GDP per capita (1000US\$) (2012)	6.09	35.13	40.93	28.99	51.5	67.51	14.68	15.25	7.59
Human Development Index (HDI) (2012)	0.715	0.872	0.884	0.869	0.912	0.931	0.806	0.819	0.654
Research and development expenditure (% of GDP) (2010)	1.76	1.26	2.24	1.4	2.74	2.39	0.62	0.42	0.76
Internet users (per 100 people) (2012)	43.2	55.8	81.4	69.8	79.3	79	55.8	61.4	41
Grape harvested area (1000Ha) (2012)	665.6	696.8	760.8	943.0	389.3	148.5	221.2	204.0	124.0
Grape yield (1000Hg/Ha) (2012)	158.4	83.5	70.8	55.5	171.1	111.6	101.5	156.9	148.3
Wine quantity (million) (2012)	1.65	4.27	4.21	3.15	2.99	1.16	1.17	1.09	1.06
Wine export value (million US\$) (2011)	22.3	6075.4	9941.5	3029.5	1343.2	1808.9	848.6	1683.5	755.6

Table 4.8. Scores of main wine producing countries.

Index	Country								
	China	Italy	France	Spain	USA	Australia	Argentina	Chile	South Africa
Forest area (%of land use) (2012)	3.65	5.11	4.74	6.00	5.39	3.11	1.71	3.54	1.23
Arable land (hectare) per person (2012)	0.23	0.35	0.81	0.78	1.42	6.00	2.78	0.23	0.67
Improved water source, rural (%of rural population with access) (2012)	5.10	6.00	6.00	6.00	5.88	6.00	5.70	5.46	5.28
Renewable internal freshwater resources per capita (1000 cubic meters) (2012)	0.25	0.36	0.36	0.28	1.06	2.56	0.84	6.00	0.10
GDP per capita (1000US\$) (2012)	0.54	3.12	3.64	2.58	4.58	6.00	1.30	1.36	0.67
Human Development Index (HDI) (2012)	4.61	5.62	5.70	5.60	5.88	6.00	5.19	5.28	4.21
Research and development expenditure (% of GDP) (2010)	3.85	2.76	4.91	3.07	6.00	5.23	1.36	0.92	1.66
Internet users (per 100 people) (2012)	3.18	4.11	6.00	5.14	5.85	5.82	4.11	4.53	3.02
Grape harvested area (1000Ha) (2012)	9.18	9.61	10.49	13.00	5.37	2.05	3.05	2.81	1.71
Grape yield (1000Hg/Ha) (2012)	12.04	6.34	5.38	4.22	13.00	8.48	7.71	11.92	11.27
Wine quantity (million) (2012)	5.02	13.00	12.82	9.59	9.10	3.53	3.56	3.32	3.23
Wine export value (million US\$) (2011)	0.03	7.94	13.00	3.96	1.76	2.37	1.11	2.20	0.99

Figure 4.10. Scored climate change adaptive capability of main wine producing countries.

Result (**Figure 4.10**) indicates that among 9 selected wine producing countries France has the comparatively highest score 73.8 of adaptive capability while South Africa has the lowest score of 34.0. The high adaptive capability of France comes from high availability of water resources for the rural population, high GDP per capita and HDI, national support on technology development, high internet user rate, all of which confirm that as a developed country France has a considerable advantage. Also, as a representative wine producing country in the “Old World” large traditional area of grape, huge wine production and good reputation and image in the international market all contribute to the adaptive capability of the French wine industry. As an emerging wine producing country in the “New World”, South Africa’s wine industry with a score of 34.0 will not be adequately prepared for the coming climate change impact. An economic study in South Africa shows that by 2100 crop, net revenues could fall by 90% based on various likely scenarios (Vink et al. 2009). Low forest-covering rate and scarcity of water put pressure on the local wineries. Low GDP, HDI, and internet user rate will present major obstacles to climate change adaptation. Comparatively smaller vineyard areas will reduce the capacity for wine production when impacted by climate

change.

China ranks the seventh of the 9 wine producing countries. Although China has a large territory with a high percentage of arable land, the arable land per capita is very limited in light of the country's 1.3 billion population. National food security is still a major issue for China. Water scarcity is a major problem in both cities and rural areas. There is also a need for improved access to the internet and other communication services in wine producing regions. As indicated in Table 8, China has the world's second highest grape yield (includes table grape, wine grape and dried grape) coupled with a relatively miniscule wine export value of 22.3 million (US Dollars). This is a reflection of the Chinese wine industry's need to improve the wine quality and wine market administration and promotion. Climate change adaptation strategies must be part of a larger effort to improve the infrastructure of the Chinese wine industry and the quality of the wine.

4.6 Climate change adaptation strategies for the Chinese wine industry

Adaptation strategies can reduce the impacts of climate change and are a major challenge for viticulturists for the coming decades (Van Leeuwen et al., 2007; Iglesias et al., 2012; Ren et al., 2013; Ollat and Touzard, 2014b). Climate change adaptation can be planned at the regional, national, and international level. Gupta et al. 2010 had invented a method- the Adaptive Capacity Wheel (ACW) to assess the inherent characteristics of institutions to enable the climate change adaptive capacity of society from variety, learning capacity, room for autonomous change, leadership, resources and fair governance. We provide recommendations to the wine industry for adaptation strategies based on current Chinese climate change policies and studies of wine and adaptation at political level, financial level, technical level, institutional level and collaborative level (**Figure 4.11**).

Figure 4.11. Adaptation strategies for the Chinese wine industry. Source: Own drawn.

4.6.1 Policy strategies

In recent years, there have been changes in Chinese government policy to support agriculture in adapting to climate change. China has promulgated a series of laws to promote agricultural development addressing the importance of sustainable water use (China's Policies and Actions for Addressing Climate Change, 2008). It is necessary to establish and improve the laws pertaining to agriculture (China's Policies and Actions for Addressing Climate Change, 2012). The "12th Five-Year (2011-2015) Plan for the Wine Industry of China" has emphasized the importance of sustainability in the development of the Chinese wine industry.

There have also been efforts to address climate change adaption at the regional level, particularly in the Ningxia Province. The climate change situation and challenges in Ningxia have been analyzed and an adaptation and mitigation plan highlighting the urgency to take actions has been proposed (Scheme of Adaptation for Climate Change in Ningxia, 2009). The first wine regional protection regulation of China was approved in Ningxia in 2012 and was intended to ensure an environmental protection for the grape growing/wine-producing regions (Regulation on the protection of Eastern Foot of Helan Mountain Wine Region in Ningxia Hui Autonomous Region, 2012).

However, climate change adaptation legislation targeting the wine industry should be further established and implemented at the national and regional level (China's National Climate Change Programme, 2007).

4.6.2 Financial strategies

The Chinese government has invested over 20 billion Yuan in disaster prevention and mitigation capabilities and 1 billion Yuan in dry land water-saving agriculture (China's Policies and Actions on Climate Change, 2014). During the period from 2001 to 2005, the government invested more than 2.5 billion Yuan for climate change-related scientific and technological work (China's Policies and Actions for Addressing Climate Change, 2008). The investments increased to 7 billion Yuan during 2006-2010, and there have been continued increases since. Adequate financial support such as facility investment, agricultural insurance and subsidy for both industrial development and climate change adaptation will be essential for continued growth and development of the grape planting and wine-producing regions of China.

4.6.3 Technical strategies

Water resources are essential for viticulture. Chinese policy has provided several technological measures to enhance the efficiency of water consumption in agriculture (China Water Conservation Technology Policy Outline, 2005). Low carbon agriculture should be promoted and agricultural waste should be recycled for sustainable agriculture. Additionally, additional irrigation facilities should be built and existing facilities should be improved in order to conserve water. It is also proposed that when crops and farming systems are chosen, climate change should be taken into consideration. The need to develop high-quality stress resistant crop varieties is also addressed (China's National Plan on Climate Change 2014-2020, 2014). Furthermore, management practices of pests and diseases should be adapted to new strains or new pathogens (Goulet, 2014).

Climate-based zoning has been attempted for viticulture in order to guide grape planting and wine production. In Xinjiang and Ningxia, the viticulture climatic zoning classification system uses three indexes: FFP, dryness index (from April to September) and mean lowest temperature below -15°C (Wolf and Boyer, 2003; Tonietto and Carbonneau, 2004; Wang H. et al., 2010; Li H., Wang and Wang et al., 2010). In the Shaanxi and Jingjintang area, which includes Beijing, Tianjin and some areas of Hebei, the amount of precipitation from July to September is used as an index (Li H. and Meng, 2009; Li H., Lan and Wang, 2011). Tonietto and Carbonneau (2004) have provided a Multicriteria Climatic Classification System (Géoviticulture MCC System) for worldwide grape and wine zoning based on classes for three indices: dryness index (DI), heliothermal index (HI) and cool night index (CI). These indices are representative of worldwide viticultural climate variability and are related to the requirements of varieties, vintage quality and typicity of wines. They were calculated to evaluate the worldwide climate for viticulture in 97 grape growing regions from 29 countries including China. Combining grape zoning methodology with climate change simulations such as climate change scenarios can enhance viticulture adaptation for the future. To deal with the uncertainties of future climatic simulations in climate change impact studies, different climatic scenarios and downscaling methods should be considered (Caubel et al., 2014). Integrated models such as ecophysiological model and the MILA-STICS model can predict complex

impacts for climate change (Caubel et al., 2014; Piéri and Lebon, 2014). Multi-scale climatic approaches such as the ANR-TERVICLIM and GICC-TERADCLIM research programmes, which intend to observe and simulate climate and climate change at local scale, can produce a scale assessment of climate change impacts in different wine-producing regions worldwide (Quénol and Bonnardot, 2014).

Mozell and Thach (2014) have provided vineyards and wineries with a series of practical solutions for adapting to climate change. Fifteen solutions for vineyards are provided to offset rising temperatures, water shortages, increases in heat, drought and light intensity and their impacts such as earlier maturation, and increases in the number of pests. Eleven solutions are provided to enhance wine production in order to offset warmer temperatures, increases in sugar and alcohol levels, reduction in acidity, vintage variability, and earlier harvest and ripening.

Further research is needed to assist the Chinese wine industry in adapting to climate change. An interdisciplinary approach will be needed that incorporates improvements in grape resistance, new grape planting and wine making technology, disaster response, climate change adaptation management and social and economic evaluation.

4.6.4 Institutional strategies

Institutional changes are indispensable for effective adaptation solutions (Ollat and Touzard, 2014a; Ollat and Touzard, 2014b). The Chinese government has strongly promoted an awareness and understanding of climate change impact in general, but a stronger focus is needed on how climate change affects the wine industry in particular. Media, materials, forums, campaigns, can promote the broadcast of climate change knowledge and adaptation for wine producers and wine traders and training during which regional wine associations in China can participate. Wine institutes in universities can assume the responsibility for educating the public. Electronic platforms can be established to broadcast and share information.

4.6.5 Collaborative strategies

Climate change demands the attention of the global wine industry. The World Conference on Climate Change and Wine has been organized three times by the Wine Academy of Spain to address the need for climate change adaptation in viticulture (Li Y.B., 2015). Several investigations of climate change and viticulture are underway in France and other wine-producing countries (Ollat and Touzard, 2014b; Yzarra et al., 2015). In France, the multidisciplinary LACCAGE project (long-term adaptation to climate change in viticulture and enology) involving 23 different laboratories from the National Institute for Agricultural Research of France (INRA), the National Center for Scientific Research (CNRS) and several French universities aims to analyze the impacts of climate change on viticulture and wine and to assess current and design future adaptation strategies (Ollat et al., 2016). With a goal to establish a scientific framework addressing climate change issues in viticulture, this project is organized in seven areas: characterization and perception of climate change; physiological and genetic bases of grapevine adaptation to climate change; development of technical innovations for adaptation to climate change; evaluation of the impact of technical innovation at a territorial scale; analysis of the evolution of economic strategies; data management and analysis; and elaboration of strategic scenarios for 2050 (Ollat and Touzard, 2014b). The importance of communication and cooperation with developed countries and international organizations has been highlighted (China's Policies and Actions for Addressing Climate Change, 2015). As China moves from the insular policies of the past to increased communication and sharing of technology at the international level, the Chinese wine industry will greatly benefit.

CHAPTER 5. STRATEGIES FOR THE FUTURE DEVELOPMENT OF THE CHINESE WINE INDUSTRY

5.1 Introduction

The dramatic growth of the Chinese economy over the past three decades has encouraged international wine companies to enter the Chinese market and has supported the development of the domestic wine industry. China is now the world's largest red wine consuming country (Willsher, 2014). China is an important wine producer as well. The wine producing Region Yantai of Shandong became an observer of the OIV in 1987 and Ningxia became the first Chinese provincial region to be an observer of the OIV in 2012. Approximately 70% of the wine consumed in China is produced domestically.

Even though the Chinese wine industry has developed significantly, many problems remain such as the scarcity of technology and administrative experience, the lack of wine making standards, high cost and low yield, all of which hinder the further development of the domestic wine industry. Since China becoming a member of the World Trade Organization (WTO), the domestic wine industry has faced competition from international wine suppliers. However, new emerging factors such as e-commerce, wine tourism, the slowdown of the Chinese economic growth rate and the —anti-corruption” campaign present both challenges and opportunities for the Chinese wine industry. China is one of the most attractive wine markets and a hopeful wine producer in the 21st century. Current studies of wine in China tend to focus on the wine market but seldom analyze the domestic wine industry, which contributes approximately 70% of the total wine consumed in the country. In this Chapter, we analyze the current situation and the perspectives of the wine industry in China considering both traditional conditions such as wine history, wine policies as well as new conditions such as e-commerce, climate change and domestic economy trend. Presently we conduct a —SWOT” of the Chinese wine industry considering four sectors (producing, processing, selling and consuming) and use a SWOT Matrix

analysis. Then we provide strategies for the development of the Chinese industry at governmental level, industrial level and business level.

5.2 Methods and data source

In Chapter 5, based on the results and data of studies of previous Chapters and literature review, we use the SWOT analysis (strength, weakness, opportunity, threat) to explore the internal and external factors that will determine the future development of the Chinese wine industry. When we identify the SWOT factors, information from literature review is collected.

SWOT represents strength, weakness, opportunities and threats. SWOT analysis considers both the current strengths and weaknesses and the future opportunities and threats (Corsi, Marinelli and Sottini, 2013). SWOT analysis has been a useful tool for analyzing complex strategic situations by reducing the information quantity needed to achieve a better decision (Helms and Nixon, 2010). The SWOT analysis has been applied in many scientific fields including studies of wine industry. A SWOT analysis is conducted to determine the present situation of the Croatian wine sector (Čačić, Kljusurić, Karpati and Čačić, 2010). An understanding of the development of the wine tourism in Australia is carried out by the implementation of SWOT analysis (Carlsen and Dowling, 2001). The strategic planning tool “SWOT” (Poitras and Donald, 2006) has done a study of sustainable wine tourism in Town of Oliver of Canada. —SWOT” as a tool (Terblanche, Simon and Taddei, 2008) studies the competitiveness of the French wine industry and the Loire region. A SWOT analysis is applied to analyze the situation of the perspectives of Italian wine in five Asian markets (Corsi, Marinelli and Sottini, 2013).

SWOT Matrix includes a list of internal and external factors (David et al., 2017). The SWOT Matrix can properly analyze the internal strengths/weakness and external threats/opportunities for archiving future strategies (Farhangi et al., 2007). In the analysis of SWOT Matrix, first, internal factors (strengths and weaknesses) and external factors (opportunities and threat) are evaluated and classified as SWOT factors. Second, internal factors (strengths and weaknesses) and external

factors (opportunities and threat) are evaluated as input in four cells namely Strength-Opportunity, Weakness-Opportunity, Strength-Threat and Weakness-Threat to achieve possible SO, WO, ST, WT strategies (**Figure 5.1**).

SWOT Matrix	<i>Strengths</i>	<i>Weaknesses</i>
<i>Opportunities</i>	SO Strategies ↓	WO Strategies ↓
<i>Threats</i>	ST Strategies ↓	WT Strategies ↓

Figure 5.1. The SWOT Matrix and strategies. Source: Farhangi et al., 2007

We use the SWOT analysis (strength, weakness, opportunity, threat) to explore the internal and external factors that will determine the future development of the Chinese wine industry. Secondly, we examine both internal and external factors in four sectors (producing, processing, selling and consuming) of the wine industry to better understand their roles. We then establish SWOT matrix strategies of strength-opportunity, strength-threat, weakness-opportunity, and weakness-threat for the Chinese wine industry. Finally, we identify strategies to enhance the development of the Chinese wine industry at governmental level, industrial level and business level.

5.3 SWOT analysis of the Chinese wine industry

According to the theory of SWOT analysis, we have reached 6 internal factors for Strength, 9 internal factors for Weakness, 9 external factors for Opportunity and 7 external factors for Threat considering both traditional and new conditions for the wine industry of China and we have listed and numbered them in **Table 5.1**.

5.3.1 Strength

S1 Large size of existing vineyard and growing trend: In 2015, China had the world's second largest vineyard area with 830,000 hectares after Spain (OIV, 2016). Even though approximately 10% of the whole vineyard is for vine grape, there is potential for vineyard expansion due to the growing wine market demand and vast territory (Decanterchina, 2016).

S2 Diverse conditions for potential activities of Viticulture and Enology: In China, there are hills, river deltas and plains in the eastern part and mountains, high plateaus and deserts in the western part and equally varied climate types (National Geographic, 2017). Diverse climate, geographical, environmental and ecological conditions gives a chance to variable activities of viticulture and enology in China.

S3 Foreign and domestic wine grape varieties: Cabernet Sauvignon is the most widely planted wine grape in China with more than 20,000 ha followed by Chardonnay, Cabernet Franc, Syrah, and Pinot (Li H. et al., 2009). There are some local wine grape varieties such as the *Vitis Amurensis* (Hill grape) in the northeast China and the Wild *Vitis quinquangularis* in the southwest China (Peng et al., 2000; Liu and Li, 2013). These Chinese original wine grape varieties have been cultivated commercially in China (Liu and Li, 2013). Both foreign introduced varieties and domestic ones contribute to divers wine grape varieties, which could be considered as species resources for the development of wine industry.

S4 *Current wine industries are widely distributed across the nation:* Current grape planting and wine- making regions are widely distributed with diverse industrial structures and clusters, which have the easier access to regional markets. Before 2002, eastern wine regions in China such as Shandong, Hebei and Tianjin produced quality wines in famous wineries meanwhile eastern wine regions such as Xinjiang, Gansu and Ningxia mostly served as wine grape base for brand enterprises in the east (Prowinechina, 2016a). However, in recently years, wine regions in the west have made great process. Now western wine regions had their own wine brand, wineries and even chateaus.

S5 *Sufficient labor force in China for wine industry:* In 2015, there were 774.51 million working people in China and 370.41 million were in rural areas (National Bureau of Statistics of China, 2016). The labor force in China with reasonable wages for wine grape planting and wine making is adequate to satisfy the labor demand of the development of wine industry (Bouzdine-Chameeva et al., 2013).

S6 *Existing advantages of domestic wine products:* The Chinese wines have significant advantages, especially the lower price for low-end consumers and the familiar image of Chinese wines in local market. Local wines of China dominate the low-end market of wine especially for wines priced between 30 and 50 Yuan (RMB) (EUSME Center, 2011).

5.3.2 Weakness

W1 *Lack of technology, infrastructure and education in wine industry:* Even though China had above 16 universities or institutes offering the major —“Viculture and Enology Engineering” in the bachelor education and 15 grape and wine research center in 2015, the lack of experience, technology, infrastructure, and professional talents is still one worrying issue for the development of wine industry. Wine professionals and talents from wine grape planting to winemaking are still lacking (Decanter, 2015).

W2 Lack of wine history record and wine culture: There is a written history of wine more than 2,000 years in China (Forbes, 2011). Even though the grape and wine history in China is long, no as European countries where there are vast number of wine related historical and cultural heritages, China lacks of well-preserved wine-related heritages. The modern wine industry in China just began in the year 1892. Meanwhile, in the Chinese wine market, there is a lack of wine drinking culture as well as wine is not a traditional alcoholic drink (Drinksbusiness, 2011).

W3 Lack of wine legal system: There is a lack of a complete legal system of wine such as “National Wine Classification System”, —“WineChateaux Classification System” as many wine producing countries such as France and Spain. There is a great need of improved regulations and legislations to solve the existing confusion and irregularity in the whole process of Chinese wine industry from wine grape planting to wine making (Li Y.H. et al., 2009)

W4 Disadvantages of domestic wine products especially the low quality: Several disadvantages such as low quality and yield, distinct standards, homogeneity of products need to be solved with a goal to further improve the Chinese wine industry (Wang et al., 2010).

W5 Wine is not hugely consumed: Compared with other alcohol drinks such as “Baijiu” (Chinese Liquor) and beer, temporally wine is not the traditional alcohol drink in China.

W6 Lack of well-known Chinese wine brands: Several wine brands such as the GreatWall and the Changyu have gotten good reputation in the Chinese market. However, there is a lack of international well-known brands. Compared with western high quality wineries, most of high-end wineries in China produce a small scale and could not compete with foreign wines in price and volume (Ibitimes, 2015).

W7 Uneven development and regional gaps in wine industries: The uneven pattern of development has been a problem for regional economies, social equality (Huang et al., 2003). The regional uneven development and regional gaps of the Chinese wine industry is obvious not only for the regional gap of technology and experience but also for the regional gap of economy and society.

W8 Lack of experience for inversion in wine industry: It is not hard to find government supports in many wine producing regions. However, non-oriented and irrational investment in the Chinese wine industry is obvious for the lack of experience and good decision (Zhang and Cao, 2014).

W9 Lack of highly developed wine clusters: Wine clusters are highly developed in some regions such as Changli of Hebei, Penglai of Shandong, Wuwei of Gansu and Manasi of Xinjiang (Li Y.H. et al., 2009). For the whole country, there is a lack of highly developed wine clusters.

5.3.3 Opportunity

O1 Large population and huge market demand: Large population size and huge demand of the Chinese market is one important factor. According to the 2016 Report of Agriculture and Agri-Food Canada, the grape wine market of China was estimated 38.3 billion dollars in 2015 and expected to have further growth in the future. In 2016, China imported 638 million liters of wine with an increase of 15% by volume and 16.3% by value compared with 2015 (Drinksbusiness, 2017).

O2 Increasing wine demand for improved life style: In recent 3 decades, the GDP Per Capita in China had grown dramatically from 973 Yuan (RMB) in 1986 to 50,251 Yuan (RMB) in 2015, almost 51 times (National Bureau of Statistics of China, 2016). Increasing economy (per-income) and improved living standard cater the growing wine demand. With improved quality of life and enhanced cultural awareness, Chinese consumers have the capability to judge the wine quality, the match between wine and food and the cost of wine performance and to decide wine consuming occasions (Prowinechina, 2016b).

O3 Government support: Strong government support at different levels (political, educational technical, financial) is crucial for the development of the Chinese wine industry. In recent 3 decades, great progresses have been achieved in areas of viticulture and enology, grape and wine research, grape and wine education and wine standards and legislations (Li H. et al., 2009)

O4 Consumers' positive reorganization of wine: Good images of wine such as the health benefits and red is a traditional lucky color in China lead to the motivation of wine consumption of Chinese customers. Health benefits and beauty purpose seem to be the first motivation of Chinese wine customers especially for the young female consumers (INS, 2017). In China, red is viewed as a lucky color, which estimates consumer to purchase red wines (Theguardian, 2014).

O5: Roles of wine in traditional Chinese culture: For the influence of Confucianism, gift giving plays a role to show respect to elders, maintain close relationship with family and friends and build new relationship networks (TheChinaCultureCorner, 2013). Dining in China has its social functions such as establishing relationship, representing social status, expressing the degree of interpersonal relationship, acting as group characteristics, celebrating important event, playing as symbolic significance and showing reward or punishment (Ma G.S., 2015). Dining and gift giving custom of Chinese can somehow contribute to increase wine demand.

O6 Improved wine knowledge of Chinese consumers: China is more and more open. More interest on wine and wine culture; increasing wine knowledge levels of Chinese customers can contribute to wine consumption. Especially in urban areas where incomes are higher and the influence of western culture is higher (Zheng and Wang, 2016).

O7 Development of wine tourism: There is a noticeable trend of increasing leisure travel for improved incomes and China has been the world's largest domestic tourism market (Zhang Qiu et al., 2013). Under the high-speed development of the domestic wine industry, China's wine tourism industry has boomed (Han et al., 2011). Development of the wine related industries such as wine tourism, grape picking, wine tasting, exhibition can lead to the broadcast of wine knowledge and contribute to wine consumption.

O8 Development of E-commerce: China is the country with fast development of E-commerce. E-commerce has been a new and emerging marketing channel for Chinese wine business (Prowine, 2016). E-commerce offers new wine channel both for wine suppliers and for wine consumers.

O9 Positive effects of climate change: Positive effects of climate change would benefit the Chinese wine industry. Several modifications in temperature, accumulated temperature and number of frost-free days may benefit wine producing in some Chinese wine regions. Climate

change may shift current wine producing regions and some famous wine regions may be replaced by China (Justmeans, 2016).

5.3.4 Threat

T1 *Challenge for imported wines*: Imported wines enter the domestic market with a fast pace especially in rich urban areas. In 2016, China imported 638 million liters of wine with a value of 2.4 billion dollars (EOSIntelligence, 2017). Competition from foreign wines such as high technology, mature management system, zero- tariff) strikes the market share and the survival of local wine industries.

T2 *Challenge for other alcoholic drinks*: China is one of the largest consumers of alcoholic beverages. The spirits industry in China can be classified into Baijiu, Huanjiu, wine and Beer (Prnewswire, 2016). Competition from other alcohol drinks such as traditional “Baijiu” and beer and new kinds of foreign drinks threat the market occupation of wines.

T3 *Slowdown of the China’s economy*: In 2016, China’s economy grew 6.7% meanwhile this number was 6.9% in 2015, making it the slowest growth since 1990 (BBC Business, 2017). Slowdown of the China’s economy somehow affects the Chinese market. The reduction of wine consumption in 2015 (7 million liters less compared with 2014) was somehow affected by the China’s general economic slow-down (Decanter, 2016). The growth rate for wine consumption is expected to be 3.8% between 2014 and 2019, which is sharply smaller than the growth rate 21.4% between 2010 and 2014 (Chinadaily, 2016).

T4 *Influence for the “Anti-Corruption Campaign”*: Due to the “Anti-Corruption Campaign” initiated by the Chinese Government in 2013, the domestic wine market has experienced a sharp sales drop of wines especially for high-end and luxury wines (Chasingthevine, 2016). Luxury and expensive wines were often given as gifts for commercial and political purpose.

T5 *Mistrust of Chinese consumers of domestic food product*: In China, counterfeits of wines shake the confidence of customers (Winespectator, 2015). There are two main types of wine

counterfeits. On the one side, foreign and domestic famous wine brands may be used without authorization or be re-packed to replace wine logos of local cheap wines. On the other hand, recycled or mimicked bottles of genuine branded wines may be refilled with cheap import wines (China Policy Institute, 2017). Mistrust of consumers towards the safety and quality of Chinese food products hurt the domestic wine industries.

T6 Negative effects of climate change: During the past century, China has experienced noticeable impacts of climate change with general increased temperature, uneven distribution of precipitation and some extreme climate events (Chen et al., 2016). Negative effects of climate change such as effected-quality/yield of grape and wine, higher frequency of drought and water scarcity will threat the Chinese wine industry.

T7 Rising cost of labor force and raw materials: With the aging population, decreased working-age population and increased level of education, China has witnessed rising cost of labor force (Chinadaily, 2016). Rising cost labor force along with rising material and management cost will increase the production cost in local wines.

Table 5.1. Strengths, weaknesses, opportunities and threats of the Chinese wine industry.

Strengths	Weaknesses	Opportunities	Threats
S1. Large size of existing vineyard and growing trend.	W1. Lack of experience, technology, infrastructure, and professional talents.	O1. Large population size and huge market demand.	T1. Competition from foreign imported wines (such as high technology, mature management system, zero-tariff).
S2. Diverse geographical /environmental/ecological conditions for viticulture and enology.	W2. Lack of wine culture and heritage.	O2. Increasing wine demand for improved life style and growing economy.	
S3. Foreign and domestic wine grape varieties.	W3. Lack of a complete legal system of wine.	O3. Government support (political, educational technical, financial).	T2. Competition from other alcohol drinks.
S4. Current grape planting and wine-making regions are widely distributed with diverse industrial structures and clusters; local wine industries have easier access to regional markets.	W4. Disadvantages of domestic wine products such as low quality and yield, distinct standards, homogeneity of products.	O4. Good image of wine such as the health benefits of wine and lucky color of red wine.	T3. Slowdown of the China's economy.
S5. Sufficient labor force for wine industry especially in the rural area.	W5. Wine is not the traditional alcohol drink in China.	O5. Dining and gift giving custom of Chinese.	T4. Sale falls for the —anti corruption” campaign.
S6. Advantages of domestic wines such as the price advantage especially for the low-end consumers and the familiar image of Chinese wines in local market.	W6. Lack of some international well-known brands of China.	O6. More interest on wine and wine culture; increasing wine knowledge levels of Chinese customers.	T5. Mistrust of consumers towards the safety and quality of Chinese food products.
	W7. Regional uneven development of the Chinese wine industry.	O7. Development of the wine related industries such as wine tourism, grape picking, wine tasting, exhibition.	T6. Negative effects of climate change.
	W8. Non-oriented and irrational investment in the Chinese wine industry.	O8. Development of E-commerce.	T7. Rising cost of raw material, labor force and management.
	W9. Lack of developed wine clusters.	O9. Positive effects of climate change.	

5.3.5 SWOT Matrix

After achieving six strength factors, nine weakness factors, nine opportunity factors and seven threat factors as in **Table 5.1**, we associate them in four sectors of the wine industry -Grape Producing, Wine Processing, Wine Selling and Wine consuming in **Figure 5.2**. The function of each factor and the relationship with other factors is established in the network of SWOT factors in **Figure 5.2**. As showed in **Figure 5.2**, each SWOT factor is connected with at least one sector of the wine industry and some SWOT factors may be connected with more than one sector, at most with four sectors. For Grape Producing, internal factors are S1, S2, S3, S4, S5, W1, W3, W4, W7, W8, W9 and external factors are O3, O7, O9, T1, T6, and T7. For Wine Processing, internal factors are S2, S4, S5, W1, W3, W4, W7, W8, W9 and external factors are O3, O7, O9, T1, T6, and T7. For Wine Selling, internal factors are S6, W2, W3, W4, W6 and external factors are O1, O2, O3, O4, O5, O6, O7, O8, T1, T2, T3, T4, T5 and T7. For Wine Consuming, internal factors are W2, W4, W5 and external factors are O1, O2, O3, O4, O5, O6, O7, O8, T1, T2, T3, T4 and T5.

Based on the previous work, we conduct SWOT Matrix strategies of strength-opportunity (SO), strength-threat (ST), weakness-opportunity (WO), and weakness-threat (WT) for the Chinese wine industry as **Table 5.2**. For each sector of the wine industry, internal factors (strengths and weaknesses) are listed horizontally and external factors (opportunities and threats) are listed vertically. If one strategy can be achieved in one matrix, the grid corresponding to such a strategy will be panted will one certain color (Yellow for SO Strength-Opportunity Strategy; Green for ST Strength-Threat Strategy; Blue for WO Weakness-Opportunity Strategy and Red for WT Weakness-Threat Strategy). For example, in the sector of Wine Producing in **Table 5.2**, several SWOT Matrix strategies have been achieved and those un-achieved strategy matrixes are S5-O9, S1-T7, S2-T7, S3-T7, S5-O9, S5-T6, W3-T7, W7-O9, W7-T6, W8-O9, W8-T6, W9-O9 and W9-T6, which are not fulfilled with color. With the same method, SWOT Matrix strategies have been achieved in the sectors of Wine Processing, Wine Selling and Wine Consuming.

Figure 5.2. Network of SWOT factors of the Chinese wine industry. Source: Own drawn.

Table 5.2. SWOT Matrix of the Chinese wine industry. Source: Drawn by author.

SWOT matrix for the wine industry of China											
Prod	S1	S2	S3	S4	S5	W1	W3	W4	W7	W8	W9
O3											
O7											
O9											
T1											
T6											
T7											
Proc	S2	S4	S5	W1	W3	W4	W7	W8	W9		
O3											
O7											
O9											
T1											
T6											
T7											
Sell	S6	W2	W3	W4	W6	Cons	W2	W4	W5		
O1						O1					
O2						O2					
O3						O3					
O4						O4					
O5						O5					
O6						O6					
O7						O7					
O8						O8					
T1						T1					
T2						T2					
T3						T3					
T4						T4					
T5						T5					
T7											
Legend				SO Strategy		ST Strategy		WO Strategy		WT Strategy	
Prod: Grape Producing, Proc: Wine Processing, Sell: Wine Selling, Cons: Wine Consuming											

5.4 Strategies for the development of the Chinese wine industry

In this section, after getting the SWOT Matrix Strategies in four sectors of wine industry- Wine Producing, Wine Processing, Wine Selling and Wine Consuming- we classify these SWOT strategies at governmental level, industrial level and business level to make certain strategies for the further development of the Chinese wine industry. For each strategy achieved in the part of Governmental Level, Industry Level and Business Level, we note the classification of SWOT Matrix of such strategy. For example, the No.1 Strategy at Governmental Level is based on the Opportunity 3 (Government support (political, educational technical, financial) which can be matched with several SWOT Factors in **Table 5.2** to achieved SWOT Matrix Strategies (S1-O3, S2-O3, S3-O3, S4-O3, S5-O3, S6-O3, W1-O3, W2-O3, W3-O3, W4-O3, W5-O3, W6-O3, W7-O3, W8-O3 and W9-O3. Finally we summary all these Strategies into the No.1 Strategy at Governmental and note the classification (SO and WO).

5.4.1 Governmental level

1. Unlike some wine producing countries where wine industry is highly supported by agricultural subsidies, in China wine industry belongs to light industry and is charged by the China National Light Industry Council while viticulture (wine grape planting) is administrated by the Ministry of Agriculture of China. Such management of wine industry leads to the tax burdens of wine enterprises and the difficulty to collect accurate and coherent data of wine grape planting and wine making. At the present stage, the Chinese wine industry is in the early phase of industrialization with a comparatively weak industrial competitiveness. The Chinese government shall fully support the domestic wine industry at legal level (administrative legislation, wine law system, wine classification system, wine geographical protection system, wine cluster guidance and regulation), financial level (subsidy, tax reduction, reward), technical level (grape and wine technology research and development, technical innovation, grape and wine zoning, green and

sustainable technologies), educational level (wine education, talent development), institutional level (administrative institute, grape and wine association, wine enterprises union, wine customer union, industry data collection and publication, information and communication platform) and cooperative level (international communication and cooperation, conference, international exposition) (SO and WO).

2. A complete wine national law system targeting all the phases of wine industry from grape planting and wine producing to wine selling and wine trade is highly needed. Meanwhile regional efforts to regulate the local wine industry such as the “Regulation on the protection of Eastern Foot of Helan Mountain Wine Region” of Ningxia should be encouraged in different wine regions of China (SO, WO and WT).

3. A national quality wine protection, which has been practiced in many main wine producing countries such as France, Italy and Spain, should be introduced. Beside this, in wine regions, local wine and winery classification system such as the “Ningxia Winery Classification System” could regulate domestic wine products and offer important information for customers (SO, WO and WT).

4. Wine product quality standards, wine quality control and inspection systems should be further improved while a wine quality and safety traceability system should be established to regulate wine products and ensure wine quality (SO, WO and WT).

5. International exchange and cooperation are beneficial for the Chinese wine industry in which advanced technology and management experience can be learned. The Yantai (Shandong) and the Ningxia Hui autonomous Region have been observers of the International Organization of Vine and Wine (OIV). More international conferences such as the “2013 International Academic Conference of Vine and Wine in Ningxia” can be held in China in order to promote the Chinese wine industry on an international stage and seek international cooperation (WO and WT).

6. Government leading mitigation and adaptation actions are indispensable for the Chinese wine industry to face the current and coming challenges and opportunities caused by global climate change, which are also highly variable in different wine producing regions. These actions could be at legal (climate change mitigation laws), financial (financial support), technical (vineyard

adaption and mitigation technologies and facilities, grape genetic modification, wine grape zoning), educational (climate change education) and cooperative (research cooperation) levels as well (SO, ST, WO and WT).

7. As the Chinese wine market has reached a new period of development with improved wine product and increasing domestic wine demand, there is a need to popularize wine knowledge and spread wine culture by wine education and wine training to guide Chinese customers for a rational and healthy consuming behavior in which domestic wine associations, wine institutes and wine academies can cooperate with government (WO and WT).

8. Wine culture and history with Chinese characteristics can be further excavated. Wine historical and cultural remains should be fully protected and more facilities such as wine museums and wine theme parks could be built (WO and WT).

5.4.2 Industrial level

1. The Chinese wine industry can fully take advantage of the broad and suitable Chinese territories for wine grape planting. The wine grape growing and wine making methods and technologies could be advanced in order to improve grape yield and wine quality (SO and ST).

2. The domestic wine regions are widely distributed and each wine region has its own natural and social conditions. According to different climatic and geographical conditions, wine grape varieties and planting methods selection should be taken into consideration. The value of local grape varieties in China such as the *Vitis amurensis* (hill grape) in the north-east part of China and the *Vitis quinquangularis* Rehd in Guangxi can be used in developing new wine grape varieties. In addition, the way towards a diverse and sustainable development is crucial for the wine industry development (SO, ST, WO, and WT).

3. Advisable plan of industry, upgrade of industrial structure and industrial innovation are indispensable factors for the development of Chinese wine clusters, which could contribute to the improvement of competitiveness. The advantage of abundant natural resources in the west

Chinese wine regions and the advantage of well-known domestic wine brands and sufficient capital in the east Chinese wine regions can be combined (SO, ST, WO and WT).

4. Wine related industries such as wine tasting education, grape picking entertainment, wine tourism and wine exhibition can lead to a diverse development of wine industry and create vast job opportunities. China is a big and diverse country where the development of wine related industries could be benefited not only from wine industry but also from a wide variety of natural and cultural resources (SO and WO).

5. The appearance of wine chateau development especially in the Shandong Peninsula and the Ningxia Hui Autonomous Region is the focus of Chinese wine enterprises towards domestic high quality wines and luxury brands. In addition, the appearance of chateau, which combines quality wines with culture and history, can enhance the quality of Chinese wines and motivate domestic customers. However, there is a great need to regulate and classify the rising Chinese chateau wines by specific regulations (WO and WT).

5.4.3 Business level

1. The confidence of Chinese customers towards domestic wine quality is a determining factor for the survival of Chinese wine companies. Meanwhile, product differentiation and product innovation can contribute to the improvement of domestic wines which face fierce a competition from foreign wines (WO and WT).

2. China has a large population and a huge economy that offer an exciting market and a major potential of wine consumption. However, wine products must be adapted to conform to consuming tradition, market trends, and a declining rate of economic growth. In the vast area of small Chinese cities and countryside, there is a major potential demand for lower- priced wines (SO, ST, WO and WT).

3. Wine is not only an alcoholic drink but also a representative of culture and history. Hence, it is reasonable to endow domestic wines with cultural symbolism. While an interest in foreign

cultures will continue contributing to the consumption of foreign imported wines, domestic vintners should highlight the Chinese culture and cater to the Chinese traditions (WO and WT).

4. The lack of wine knowledge and information hinders wine consumption of domestic customers. It is necessary to broadcast wine knowledge and guide customers' wine drinking behaviors. The total number of Chinese on-line consumers is increasing annually and e-commerce has offered a new platform where wine companies have new channels for wine selling and customers have a new option for wine purchase. A new marketing network, which combines traditional market channels and e-commerce, is crucial for the market expansion and the market competitiveness of Chinese wine companies (SO, WO and WT).

CHAPTER 6. CONCLUSION

6.1 Major Conclusions

This Thesis integrates methods to evaluate the potential of wine production of the Chinese wine industry and its competitiveness in the international market. Even though China has a long history of grape cultivation and wine-making, the wine production and wine consumption have not been outstanding in the international wine world until recent decades. The wine industry in the world in a whole has experienced decrease in vineyard area and reduction of wine production especially in the Old World, meanwhile emerging wine countries such as the New World and China have got great advance not only in the area of vineyard, the amount of wine production but also in technology and management. The success of opening up and economy growth of China has contributed to the dramatic increase in both wine production and wine consumption.

Along with the increasing domestic production and demand, there are government efforts in implementing policies and regulation to guide the wine industry in China and there are more universities and research centers engaged in viticulture and enology education and investigation. The improved life standards, the curiosity of wine culture and the health benefit all contribute to the increasing trend of wine consumption per capital in China. Also, e-commerce, wine tourism and domestic economic and social trend provide both opportunities and challenges.

The wine market is extremely competitive both in China and the international stage. Foreign wines have entered the Chinese market in a large scale after the China's WTO entry and the reduction of import-tariff. Chinese wine industry is facing fierce competition. Even though there is a great advance in the development of domestic wine industry, the current competitiveness of China's wine production is weak compared with main wine players in the world mainly owing to high cost, low quality, lack of technology and administrative experience.

According to the analysis of regional competitiveness, at regional level, local wine industries are widely distributed across the broad territory with diverse natural and social conditions, which

may shape and determinate characteristics of wine products. Xinjiang has the strangest advantage in Factor Conditions especially for the large scale of vineyard area which shows a potential for viticulture, Beijing has the strangest advantage in Demand Conditions for its economy power and urbanization rate which may contribute to a large demand of wine, Xinjiang has the strangest advantage in Related and Supporting Industries for the developed transportation system and Shandong ranks the first of the competitiveness of Firm Strategy, Structure and Rivalry for its number of wineries and strong educational and researching support in viticulture and enology. Considering all the four factors, Shandong where began the first modern winery of China (Changyu in 1892) has the strongest competitiveness mainly owing to its large size of wine production, higher power of agricultural machinery per capita, highest revenue of wineries above designed size, more number of wineries above designed size, more number of universities and institutes and more number of universities with education of viticulture and enology compared with other wine regions of China.

In the meanwhile, global climate change, which affects the quantity, quality and distribution of wine, will have a strong effect on the wine industry in China. In the last several years, domestic wine production has experienced a dramatic increase in China, boosted by rising consumption and a favorable economic situation. This increase faces important future challenges, a number of them emerging from the impacts of climate change, which may affect the quantity and quality of the wine production and even the vineyard location. The analysis of the climate trend in China, which is focused on variables with climate relevance to viticulture, exhibits inconsistent effects, and confirms the relevance of the changes in the primary wine producing regions. The literature suggests a general tendency of increasing temperatures and accumulated temperature, water scarcity, increasing number of frost-free days and higher frequency of extreme events in the whole nation and main wine regions, all of which will bring both challenges and opportunities to the young Chinese wine industry. Climate change scenarios indicate general increasing trend of temperature, reducing trend of frost-free days and anomalies in precipitation across China. These effects of climate change require adequate adaptations. The analysis of climate change adaptive capacity intends to identify aspects of adaptive capacity of climate change. According to the measurement of climate change adaptive capacity, even though the total vineyard area and wine production strength the adaptive capacity of China, existing water scarcity, lack of internet and communication services need to be considered seriously to improve climate change adaptive

capacity for the wine industry in China. The identified effects indicate the need for more research at the regional level for an accurate assessment of climate change impact on the Chinese wine industry and a proper design of adaptation measures, considering the specific needs and characteristics of wine production. These specific adaptation measures have to be implemented under the national framework of climate change adaptation and need to consider the coordination of policy, financial, technical, institutional and collaborative strategies.

Based on all the previous work, to provide development strategies, the study has identified internal factors as Strength such as large size of existing vineyard, as Weakness such as lack of technology, infrastructure and education in wine industry. External factors have been identified also as Opportunities such as large population and huge market demand and as Threat such as challenge for imported wines considering both traditional and new conditions for the wine industry in China. After a SWOT Matrix analysis from four sectors of wine industry- Grape Producing, Wine Processing, Wine Selling and Wine Consuming, for the future development of Chinese wine industry, the study provides strategies at governmental level such as establishment of wine law system, industrial level such as improvement of technology and business level such as E-commerce. In conclusion, the Chinese wine industry has experienced a great advance benefiting from excellent natural condition, growing domestic economy, strong government support, and advanced technologies and management. There is a great need to make further improvements in several aspects such as the establishment of a complete wine law system and a wine classification regulation. While opportunities such as e-commerce and increasing wine knowledge levels of customers are heightened, coming challenges such as climate change cannot be ignored.

6.2 Limits and future work

During the study of this Thesis, several contributions including scientific publications have been achieved which may provide implications for both scientific and social parties. However, there are some limits and future work.

- As China is a huge country and wine regions are widely distributed across the country and the Chinese wine market is fast growing and very dynamic, this Thesis may not include all the perspectives and situation of the wine industry in China.
- The lack of climate change data and information, several analyzes of this Thesis may need to be deepen and improved in the future.
- Due to the difficulty in conducting local investigation, personal interviews and market questionnaires, there may be a need to collect primary and secondary data and information at both national and regional level in future studies.

7. REFERENCES

- Agriculture and Agri-Food Canada, 2016. The Wine Market in China. Report. Available at <http://www.agr.gc.ca/resources/prod/Internet-Internet/MISB-DGSIM/ATS-SEA/PDF/6799-eng.pdf>
- Airfield, 2010. The Scoop on Machine Harvesting Wine Grapes. Available at <http://www.airfieldwines.com/blog/2010/05/11/the-scoop-on-machine-harvesting-wine-grapes/>.
- Amerine M.A. and Winkler A.T., 1944. Composition and quality of musts and wines of California grapes. *Hilgardia*, 15 (6), 504-505.
- Anderson and Wittwer, 2015. Asia's evolving role in global wine markets. *China Economic Review*, 35 (2015):1-14.
- Anderson K. and Wittwer G., 2015. Asia's evolving role in global wine markets. *China Economic Review*, 35 (2015): 1-14.
- Ashenfelter O. and Storchmann K., 2016. Climate change and wine: a review of the economic implications. *Journal of Wine Economics*, 11 (1), 105-138.
- ASKCI (In Chinese), 2015. China Business Intelligence Network. <http://www.askci.com/>.
- ASKCI (In Chinese). 2016. Available at <http://www.askci.com/>.
- Atkin T. And Gurney N., 2013. Protecting quality of wine exports to China: Barriers and bridges. *Journal of International Food & Agribusiness Marketing*, 25: 171-186.
- Aylward D.K., 2005. Global landscapes: A speculative assessment of emerging organizational structures within the international wine industry. *Prometheus*, 23 (4): 421-436.
- Aylward D.K., 2003. A Documentary of Innovation Support Among New World Wine Industries. *Journal of Wine Research*, 14 (1): 31-43.
- Bai Q.F., Li X.M. and Zhu L., 2013. The changes of the frost-free periods from 1961 to 2010 and its impact on apple industry in Shaanxi province. *Journal of Arid Land Resources and Environment*, 27 (8), 65-70 (In Chinese).
- Balestrini P. And Gamble P., 2006. Country-of-origin effects on Chinese wine consumers. *British Food Journal*, 108 (5): 396-412.

Bardaji I. and Iraizoz B., 2015. Uneven responses to climate and market influencing the geography of high-quality wine production in Europe. *Regional Environment Change*, 15 (1), 79-92.

Battaglini A., Barbeau G., Bindi M. and Badeck F.W., 2009. European winegrowers' perceptions of climate change impact and options for adaptation. *Regional Environment Change*, 9 (2), 61-73.

BBC Business, 2017. China's economy grows 6.7% in 2016. Available at <http://www.bbc.com/news/business-38686568>

Belliveau S., Smit B. and Bradshaw B., 2006. Multiple exposures and dynamic vulnerability: evidence from the grape industry in the Okanagan Valley, Canada. *Global Environmental Change*, 16 (4), 364-378.

Beverland M., 2008. Boundary conditions to business relationships in China: the case of selling wine in China. *Journal of Business & Industrial Marketing*, 24 (1): 27-34.

Bouzdine-Chameea T., Zhang W.X and Pesme J.O., 2014. The evolution of wine emerging markets: the case of china. *Asian Journal of Management Research*, 4 (4): 683-698.

Bouzdine-Chameeva T., Pesme J.O. and Zhang W.X., 2013. Chinese wine industry: current and future market trends. Conference paper of American Association of Wine Economists. Available at http://www.wineeconomics.org/aawe/wpcontent/uploads/2013/07/Bouzdine_Pesme_Zhang.pdf

Bretherton P. and Carswell P., 2001. Market entry strategies for western produced wine into the Chinese market. *International Journal of Wine Marketing*, 13 (1): 23-35.

Čačić J., Kljusurić J.G., Karpati L., and Čačić D., 2010. Collective Wine Export Promotion in Transitional Countries: The Case of Croatia. *Journal of Food Products Marketing*, 16, 262-277.

Cai X.L., Ye D.X., Li X., Zhang C.J. and Wang N., 2013. Analysis of temporal-spatial variation characteristics of drought in Shaanxi Province based on compound meteorological drought index (CI). *Agricultural Research in the Arid Areas* 31 (5), 1-8 (In Chinese).

Calwineries, 2017. Climate. Available at <http://www.calwineries.com/learn/grape-growing/climate>.

Camillo A.A., 2012. A strategic investigation of the determinants of wine consumption in China. *International Journal of Wine Business Research*, 24 (1): 68-92.

Cao Maksymets S.F., Li F. and Zhang J., 2011. Export competitiveness of Agri-products between China and Central Asian Countries: A comparative analysis. *Canadian Social Science*, 7 (5): p129-p134.

- Capitello R., Agnoli L. and Begalli D., 2015. Chinese import demand for wine: evidence from econometric estimations. *Journal of Wine Research*, 26 (2): 115-135.
- Carlsen J., and Dowling R., 2001. Regional Wine Tourism: A Plan of Development for Western Australia. *Tourism Recreation Research*, 26 (2), 45-52.
- Castex V., Tejeda E.M. and Beniston M., 2015. Water availability, use and governance in the wine producing region of Mendoza, Argentina. *Environmental Science & Policy*, 48, 1-8.
- Caubel J., Launay M., Garcia de Cortazar-Atauri I., Ripoché D., Huard F., Buis S. and Brisson N., 2014. A new integrated approach to assess the impacts of climate change on grapevine fungal diseases: the coupled mila-stics model. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 43-52.
- Cetrángolo H., Escribano J.B. and Gelabert C., 2007. The Argentinean wine industry and its relation with the UK quality wine market. *New Medit*, 2007, 4,30-35.
- CGNJ (in Chinese), 2011 <http://www.zgnj.org/magazine/info10624.html>
- Chand R., 1997. *Agricultural Diversification and Development of Mountain Regions: With special reference to Himachal Pradesh*. Publication of M D Publications.
- Chang H.S., Campbell G. and Sniekers, P., 2007. Geographical Indication for New England Wines in NSW. 51st AARES Annual Conference 2007, Queenstown, New Zealand. Available at <http://ageconsearch.tind.io/bitstream/10414/1/cp07ch01.pdf>.
- Chasingthevine, 2016. The Chinese wine and spirits market: opportunities and challenges. Available at <https://chasingthevine.com/category/china/future-of-chinas-wine-and-spirits-market/>
- Chen S., Chen X.G. and Xu J.T., 2016. Impacts of climate change on agriculture: evidence from China. *Journal of Environmental Economics and Management*, 76, 105-124.
- Chen X.G., Conway D., Chen X.J. and Zheng G.F., 2008b. Trends of extreme precipitation events in Ningxia during 1961-2005. *Advances in Climate Change Research*, 4(3), 156-160 (In Chinese).
- Chen X.G., Conway D., Zheng G.F. and Chen X.J., 2008a. Trends of extreme temperature in Ningxia during 1961-2004. *Advances in Climate Change Research*, 4 (2), 73-77 (In Chinese).
- China Flood & Drought Management (In Chinese), 2009. Publication of China Water & Power Press, 2009. <http://mall.cnki.net/magazine/magalist/FHKH2009.htm>.
- China Meteorological Administration (In Chinese), 2015. <http://www.cma.gov.cn/>.
- China Policy Institute, 2017. Fake wine in China. Available at <https://cpianalysis.org/2017/01/16/fake-wine-in-china/>

China Sugar & Liquor Yearbook (In Chinese), 2011. Publication of China National Association for Liquor and Spirits Circulation, December 2011. Available at <http://tongji.cnki.net/kns55/navi/HomePage.aspx?id=N2012070054&name=YZGTJ&floor=1>.

China Water Conservation Technology Policy Outline, 2005. Announcement of National Development and Reform Commission of the People's Republic of China, Ministry of Science and Technology of the People's Republic of China, Ministry of Water Resources of the People's Republic of China, Ministry of Construction of the People's Republic of China, Ministry of Agriculture of the People's Republic of China, April 2005. Available at <http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan036722.pdf>.

China Yantai Vine and Wine Officer (In Chinese), 2016 Available at http://ptjj.yantai.gov.cn/art/2016/9/18/art_1630_568509.html.

China's National Climate Change Programme, 2007. Report of National Development and Reform Commission (NDRC), June 2007. Available at <http://en.ndrc.gov.cn/newsrelease/200706/P020070604561191006823.pdf>.

China's National Plan on Climate Change 2014-2020 (In Chinese), 2014. Report of National Development and Reform Commission (NDRC), November 2014. <http://www.ndrc.gov.cn/zcfb/zcfbtz/201411/W020141104584717807138.pdf>.

Chinadaily, 2016. China's labor market: Shrinking workforce, rising wages. Available at http://www.chinadaily.com.cn/china/2016-11/21/content_27444998.htm

Chinadaily, 2016. Slower growth expected of China's wine market. Available at http://usa.chinadaily.com.cn/china/2016-01/23/content_23208973.htm

China's Policies and Actions for Addressing Climate Change, 2008. Report of National Development and Reform Commission (NDRC), October 2008. Available at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File419.pdf>.

China's Policies and Actions for Addressing Climate Change, 2012. Report of National Development and Reform Commission (NDRC), November 2012. Available at <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File1324.pdf>.

China's Policies and Actions for Addressing Climate Change (In Chinese), 2015. Report of National Development and Reform Commission (NDRC), November 2015. Available at <http://www.ccchina.gov.cn/archiver/ccchinacn/UpFile/Files/Default/20151120095809029882.pdf>.

China's Policies and Actions on Climate Change, 2014. Report of National Development and Reform Commission (NDRC), November 2014. Available at <http://en.ccchina.gov.cn/archiver/ccchinaen/UpFile/Files/Default/20141126133727751798.pdf>.

CHOBANYAN, A.; LEIGH, L. The Competitive Advantages of Nations Applying the “Diamond” Model to Armenia. *International Journal of Emerging Markets*, 1 (2), 147-164, 2006.

CHYXX (In Chinese), 2016. Available at <http://www.chyxx.com/>.

CNWINENEWS (In Chinese), 2016 a. Available at http://www.cnwinenews.com/html/2016/putaojiu_0118/93526.html.

CNWINENEWS (In Chinese), 2016 b. Available at http://www.cnwinenews.com/html/2016/putaojiu_0415/96007.html.

CNWINENEWS (in Chinese), 2016 c. Available at http://www.cnwinenews.com/html/2016/putaojiu_0907/102746.html.

Collopack, 2017. Grape and wine processing. Available at <http://www.collopack.com/Grape-Wine-Processing/>.

Corsi A.M., Marinelli N., and Sottini, V.A., 2013. Italian wine and Asia: policy scenarios and competitive dynamics. *British Food Journal*, 115 (3), 342-364.

David M.E., David F.R. and David F.R., 2017. The quantitative strategic planning matrix: a new marketing tool. *Journal of Strategic Marketing*, 25 (4), 1-12.

De la Fuente M., Linares R. and Lissarrague J.R., 2016. Adapting to climate change: the role of canopy management and water use efficiency in vineyards. *Wine & Viticulture Journal*, 31 (1), 43-46.

De Orduña R.M., 2010. Climate change associated effects on grape and wine quality and production. *Food Research International*, 43 (7), 1844-1855.

Decanter, 2015. Ningxia aims to be wine talent hub. Available at <https://www.decanterchina.com/en/news/ningxia-aims-to-be-wine-talent-hub>.

Decanterchina, 2016. A guide to Chinese wine regions. Available at <https://www.decanterchina.com/en/columns/demeisview-wine-communication-from-a-chinesewinemaker/a-guide-to-chinese-wine-regions>.

Decanter, 2016. China’s economic slowdown hit wine consumption in 2015 – study. Available at <https://www.decanterchina.com/en/news/china-s-economic-slowdown-hit-wine-consumption-in-2015-study>.

Del Valle Fernández Moreno M., García-Pardo I.P. and De Pablo González del Campo J.D.S., 2011. Factors of competitiveness in the wine industry: an analysis of innovation strategy. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 5 (6), 847-857.

- Deloitte, 2016. 2016 Global Manufacturing Competitiveness Index. Available at <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx-global-mfg-competitiveness-index-2016.pdf>.
- Deng Z.Y., Zhang Q., Wang R.Y., Zhao H., Xu J.F., Liu M.C., Zhao H.Y. and Yao Y.B., 2012. The response of plant diseases and pests to climatic warmer-drying and its adaptive technique in the Northwest China. *Advances in Earth Science*, 27, 1281-1287 (in Chinese).
- Dewald B.W.A. (Ben), 2003. Wine Consumption in Hong Kong. *International Journal of Wine Marketing*, 15 (1): 54-68.
- DÖGL C., HOLTBRÜGGE D. and SCHUSTER T., 2012. Competitive Advantage of German Renewable Energy Firms in India and China. *International Journal of Emerging Markets*, 7 (2), 191-214, 2012.
- Dong X.G., Gu W.Z., Meng X.X. and Liu H.B., 2014. Change features of precipitation events in Shandong Province from 1961 to 2010. *Acta Geographica Sinica*, 69 (5), 661-671 (in Chinese).
- DQAGRI (in Chinese), 2016. Available at <http://www.dqagri.gov.cn/dq/news667/20160527/>.
- Drinks Business, 2016. E-commerce driving China's wine sales. Available at <https://www.thedrinksbusiness.com/2016/08/e-commerce-driving-chinas-wine-sales/>.
- Drinksbusiness, 2011. China lacks wine drinking culture. Available at <https://www.thedrinksbusiness.com/2011/11/china-lacks-wine-drinking-culture/>.
- Drinksbusiness, 2017. China's wine imports up in volume and value in 2016. Available at <https://www.thedrinksbusiness.com/2017/02/chinas-wine-imports-up-in-volume-and-value-in-2016/>.
- Duchene E., 2016. How can grapevine genetics contribute to the adaptation to climate change? *Journal international des sciences de la vigne et du vin*, 50 (3), 113-124.
- Eads L. 2015. Bordeaux takes hit over China crackdown. *The Drinks Business*. Retrieved from [https://www.thedrinksbusiness.com/2015/03/bordeaux-takes-hit-over-china-crackdown/\[2015/11/20\]](https://www.thedrinksbusiness.com/2015/03/bordeaux-takes-hit-over-china-crackdown/[2015/11/20]).
- EOSIntelligence, 2017. China's wine market: will challenges crush the growing appetite for imported wines? Available at <http://www.eos-intelligence.com/perspectives/?p=2924>.
- Euromonitor International (2014). Available at <http://www.euromonitor.com/>.
- European Commission, 2014. Study on the competitiveness of European wines. Report of the European Union, 2014.

- EUSME Center, 2011. Wine market in China. Available at http://www.ccilc.pt/sites/default/files/docs/mercado_do_vinho_en_eusmecenter.pdf.
- FAO, 2010. Managing forests for climate change. Food and Agriculture Organization, Rome.
- FAO, 2014. Farm machinery and sustainable agriculture must evolve together. Available at <http://www.fao.org/news/story/en/item/212184/icode/>.
- FAO, 2015. Available at <http://www.fao.org/>.
- FAO, 2016. Food and Agriculture Organization of the United Nations, 2016. Available at <http://www.fao.org/>.
- Farhangi A.A., Far M.S. and Danaei A., 2012. Development SWOT Matrix for strategic planning in media organizations. *International Journal of Business and Commerce*, 1(5), 1-12.
- Fleming E., Mounter S., Grant B., Griffith G. and Villano R. 2014. The New World challenge: Performance trends in wine production in major wine-exporting countries in the 2000s and their implications for the Australian wine industry. *Wine Economics and Policy*, 3 (2), 115-126.
- Forbes, 2011. The future of wine. Available at <https://www.forbes.com/global/2011/0718/life-china-vineyard-mike-veseth-two-buck-chuck-future-wine.html>.
- Fraga H., Malheiro A.C., Moutinho-Pereira J. and Santos J.A., 2012. An overview of climate change impacts on European viticulture. *Food Energy Security*, 1(2), 94-110.
- Galvez L.C., Korus K., Fernandez J., Behn J.L., Banjara N., 2010. The Threat of Pierce's Disease to Midwest Wine and Table Grapes. *APSnet Features*. DOI 10.1094/APSnetFeature-2010-1015.
- Gao X., Wang H., Yu C.W., Dai X.G. and Shi L.H., 2009. Analysis of extreme precipitation events change for Hebei Province. *Meteorological Monthly*, 35 (7), 10-15 (in Chinese).
- General Administration of Customs of China (GACC) (In Chinese), 2016. Available at <http://www.customs.gov.cn/publish/portal0/> [2016/2/1].
- Georgiev Chang, B., Competitiveness of the Bulgarian wine industry. Publication of Institute for Market Economics, 2007. Available at <http://ime.bg/en/articles/competitiveness-in-the-bulgarian-wine-industry/>.
- Goulet E., 2014. Climate change and impact on the wine industry: the Val de Loire perspective. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 11-12.
- Green D.R. and Szymanowski M., 2012. Monitoring, mapping and modelling the vine and vineyard: collecting, characterising and analysing spatio-temporal data in a small vineyard. In: *Proceedings of the IXth International Terroirs Congress*, 2012, 8-35.

- Gupta J., Termeer C., Klostermann J., Meijerink S., Brink M.V.D, Jong P., Nooteboom S. and Bergsma E. 2010. The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy*, 13 (2010), 459-471.
- Hacker R.S., Johansson B. and Karlsson C., 2004. Emerging market economies and European economic integration. Publication of Edward Elgar Publishing.
- Hadarits M., Smit B. and Diaz H., 2010. Adaptation in viticulture: a case study of producers in the Maule Region of Chile. *Journal of Wine Research*, 21 (2-3), 167-178.
- Han L.R., 2011. The Prospect and Forecast of China's wine tourism in 2011. *Energy Procedia*, 5 (2011), 1616-1620.
- Hannah L., Roehrdanz P.R., Ikegami M., Shepard A.V., Shaw M.R., Tabor G., Zhi L., Marquet P.A. and Hijmans R.J., 2013. Climate change, wine, and conservation. *Proceedings of the National Academy of the Sciences of the United States of America*, USA 110, 6909-6912.
- Helms M.M. and Nixon J., 2010. Exploring SWOT analysis –where are we now? A review of academic research from the last decade. *Journal of Strategy and Management*, 3 (3), 215-251.
- Holland T. and Smit B., 2010. Climate change and the wine industry: current research themes and new directions. *Journal of Wine Research*, 21 (2-3), 125-136.
- Holland T. and Smit B., 2014. Recent climate change in the Prince Edward County winegrowing region, Ontario, Canada: implications for adaptation in a fledgling wine industry. *Regional Environment Change*, 14 (3), 1109-1121.
- Hu Q., Pan X.B., Zhang D., Yang N., Li Q.Y. and Shao C.X., 2015. Variation of temperature and frost-free period in different time scales in Northeast China. *Chinese Journal of Agrometeorology*, 36 (1), 1-8 (in Chinese).
- Hu X.L., Li L., Xie C. and Zhou J., 2008. The effects of country-of-origin on Chinese consumers' wine purchasing behaviour. *Journal of Technology Management in China*, 3 (3): 296-306.
- Huang J.T., Kuo C.C. and Kao A.P., 2003. The inequality of regional economic development in China between 1991 and 2001. *Journal of Chinese Economic and Business Studies*, 1 (3), 273-285.
- Ibitimes, 2015. China's wine industry explodes but not yet on the world stage. Available at <http://www.ibitimes.com/chinas-wine-industry-explodes-not-yet-world-stage-1902284>.

Iglesias A., Quiroga S., Moneo M. and Garrote L., 2012. From climate change impacts to the development of adaptation strategies: challenges for agriculture in Europe. *Climatic Change*, 112 (1), 143-168.

Iglesias A., Mougou R., Moneo M. and Quiroga S., 2011. Towards adaptation of agriculture to climate change in the Mediterranean. *Regional Environmental Change*, 11, 159-166.

Independent. 2014. Available at <http://www.independent.co.uk/news/business/news/chinese-overtake-french-as-top-red-wine-drinkers-9093682.html> [2016/3/16].

INS, 2017. How to enter the wine market in China. Available at <https://ins-globalconsulting.com/enter-wine-market-china-2/>.

International Organisation of Vine and Wine (OIV), 2016. Available at <http://www.oiv.int/>.

Internet Live Stats. 2015. Available at <http://www.internetlivestats.com/> [2015/11/1].

Ionescu C., Klein R.J.T., Hinkel J., Kumar K.S.K. and Klein R., 2009. Towards a formal framework of vulnerability to climate change. *Environmental Model Assess*, 14 (1), 1-16.

IPCC, 2007. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC, 2013. Observations: atmosphere and surface. In: Stocker TF, Qin D, Plattner GK, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM (eds) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp 159-254.

IPCC, 2014 a. Climate-resilient pathways: adaptation, mitigation, and sustainable development. In: F., T.J. Wilbanks, A.C. Abeyasinghe, I. Burton, Q. Gao, M.C. Lemos, T. Masui, K.L. O'Brien, and K. Warner, 2014: *Climate-resilient pathways: adaptation, mitigation, and sustainable development*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1101-1131.

IPCC, 2014 b. Food security and food production systems. In: Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL (eds) *Climate Change 2014:*

Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp 485-533.

IPCC, 2017. Scenarios background information. Available at http://sedac.ipcc-data.org/ddc/ar5_scenario_process/scenario_background.html.

IRResearch. 2015. Available at <http://www.iresearchchina.com/> [2015/11/24].

Ismail M.M. and Abdullah A.M., 2013. Shrimp trade competitiveness of Malaysia and selected ASEAN countries. *Journal of International Food & Agribusiness Marketing*, 25 (1), 98-115.

JARUNGKITKUL, W., Sukcharoensin, S. Benchmarking the Competitiveness of the ASEAN 5 Equity Markets: An Application of Porter's Diamond Model. *Benchmarking An International Journal*, 23 (5), 1312-1340, 2016.

Jenster P. and Cheng Y.T., 2008. Dragon wine: developments in the Chinese wine industry. *International Journal of Wine Business Research*, 20 (3), 244-259.

Ji S.T., Yang M., Ji Y.H., Wang P., Jiang L.X., Zhu H.X. and Yan P., 2009. Change of accumulated temperature and evolution trends of accumulated temperature zone over last 45 years in Heilongjiang Province. *Chinese Journal of Agrometeorology*, 30 (2), 133-137 (in Chinese).

Jiang Y., 2009. China's water scarcity. *Journal of Environmental Management*, 90 (11), 3185-3196.

Jing Daily, 2014. China's Gigantic Wine Market Goes Digital. Available at <https://jingdaily.com/chinas-gigantic-wine-market-goes-digital/>.

JiuQ (in Chinese), 2013. Available at <http://www.jiuq.com/article.php?id=17909>.

Jones G.V. and Alves F., 2011. Impacts of climate change on wine production: a global overview and regional assessment in the Douro Valley of Portugal. *Proceeding of the Global Conference on Global Warming 2011*, 2011, Lisbon, Portugal.

Jones G.V. and Davis R.E., 2000. Climate influences on grapevine phenology, grape composition and wine production and quality for Bordeaux, France. *American Journal of Enology and Viticulture*, 51, 249-261.

Jones G.V., 2005. Climate change in the western United States grape growing regions. *Acta Horticulturae*, 689, 41-60.

- Jones G.V., 2007. Climate change: observations, projections, and general implications for viticulture and wine production. In: Proceedings of the XIIIth Conference on Climate and Viticulture, International Organization of Vine and Wine (OIV), Zaragoza (Spain), pp 55-66.
- Jones G.V., White M.A., Cooper O.R. and Storchmann K., 2005. Climate change and global wine quality. *Climatic Change*, 73 (3), 319-343.
- Jones G.V. and Webb L.B., 2010. Climate change, viticulture, and wine: challenges and opportunities. *Journal of Wine Research*, 21(2-3), 103-106.
- Jones G.V. ,2006. Climate and Terroir: Impacts of Climate Variability and Change on Win”. In *Fine Wine and Terroir - The Geoscience Perspective*. Macqueen, R.W., and Meinert, L.D., (eds.), Geoscience Canada Reprint Series Number 9, Geological Association of Canada, St. John's, Newfoundland, 247 pages.
- Justmeans, 2016. Climate change is affecting the world’s wine production. Available at <http://www.justmeans.com/blogs/climate-change-is-affecting-the-worlds-wine-production>.
- Kharaishvili E.; Chavleishvili M. and Natsvaladze M., 2014. Trends and Prospects for the Development of Georgian Wine Market. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 8 (10), 3162-3166.
- Lereboullet A.L., Bardsley D. and Beltrando G., 2013. Assessing vulnerability and framing adaptive options of two Mediterranean wine growing regions facing climate change: Roussillon (France) and McLaren Vale (Australia). *EchoGéo*, 23, 1-16.
- Li C., Liu D.Y. and Huang H., 2010. Characteristics of precipitation and precipitation days from 1958 to 2007 in Tianjin. *Journal of Meteorology & Environment*, 26 (4), 8-11 (in Chinese).
- Li D.M., 2016. A guide to Chinese wine regions. *Decantar China*. Retrieved from <https://www.decanterchina.com/en/columns/demeis-view-wine-communication-from-a-chinese-winemaker/a-guide-to-chinese-wine-regions> [2016/2/14].
- Li H. and Meng J., 2009. Climatic zoning indexes and the viticultural climatic zoning in Shaanxi Province. *Science & Technology Review*, 27 (6), 78-83 (in Chinese).
- Li H., Lan Y.F. and Wang H., 2011. Study on viticultural climatic zoning in Jingjintang area. *Journal of Northwest A & F University (Nat Sci Ed)*, 39 (9), 159-166 (in Chinese).
- Li H., Li J.G. and Yang H.C., 2009. Review of grape and wine industry development in recent 30 years of China’s reforming and opening-up. *Modern Food Science and Technology*, 25, 341-347 (In Chinese).
- Li H., Wang H. and Wang H., 2011. Study on the viticultural climatic zoning of Xinjiang Uygur Autonomous Region. *Science & Technology Review*, 29 (2), 70-73 (in Chinese).

- Li H., Wang H., Fang Y.L. and Huo X.S., 2007a. Study on the viticulture climatic zoning in China (I). *Science & Technology Review*, 25 (18), 63-68 (in Chinese).
- Li H., Wang H., Fang Y.L. and Huo X.S., 2007b. Study on the viticulture climatic zoning in China (II). *Science & Technology Review*, 25 (18), 57-64 (in Chinese).
- Li H., Wang H., You J., Huo X.S. and Wang Y.Q., 2007. Relationship between frost indexes and viticulture zoning in China in recent 45 years. *Science & Technology Review*, 25 (15), 16-22 (in Chinese).
- Li H., Wang Y.J., Meng J., Wang H., You J., Huo X.S. and Wang Y.Q., 2009. The effect of climate change on the climatic zoning for wine grapes in China. *Acta Horticulturae Sinica*, 36 (3), 313-320 (in Chinese).
- Li J., Yan X.Y. and Wang Y., 2010. Variations of frost under the background of climate change in Liaoning Province in recent 50 years. *Meteorological Monthly*, 36 (11), 38-45 (in Chinese).
- Li J.G., Jia J.R., Taylor D., Bruwer J. and Li E., 2011. The wine drinking behaviour of young adults: an exploratory study in China. *British Food Journal*, 113 (10), 1305-1317.
- Li R.L. and Shu G., 2013. Impacts of climate change on agriculture and adaptive strategies in China. *Journal of Integrative Agriculture*, 12 (8), 1402-1408.
- Li T., Zhao F., 2014, 辽宁省恒仁县葡萄酒产业发展的思考 (Thought of the grape wine industry in Hengren, Liaoning) (in Chinese), *Economic Research Guide*, 2014 (29), 62-63.
- Li X., Zhen G.F., Na L. and Wang S.Y., 2013. Analysis on spatial and temporal changes of extreme precipitation events in Ningxia in recent 50 years. *Journal of Anhui Agricultural Sciences*, 41 (8), 3533-3535, 3578 (in Chinese).
- Li Y.B., 2015. Impact of global climate change on European wine industry and the revelation to China. *Liquor-making Science & Technology*, 5, 126-129 (in Chinese).
- Li Y.H., Liang J.S. and Zhang Y., 2009. Research progress in wine industrial clusters. *Progress In Geography*, 28 (5), 683-689 (In Chinese).
- Liang X., Feng J.M., Zhang Z. and Zheng G.F., 2007. A study on drought climate change and its causes. *Journal of Arid Land Resources and Environment*, 21 (8), 68-74 (in Chinese).
- Lin H. and Tavoletti E., 2013. The Marketing of Italian Wine Brands in China: The ‘Mainstreaming’ Approach. *Transition Studies Review*, 20, 221-237.
- Liu D.X., Dong A.X., Zhang P.L. and Fei X.L., 2005. Impact of climate warming on agriculture in Gansu Province. *Progress in Geography*, 24 (2), 49-58 (in Chinese).

- Liu D.Y. and Hsu H.F., 2009. An international comparison of empirical generalized double diamond model approaches to Taiwan and Korea. *Competitiveness Review: An International Business Journal*, 19 (3), 160-174.
- Liu F. and Murphy J., 2007. A qualitative study of Chinese wine consumption and purchasing. Implications for Australian wines. *Journal of Wine Business Research*, 19 (2): 98-113.
- Liu F.Y., Xiao S.R., Liu H. and Mu Z.Y., 2014. Research of impacts of climate change on agriculture in Hebei Region. *Geography and Geo-Information Science*, 30 (4), 122-126 (in Chinese).
- Liu H.B., McCarthy B., Chen T.Z., Guo S. and Song X.G., 2014. The Chinese wine market: a market segmentation study. *Asia Pacific Journal of Marketing and Logistics*, 26 (3): 450-471.
- Liu S.H., Yan D.H., Weng B.S., Xing Z.Q. and Wang G., 2013. Spatiotemporal evolution of effective accumulated temperature $\geq 10^{\circ}\text{C}$ in China in recent 50 years. *Arid Zone Research*, 30, 689-696 (in Chinese).
- Liu S.M., Gao H. and Li Z.F., 2009. Impacts of climate warming on crops planting structure in Tianjin. *Chinese Journal of Agrometeorology*, 30 (1), 42-46 (in Chinese).
- Liu X.M. and Ouyang Z.H., 2014. Gray correlation of China's logistics capacity and the growth of agriculture economy. *Proceeding of the 2014 International Conference on Manufacturing and Engineering Technology*, Sanya, China.
- Lobell D.B., Field C.B., Cahill K.N. and Bonfils C., 2006. Impacts of future climate change on California perennial crop yields: Model projections with climate and crop uncertainties. *Agricultural and Forest Meteorology*, 141 (2-4), 208-218.
- Lockshin L., 2014. A letter by the Regional Editor for Oceania: China and wine: Its impact on the global wine trade. *Wine Economics and Policy*, 3 (2014), 1-2.
- Lockshin L., Corsi A.M., Cohen J., Lee R. and Williamson P., 2017. West versus East: Measuring the development of Chinese wine preferences. *Food Quality and Preference*, 56: 256-265.
- Lockshin L., Cohen E. and Zhou X., 2011. What influences five-star Beijing restaurants in making wine lists? *Journal of Wine Research*, 22 (3), 227-243.
- Louise C, Michael T. 2015. Chinese FDI in the French and Australian Wine Industries: Liabilities of Foreignness and Country of Origin Effects. *Front. Bus. Res. China*. 9 (3):443-480.
- Lu D. and Neilson W. A.W., 2004. China's west region development: Domestic strategies and global implication. *Publication of World Scientific Publishing*.

- Lv Q.F, Zhang B. 2013. History of Native Grape and Wine in Ancient China (In Chinese). *Journal of Northwest A&F University (Social Science Edition)*, 13(3), 157-162.
- Ma G.S., 2015. Food, eating behavior, and culture in Chinese society. *Journal of Ethnic Foods*, 2 (4), 195-199.
- Ma H.Q., 2013. A letter by the Regional Editor for Asia: The current wine production–consumption in China. *Wine Economics and Policy*, 2 (2013), 55-56.
- Ma X.R. and Qiao J., 2009. Cluster Development of Wine Industry in China: Status, Measurement and Evaluation (in Chinese). *Technology Economics*, 28 (5), 41-46.
- Ma Y., Ren Y.Y., Chen C.Y. and Chu C.J., 2005. Change characteristic of fog and analysis on weather process of heavy fog in Xinjiang in nearly 40 years. *Arid Land Geography*, 28 (4), 474-478 (in Chinese).
- Ma J.Z., 2015. 关于北京葡萄与葡萄酒产业发展的思考 (Thought of the grape wine industry development in Beijing) (in Chinese). *Journal of Beijing Agricultural Vocation College*, 29 (5), 10-15.
- Maksymets O. and Lönnstedt L., 2016. International competitiveness: A case study of American, Swedish, and Ukrainian forest industries. *The International Trade Journal*, 30 (2), 159-176.
- MANN M. and Byun S.E., 2011. Accessing Opportunities in Apparel Retail Sectors in India: Porter's Diamond Approach. *Journal of Fashion Marketing and Management: An International Journal*, 15 (2), 194-210, 2011.
- Marketing-Insider, 2016. Available at <https://marketing-insider.eu/porter-diamond-model/>.
- Masset P., Weisskopf J.P., Faye B. and Le Fur E., 2016. Red obsession: The ascent of fine wine in China. *Emerging Markets Review*, 29, 200-225.
- Miao Q.L., Yuan Y., Wang Y. and Duan C.F., 2009. Impact of climate warming on the distribution of China's thermal resources. *Journal of Natural. Resources*, 24 (5), 934-944 (in Chinese).
- Min J.J., Cao X.Z., Duan Y.H., Liu H.Z. and Wang S.G., 2012. Analysis on the climate characteristics of hail and its break in Beijing, Tianjin and Hebei during recent 30 years. *Meteorological Monthly*, 38 (2), 189-196 (in Chinese).
- Mitry D.J., Smith D.E. and Jenster P.V., 2009. China's role in global competition in the wine industry: A new contestant and future trends. *International Journal of Wine Research*, 2009 (1), 19-25.

- MOFCOM (in Chinese), 2016. Available at <http://gansu.mofcom.gov.cn/article/sjshangwudt/201609/20160901391883.shtml>.
- Moriondo M., Jones G.V., Bois B., Dibari C., Ferrise R., Trombi G. and Bindi M., 2013. Projected shifts of wine regions in response to climate change. *Climatic Change*, 119 (3), 825-839.
- Morrison A. and Rabellotti R., 2017. Gradual catch up and enduring leadership in the global wine industry. *Research Policy*, 46 (2017), 417-430.
- Mozell M.R. and Thach L., 2014. The impact of climate change on the global wine industry: challenges & solutions. *Wine Economics & Policy*, 3 (2), 81-89.
- Muhammad A., Leister A.M., McPhail LH and Chen W., 2013. The evolution of foreign wine demand in China. *Australian Journal of Agricultural and Resource Economics*, 58 (3), 392-408.
- National Bureau of Statistics of China (In Chinese), 2016. Available at <http://www.stats.gov.cn/>.
- National Bureau of Statistics of China, 2012 (In Chinese). Available at http://www.stats.gov.cn/tjzs/tjsj/tjcb/dysj/201208/t20120802_38088.html
- National Bureau of Statistics of the People's Republic of China, 2015 (in Chinese). <http://www.stats.gov.cn/tjsj/>.
- National Geographic, 2017. Available at <http://travel.nationalgeographic.com/travel/countries/china-facts/>.
- Nicholas K.A. and Durham W.H., 2012. Farm-scale adaptation and vulnerability to environmental stresses: insights from winegrowing in Northern California. *Global Environmental Change* 22 (2), 483-494.
- Ningxia Statistical Yearbook 1985-2013 (in Chinese). Publication of China Statistics Press. 1985-2013. Available at <http://tongji.cnki.net/kns55/navi/HomePage.aspx?id=N2013100032&name=YNXTJ&floor=1>.
- NOAA, 2015. Available at <http://www.noaa.gov/>.
- Nwsuaf (in Chinese), 2016. Available at <http://wine.nwsuaf.edu.cn/gjjl/301514.htm>.
- OECD, 2010. Household Final Consumption Expenditure. Available at <https://stats.oecd.org/glossary/detail.asp?ID=1257>.
- OIV, 2015. International Organisation of Vine and Wine. Available at <http://www.oiv.int/>.
- OIV, 2016. International Organisation of Vine and Wine. Available at <http://www.oiv.int/>.

- Ollat N. and Touzard J.M., 2014a. Impacts and adaptation to climate change: new challenges for the French wine industry. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 75-78.
- Ollat N. and Touzard J.M., 2014b. Long-term adaptation to climate change in viticulture and enology: the Laccave project. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 1-7.
- Ollat N., Touzard J.M. and Van Leeuwen C., 2016. Climate change impacts and adaptations: new challenges for the wine industry. *Journal of Wine Economics*, 11, 139-149.
- Pan S.K., Zhang M.J., Wang B.L. and Ma X.N., 2013. Changes of the first frost dates, last frost dates and duration of frost-free season in Xinjiang during the period of 1960-2011. *Arid Zone Research*, 30 (4), 735-742 (in Chinese).
- Peng H.X., Huang R.L. and Pan R.S., 2000. Characteristics and viticulture of wild *Vitis amurensis* Rupr. *Guangxi. Guangxi Agricultural Sciences*, 1, 30-34 (In Chinese).
- Piao S.L., Ciais P., Huang Y., Shen Z., Peng S.S., Li J.S., Zhou L.P., Liu H.Y., Ma Y.C., Ding Y.H., Friedlingstein P., Liu C.Z., Tan K., Yu Y.Q., Zhang T.Y. and Fang J.Y., 2010. The impacts of climate change on water resources and agriculture in China. *Nature*, 467 (7311), 43-51.
- Piéri P. and Lebon E., 2014. Modelling the future impacts of climate change on French vineyards. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 33-41.
- Pinilla V., 2004. Creating wine: the emergence of a world industry 1840-1914. *Journal of Wine Research*, 24 (2): 162-164.
- Poitras L. and Donald G., 2006. Sustainable Wine Tourism: The Host Community Perspective. *Journal of Sustainable Tourism*, 14 (5), 425-448.
- Porter M. and Takeuchi H. The French Wine Cluster-Microeconomics of Competitiveness. Harvard Business School, 2013. Available at http://www.google.es/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiigJLtqa7TAhVIwBQKHarkBPsQFggjMAA&url=http%3A%2F%2Fwww.isc.hbs.edu%2Fresources%2Fcourses%2Fmoc-course-at-harvard%2FDocuments%2Fpdf%2Fstudent-projects%2FFrance_Wine_2013.pdf&usg=AFQjCNH5VyprhFAa_pmG6qRSy-666HYILA&sig2=cbj-Sjx1GgJxJPcS4fc6cQ.
- Porter M. E., 1990. *The Competitive Advantage of Nations*. New York: Free Press, 1990.
- Prnewswire, 2016. China spirits market (Baijiu, Huanjiu, beer, wine, imported beer, imported wine) 2016 Edition Research Report Offers 2018 Forecasts. Available at <http://www.prnewswire.com/news-releases/china-spirits-market-baijiu-huanjiu-beer-wine->

imported-beer-imported-wine-2016-edition-research-report-offers-2018-forecasts-572240191.html.

Progressive Viticulture, 2016. Comparative wine growing climatology. Available at <http://www.progressivevit.com/comparative-wine-growing-climatology/>.

Prowine, 2016. Who consume wine in China? Available at <http://www.prowinechina.com/contents/138/1362.html>

Prowinechina, 2016a. A Glimpse of China's Wine Regions: Ambitions and Challenges. Available at <http://www.prowinechina.com/contents/138/862.html>

Prowinechina, 2016b. Three new trends shaping Chinese wine industry. Available at <http://www.prowinechina.com/contents/138/222.html>

Pu Z.C., Zhang S.Q., Li J.L., Xu W.X. and Wang M.Q., 2013. Spatiotemporal change of duration and accumulated temperature of temperature $\geq 0^{\circ}\text{C}$ in Xinjiang in recent 50 years. *Arid Zone Research*, 30 (5), 781-788 (in Chinese).

Pu Z.C., Zhang S.Q., Li J.L., Xu W.X., Wang M.Q. and Yili H., 2014. Spatial-temporal variation of heat resources in winter of Xinjiang near 50 years. *Agricultural Research in the Arid Areas*, 322 (2), 40-46 (in Chinese).

Qing P., Xi A.Q. and Hu W.Y., 2015. Self-consumption, gifting, and Chinese wine consumers. *Canadian Journal of Agricultural Economics*, 63 (2015), 601-620.

Quénol H. and Bonnardot V., 2014. A multi-scale climatic analysis of viticultural terroirs in the context of climate change: the —TRADCLIM” project. *Journal international des sciences de la vigne et du vin*, Laccave Special Issue, 23-32.

Regulation on the Protection of Eastern Foot of Helan Mountain Wine Region in Ningxia Hui Autonomous Region, 2012 (in Chinese). *Gazette of Ningxia Government*, May 2012. Available at <http://61.181.156.156:8080/kcms/detail/detail.aspx?QueryID=16&CurRec=2&DbCode=cjtz&db name=CJFZLAST&filename=NXZB201224003>.

Remeikiene R., Startiene G. and Dumciuvienė D., 2015. Assessment of the industry competitiveness of the Baltic States in the EU during the period of economic recession. *Technological and Economic Development of Economy*. 21(1):79-95.

Ren Y.J., Cui J.X., Wan S.Q., Liu M., Chen Z.H., Liao Y.F. and Wang J.J., 2013. Climate change impacts on central China and adaptation measures. *Advances in Climate Change Research*, 4 (4), 215-222.

- Rendleman C.M., Hoemmen G.A., Altman I., Taylor B, Moon W. and Smith S., 2016. Wine Industry Competitiveness: A survey of the Shawnee Hills American Viticultural Area. *Wine Economics and Policy*, 5 (1), 4-13.
- Rensheng2 (in Chinese), 2015. Available at <http://www.rensheng2.com/450000/440268.shtml>.
- Resco P., Iglesias A., Bardaji I. and Sotes V., 2016. Exploring adaptation choices for grapevine regions in Spain. *Regional Environment Change*, 16 (4), 979-993.
- Rooyen J.V., Esterhuizen D. and Stroebe L., 2011. Analyzing the Competitive Performance of the South African Wine Industry. *International Food and Agribusiness Management Review*, 2011.14(4), 179-200.
- Sang J.R., Liu Y.L. and Shu Z.L., 2007. Response of severe drought events in Ningxia to climate change during recent 44 years. *Journal of Desert Research*, 27 (5), 878-882 (in Chinese).
- Sardy M. and Fetscherin M., 2009. A Double Diamond Comparison of the Automotive Industry of China, India, and South Korea. *Rollins College Faculty Publications*, 1 (1), 2009, 1-14.
- Scheme of Adaptation for Climate Change in Ningxia, 2009 (in Chinese). *Gazette of Ningxia Government*, November 2009. Available at http://wenku.baidu.com/link?url=oDcPd4zVYo-LTN7AMOrTcngFzvzj3XDzvOTZqR6UowwGdsjwEtE82G1sv7uSLsrM1Hh_nN4ThStHG2z-hEUmtA9X2VbV2EYZIMi7cO1DrW.
- Schultz H.R. and Jones G.V., 2010. Climate induced historic and future changes in viticulture. *Journal of Wine Research*, 21, 137-145.
- Seleka T.B. and Kebakile P.G., 2017. Export competitiveness of Botswana's beef industry. *The International Trade Journal*, 31 (1), 76-101.
- Shen X.J., Wu Z.F. and Du H.B., 2014. Characteristics of climatic change in semiarid region of western Jilin in recent 50a. *Journal of Arid Land Resources and Environment*, 28, 190-196 (in Chinese).
- Škorpíková A. , 2002. Factors conditions of the viniculture and wine sector in the EU member states, in the Czech Republic and in the selected candidate countries. *Agricultural Economics*, 48, 2002 (7), 303-310, 2002.
- Somogyi S., Li E., Johnson T., Bruwer J. and Bastian S., 2011. The underlying motivations of Chinese wine consumer behaviour. *Asia Pacific Journal of Marketing and Logistics*, 23 (4), 473-485.
- Song X.X. , 2016. Study on Brand Building of Grape Industry in Ningxia. 2016 2nd International Conference on Social Science and Development. Chengdu, China

Statista, 2015. Available at <http://www.statista.com/> [2015/11/14].

Su ZX, 2005. On grape culture in ancient communication between the East and West (In Chinese). *Journal of Yanshan University (Philosophy and Social Science Edition)*, 6 (2), 25-31.

Sun G.L., Chen Y.M. and Li W.H., 2011. Interannual and interdecadal variations of extreme hydrological events and response to climate change in Xinjiang. *Scientia Geographica Sinica*, 31, 1389-1395 (in Chinese).

Svetličič M., 2010. Enhancing Competitiveness by Education and Training. *Journal of Innovative Business and Management*. 1 (2010). Available at http://journal.doba.si/letnik_2-2010-st_1/enhancing-competitiveness-by-education-and-training.

Szymanowski M., Kryza M. and Smaza M., 2007. A GIS approach to spatialize selected climatological parameters for wine-growing in Lower Silesia, Poland. In: Střelcová K, Škvarenina J, Blaženec M (eds) *Proceedings of the —Bioclimatology and natural hazards— International Scientific Conference, Poľana nad Detvou (Slovakia)*, ISBN 978-80-228-17-60-8.

Tan C.P., Yang J.P., Qin D.H. and Li M., 2014. Climatic background of persistent drought in Ningxia Hui Autonomous Region, China. *Journal of Desert Research*, 34 (2), 518-526 (in Chinese).

Tang V.C.M., Tchetchik A. and Cohen E., 2015. Perception of wine labels by Hong Kong Chinese consumers. *Wine Economics and Policy*, 4 (2015), 12-21.

Tao Y., Duan X., Duan C.C. and Duan W., 2011a. Change characteristic of Yunnan hail. *Plateau Meteorology*, 30 (4), 1108-1118 (in Chinese).

Tao Y., Duan X., Duan C.C., Duan W. and Ren J.Z., 2011b. The change characteristics of fog in Yunnan during the nearly 50 years. *Journal of Yunnan University*, 33, 308-316 (in Chinese).

Terblanche, N.S., Simon, E., & Taddei, J.C., 2008. The Need for a Marketing Reform: The Wines of the Loire Region. *Journal of International Food & Agribusiness Marketing*, 20 (4), 113-138.

The China Culture Corner, 2013. The art of giving gifts in China. Available at <https://chinaculturecorner.com/2013/10/30/giving-gifts-in-china/>.

Theconversation, 2014. Chinese vintners are winning renown as wine industry soars. Available at <http://theconversation.com/chinese-vintners-are-winning-renown-as-wine-industry-soars-34474>.

Theguardian, 2014. China becomes biggest market for red wine, with 1.86bn bottles sold in 2013. Available at <https://www.theguardian.com/world/2014/jan/29/china-appetite-red-wine-market-boom>

- Themanager, 2015 <http://www.themanager.org/2015/01/porters-diamond-national-advantage/>
- Thorpe M., 2009. The globalisation of the wine industry: new world, old world and China. *China Agricultural Economic Review*, 1 (3), 301-313.
- Tonietto J. and Carbonneau A., 2004. A multicriteria climatic classification system for grape-growing regions worldwide. *Agricultural & Forest Meteorology*, 124 (1-2), 81-97.
- Toolshero, 2016. Available at <https://www.toolshero.com/strategy/porter-diamond-model/>.
- UN COMTRADE. 2015. Available at <http://comtrade.un.org/> [2016/5/10].
- UN COMTRADE. 2016. Available at <http://comtrade.un.org/> [2016/5/10].
- UNDP, 2014. Competitive Industrial Performance Report 2014. Available at http://www.unido.or.jp/files/WP2014_12_CIPReport2014.pdf.
- UNDP, 2015. Available at <http://www.undp.org/>.
- United Nations Development Programme (UNDP), 2016. Available at <http://www.cn.undp.org/content/china/zh/home/countryinfo.html>.
- Van Leeuwen C., Bois B., Pieri P. and Gaudillère J.-P., 2007. Climate as a terroir component. In: *Proceedings of the XIIth Conference on Climate and Viticulture*, Zaragoza (Spain), pp 1-12.
- Vinehoo, 2017. Available at <http://www.vinehoo.com/index.php/Home/Wiki/details/id/676>.
- Vink N., Deloire A., Bonnardot V. and Ewert J., 2009. Terroir, climate change, and the future of South Africa's wine industry. Paper presented at *The World's Wine Markets by 2030: Terroir, Climate Change, R&D and Globalization*, Australian Agricultural and Resource Economics Society, Adelaide, 7-9 February, 2010.
- Wall E. and Marzall K., 2006. Adaptive capacity for climate change in Canadian rural communities. *Local Environment*, 11(4), 373-397.
- Wang H., Ning X.G., Yang P. and Li H., 2016. Ancient world, old world and new world of wine(In Chinese). *Journal of Northwest A&F University (Social Science Edition)*, 16 (6), 150-153.
- Wang H., Zhao X.H., Liu J. and Fu R.P., 2010. Research progress in sustainable development of grape and wine production (In Chinese). *Scientia Agricultura Sinica*, 43 (15), 3204-3213.
- Wang H., Wang L.G., Song H.H., Yan Y. and Li H., 2010. Climatic zoning of grapevine in Ningxia Hui Autonomous Region. *Science & Technology Review*, 28 (20), 21-24 (in Chinese).

- Wang H.Y., Gao H.J. and Zhang X., 2011. Analysis on the climate variation characteristics of frost in Shandong Province. *Journal of Anhui Agricultural Sciences*, 39 (15), 9062-9063 (in Chinese).
- Wang S., Li H. and Wang H., 2015. Wind erosion prevention effect of suspending shoots on wires after winter pruning in soil-burying zones over-wintering. *Transactions of the Chinese Society of Agricultural Engineering*, 31(12), 206-212 (in Chinese).
- Wang S.F., 2013. The International Competitiveness of Computer and Information Service Trade between China and India. *International Academic Workshop on Social Science (IAW-SC 2013)*. p 243-p246.
- Wang S.T., 2017. When Chinese cuisine meets western wine. *International Journal of Gastronomy and Food Science*, 7, 32-40.
- Wang S.Z. and Huang P., 2009. Discussion on grape wine history in China (In Chinese). *Liquor-making Science & Technology*, 2009 (11), 136-143.
- Wang Y., 2006. On the factors influencing the competitiveness of Chinese service trade after entering WTO - An analysis based on grey incidence. *New Aspects of Systems Theory and Scientific Computation*. 10th WSEAS International Conference on Systems Theory and Scientific Computation, Taipei, Taiwan, 2010.
- Wang Y.H., 2014. Analysis on spatial and temporal variation characteristics of temperature and precipitation in Shaanxi Province. *Journal of Inner Mongolia Forestry Science & Technology*, 40 (4), 33-39 (in Chinese).
- Wang Y.J. and Yan F., 2014. Regional differentiation and decadal change of precipitation in China in 1960-2010. *Progress in Geography*, 33 (10), 1354-1363 (in Chinese).
- Wang Y.R., Liao Y.C. and Mao M.C., 2011. Change of the accumulated temperature above 5 °C critical temperature in Shaanxi during past 48 years. *Acta Agriculturae Boreali-Occidentalis Sinica*, 20 (7), 201-206 (in Chinese).
- Wang H., Zhao X.H., Liu J., and Fu R.P., 2010. Research progress in sustainable development of grape and wine production (In Chinese). *Scientia Agricultura Sinica*, 43 (15), 3204-3213.
- Wen J.H., 2013. The textual about the source of the name “Grape” (In Chinese). *China Brewing*, 32 (9): 158-160.
- Williamson P.O., Robichaud J. and Francis I.L., 2012. Comparison of Chinese and Australian consumers' liking responses for red wines. *Australian Journal of Grape and Wine Research*, 18, 256-267.

Willsher K. (2014, January 29), 2014. China becomes biggest market for red wine, with 1.86bn bottles sold in 2013. The Guardian. Retrieved from <http://www.theguardian.com/world/2014/jan/29/china-appetite-red-wine-market-boom>.

Wilson I. and Huang Y.L., 2003. Wine Brand Naming in China. *International Journal of Wine Marketing*, 15 (3), 52-63.

WINECHINA (in Chinese), 2013. Available at <http://www.winechina.cn/news/show-6512.shtml>.

WINECHINA (In Chinese), 2014a. Available at <http://www.winechina.com/html/2014/10/201410269220.html>.

WINECHINA (in Chinese), 2014b. Available at <http://www.winechina.com/html/2014/07/201407266809.html>.

Wine&Spirit Education Trust (WSET), 2015. Available at <http://www.wsetglobal.com/> [2015/12/16].

WineAustralia, 2017. Available at <https://www.wineaustralia.com/whats-happening/stories-of-australian-wine/february-2017/china-export-report-2016>.

Wineinstitute. 2015. Available at <http://www.wineinstitute.org/resources/statistics> [2015/11/09].

Wine-searcher, 2017. Rutherford wine. Available at <http://www.wine-searcher.com/regions-rutherford>.

Winespectator, 2016. How big is China's counterfeit-wine problem? French report calls it an industry. Available at <http://www.winespectator.com/webfeature/show/id/52194>.

Winsinfo (in Chinese), 2015 <http://www.winesinfo.com/html/2015/3/32-60688.html>

Wolf T.K. and Boyer J.D., 2003. Vineyard Site Selection. Virginia Tech, Virginia State University.

World Bank, 2015. Climate Wizard, developed through collaboration between The Nature Conservancy, The University of Washington, and The University of Southern Mississippi. Available at World Bank Group, Data. <http://data.worldbank.org/>.

World Bank, 2016. Available at http://wits.worldbank.org/wits/wits/witshelp/Content/Utilities/e1.trade_indicators.htm.

Wu Y.J., Li Y.E., Liu Y.T. and Huang Y., 2008. Changes of meteorological disasters and their impacts on grain crop yield in Ningxia. *Chinese Journal of Agrometeorology*, 29 (4), 491-495 (in Chinese).

- Xiang L., Hao L.S., An Y.G., Zhang J. and Liu M.M., 2014. Time-spatial distribution and variational characteristics of rainfall in Hebei Province in 51 years. *Arid Land Geography*, 37(1), 56-65 (in Chinese).
- XJFTEC (in Chinese), 2015. Available at http://www.xjftec.gov.cn/root26/jlzm/201506/t20150611_126304.html.
- Xu P. and Zeng Y.C., 2014. Factors that affect willingness to pay for red wines in China. *Journal of International Consumer Marketing*, 26, 426-439.
- Xu P., Zeng Y.C., Song S.F. and Lone T., 2014. Willingness to pay for red wines in China. *Journal of Wine Research*, 25 (4), 265-280.
- Yang C.M., 2009. Analysis on the service trade between China and ASEAN. *International Journal of Economics and Finance*, 1 (1), 221-224.
- Yang K., Sang J.R., Li Y.C., Su Z.S. and Chen X.J., 2012. Analysis of climatic and extreme features of hail in Ningxia in recent 50 years. *Journal of Arid Meteorology*, 30 (4), 609-614 (in Chinese).
- Yang Y. and Paladino A., 2015. The case of wine: understanding Chinese gift-giving behavior. *Marketing Letters*, 26 (3), 335-361.
- Yearbook of China Alcoholic Drinks Industry (2008-2013) (In Chinese). Publication of China Alcoholic Drinks Industry Association.
- Yearbook of China Alcoholic Drinks Industry (2001) (In Chinese). Publication of China Alcoholic Drinks Industry Association.
- Yohe G. and Tol R. S.J., 2002. Indicators for social and economic coping capacity-moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12 (1), 25-40.
- Yu H., Qi Y.B., Yan Y.B. and Cui P.B., 2015. Research on the International Export Competitiveness of Honey – Taking Anhui Province as an example. *SHS Web of Conferences*, 2015, 14.
- Yu Y., Sun H.H., Goodman S., Chen S.W. and Ma H.Q., 2009. Chinese choices: a survey of wine consumers in Beijing. *International Journal of Wine Business Research*, 21 (2), 155-168.
- Yzarra W., Sanabria J., Caceres H., Solis O. and Lhomme J.P., 2015. Impact of climate change on some grapevine varieties grown in Peru for Pisco production. *Journal international des sciences de la vigne et du vin*, 49, 103-112.

- Zhang H.F., Zhang K.X., Pan L.J. and Qian Q.R., 2013. Characteristics of fog spatial-temporal patterns and atmospheric circulation in last 51 years over Shaanxi Province. *Meteorological Science & Technology*, 41 (4), 702-712 (in Chinese).
- Zhang H.M. and Cao J.J., 2014. Status and trends of Chinese wine industry and sustainable development strategy. *Research of Agricultural Modernization*, 35 (2), 183-187 (In Chinese).
- Zhang H.W., Lin M.M., Xu M.H., Li Y.N., Feng X., Pang T. and Sun J.Y., 2009. Impact and counter measures for climate warming on arid disaster in Henan .*Meteorological Science & Technology*, 32, 239-241 (in Chinese).
- Zhang J., Wang H., Dong X.Y., Zhao X.H., Liang S. and Li H., 2013. Technical and economic assessment on crawled cordon training in the soil-bury over-wintering zone based on the survey data of grape growers in Xiaxian, Shanxi Province. *Journal of Northwest Forestry University*, 28 (1), 94-99 (in Chinese).
- Zhang L., Zhang X.Y., Li H.Y., Yuan H.Y. and Wang J., 2013. Characteristics of frost-free days changes over Ningxia from 1961 to 2010. *Ecology & Environmental Sciences*, 22 (5), 801-805 (in Chinese).
- Zhang M.J., Wang B.L., Wei J.L., Wang S.J., Ma Q. and Li X.F., 2012. Extreme event changes of air temperature in Ningxia in recent 50 years. *Journal of Natural Disasters*, 21 (4), 152-160 (in Chinese).
- Zhang Qiu H.Q., Yuan J.X.(Jessica), Ye B.H.B., Hung K., 2013. Wine tourism phenomena in China: an emerging market. *International Journal of Contemporary Hospitality Management*, 25 (7), 1115-1134.
- Zhang S.P., Zhang X., Wang H.J., Xiang Z. and Du Z.L., 2011. Influence of climate change on precipitation and extreme climate in Shandong Province. *Journal of China Hydrology*, 31 (4), 62-65 (in Chinese).
- Zhang W.C., Zheng J.M. and Ren J.Z., 2013. Climate characteristics of extreme drought events in Yunnan. *Journal of Catastrophology*, 28 (1), 59-64 (in Chinese).
- Zhang Z. and Lin L., 2008. Study on the accumulative temperature and the precipitation in the period of the accumulative temperature in Ningxia. *Agricultural Research in the Arid Areas*, 26 (2), 231-234, 239 (in Chinese).
- Zhao H.R., 2013. Temporal and spatial variations and transition of precipitation in China during 1960-2010. *Tropical Geography*, 33 (4), 414-419 (in Chinese).
- Zhao P., Jones P., Cao L.J., Yan Z.W., Zha S.Y., Zhu Y.N., Yu Y. and Tang G.L., 2014. Trend of surface air temperature in eastern China and associated large-scale climate variability over the last 100 years. *Journal of Climate*, 27 (12), 4693-4703.

- Zhao X.L., Li L.G., Jia Q.Y., Xie Y.B. and Zhou G.S., 2009. Analysis of main agrometeorological disasters from 1988 to 2007 in Liaoning Province. *Journal of Meteorology and Environment*, 25 (2), 33-37 (in Chinese).
- Zheng Q.J. and Wang H.H., 2016. Market power in the Chinese wine industry. *Agribusiness*, 33 (1), 30-42.
- Zheng S.Q. and Saiz A., 2016. Introduction to the special issue China's urbanization and housing market". *Journal of Housing Economics*, 33, 1-1.
- Zhou C.F., Chen N. and Zhang G.P., 2010. Temporal and spatial distribution characteristic and forecast methods research of fog in Ningxia. *Journal of Anhui Agricultural Sciences*, 38 (30), 17074-17078 (in Chinese).

APPENDICES

Appendix 1. Map and wine production/ vineyard by region

Shandong Province: The beginning of the modern wine industry of China

Figure A1.1. Main wine regions of Shandong, China.

Figure A1.2. Wine and grape industry of Shandong, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Ningxia Hui Autonomy: An approach towards high quality wines and Chateaus in the Chinese “Napa”

Figure A1.3. Main wine regions of Ningxia, China.

Figure A1.4. Wine and grape industry of Ningxia, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Henan Province: Wine regions in the Abandoned Yellow River Area in Central China

Figure A1.5. Main wine regions of Henan, China.

Figure A1.6. Wine and grape industry of Henan, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Xinjiang Autonomy: Origin of Chinese wine history and a combination of the East and the West World

Figure A1.7. Main wine regions of Xinjiang, China.

Figure A1.8. Wine and grape industry of Xinjiang, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Hebei Province: The wine cluster development in a historical wine region

Figure A1.9. Main wine regions of Hebei, China.

Figure A1.10 Wine and grape industry of Hebei, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Tianjin Municipality: A fine wine producing area in a modern city near the Chinese Capital

Figure A1.11. Main wine regions of Tianjin, China.

Figure A1.12. Wine and grape industry of Tianjin, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Beijing Municipality: High-quality vineyards and diversified development in in the capital of China

Figure A1.13. Main wine regions of Beijing, China.

Figure A1.14. Wine and grape industry of Beijing, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Gansu Province: Wine industry in the Hexi Corridor Area in the western inland of China

Figure A1.15. Main wine regions of Gansu, China.

Figure A1.16. Wine and grape industry of Gansu, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Shaanxi Province: Wine industry in the historical center of China

Figure A1.17. Main wine regions of Shaanxi, China.

Figure A1.18. Wine and grape industry of Shaanxi, China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Three provinces in the northeast of China (Jilin, Liaoning, Heilongjiang): A vast cultivating areas for “Hill Grape” wines and ice-wines

Figure A1.19. Main wine regions in the northeast China.

Figure A1. 20. and A1.21. Wine and grape industry in the Northeast China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Yunnan Province: High mountain wine region in the South-West China

Figure A1.22. Main wine regions of Yunnan, China.

Figure A1.23. Wine and grape industry in the Northeast China. Source: Yearbook of China Alcoholic Drinks Industry (2008-2013), ASKCI (2016), National Bureau of Statistics of China (2016).

Appendix 2. Geographical, natural, social, historical and cultural conditions in wine regions

Table A2.1 Wine regions, wine grape varieties.

Province	Main wine producing regions	Main wine grape varieties
Shandong	Yantai (Penglai, Laizhou, Longkou), Weihai, Qingdao, Weifang	Chardonnay, Italian Riesling, Cabernet Sauvignon, Cabernet Franc, Cabernet Gernischt
Ningxia	Helan Mountains East Piedmont Region (Shi Zuishan, Yinchuan, Qingtongxia), Wuzhong (Hongwasi)	Cabernet Franc, Cabernet Sauvignon, Merlot, Pinot Noir, Riesling and Cabernet Gernischt
Henan	Shangqiu (Minquan), Kaifeng (Lankao), Zhoukou (Xihua)	Cabernet Franc, Cabernet Sauvignon, Merlot
Xinjiang	Turpan, Hami, Hetian, Changji, Kizilsu, Kshagar, Yili, Aksu	Cabernet Sauvignon, Cabernet Franc, Chardonnay, Chardonnay, Riesling, Cabernet Gernischt
Hebei	Qinhuangdao (Changli), Zhangjiakou (Huailai), Tangshan, Langfang	Cabernet Sauvignon, Merlot, Syrah, Chardonnay, Cabernet Franc
Tianjin	Jixian, Hangu	Cabernet strains, Merlot, Cabernet Franc, Muscat
Beijing	Yanqing, Miyun, Fangshan	Cabernet Sauvignon, Cabernet Gernischt, Chardonnay, Merlot
Gansu	Jiuquan, Zhangye, Wuwei	Cabernet Sauvignon Merlot, le Pinot, Chardonnay
Shaanxi	Xi'an (Huxian), Xinyang (Jingyang), Shangluo (Danfeng)	Cabernet Sauvignon, Cabernet Gernischt, Chardonnay, Riesling
Heilongjiang	Mudanjiang, Jixi	Local Vitis Amurensis
Jilin	Tonghua (Liuhe, Tonghua), Jilin (Jiaohe), Yanbian (Hunchun)	Local Vitis Amurensis, Hybrids of Vitis Vinifera
Liaoning	Fushun(Hengren, Xinbin), Chaoyang	Local Vitis Amurensis, Hybrids of Vitis Vinifera, Cabernet Sauvignon
Yunnan	Diqing (Deqin), Hani (Mile), Wenshan (Qiubei, Wenshan)	Rose Honey, Crystal, Cabernet Gernischt, Chardonnay, Cabernet Sauvignon, Pinot Noir, Syrah

Table A2.2. Geographical and climatic conditions.

Province	Area (km²)	Climate	Annual average temperature (°C)	Annual accumulated temperature (≥ 10 °C)	Frost Free Days	Average Precipitation (mm)
Shandong	158,000	Warm temperate monsoon climate	11-14	3800-4200	174-260	800
Ningxia	66,000	Medium - temperate continental climate	10-15	3200-3700	105-160	200
Henan	167,000	Warm temperate - subtropical, humid - semi-humid monsoon climate	12.1-15.7	4300-5000	189-240	532-1380
Xinjiang	1,664,900	Temperate continental climate	10-13	3500-4000	150-220	150
Hebei	188,800	Semi-arid sub-humid continental monsoon climate	4-13	2800-5200	80-205	350-770
Tianjin	11,760	Temperate monsoon climate	12.3	4116-4428	196-246	520-660
Beijing	16,411	Warm temperate semi - humid continental monsoon climate	12.9	3800-4500	180-200	640

Gansu	454,430	Temperate monsoon climate	0-16	2000-4500	140-180	36.6- 734.9
Shaanxi	205,800	North subtropical climate in the south, Warm temperate climate in the central and Medium - temperate climate in the north	13.7	1945-5000	160-250	340- 1240
Heilongjiang	469,000	Temperate continental monsoon climate	-4-5	1900-2700	400-700	100-160
Jilin	187,400	Temperate continental monsoon climate	2-6	2100-3200	550-910	125-150
Liaoning	148,000	Temperate continental monsoon climate	5.2-11.7	2700-3700	400-969	130-200
Yunnan	394,000	Mainly Plateau monsoon climate with 9 divers climate types	5-24	3500	210-330	720

Table A2.3. Historical, cultural and social conditions.

Province	Historical symbols	Cultural symbol	Wine symbols
Shandong	The first Chinese winery ChangYu Winery since 1892	Confusion culture; –Baijiu culture”	Yantai Observer of OIV; China Geographical Indication
Ningxia	Wine industry since the 1980’s as wine grape base for Chinese big wine brands such as Changyu, GreatWall and Dynasty	Vineyards in desert area; Chinese –Napa”	Ningxia Observer of OIV; Helan Mountains East Piedmont Region; Wine chateau development
Henan	Minquan Winery since 1958	Chinese –Zhongyuan Culture”; Shaolin Temple; –Chinese Kongfu”; –Baijiu culture”	Wine producing in the Abandoned Yellow River Area
Xinjiang	Wine in the –Silk Road” from ancient time; Wine industry since 1959	Diverse culture; Ethic diversity and culture	The largest province of China with vast vineyard area; the largest grape production of China; Xinjiang could produce Red wine, White wine, Sherry, Port wine and many other kinds of fine wines
Hebei	First bottle of white wine of China in 1979 in Huailai in the Great Wall Factory and the first bottle of dry red wine in the in Huailai in the Great Wall Factory in 1983	Yan culture; –Baijiu culture”	One of the biggest wine producing regions of China; China Geographical Indication for wines from Changli and Shacheng; wine cluster consisted of big wine companies such as GreatWall, DiWang, MaoTai and Xiadu

Tianjin	The local wine industry of Tianjin started in the 1980's in the area of Ji Xian as a wine grape producing base mainly for the Dynasty Winery	Treaty port culture; local culture combines with Chinese tradition and foreign tradition for the history since Qing Dynasty	Hangu is famous for Muscat Hamburg Grape and related wine production
Beijing	Modern wine history since 1910 for the Dragon Seal Company;	Brilliant culture as the Chinese Capital for several decades; Several World Heritages such as the Great Wall	Wine chateau development; OIV world-class-standard designed Chateau-Changyu AFIP Global
Gansu	The wine industry of Gansu started in the early 1980's; wine in the –Silk Road” from ancient time	Silk Road culture; Yellow River culture	Wines in the Hexi Corridor with large scale of geographical expansion and divers planting conditions
Shaanxi	The first wine company Danfeng in 1911; in Han Dynasty the Chinese explorer Zhang Qian brought back common grape vine and technology from the Central Asia	Several cultural symbols as the ancient Chinese capital such as the Terracotta Warriors	Several wine grape varieties brought from domestic and international wine regions; the Changyu Rena Chateau
Heilongjiang	The modern alcohol making history began with the Hengdaohezi Winery of 1900 in Heilongjiang	Local culture in cold and snowing environment	Wine grape in cold area
Jilin	The Changbaishan Winery and the Tonghua Winery of Jilin since the 1930's	Local culture in cold and snowing environment; agricultural activities related with hill grape production	Wine grape in cold area; China Geographical Indication for hill grape wines from Tonghua

Liaoning	Wunv Shan Milan Wine Company since 2001based on the Hengren Winery with more than 60 years	Local culture in cold and snowing environment; agricultural activities related with ice-grape production	Wine grape in cold area; China Geographical Indication for ice-wine from Hengren;
Yunnan	The wine grape cultivation history in 1866 around one Catholic Church in the Lancang River Basin; the first modern wine factory Shilin was built around 1980	Ethnic and cultural diversity; high mountain grape cultivation activities	Wines in high mountain regions

Appendix 3. Universities and institutes for wine and grape education and research

Table A3.1. Universities and institutes for wine and grape education and research.

Province	Number of wineries above designed size (2013)	Number of Universities and Institutes for higher education (2016)	Universities and Institutes with the major “Viticulture and Enology Engineering” (2016)	Grape and wine research center (2016)
Shandong	59	154	5; Shandong Agricultural University, Taishan University, Binzhou Medical University, Ludong University, Qingdao Agricultural University	1; Grape and Wine Engineering Research Center of Shandong Academy of Agricultural Sciences
Ningxia	6	14	1; Ningxia University	1; Ningxia Grape and Wine Research Institute
Henan	24	100		1; Alcoholic Research Center of Jiangnan University
Xinjiang	16	32	1; Xinjiang Agricultural University	1; Research Center of Wine in Dry Regions of China
Hebei	20	75		1; Hebei Wine Engineering Technology Research

				Center
Tianjin	4	40		2; Miniature winery research center of Chinese Society for Viticulture, Industrial Research Center of Muscat Grape of China
Beijing	4	79	2; China Agricultural University, Beijing University of Agriculture	2; The Grape and Wine Research Center of the China Agricultural University, Beijing Grape and Wine Engineering Technology Research Center
Gansu	6	30	2; Gansu Agricultural University, He Xi University	1; Gansu Grape Seedling Engineering Technology Research Center
Shaanxi	3	96	1; Northwest Agriculture and Forest University	1; Shaanxi Grape and Wine Engineering Research Center

Heilongjiang	1	69		
Jilin	25	58		2; Wine Research Center of Jilin; Vitis amurensis and Wine Research Center of Jilin
Liaoning	18	97	2; Shenyang Pharmaceutical University, Dalian Polytecnic University	1; Liaoning Grape Brewing Technology Engineering Research Center
Yunnan	4	36	1; Chuxiong Normal University	1; Grape Research Center of Yunnan Academy of Agricultural Sciences

CURRICULUM VITAE

Yuanbo Li (李远博)

lybgood123@163.com

Education

Universidad Politécnica de Madrid (UPM) 2014, 10-2017,11, Madrid, Spain
Ph.D. Agro-Environmental Technology for Sustainable Agriculture (TAPAS) (Area of Agricultural Economics and Management), supported by China Scholarship Council (CSC)

Universidad Politécnica de Madrid (UPM) 2013, 09-2014, 07 Madrid, Spain
Master of Economics Applied to Agriculture, Food and Natural Resources

China Agricultural University (CAU) 2008, 09-2012, 07 Beijing, China
Bachelor of Biology Science
Dual degree of Business Administration

Language Skills

Chinese: Native; English: Advanced; Spanish: Advanced (DELE B2, 2014);
Portuguese (Portugal/ Brazil): Independent (DIPLE B2 2016; CELPE-BRAS B2 2017); Italian:
Basic

Universidad Politécnica de Madrid (UPM) 2017,07, Madrid, Spain
Course of Italian A2

Casa do Brasil 2015, 02-2017, 06, Madrid, Spain
Course of Portuguese and culture of Brazil A1-C1

Instituto Italiano de Cultura 2016, 10-2017, 02, Madrid, Spain
Course of Italian and culture A1

Universidad Politécnica de Madrid (UPM) 2016, 10-2016,12, Madrid, Spain
Course of Spanish applied to science and technology

Faculdade de Letras da Universidade de Lisboa 2016, 08, Lisbon, Portugal
Course of Portuguese and culture of Portugal B2

Agoralingua 2016, 03-2016, 06, Madrid, Spain
Course of Portuguese of Portugal B2

Colegio Hispano Continental 2012, 09-2013, 05 Salamanca, Spain
Course of Spanish and culture A2-C1

Scientific Conferences

In the Ministry of Agriculture and Fisheries, Food and Environment of Spain (MAPAMA):

1. —Seminar Adapting to Climate Change in the Agrarian Sector”, host by the Spanish Office of Climate Change (OECC) and the Research Centre for the Management of Agricultural and Environmental Risks (CEIGRAM) of the Technical University of Madrid (UPM), (20/01/2014).
2. —Viticulture and Climate Change”, host by the Spanish Office of Climate Change (OECC) and the Spanish Wine Federation (FEV), (27/10/2014).
3. —Perspectives on agriculture and Rural development in the America: Latin America and the Caribbean 2015-2016” host by the Inter-American Institute for Cooperation on Agriculture (IICA), Food and Agriculture Organization of the United Nations (FAO) and the Economic Commission for Latin America and the Caribbean of the United Nations (CEPAL), (29/11/2016).
4. —Feeding the World: the innovation feed a sustainable world/the sustainable goals of the United Nations in the Agri-foods”, host by the Ministry of Agriculture and Fisheries, Food and Environment of Spain (MAPAMA), (29/11/2016).
5. —Contribution of Agriculture to the Mitigation of the Effects of Climate Change”, host by the Embassy of the Netherlands in Spain, (26/01/2017).

Seminar in the Botín Foundation of Spain

1. —Agricultural policies realizing its environmental sustainability goals? Lessons and opportunities learnt from the Swiss and the European Common Agricultural Policy”, host by the CEIGRAM, the IMDEA-Agua and the Botín Family Foundation of Spain, (07/04/2017).

Academic Activities

Registered Student Member of the Spanish Association of Agricultural Economists (AEEA)

Registered Member of the American Association of Wine Economists (AAWE)

Registered Member of the European Association of Wine Economist (EuAWE)

Investigator of Comunidad de Estudios Chinos y Latinoamericanos (CECLA)

Scholarship of Collaboration, XI Congress of the Spanish Association of Agricultural Economists (AEEA), Oriuela-Elche, Spain, September, 2017

Scholarship of Collaboration, X Congress of the Spanish Association of Agricultural Economists (AEEA), Cordoba, Spain, September, 2015

Invited Reviewer, Journal of International Food and Agribusiness Marketing (USA), July, September, 2017