Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Diploma Thesis

Foreign trade of Italy - case study of grapes wine

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DIPLOMA THESIS ASSIGNMENT

Bc. Ksenia Shapko

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Economics and Management

Thesis title

Foreign trade of Italy – case study of grapes wine

Objectives of thesis

The main aim of thesis is to conduct the analysis of Italian foreign trade with focus on export of grapes wine. Analyzing trade balance of Italy, identifying determinants influencing Italian export of wine and testing which factors have significant impact on Italian wine export are partial objectives of the thesis.

Methodology

The diploma thesis consists of two main parts (theoretical and analytical). First part is literature review which is processed on a basis of available books and scientific articles connected to history of wine, wine trade, econometric modelling. The content of analytical part of the thesis is connected with Italian trade and construction of one-equation econometric model in order to process the quantitative analysis of Italian export of wine. For this purpose the secondary data are used from the database called Food and Agriculture Organization of the United Nations. Programs Gretl and MS Excel, statistical techniques are implemented for testing, elaboration and to achieve set

objectives.

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Recommended information sources

Crestacimanno Maria and Galati Antonino 2014. Competitiveness of Italian Wines in The International Market. Bulgarian Journal of Agricultural Science 2014, 20 (1): 12–22pp

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Declaration

I declare that I have worked on my diploma thesis titled "Foreign trade of Italy - case study of grapes wine" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break any copyrights.

In Prague on 31.03.2021 _____

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Foreign trade of Italy - case study of grapes wine

Abstract

The diploma thesis is focused on the Italian foreign trade, particularly on grapes wine export in the period of time from 1994 to 2018. The main aim of the thesis is to compose analysis of foreign trade of Italy with the intention of wine export. The work is divided into theoretical and practical part. Theoretical part is devoted to description of wine history, characteristics and classifications, world trade, econometric analysis and its methods. Practical part deals with economic overview of Italy, Italian wine production, exports and analysis of selected determinants. This is followed by Italian wine export volume analysis in the period from 1994 to 2018. One-equation econometric model is composed as a part of analysis within which factors affecting the Italian wine export quantity are determined. Furthermore, model is economically statistically and econometrically verified. Elasticities of exogenous variables, prognoses of endogenous variable for the years 2019,2020,2021 are computed.

Keywords: foreign trade, export, economic analysis, wine, USA, Italy

Zahraniční obchod Itálie – případová studie vývozu hroznového vína

Abstrakt

Diplomová práce je zaměřena na italský zahraniční obchod, zejména na vývoz hroznového vína v letech 1994-2018. Hlavním cílem této diplomové práce je provést analýzu zahraničního obchodu Itálie se zaměřením na vývoz. Práce je rozdělena na dvě části: teoretickou a praktickou. Teoretická část se zabývá obecně charakteristikou, klasifikací, světovým obchodem s vínem, teorií ekonometrické analýzy. Praktická část se věnuje již konkrétně ekonomickému přehledu Itálie, výrobě vína, jeho vývozem, a analýzou vybraných determinantů. Následně je zpracovaná analýza množství vína vyvezeného z Itálie v letech 1994-2018. V rámci analýzy je vytvořen jednorovnicový ekonometrický model, v rámci kterého je určeno, jaké faktory ovlivňují objem vývozu italského vína. Ekonometrický model je zcela ověřen ekonomicky, statisticky a ekonometricky. Pružnosti exogenních proměnných a prognózy endogenní proměnné jsou vypočtené pro následující roky 2019, 2020, 2021.

Klíčová slova: export, zahraniční obchod, ekonomická analýza, víno, USA, Itálie.

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List of abbreviations

AOC ……..Appellation d'origine contrôlée
AVA ……..American Viticultural Area
CAP…… …..Common Agricultural Policy
CMO…….Common Market Organisation
DOC……..Denominazione di Origine Controllata, Appellation of Controlled Origin
DOCG ……..Denominazione di Origine Controllata e Garantita, Appellation of Controlled and Guaranteed Origin
EU……..……European Union
GATT…….....The General Agreement on Tariffs and Trade
GDP……..….Gross Domestic Product
IGT…….Indicazione Geografica Tipica, Typical Geographic Indication
FAOSTAT…..… Food and Agriculture Organization of the United Nations
Mhl…….Million hectoliters
OEC…….…. The Observatory of Economic Complexity
OIV……...… Organization of Vine and Wine Intergovernmental Organization
OLSM…… The Ordinary Least Squares method
PDO……Protected Designation of Origin
QBA ……..Qualitätswein bestimmter Anbaugebiete
VDT……Vino da Tavola or,Table Wine
US……..The United States
USA…….The United States of America
USD….…….…...The United States Dollar
WTO…….……..World Trade Organization
WWTG…… The World Wine Trade Group

1 Introduction

Wine is one of the commonly consumed alcohol beverages traditionally fermented from the grapes juice. The first archaeological and archaeobotanical evidence for grape wine and viniculture, dating to 6000–5800 BC was found on the territory of modern Georgia. To European lands the drink comes with ancient Romans who overtook the tradition after their military campaigns and planted vineyards near garrison towns so wine could be produced locally rather than shipped over long distances. Some of these areas are now world-renowned for wine production. The Romans discovered that burning sulfur candles inside empty wine vessels, kept them fresh and free from a vinegar smell. In medieval Europe, the Roman Catholic Church supported wine because the clergy required it for the Mass. Monks in France made wine for years, aging it in caves. The grapes beverage appeared in The North America with the Franciscan monks' missions in the middle of the 17th century.

Although wine is not considered an essential food for human nutrition, it has always influenced the economy of the wine-producing countries thanks to its symbolic values, full of social and cultural meanings.

World wine production is very outstanding. It is around 292 million hectoliters, considering the last data available referring to report International Organization of Vine and Wine Intergovernmental Organization (OIV) by 2016.

However, the wine market represents a challenging global market with an evident contraposition between the Old World producing countries and the New World ones. The first group is the production leader where only three countries, respectively Italy, France and Spain, contribute to the half of the entire volume, thanks to a long tradition in this sector. But in the Old World consumption is decreasing, differently from the New World, where production and, above all, consumption are increasing, showing interesting numbers. For example, the US is the fourth worlds producer with 23,9 million hectoliters, but the first consuming country with 31,8 million hectoliters, so the biggest importer.

Taking into consideration world wine market changes and new challenges for the main players, diploma thesis deals with the wine market of Italy as one of the biggest producer and exporter and examines the factors influencing on it through building economic model for the certain time range of 1994-2018.

2 Objectives and Methodology

2.1 Objectives

The primary objective of this diploma thesis is to create an analysis of foreign trade of Italy with a focus on export of wine during the time period from 1994 to 2018. Another objective is to examine globally the market players and producers. Analyzing the trade of Italy, identifying factors influencing wine Italian export and testing which factor has a significant influence on Italian wine, are partial objectives of the thesis. Also, the prognosis for the years 2019, 2020,2021 will be computed at the application part of the econometric modelling of wine volume exported from Italy.

Hypotheses:

- If Italian wine export value increases, the Italian wine export quantity increases.
- If the first differences of total population of the US increases, the Italian wine export quantity increases.
- If the US wine production increases, the Italian wine export quantity decreases.
- If Italian wine production increases, the Italian wine export quantity increases.

2.2 Methodology

The diploma thesis is split into theoretical and practical part. Theoretical part is built on information available in scientific articles and books about wine, foreign trade, statistics, and econometric modelling. In this part is going to be an overview of wine its history, diversity of types and origins and the biggest importers and exporters. At the beginning of the analytical part, Italy and its trade of agricultural products are described. Selected determinants of export of wine are introduced and their trend analysis within the period from 1994 to 2018 is performed. In practical part, the one-equation econometric model conforming to economic theory is provided with data obtained from the International Organization of Vine and Wine (OIV) and the Food and Agriculture Organization of the United Nations (FAOSTAT) statistics. The Ordinary Least Squares method is used for the individual parameters' estimation. Gretl and MS Excel programs are applied to verify the regression model. The analytical part conclusion includes the computation of the model for calculations of elasticities and forecasts for the years 2019-2021. For the aims of this thesis, an analysis of data obtained from secondary sources was accomplished.

3 Literature Review

The theoretical background on wine and its utilization, its history and versatility of types, world wine production and consumption as well as the importance of wine industry to the economy is described and estimated in this part. Furthermore, world market, major exporting and importing countries, determinants of wine export, international organizations associated with wine and development of price of wine, trade policies of selected countries are discussed in this part. The literature review of this diploma thesis used secondary data for the research on the basis of available books, articles, reports, statistical bulletins and official documents.

3.1 Wine characteristics

3.1.1 Wine definition

Wine is defined according to the economic commission of the European Union as a product produced only by alcoholic fermentation, in whole or in part, of fresh grapes, ground or whole, or of juice obtained from grapes (Kraus, 2008). The original meaning of the word wine was the designation of the product formed by the water fermentation of sugar yeasts contained in grape juice. But even fermented juices from many other fruits were also sometimes called wine, however, they never achieved such popularity or prestige as grape wines.

The beverage consists of bound acids, mineral and organic acids, nitrogen-containing substances, volatile acids, trace elements, vitamins, carbon dioxide, tannins, aromatic substances, sugar and sulfur dioxide (Kraus et al., 2012).

3.1.2 Wine history

Wine is considered the oldest social drink, which dates its beginning several millennia before our era. Therefore, the first mention of production can be found in areas where there are references to the first human civilizations, especially in the territory of today's Iran, Greece, and Armenia, where the oldest winery in the world was also discovered. Its age is estimated at 6100 years (Owen, 2011). Popularity of wine was also mentioned in the ancient Egypt, where wine was the privilege of noble men and kings, and was also used in religious ceremonies. Most of the wine was grown in the Nile Delta and during the reign of Ramose III. 513 vineyards were counted in Egypt (Unwin, 1996).

Perhaps the greatest contribution to the development of wine culture was made by the ancient Greeks, who contributed not only to the geographical expansion of wine cultivation, but also to the improvement of the technique for growing, collecting, producing wine (Dominé, 2008). Ancient Greeks brought wine to Apennines and to all their colonies in the Mediterranean's. Romans developed overtaken from Greeks technologies and first started to cultivate new varieties of vines and established first wine producing regions, that remain the same till now. They believed that mixture of herbs and wine strengthen health. The Romans identified three first appellations as certain regions gained reputations for their fine wine: Caucinian Falernian, Faustian Falernian, generic Falernian- all harvested in modern territory of Lazio and Campania.

In the Middle Ages wine became a symbol of the Sacred Church. Though some ancient technologies were lost within The Dark Ages close to Renaissance monks turned out to its biggest wine producers and exporters.

In the beginning of 16th century Columbus brought vines to America and first vineyards appeared near Mexico (Unwin, 1996).

With world trade development the industry needed to adapt to up-to-date legal, production and other requirements Besides economic challenges wine production is one of the most profitable business in the world.

3.1.3 Wine production

Vitis vinifera, the common grape vine- liana or vine that reaches 10-20m growing in Subtropics. The choice of grape variety has the greatest impact on the resulting taste of wine. Each variety differs in the size of the berries, the structure of the peel, the color and thickness of the peel, and the sugar content. The amount of sugar in grapes affects the level of alcohol and natural sweetness (Stevenson,1999). The quality of wine is most influenced by the way the vines are grown. For cultivation, it is necessary to properly guide the plant, use spraying, cut, do not neglect flowering and harvest time. The winegrower should make maximum use of location, local conditions and climate when growing vines.

Production steps

1. Harvesting. Production begins on the vineyard with the collection of grapes. For winemakers, the most important thing is to estimate the harvest time. If the winemaker waits for the so-called perfectly ripe grapes, he can produce excellent

wines even in the worst seasons. To achieve perfectly ripe grapes is nothing simple. Harvesting of grapes is carried out from August to November. With prolonged waiting, there is a risk of damage to the harvest by frost, or the grapes may begin to rot. Thus, the winemaker can lose income for the whole year (Grainger et., 2005). Harvesting can be manual or mechanical. Mechanized harvesting is fast and with significantly lower costs, even though the initial costs of acquiring and adapting a vineyard are high. It is disadvantageous for several reasons.

2. Crushing. Once the grapes are sorted in bunches, now it is time to de-stem them and crush them. This crushing process used to be done by feet in the past. The decision about destemming is versatile for red and white wine making. Generally, when making white wine the fruit is only crushed, the stems are then placed in the press with the berries. The presence of stems in the mix facilitates pressing by allowing juice to flow past flattened skins. For red winemaking, stems of the grapes are usually removed before fermentation since the stems have a relatively high tannin content; in addition to tannin, they can also give the wine a vegetal aroma.
3. Pressing is one of the most important processes in the production of wine and has a direct effect on the final product. The goal of pressing is to obtain the largest possible amount of must with minimal impact on quality. The gentler the pressing, the winemaker will get better quality juice and, accordingly, wine. When pressing, as in the case of abrasion, it is important not to break the seeds.
4. Fermentation. Crushing and pressing is followed by the fermentation process. Must naturally starts fermenting within 6 to 12 hours when wild yeast is added to it. But many of winemakers add cultured yeast to the must to predict the outcome and ensure consistency. Fermentation occurs either spontaneously or with the use of cultural yeast. Cultural yeast is a natural yeast bred in laboratories. When using cultural yeast, high temperature is not used, since with it many aromatic substances co-evaporate. The secondary fermentation usually takes place in large stainless-steel vessels with a volume of several cubic meters, oak barrels, or glass demijohns (also referred to as carboys), depending on the goals of the winemakers. Unoaked wine is fermented in a barrel made of stainless steel or other material having no influence in the final taste of the wine. Depending on the desired taste, it could be fermented mainly in stainless steel to be briefly put in oak, or have the complete

fermentation done in stainless steel. Oak could be added as chips used with a non-wooden barrel instead of a fully wooden barrel. This process is mainly used in cheaper wine.

5. Bottling - the settled yeast is separated from the wine to obtain a clear wine. Bottling takes place during maturation, and the process is repeated several times. In some types of wine, bottling does not occur at all.
6. Using preservatives. Sulfur dioxide has two primary actions, firstly it is an anti-microbial agent and secondly an anti-oxidant. In the making of white wine it can be added prior to fermentation and immediately after alcoholic fermentation is complete. If added after alcoholic fermentation it will have the effect of preventing or stopping malolactic fermentation, bacterial spoilage and help protect against the damaging effects of oxygen.
7. Clarification and filtration. Filtration in winemaking is used to accomplish two objectives, clarification, and microbial stabilization. In clarification, large particles that affect the visual appearance of the wine are removed. In microbial stabilization, organisms that affect the stability of the wine are removed therefore reducing the likelihood of re-fermentation or spoilage.
8. Final bottling- filling bottles with wine significantly affects the final quality of the wine. Bottles must be clean, otherwise they can negatively affect the resulting product. If even slight impurities get into the wine, a great wine can be completely spoiled. The wine must taste after opening the bottle as well as before closing it. By bottling, the production of wine is completed (Grainger et., 2005,Horák,2018).

3.1.4 Wine classification and types

According to James Suckling (2021) wine can be fundamentally broken down into a few main types:

- **Red wines** are defined by their dark fruit flavors and tannins (chemical compounds giving bitterness) that make them a great match for food. Oak aging plays a part in many red wines.
- **White wines** tend to be tarter and refreshing than reds, with aromatic notes like flowers, citrus, and orchard fruits. White wines are usually lighter in body and in alcohol.

- **Rosé, sparkling, and fortified wines**. These styles of wine are often paired with a matching occasion: rosé wine during the summer, sparkling wine for special events, and fortified wine after a big meal.

3.1.4.1 Red wine description

Red wines are made from black-skinned grapes that have colorless juice. When the grapes are pressed at the winery the grape skins mix with the juice (called must) to create a reddish-purple beverage. Most famous: Chianti, Primitivo, Nero D'avola-Italy, Rioja-Spain, Syrah-France (Suckling,2021).

Tannins. The grape skins also contain tannins, the compounds responsible for red wine's bitterness and mouth-drying quality. The tannins in red wine act as a preservative, which means that red wines with higher tannin can generally age longer than white wines (which don't have tannin) or red wines with lower tannin. As they age, the tannins and anthocyanins in red wine fall out of suspension, forming sediment at the bottom of the bottle. This sediment can be removed by decanting.

Aging. Many red wines are aged in new oak barrels to add flavors and aromas of sweet baking spice, cocoa, chocolate, and vanilla to the wine. Oak barrel aging also softens the tannin structure of red wine, making the wine taste smoother.

Taste. The flavors and aromas of red wine vary depending on the aging method and grape varieties included. Fruit flavors in red wines include red fruit (like strawberry, raspberry, red cherries, red plum, pomegranate, cranberry), black fruit (like black cherry, black plum, blackberry, blackcurrant), and blue fruit (blueberry). Warmer climates produce wines with riper, jammier fruit qualities. In the Old World, earthy aromas like potting soil, wet leaves, and barnyard are common.

Varietals. Red wines can be varietal wines made from a single type of red grape. These wines will be labeled with the name of the grape (more common in New World wine regions like the USA, South America, Australia and New Zealand, and South Africa) or the name of the wine's appellation, like Burgundy. Some grapes have different names depending on where they are grown, like French syrah, which is known as shiraz in Australia (Suckling,2021).

3.1.4.2 White wine description

White wines are made from green-skinned grapes whose juice is also colorless. For white wines, the grape skins are removed from the must before fermentation. Acid structure and aroma are more important in white wines because they lack the tannins that red wines have from contact with the grape skins. Most famous: Sauvignon Blanc, Riesling, Chardonnay-France, Italy, Germany, the USA (Suckling,2021).

Aging. White wines are more likely to be aged in stainless steel barrels, a technique which maintains their fresh aromatics. Oak aging can add aromas and flavors of vanilla, baking spices, coconut, and caramel to white wines.

Varietals. White wines are most often varietal wines made from one grape variety. Like red wines, they will commonly be labelled by variety in the New World and by appellation in the Old World. White wines made from a blend of grapes are more common in certain areas, including Spain, Bordeaux, and France's southern Rhône.

Taste. White wines can range from dry to sweet in style. Classic dry white wines include Italian pinot grigio, French muscadet, or Austrian grüner veltliner. Some producers make dry wine and sweet wine from the same grapes. In Germany, riesling grapes are harvested at varying levels of ripeness to make different types of wine, some sweet, some dry, from the same vineyard. In France's Loire Valley, producers growing chenin blanc grapes will make dry sparkling wine in cool vintages and sweet dessert wine in warm vintages.

Aroma. Some white wine grapes, including gewürztraminer, muscat, riesling, and pinot gris, are considered aromatic, meaning they have powerful fruit and floral aromas. Semi-aromatic grapes include sauvignon blanc, and albariño from Spain. Neutral grapes, like chardonnay, have less distinct aromas but respond well to winemaking processes like oak aging or sparkling winemaking. Many white wines also have stone fruit aromas like peach, nectarine, apricot, apple, and pear. Floral, herbaceous, and mineral are common non-fruit descriptors for white wines.

Climate. The flavors and aromas of white wines vary based on the grape and the climate they are from. Warmer climates tend to produce riper tropical fruit aromas like guava, passionfruit, pineapple, and melon. Citrus, like lemon, lime, grapefruit, and orange dominate in cool climate wine regions (Suckling,2021).

3.1.4.3 Rosé wine description

Rosé wines are made from red grapes, but the grape skins are removed from the must after a short period of maceration (usually less than 24 hours). The skins give the wine its pink color but do not impart much tannin. Rosé wines can have flavors common to red wines, like strawberry, cherry, and raspberry, and also more typical white wine flavors, like citrus and tropical fruit (Suckling,2021).

3.1.4.4 Sparkling wine description

Sparkling wines can be white, rosé, or red in color. They can be made from any grape types, depending on the appellation rules of the area where they are made. Sparkling wines can be single-varietal wines or made from a mix of grapes. Sugar content in sparkling wines varies from dry (like brut nature Champagne) to sweet (like Moscato d'Asti). Most sparkling wines contain a few grams of sugar to balance their high acidity. Two of the most well-known sparkling wines are Champagne and prosecco.

Champagne can be a varietal wine (made from one variety, such as chardonnay, pinot noir, or pinot meunier) or a blended wine, made from a blend of the permitted grapes. It is made in the méthode champenoise, also called the traditional method, which involves a primary alcoholic fermentation followed by a secondary fermentation in the bottle to produce its bubbles.

Prosecco, which is always a varietal wine made from the glera grape, is made via the Charmat method, where the secondary fermentation happens in a large, closed tank before the wine is bottled (Suckling,2021).

3.1.4.5 Fortified wine description

Fortified wines (called *vin de liqueur* in Europe) are made by adding distilled grape spirit to fully- or partially fermented wine. Most fortified wines are sweet, except for certain dry styles of sherry. Fortified wines include Port, Madeira, Marsala, macvin, and the *vin doux naturels* of southern France. Fortified wines like vermouth are sometimes aromatized with herbs and botanicals. Fortified wines are higher in alcohol than other types of wine (Suckling,2021).

3.2 Wine production regulations

3.2.1 International appellation system

A wine appellation system is a regulations list that prescript how wine is classified, labelled and, in some cases, produced, and provides information to consumers concerning where the grapes used to produce the wine were grown (Maher, 2001).

The most known wine appellation systems are the French AOC, the German QBA, the Italian DOCG and DOC and the American AVA:

- French AOC wines are named after the regions in which they are produced
- The German QBA designates region and grape ripeness
- The two Italian appellations designate wines by place, grape, both place and grape or name
- The American appellation only specifies geographic origin of the wine

Other wine appellation systems around the world indicate where grapes were grown.

3.2.2 European Union wine regulations

European Union wine regulations are common legislation related to wine existing within the European Union, forming a part of the Common Agricultural Policy (CAP) of EU (first introduced in 1962 since Common Market Organization (CMO)), and regulate such things as the maximum vineyard surface allowed to individual EU member states, allowed winemaking processes and principles for classification of wine and labelling. The wine regulations exist to control total production to combat overproduction of wine and to provide an underlying reason to protected designations of origin (PDOs), among other things. The EU wine regulations form a scope for the wine laws of the European Union member states. Since national wine laws have a much longer history than the EU wine regulations, the EU regulations have been intended to accommodate existing regulations of several member states (European Commission,2020).

Wine support programs

The wine support programs implemented under the 2008 wine CMO reform included 13 measures at the beginning. The 2013 CMO reform finishes to support for potable alcohol distillation, crisis distillation and beneficiation by use of concentrated must.

In indemnity, it introduced as innovation measure in the wine sphere aiming at the new products, development of processes and technologies concerning the wine products. Moreover, it spreads promotion measures in EU countries, with an aim of informing consumers about the responsible consumption of wine and about the EU systems covering origin designations and geographical indications.

It also extended the reorganization and conversion of vineyards to replanting of vineyards where it is necessary following obligatory excavation for phytosanitary or health reasons.

Wine-producing EU countries may currently offer support for the following actions: informing consumers about the responsible consumption and EU quality schemes, promotion in non-EU countries, restructuring and conversion of vineyards including replanting for phytosanitary or health reasons, investments in enterprises, mutual funds, green harvesting, harvest insurance, innovation aiming at the development of new products, technologies, and processes by-product distillation.

The yearly allocations from the EU budget are fixed by EU country, considering the transfer for several EU countries to the single payment scheme (European Commission,2020).

3.2.2.1 Classification and labelling

The wines produced within EU are split into two quality groups: Table wines and Quality Wines Produced in Specified Regions, where the last is the higher category.

These types are translated into different national wine classification for each member state. Thus, some member states may have more than two levels of classification, but all national levels correspond to either table wines or quality wines produced in specified regions and are subject to the common minimum standards set out in the EU wine regulations (European Commision,2002).

- Labelling information is split into mandatory and optional information. Information not listed as part of either of these two categories may not be displayed on the bottle.
- The labelling regulations contain requirements for how grape varieties and vintage may be mentioned on the label.
- Requirements and procedures for protected designations of origin for wine.

o Label indications of sweetness – from dry to sweet – are regulated in terms of which residual sugar levels they correspond to.

o Certain traditional bottle types may only be used for wines of certain origins; these are the Bocksbeutel and the Clavelin, as well as the Flûte d'Alsace, the use of which is only regulated within France (European Council,2008).

3.2.2.2 Winemaking practices

The regulations define wine as "the product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must". Furthermore, wine can only be made from grape sorts listed as allowed, and only those vine varieties may be planted for commercial purposes. Each EU member state draws up such lists of varieties, which may only contain purebred Vitis vinifera varieties, and certain crosses between Vitis vinifera and other species of the Vitis genus (Council Regulation,2008). Thus, uncrossed so-called American vines, such as Vitis labrusca, may not be used for wine and are not allowed in EU vineyards.

Some practices also depend on the vineyard location, since normal challenges to winemakers in colder or hotter climates are somewhat different. The defined European Union wine growing zones are used to regulate these practices, but some freedom is given for authorizing deflections in vintages of exceptional climatic conditions.

- Minimum grapes ripeness to be used for wine.
- Minimum alcohol content for wine, and maximum alcohol content of non-fortified wine.
- Chaptalization and other forms of enrichment, the term used by the regulations. An upper limit is set, dependent on the wine growing zone, both on the extent of chaptalization and the maximum alcohol level that may be received by chaptalization.
- Deacidification, dependent on the wine growing zone.
- Sweet reserve use(often referred to by its German name, Süßreserve), which is more restricted if the wine is also chaptalized.

The amount of sulfur dioxide in the wine, the allowable amount of which depends on the color and sweetness of wine (European Commission, 2002).

3.2.2.3 The EU current wine legislation

EU regulation 2008/479 – establishing Common organization of the market in wine (COM)

EU regulation 1308/2013 – establishing a common organization of the markets in agricultural products, repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007

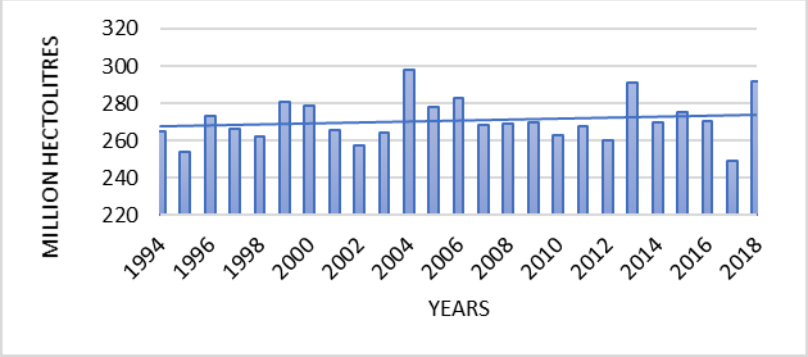
EU regulation 1306/2013 – on the financing, monitoring management of the common agricultural policy.

The reform adopted by the EU aimed at harmonizing, streamlining, simplifying the provisions of the CAP adopted in the course of the previous reforms.

3.3 World wine production and consumption

Wine is one of the world most popular alcoholic beverages, sometimes even a cultural attribute, being grown in many countries. According to the OIV 2019 Statistical Report on World Vitiviniculture for 8 years in a row the US remains the most wine drinking country with 33 million hectoliters-13% of total 246 million hectoliters, the second is France with 26 million hectoliters-11%, Italy consumes 22.4 million hectoliters-9%. Interesting is that though the States take this leadership, they are just on 18th place with consumption per capita -12.4 liters. Portugal that is on 11th place by total consumption is heading the list of consumption per capita-62.1 liter. Each Italian enjoys 43.6 liters a year and French 50.2 liters.

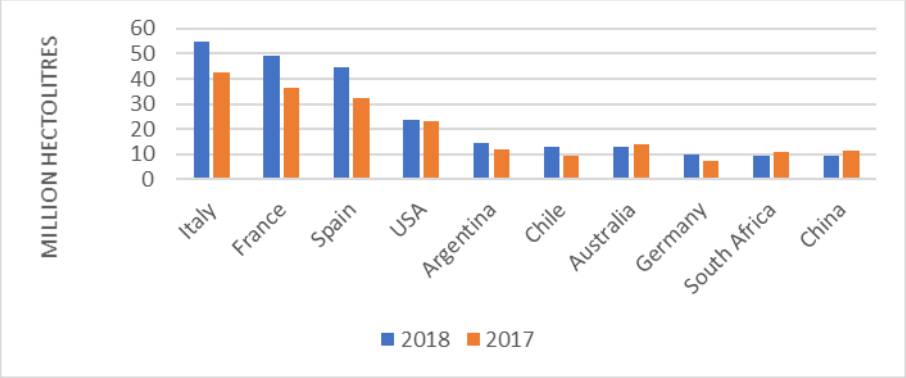
Figure 1: World wine production volume in million hectoliters (Mhl), 1994-2018



Source: own elaboration, OIV, Statistical Report on World Vitiviniculture (2019)

Wine production depends on many factors, most important are grapes harvest and production costs. In 2018 harvest reached record of 292.3 million hectoliters, which is biggest wine harvest in 15 years, since 2004/2005. It is a very big increase of 42.5 Million hectoliters from 2017. However, 2017 was the smallest harvest recorded in an even longer time, due mainly to weather issues in Europe that led to much reduced yields. From the figure 1 is visible that the worst years though were 1994 and 2017.The three biggest wine producers, Italy, France and Spain all made big harvests, each of them increased the production with between 22% and 26%, from the figure 2. Italy remains the lead, by quite a big margin ahead of France, as the biggest wine producing country. Historically the two have battled for the top spot but Italy seems to have subscribed to it the last few years, maybe thanks to a more dynamic view on new plantings.

Figure 2:World wine production by country, million hectoliters (Mhl) in 2017-2018



Source: own elaboration, OIV (2019)

In total, the European Union produced 181.9 million hectoliters, which is then 62% of the world total. The trend declining and it may be just a matter of time before the rest of the world passes Europe. One reason for this is, of course, the very restrictive regulations regarding plantations makes changes in Europe very slow. It is much easier to plant new vineyards, if one can find a demand, in countries outside of Europe. Observing the five countries following the top three in 2018: in falling order, US, Argentina, Chile, Australia, they account for 25% of world production.

3.4 World wine market

In economic theory, the market is the place where demand and supply confront, and the result of this collision is the price and traded volume (Macáková, 2010). The causes of

foreign trade can be identified by the reply to the question of why the countries trade among themselves and what advantages they bring. The respond can be that, in order of the natural resources' natural disparity, the facilities of different countries and other factors, each country is able to produce other products and services that other countries cannot and vice versa. This production is then the subject of foreign trade. The cause for foreign trade may, therefore, have differences in production conditions. Each country is alternatively equipped with natural resources and other climatic and geographic conditions affecting the country's consumption and production capability. It can, therefore, occur that for the particular commodity production, home countries will not have a adequate supply of raw material, which then becomes a element of imports. The second variant is that the country is equipped with a raw material base, but conversely, it does not have the means to process it, and thus it will become an export item (Carpenter, et al., 2012).

3.4.1 Wine trade

Wine is an essential commodity that is produced in 73 countries in the world. It also creates irreplaceable part of the global food market. From the perspective of the history of goods exchanges, the beverage is one of the longest traded commodities at all, which is traded on the open market At around the world, about 67% of the wine produced is consumed directly in the country where it is produced, which means that even minimal changes in domestic consumption have a substantial impact on the price. There are also numerous barriers to trade in the wine market, such as import quotas, duties and other state regulations (Bernetti et al. 2006). The international wine trade has experienced considerable growth: in the 1960s the exported share of global wine production was 10% and in 1990 this share had reached only 15%. However, by the year 2000the exported production had reached 25% of global production and more than 30% in 2010 (Mariani, et al., 2012). In 2018 the global production reached 292 million hectoliters while the trade volume was 108 million hectoliters, with the grow up to 3% since 2014 and almost doubled since 2000.

3.4.2 Major exporters and importers of wine

World trade balance is always represented by import, export by volume and value. Analyzing these constrains gives the understanding country positioning in the particular market niche.

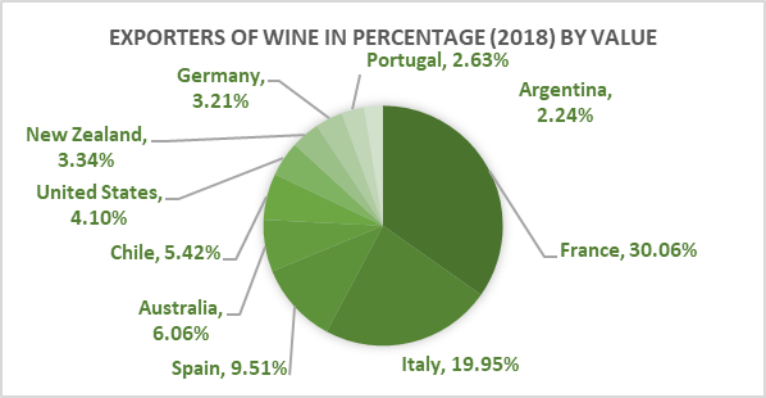
2018 brought many interesting trends to the world of wine. Spain became the top exporter by volume with 21 million hectoliters, though its 3rd by value with gained 3.5 billion US dollars after France-11.1 billion and Italy -7.4 billion, that are second with 14.1 million hectoliters and first with 19.7 million hectoliters relatively. Figure 3 represents the share of exports in percentages and table 1 the values. Though the "New world" members are succeeding with in exports from Argentina (+23.5%) and Australia (+10.2%) in a year. France gets a big boost in value from its expensive champagnes, half of which is exported (some 150 million bottles roughly), with a very high average price. Spain exports much of cheap bulk wine, much of it to France. American wines are expensive, the highest average per-bottle export prices for still wines. New Zealand wines are also expensive, the second highest average for still wines. But the total value for both the US and New Zealand drowned in 2018 (-6.2% and -4.6% respectively).

Table 1: Major wine exporters

	Volume (Mhl)		Value (m USD)	
	2017	2018	2017	2018
Spain	23	21	3,233	3,441
Italy	21.5	19.7	6,726	7,255
France	14.9	14.1	10,264	11,016
Chile	9.8	9.3	2,003	1,982
Australia	7.8	8.6	2,003	2,158
South Africa	4.5	4.2	714	782
Germany	3.8	3.8	1,137	1,218
United States	3.5	3.5	1,477	1,447
Portugal	3	3	881	949
Argentina	2.2	2.8	806	795
New Zealand	2.6	2.6	1,198	1,193

Source: own elaboration OEC, OIV(2019)

Figure 3: Major wine exporters by value in percentage 2018



Source: own elaboration, OIV(2019)

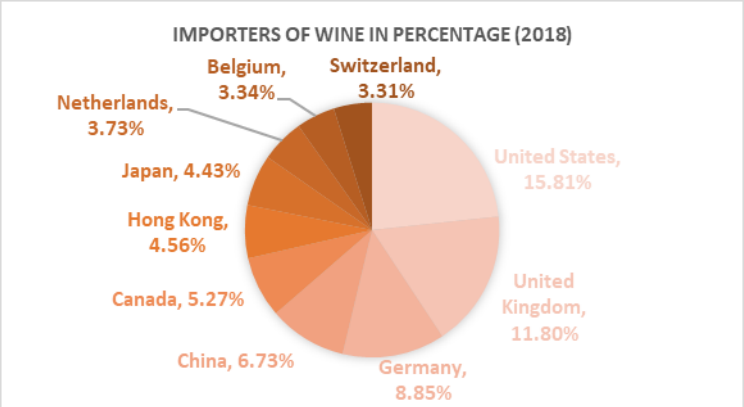
The top consumers (import value is greater than 2 million hectoliters) are shown below in the table 2 and figure 4.

Table 2: Major wine importers

		Volume (Mhl)		Value (m USD)	
		2017	2018	2017	2018
Germany		15.2	14.5	2,866	3,026
United Kingdom		13.3	13.2	3,867	4,056
United States		12.1	11.5	5,834	6,061
China		7.5	6.9	2,748	2,791
France		7.3	6.2	840	995
Canada		4.2	4.2	1,860	1,956
Netherlands		4.4	4.2	1,279	1,343
Russia		4.5	4.1	1,457	1,417
Belgium		3.1	3	1,059	1,127
Japan		2.8	2.6	1,572	1,640

Source: own elaboration, OEC,OIV(2019)

Figure 4: Major wine importers by value in percentage 2018



Source: own elaboration, OIV, OEC(2019)

Describing the world import we see that it decreases in volume but not the value, due to inflation and new barriers, new situation with Brexit for the United Kingdom and agreements between the EU and the US. The most expensive wine is bought by Americans while French people on low-cost wines, which is probably because a big portion of it is bulk wine from Spain, as they have their own quality production on the track. German imports obviously focus on low-cost wines. It is a well-known fact that the German market is focused on "budget" wines. As opposed to what many people think, China is not mainly buying very expensive wines and their average import price is average, in an international comparison.

3.4.3 Development of price of wine

Product price determination was never an easy calculation, especially for alcoholic beverages and wine, but there are always common factors influencing on selling price (Chiffoleau and Laporte,2006):

- Product quantity and wine-making methods

It is easy to understand that one particularly important aspect of determining the selling price of wine is production quantity and production costs. Each harvest has its own fixed costs, which cannot be reduced, and aren't directly related to the quantity of bottled products.

Winemaking techniques also directly affect prices. Using quality-oriented techniques invariably leads to higher costs than yield-oriented methods, because these products would be available on the market in scant quantities.

- Origin, history, critical acclaim

The big share of the price is determined by a combination of territorial origin, critical acclaim, and the history of the product and the wine cellar. Certain parts of the world are well suitable for producing quality wine for historical reasons, and because of good climatic conditions. Some classic Italian examples include the Piedmontese Langhe and its Barolo wine, Toscana and its Chianti Classico.

- Supply and demand

As with all semi-luxury or luxury items, supply and demand is a significant factor in determining wine prices. Scarcity is a highly effective catalyst for a wine's market value, provided the wine has an existing reputation to build on. Salient examples include 12 bottles of Domaine de la Romanée-Conti, Romanée-Conti 1988 sold for 362,880 US dollars at Christie's auction in 2018, 6 litter bottle of Screaming Eagle Cabernet Sauvignon 1992 sold at Napa valley charity auction for 500,000 US dollars in 2000. Though the rareness of wine attracts wine wealthy collectors and gourmets, the demand for ordinary wine, that could be found in specialized shops and wineries is also huge. The social factor in this case is very important as in many cultures, for example in Italy Vino di Tavola presents commonly for family lunch and dinner meals.

- Economic factor

The economic conditions of a country, or the world as a whole, also have a strong bearing on the wine market. Whether for investment or consumption, wine prices traditionally mirror local and global economic trends. A good example is the worldwide financial recession of 2008 and 2009.

- Trade policies

Trade agreements play not the last role in price structure, as they settle the trade flows upon accepted tariffs between the countries. The main regulations are applied by international trade organizations, as WTO.

3.4.4 International organizations and trade policies in world wine market

The World Trade Organization is governed by the agreements on trade rules and tariff concessions negotiated under the Uruguay round of the GATT (general agreement on tariffs and trade) between 1986 and 1994. By these agreements, which form the legal basis for the rules of international trade, the member states undertake to comply. The WTO aims to achieve full liberalization of international trade relations and to build a universal international legal system. The WTO is based on the principles of trade without discrimination, trade liberalization, predictability, fair competition, and development (Kalínská et al., 2010).

International Organisation of Vine and Wine (OIV)- substitutes the International Vine and Wine Office, was established by the Agreement of 3 April 2001.The OIV is an intergovernmental organization of a scientific and technical nature of recognized authority for its works with wine, vines, wine-based beverages, raisins, table grapes and other vine-based products(OIV). In the scope of its competence, the objectives shall be as follows:

a) to inform its representatives of measures whereby the concerns of producers and consumers, and other players in the wine and vine products sector may be considered

b) to assist international organizations, both non-governmental and intergovernmental, mainly those which carry out standardization activities;

c) to promote international harmonization of existing practices and standards, as necessary, to the preparation of new international norms in order to develop the conditions for producing and marketing vine and wine products, and to help ensuring that the interests of consumers are taken into account (OIV).

The World Wine Trade Group (WWTG) is a group of industry and government representatives from the wine-producing countries of Argentina, Australia, New Zealand, Canada, South Africa, Chile, Georgia the United States, and Uruguay. Founded in 1998, the Group aims to contribute international trade in wine through information sharing, discussion of regulatory issues in markets of wine, and actions for the amending of trade barriers. The Group is managed by principles that encourage trade in wine and protect consumers, benefiting both wine importing and exporting countries. The WWTG identifies the specific characteristics of each regulatory system and works towards the joint practices admission and labelling rather than imposing a single regulatory attitude.

Italian Trade Commission – Wine & Food Centre is the government organization which promotes the internationalization of companies in Italy, together strategies of the Ministry of Economic Development. ICE provides support, advice, information to local and foreign companies.

In addition to its headquarters in Rome, ICE works around the world from a large network of Trade Promotion Offices connected to Italian consulates and embassies working closely with local authorities and businesses.

ICE has a extensive range of services worldwide helping foreign businesses and Italian to connect with each other: identification of possible business partners, trade delegation visits Italy, bilateral trade meetings with Italian companies, official participation in local fairs and exhibitions, forums and seminars with Italian experts.

Over the past century, the growth of the international wine trade has been fostered by the trade liberalization process. This process has been brought about both by the establishing of economic integrated areas (the most relevant to the wine trade are the EU, NAFTA, MERCOSUR and ANZCERTA3) where tariffs and, in varying degrees, non-tariff barriers have been removed and by the progress of the World Trade Organization (WTO) towards a general and progressive reduction of tariffs and more effective regulation of non-tariff barriers.

Tariffs on wine, depending on the importing countries, could be expressed as: ad valorem, with one rate or different rates according to the price level of the product; specific volume-based (per litre); specific alcohol-based (alcoholic strength); a mixed of ad valorem and specific. They could differ according to the various types of wine (still bottled or bulk, sparkling wine). Specific tariffs based on volume are the most popular in Europe and North America, whereas ad valorem tariffs are used in the Asia-Pacific region with the exception of Japan and Malaysia (Anderson, 2018). Due to the presence of specific tariffs, evaluating and comparing the level of market protection for wine requires complex estimates. According to the literature, tariff protection is quite low in countries which have long been involved in importing wine, although the main new world exporters complain that the EU has a higher tariff level. By contrast, the tariff level is high in countries which have recently experienced growing wine imports, i.e. mainly Asian markets (Anderson, 2010).

Non-tariff barriers refer to the wide and heterogeneous range of policy interventions other than border tariffs that affect and distort trade in goods, services and factors of production (Deardorff and Stern, 1998). In this range, particularly critical are the technical barriers to trade which have been regulated by the WTO through two agreements (Agreement on Technical Barriers to Trade and the Sanitary and Phytosanitary Agreement) on the basis of common principles of harmonization, equivalence and mutual recognition (Commonwealth Secretariat, International Trade Centre, 1999). Implementation of such WTO regulations has given rise to some critical issues and has not proved effective at preventing the increase in technical barriers.

In the 21st century as the fast-growing new wine importers are highly protected by tariffs and are developing wine market regulations (in some cases even to protect the domestic wine industry in its infancy) which could prove to be non-tariff barriers, the issue of the level and types of barriers to trade is assuming new importance. Indeed, trade barriers could seriously constrain the growth potential of world wine imports, and processes of non-uniform reduction could affect the competitive advantages of suppliers (Hussain et al., 2008).

With reference to the reduction in non-tariff barriers in the wine trade, a major initiative is the World Wine Trade Group (WWTG) which currently includes 8 countries long involved in the wine business. These countries have implemented an effective approach, based on WTO ideas of harmonization and mutual recognition, to removing technical barriers (wine labelling regulations, wine-making practices, maximum residue limits of agrichemicals) to the wine trade among its members, attaining some important agreements, and are now trying to involve fast-growing importing countries.

Increased complexity of the regulatory framework of the market, related to trade barriers and so-called private standards. The countries which are the new fast-growing wine importers are the most protected by tariffs. Further, wine market technical regulations are being developed which could prove to be non-tariff barriers. Indeed, the rising interest in the growth of domestic wine production could lead some of these countries to maintain (or even increase) protectionism and support to local producers.

Given that at the multilateral level the Doha Round of WTO is encircled by several difficulties, the involvement in the WWTG of a growing number of countries and the progress in establishing Preferential Trade Agreements undoubtedly represent progress in

trade liberalization but are likely to create distortions in competition (Mariani et al., 2012). The international wine trade is constrained not only by national technical regulations resulting in non-tariff barriers but also by private standards. In the last decade there has been intensive development of private standards, initially mainly targeting food safety and in recent years mainly related to social and environmental aspects. The standards can be set by individual firms (predominantly large retailers), collective national organizations, or international standards organizations. Private standards are voluntary, but if they are required by large retailers and/or large companies, they become de facto mandatory for suppliers. Private standards do not fall within the rules of the WTO. Indeed, they are a matter of increasing concern for the effects that they may have upon access to international markets, especially for small businesses (Henson and Humphrey, 2009).

3.5 Econometric analysis

Econometric analysis is a mixture of econometric theory, mathematics, statistics, and information technology for search, determination, and empirical verification. The methodology of econometric analysis is settled on a multistep abstraction relying on the qualitative analysis theory of the examined economic problem. The process is split into four phases: specification, quantification, verification, and application (Hušek, 2007).

3.5.1 Econometric model

An econometric model portrays a real phenomenon which entity is the real process or system. The model predicts, explains and enables the management of a given real event. Mathematic models are usually used to demonstrate the real economic structure of the equations system, in econometrics (Tvrdoň, 2001).

Econometric models can contain one or more than one equation, depending on the research aim. There are versatile model types, such as single equation models, multiple-equation models or simultaneous-equation models (Gujarati, 2003).

Further steps demonstrate the econometric model construction principle:

1. Economic model creation
2. Econometric model composition
3. Gathering data and their verification
4. Econometric model parameter estimation

5. Verification of the model

6. Econometric model application or rejection (Gujarati, 2003).

3.5.1.1 Economic model creation

It is essential to frame the economic model of the investigated reality that catches relations among economic variables and helps in visualizing economic theory in reality (Gujarati, 2003).

The first phase is the creation of the economic model in which the examined object is identified, the selection and the description of the variables are used. The fundamental hypothesis or assertion about the behavior of economic variables or social phenomena is defined. The inference of this step is an economic model that simplifies the investigated problem (Hančlová, 2012). According to (Tvrdoň, 2001) there are three essential steps when outlining the economic model:

1. Defining the study subject, which is expressed as an endogenous variable in the model

2. Selection of suitable exogenous variables

3. Setting a functional form of the model

Economic model has to perform specification assumption, such as the inclusion of relevant model variables, irrelevant model variables elimination, the compilation of an appropriate functional model form, and no simultaneous relationship between the exogenous variables or between the endogenous and exogenous variables. Thus, a defined economic model is used for the contradiction of economic theory with reality (Čechura,et al., 2017).

$$y = f(x_1,x_2,x_3,x_k) \qquad (1)$$

where:

y … dependent/ explained/endogenous/ variable

$x_{1\text{-}k}$ … independent/ explanatory/exogenous/ variables

3.5.1.2 Econometric model composition

At the end of the model formulation step, an econometric model is created by denoting a random component ut, which will settle hypotheses on the nature of the disorder distribution. Thus, the deterministic model becomes stochastic (Hančlová, 2012). The

econometric model contains a random component that contains the impact of all other variables on dependent variables that are not comprised in the model. It also contains measurement of errors and distortions resulting from inappropriate type of the function, related to as the letter u (Čechura, et al., 2017). The econometric model has 3 core differences from the economic model. The econometric model includes a stochastic variable, includes parameters and has specific functional form (Hušek, 2007).

The econometric model can be mathematically expressed as following:

$$\beta_{11}y_{1t} = \gamma_{11}x_{1t} + \gamma_{12}x_{2t} + \cdots + \gamma_{1k}x_{kt} + u_t \qquad (2)$$

where:

β … parameter of endogenous variable

γ … parameter of exogenous variable

y_t … endogenous variable at time t

x_{1t-kt} …exogenous variables at time t

u_t … random/stochastic component

The specification is the model formulation and construction. It is a combination of a theoretical model with accessible information from economic reality. When indicating a model, it is often required to use a variant detail and, on the basis of the model, experiment with choosing the most suitable model shape. The essential points of the specification are the right choice of the model mathematical form, classification and clarification of all variables which are included in the econometric model, and appraisement of size and direction of estimated parameters of the econometric model (Fiala, 2008).

1. Right selection of mathematical form of the model

One-equation model has the character of a stochastic regression model, outlines one explained endogenous variable depending on one or more explanatory, exogenous or lagged endogenous variables and the random component (Hušek, 2007).

Multiple-equation model includes more than one endogenous variables. Each endogenous model variable has its own equation and each equation can be examined as a single equation model (Hušek, 2007).

Simultaneous model, includes interrelationships between variables, can have both stochastic and non-chaotic equations (Seddidhi, et al., 2000). This type of model is settled on the fact that the endogenous variables that are not lagged show up in the model

individual equations in a simultaneous role, both as explanatory and explanatory variables, and are designed to address all equations at one time (Hušek, 2007).

2. Classification and determination of all variables which are included in the econometric model.

Endogenous variables, designated by y, are interpreted by the model, that is why they are called as explained variables. Their values are generated by the model. **Exogenous variables,** are variables that interpret endogenous variables, so they are called explanatory variables, are marked as x. The model expresses the external environment that is identified by significant relations dynamics between variables, so static models are usually not substantial, and the model needs to be dynamized, using lagged variables, both endogenous and exogenous. A set of exogenous variables lagged exogenous variables, as well as lagged variables are called as predetermined variables (Čechura, et al., 2017).

Random variables, each equation has only one random component. It is composed of three components that act at once and cannot be allocated from each other. It is the action of all factors on endogenous conversions that were not included or ignored in the model, as well as the empirical errors that arise when measuring the variables used, as well as the errors resulting from the simplification of the shape of the respective function. The random variable can be computed as the deviation of the actual value of the endogenous variable from its theoretical value (Hušek, 2007; Tvrdoň, 2001).

3. Appraisement of size and direction of estimated parameters of the econometric model

Economic theory ascertain the signs of parameters. Based on that, the decision of specific parameter sign can be defined as positive or negative. It is also possible to find the interval of expected values of the estimated parameters (Hušek, 2007).

3.5.1.3 Gathering data and their verification

Model quantification is used to assess numerical values of parameter. This phase begins by collecting and editing statistical data. Data are typically the nature of quantitative statistical observations of the non-experimental nature. They are not uniquely generated for estimation of the model. They can be of a versatile kind, such as panel, time series data or cross-sectional, that are most often used. Quality of the results of the econometric analysis impacts not only the quality of the obtained data but also the econometric model

specification and verification. These two phases need not only the knowledge of the relating economic theory but also the knowledge and experience in the functioning of the particular studied system (Hušek, 2007).

There are 3 categories of data in econometrics: time series, cross-sectional data and panel data (Krkošková, et al., 2010):

- **Time series** give information about the numerical values of variables in sequential periods of diverse lengths, most often the yearly data with which it is most often used (the value is recorded regularly every year). In addition, they are quarterly, monthly or daily data (Krkošková, et al., 2010; Hušek, 2007). The time index t is used for marking, and the symbol T is used for the total number of observations (Cipra, 2008).Time series can be stationary and non-stationary, they are considered strictly stationary if the data properties remain unaffected by a shift in the time origin or time series is covariance stationary when it has a finite mean and variance (Enders, 2010). For regression analysis to be performed, data has to be stationary.
- **Cross-sectional data** represent variables observations in the same period, but in more subjects, cross-sectional data have the character of spatial data (Hušek, 2007). For cross-sectional data, it is not essential to arrange them so that they can be sorted arbitrarily (Cipra, 2008).
- **Panel data** is an essential type of statistical data, which is produced by repeating a sample survey with a predefined set of questions for the same group of respondents in diverse periods (Hušek, 2007).

3.5.1.4 Econometric model parameter estimation

When choosing an appropriate method, it is necessary to take into account the model aim and character, and the demands of the method on the quality and quantity of the data. The most well-known parameter estimation methods include (Fiala, 2008):

a) Ordinary Least Square method
b) Generalized Least Squares method
c) Two-stage Least Squares method

The most used is the Ordinary Least Square method (OLSM) which will be discussed in details in the chapter “Ordinary Least Square method”.

3.5.1.5 Verification of the model

If the model is estimated by using sufficient econometric methods and techniques, its verification follows. Verification means confirming that the estimated parameters are in compliance with the initial theoretical assumptions using properly selected test criteria. The quality of the results of the econometric analysis influences both the data and the specification and verification of the econometric model, which needs knowledge of the relating economic theory (Hušek, 2007).

Mathematical verification

The mathematical verification is required to estimate the calculations accuracy of the parameters, which is verified by the fact that the average value of the explanatory variable is equal to the theoretical value received by fitting the average values of the explanatory model variables into the equation estimated (Čechura, et al., 2017).

Economic verification

Economic verification is settled on a priori economic norm or restriction and is essential for the economic interpretation and usability of quantification results. The correctness of the estimated parameters signs and the numerical values are verified. If estimates are in line with assumptions about the values of the individual parameters and signs, they can be explained in conformity with the theoretical economic assumptions. The estimated econometric model thus becomes a relevant, simplified image of the economic problem or system under review. If the signs or values of the estimated parameters do not match the initial economic assumptions, it is necessary to determine the individual equations or model its in a different way. The reason is frequently the insufficient empirical data used to estimate the model, but the non-fulfillment of some assumptions needed for the use of an econometric estimation method (Hančlová, 2012; Hušek, 2007).

Statistical verification

Statistical verification is implied to evaluate the statistical reality of the estimated parameters and the entire econometric model. Using statistical tests, significance of the quantification results purchased from one observation selection founded on statistical induction is confirmed. (Hušek, 2007) The most often applied statistical verification criteria include estimated parameters standard errors and multiple determinations. Moreover, the estimates statistical significance at the level of significance is tested by means of the t-test and the F-test. Given the statistical criteria, a priori economic constraint

is a priority. If the the size of the estimated parameters or signs are inappropriate to the theoretical economic criteria, we will reject them even if they are statistically significant and the model performs a significant degree of implementation with the observed data (Hušek, 2007).

Testing the significance of the estimated parameters

The essential requirement is that the random vector u has a normal distribution with scalar covariance matrix and a zero mean vector

$$u \sim N(0, \delta^2 I_n) \quad (3)$$

The t-test is used to test the estimated parameters significance. First, the root of the scatter estimates is expressed on the diagonal of the covariance matrix

$$s^2_{bj} = s^2 x^{ij} \quad (4)$$

These values are estimates for standard error estimates bj and are valid for them as well

$$s_{bj} = s \sqrt{xij} \quad (5)$$

Elements that are outside the diagonal express the estimated covariances of point estimates pairs:

$$cov(b_i b_j) = s^2 x^{ij} \quad (6)$$

The test criterion is then the ratio

$$T = \frac{bj - \beta j}{sbj} \quad (7)$$

Where all j, so called Student t-distribution, have degrees of freedom. The test criterion is utilized especially for small selections ($n \leq 30$). Also, a 5% significance level is usually chosen, $\alpha = 0.05$, the supposed value of parameter βj is assumed and for the estimates bj and sbj the value tj If the rule applies: $| tj | > t * \alpha / 2$, then we reject the zero hypothesis at a 5 percent level of significance in favor of an alternative hypothesis. If this is the case, the zero hypothesis is accepted (Hušek, 2007).

Match the estimated model with the data

The selective regression function can be designed to represent the maximum possible match with the observed data, using the smallest square method. While the selection criterion of selective regression function is the minimum sum of the squares of residues, it is beneficial to test and counts the experiential observations variance of the explained variable around the multitude of regression. The smaller this scatter, the better

the dependent variable variation due to changes in independent explanatory variables. The compliance degree of the estimated linear model with empirical data is often expressed by the multiplication factor, which reflects the magnitude of the interpretation of the endogenous variable dispersion by all the independent variables of the model at the same time (Hušek, 2007).

$$R^2 = 1 - \frac{s_u^2}{s_y^2} \tag{8}$$

s_u^2 …the residual variance, given by equation

s_y^2 ….variance of endogenous variable given by equation:

$$s_y^2 = \frac{\sum_{t=1}^{n}(y_t - \bar{y_t})^2}{n} \tag{9}$$

$$s_u^2 = \frac{\sum_{t=1}^{n}(y_t - \hat{\bar{y}}_t)^2}{n} \tag{10}$$

$\hat{y}_t$ …theoretical values of endogenous variable

y_t …real values of endogenous variable

y_t …real values average of endogenous variable

n … length of time series

The R^2 value ranges from zero to one. If there is a maximum that all residues are zero, $R^2=1$ and the variables of dependent variables are 100% explained by changes in the variables independently. The opposite minimum is $R^2 = 0$, where the model is not explained by explanatory variables (Hušek, 2007).

Moreover, a Corrected Multiple Determination Coefficient (R^2 adjusted) -impartial version of the R^2 estimate is used. It is obtained by amending the number of degrees of freedom when correlating the explanatory models capability having versatile numbers of observations or having other sets of explanatory variables. The fixed multiplying factor can be stated as:

$$R^2 = 1 - (1 - R)^2 \frac{n-1}{n-k} \tag{11}$$

k…number of degrees of freedom

$\bar{R}^2$ and R^2 are small for large selection of files. If the number of degrees of freedom is small, the corrected determinant is normally less than R^2 and may have negative

values. In this case, its value is interpreted as zero and R^2 is remarkably close to zero. The model statistical significance as a whole can be examined using the F-test. If the F ratio is more than the F* value, then the zero hypothesis about the statistical insignificance R^2 in the alternative hypothesis is denied at the picked significance level with a certain number of degres of freedom. Compliance of the estimated data model is so statistically significant (Hušek, 2007).

Econometric verification

The model econometric verification is based on the verification of the necessary conditions for the successful econometric methods utilization, tests, and other techniques. The validity or authorization of the use of statistical criteria are investigated using econometric criteria, especially in case of a small number of observation selection. If the suppositions required to apply a certain process or test are not met, then the parameter estimates do not have some of the necessary features, or statistical tests power drops to give unrealistic results (Hušek, 2007). Econometric criteria include, for example, multichanneliness criteria for explanatory variables, autocorrelation tests for random components, or conditions for the identifiability of the structural equations of a simultaneous model. According to all above, that determining the reality of the estimated model is an significant part of the econometric analysis. Practically, only the results of the econometric model quantification that meet all the criteria stated at the same time can be used (Hušek, 2007).

Heteroskedasticity

The requirement of a classic linear regression model is the constant and final dispersion of random components, which is referred to as homoskedasticity. If this is not the case, the term "heteroskedasticity" is used. This usually happens in the cross-sectional data model where there are large changes in the values of explanatory variables (Seddidhi, et al., 2000).

Causes and consequences of heteroskedasticity:

1. Improper model specification - omission of a substantive explanatory variable
2. Microeconomic cross-sectional data with large differences in values
3. Accumulation of errors with a increasing explanatory variable
4. Model parameters estimation based on group averages (Hušek, 2007).

Testing the heteroskedasticity existence usually begins with graphical analysis. Depending on the development of the functional dependence of fluctuating residual scatter, an consistent test, eg Goldfeld-Quandt Test, and others are used (Hančlová, 2012).

Autocorrelation

Autocorrelation is a case when there is a dependence between the sequence of values of one variable, arranged in time or space (Hušek, 2007). The formula:

$$E(u_t,u_s) \neq 0;\ t \neq s \qquad (12)$$

This phenomenon takes place by the fact that the residual component εt is correlated with its delayed and future values $\varepsilon t+k$ ($k \neq 0$). Correlation over time is mutual for time-based variables, and the prefix "auto" means that this correlation occurs in one time series (Cipra, 2008).

Reasons for autocorrelation:

1. Macroeconomic time series inertia
2. Incorrect model specification – the omission of an significant exogenous variable or improperly chosen model functional form
3. Measurement errors
4. Inaccurately set delay for explanatory variables
5. Inaccurately modified observed data

If residual component is autocorrelated, the estimates features reach inconsistent and impartial estimates or/and estimates do not have minimal scattering or/and estimates are not strong asymptotically (Gujarati, 2003). The estimated variance of the random component and the regression parameter is then rejected, and the hypothesis testing using the confidence interval is not accurate and disappears (Hančlová, 2012). Mostly, Durbin-Watson statistics are utilized to test the autocorrelation of first-order residues. Using the table values for number of degrees of freedom (so-called upper and lower limits) and computed Durbin-Watson statistics value, the interval <0; 4> is separated into 5 parts - negative autocorrelation, grey zone, auto-correlation, grey zone, and positive autocorrelation. Higher order autocorrelation can be proven, for example, using the Breusch Godfrey test (Hušek, 2007). Time series regression equations can be with high degree of fit, R^2 or the adjusted coefficient R^2, but with an extremely low value for the Durbin-Watson statistic. However, we shall suggest that cases with much less extreme values may well be entirely spurious, or correlation doesn’t have causality (Granger,1974).

Multicollinearity

The multicollinearity means that there are more than one linear dependence relation between explanatory variables it also emerges in matrix X. In an econometric analysis, it is important to determine the dependence intensity between two or more explanatory variables and not only to identify whether or not it is present (Hušek,2007).

The high multicollinearity existence can be defined by quantifying a correlation matrix that have the pair correlation coefficients of each explanatory variable (Čechura, et al., 2017). Multicollinearity is detected by evaluating pairwise explanatory variables correlation coefficients of the that take values <-1; 1>. If one of the pair correlation coefficients has an absolute value of greater than 0.8, there is a high multi-collinearity and it needs to be eliminated appropriately (Hušek, 2007).

The reasons for multicollinearity:

1. The same trend of economic time series
2. Inaccurately set delay for explanatory variables
3. Unsuitable established artificial variables (zero-unit explanatory variables)
4. Non-empirical kind of available data in a cross-sectional analysis

The multicollinearity presence then provokes unfavorable consequences such as the large variance and covariance of the estimated parameters, the impact of the discrete explanatory variables on the explained variable cannot be excluded, thus cannot interpret the parameters (Hančlová, 2012).

Best practices for multicollinearity deletion:

- Neglecting multi-collinearity
- The omission of exogenous variables resulting in multicollinearity
- Some exogenous variables transformation
- Use a larger data file
- Use of a priori information
- Utilization of the main component method (Cipra, 2008).

3.5.1.6 Econometric model application or rejection

If the model is endorsed and its practical use is decided, the model can be used in the area for which it was derived. There are a lot of ways of econometric models' implementation, that can be grouped into 3 categories. The first category depicts the

forecast use of the econometric model, the second group is the area of structural analysis, and the last group is the modelling of effects and results of various scenarios (Čechura, et al., 2017). The relative expression of the effect of the explanatory variable on the explained transformation is elasticity, that is calculated according to the following formula (Čechura, et al., 2017):

$$E = \frac{\delta y_i}{\delta x_i} * \frac{x_i}{\hat{y}_i} \quad (13)$$

Prognosis of econometric models is done in 2 stages. In the 1st step, expected values of predetermined variables are found in the predicted period by extrapolating trending functions. Then the estimated predicted values of endogenous variables are found according to the equation. (Tvrdoň, 2001).

3.5.2 Linear regression model

A setting of assumptions about some economy features is the beginning of an econometric study. The linear regression model is the most useful tool in the econometrics as it is used to study the relation between one or more independent variables and one dependent (Greene, 2003).

3.5.2.1 Linear regression model assumptions

The most common least squares method is employed to estimate the linear regression model parameters. This method provides the best, consistent, impartial estimates of model parameters when the following assumptions are complied.
explanatory substantive variable

- deleting irrelevant explanatory variables
- selection of the accurate functional form of the model
- stable estimated parameters, time invariance
- respecting the relations simultaneity between variables
- zero average random component ut
- no heteroscedasticity
- the lack of residues autocorrelation
- independent variables are non-linear and fixed in repeating files
- the lack of ultimate multi-collinearity
- normal distribution of the random component (Čechura, et al., 2017).

3.5.2.2 Ordinary Least Square method (OLSM/OLS)

The most often used method for linear regression model parameters estimation is the ordinary least squares method (Cipra, 2008). This method ensures the best, consistent and objective parameter estimates, suggesting the assumptions mentioned in the previous chapter are fulfiled (Gujarati, 2003). The importance of the ordinary least square method is to discover parameters that minimize the sum of squares of the variations of the theoretical values of the variable to its actual values, expressed by the formula:

$$\min \sum_{t=1}^{n} (y_t - \hat{y}_t)^2 \qquad (14)$$

If a partial derivative of formula (12) is created according to estimated parameters and set to zero the model parameters will be found. The requested parameters will be determined by solving the achieved system of equations. By generating the "k" explanatory variables, the relationship will have the formula (Gujarati, et al., 2009):

$$\gamma = (XX^T)^{-1}X^T y \qquad (15)$$

γ … vector of estimated parameters with size of (k x 1)

X … matrix of observed values of exogenous variables with size of (n x k)

y … vector of observed values of endogenous variable with size of (n x 1)

4 Practical Part

The diploma thesis is going to focus on wine production and export as theoretical part of the diploma thesis described that wine as the essential commodity for Italian trade.

4.1 Italy overview

Italy is the 9th biggest economy in the world, which structure relies mainly on manufacturing and services, populated by 61 million people. The sector of services counts for almost 75% of total GDP and employs around 65% of the country's total employed people. In the sector of services, the most important participants are the transportation, wholesale, retail sales sectors. Industry employs around 30% of the total workforce and accounts for a quarter of Italy's total production. Agriculture takes the remaining share of total GDP and it employs around 4.0% of the total workforce.

The country is divided into a highly industrialized and developed northern part, where approximately 75% of the nation's wealth is produced; and a less-developed, more agriculture-depended southern part. As a result, unemployment in the north is lower and per capita income in higher compared to the south.

4.2 Trade balance of Italy

Italy is the 9th largest exporter in the world, in 2018 the country gained 541 billion US dollars and imported goods on 480 billion USA dollars, having a good trend in trade balance within last ten years. Trade of goods and services makes 31% of countries GDP. In 2009 due to the Great Recession the economy shrunk by 6.8%, having recovered only after 4 years. The trend is presented on figure 5.

The most exported goods are packaged pharmaceuticals-20.3 billion US dollars, cars 17.3 billion US dollars and refined petroleum with 16 billons. Wine is on the 8th place in this scale. The country's target partners are Germany, France, Spain form the EU and China, the US, Russia (OEC, 2018) Import partners are the same, goods provided are crude petroleum, cars, petroleum gas, packaged medicaments. Foreign trade is 60.5% of GDP, that means that the economy is strongly dependent on the international market positioning and processes. The reasons for the external oriented economy are historical separation into agricultural South and industrial North, fiscal deficit, strict internal tax system.

Figure 5: Trade balance of Italy in billion dollars, 1994-2018

Source: own elaboration World bank (2019)

As diploma thesis deals with the wine trade of the Apennine peninsula, the agricultural products trade is to be observed. Stereotypically Italy is associated with pasta, tomatoes, citruses. The country is the second exporter in Europe after Spain in this field and sells 1/3 of the production. Apulia, Calabria, Sicily, Emilia-Romagna are responsible for production of main exported sector commodities. Agri-food goods bring to the economy 10.73 billion US dollars or 1.94% of GDP with the main market in the EU-Germany, France. Coffee beans roasted in Italy cost 1.82 billion USD to the country. Table 3 corresponds to the vales of Italian imports and exports of the agri-food goods and shows the rank in the global exports and imports in 2018.

Table 3: Major exported and imported agri-food commodities, rank in total Italian trade in 2018

Rank	Imported Commodity	Import value, billion USD	Rank	Exported Commodity	Export value, billion USD
34	Rolled Tobacco	2.19	8	Wine	7.40
37	Pig Meat	2.13	29	Cheese	3.33
38	Cheese	2.1	36	Pasta	2.90
45	Bovine Meat	1.99	56	Chocolate	2.10
56	Coffee	1.82	64	Tomatoes	1.80

Source: own elaboration, OEC (2019)

Taking into consideration that Italy is the second exporter and first producer of wine in the next chapter discusses its export destination and production.

4.3 Italian wine production and exports

Italy has one of the longest traditions, producing a great variety of wines from many geographically different regions. Wine is, in fact, one of the most representative products of the 'Made in Italy' food productions, that, thanks to its high quality and marked distinction, has contributed to the strengthening of the reputation of Italian products in the world as an offer of excellence, strongly tied to the territory (Carbone and Henke, 2012). Concentration in 2011 of 10.2% of surface under vineyard, and 15.7% of the world wine supply, preceded only by Spain and the United States, and 24.4% of the world export, proving itself as the main exporter. The dynamics registered in the period 2000-2011 confirm the change of the world competitive scenario which had begun some decades earlier, marked by a reduction in the market shares held by the main European producers who, nevertheless, continued to maintain leadership in the world market, in favor of emergent producers, particularly China, Chile, Australia and the USA, who have appeared more recently on the global competitive market, but where there are lots of large size firms which have achieved good performances and high market shares, while applying targeted marketing policies (Crescimanno et al., 2014).

Country has more significant rise in its wine industry since 2014. Volume produced has increased by around 34% in the past five years (from 4.2 billion liters to 5.4 billion liters). While the country is a global leader today producing 54.8 million hectoliters, the Italian wine industry faced considerable challenges in the early 20th century, mainly due to maintaining high production standards. Nevertheless, Italy overcame these issues through the implementation of strict regulation, authenticity, and labelling requirements, discussed in this chapter further.

Structure of wine production remains the same during the last decade. White type is making 55% of the whole production. Still wines prevail on sparkling, but its production rose on 5.3 mhl in 2018, on about 10% of total wine production. Since 2008 the production volume of Italian sparkling wines has more than doubled, recording an average annual growth rate of 9% (Carbonari, 2011). This substantial increase has been mainly driven by high demand for both closed tank sparkling wines (e.g. Prosecco) and, although to a lesser extent, bottle-fermented wines (e.g. Franciacorta and Trento). Out of the total national production volume of sparkling wine, Prosecco alone represents 66%. Italy makes 27% of

all the sparkling wines in the world, followed by France with 22% and is the first exporter of sparkling wines both by volume and value (OIV, 2018).

Today, Italy's geographical territory represents 20 wine-producing regions such as Veneto, Apulia, Emilia-Romagna and Sicily leading in terms of wine production. Figure 6 demonstrates volumes of production by region(Mowery, 2016).

Sicily.

The largest island in the Mediterranean, Sicily's dry, warm climate and copious sunshine are perfect for viticulture. There are fruity, medium-bodied red wines made from Nero d'Avola and juicy, peachy white wines made from Grillo, which are most prolific from the Sicilia DOC. Productions volumes by region are demonstrated on figure 6.

Tuscany.

Tuscany is centrally positioned along the Tyrrhenian Sea on the west coast and stretches inland across rolling countryside. For reds, its most famous Sangiovese-based wines are the Chianti, Chianti Classico ,Vino Nobile di Montepulciano and Brunello di Montalcino DOCGs. Many wines are labeled as Toscana IGT because they do not conform to traditional production rules. These wines can be 100% Sangiovese or with blends of international varieties like Cabernet Sauvignon or Syrah. For whites, the most famous appellation is Vernaccia di San Gimignano DOCG.

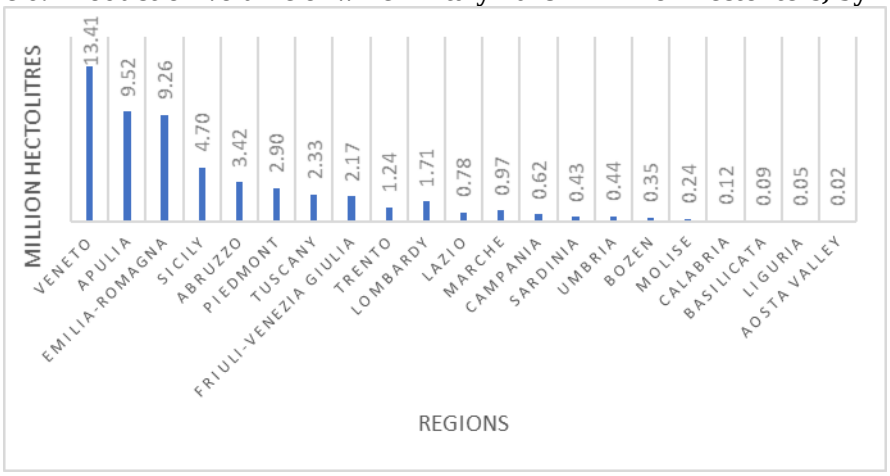
Veneto.

Though Veneto turns out many storied wines, it's the volume of Pinot Grigio and demand for Prosecco that have made it famous. Great versions of the latter come from Conegliano Valdobbiadene DOCG and Cartizze DOCG. The red wines of Valpolicella DOC and Amarone della Valpolicella DOCG are both based largely on black grape Corvina, as are the rosé and red wines of Bardolino DOC.

Apuglia

This southern region has grown in popularity for its wines of good value based on indigenous grapes. The warm Mediterranean climate lends itself ripe, fruity, robust reds based on Primitivo (a.k.a. Zinfandel) and Negroamaro. Other varieties: Chardonnay, Bombino Bianco, Bombino Nero, Moscato, Nero di Troia, Susumaniello

Figure 6: Production volume of wine in Italy 2018 in million hectoliters, by region



Source: own elaboration, statista (2019)

In 2018 Italian wine exports of 54.8 million hectoliters is composed of 34% red wine, 33% white wine and 20% sparkling wines and valued 7.29 billion USD and are the second great for value and volume in the world and Germany, the US and UK are the biggest buyers(Conway,2020).

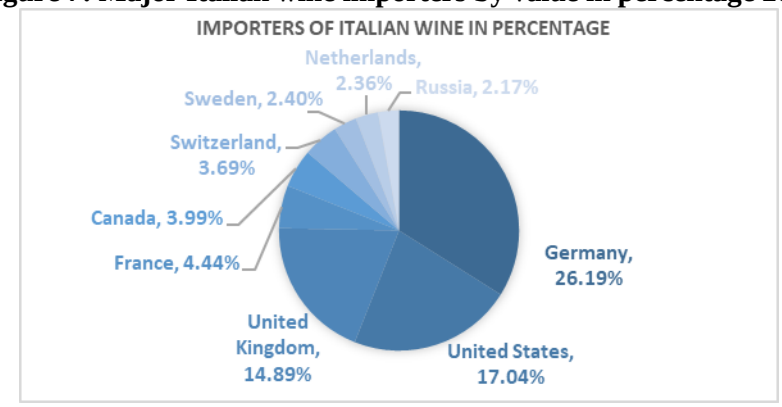
Within 20 years of the EU common market Germany is seen as long-term strong market for Italy, though not without challenges. The Great Crisis of 2008-2009 was a flashpoint, to be sure, along with smaller swings in the economy before that. Germany has a resilience that is attractive to Italian wine producers. One is that the demand for red wine is strong, and Italy offers good value, often better than France. With all the uncertainty in global economic conditions and forecasting for the future, economies like Germany's still a target for the Italian wine producer (Roca,2020).

The United States, the second main consumer had several the economic tsunamis of the last 20 years as well. Enormous interest in Italian wine is there for many reasons. One of them is Italian immigrant's community forming for the last 150 years laid down a foundation for Italian goods trade. Apennine peninsula country benefited from the market for sparkling wines in general and Prosecco in particular. And it gained an unexpected advantage over its European neighbors due to the peculiarities of the recently-imposed US tariffs on European wines. Imports of many wines from France, Germany, Spain, and the U.K. are subject to a 25% tax, when there is no tax on Italian wine imports.

The United Kingdom is at a difficult political and economic stage due to Brexit, and wine for the country is not a necessary imported commodity. For the EU wine

producers Albion was always a great market, so the trade should remain on the same base- no entrance tariffs, as it is between all current member countries. Figure 7 illustrates the share of main Italian wine importers.

Figure 7: Major Italian wine importers by value in percentage 2018



Source: own elaboration, OIV(2019)

4.4 Italian wine regulations

History of wine industry regulations roots to middle centuries and to Cosimo III de Medici, Grand Duke of Tuscany who designated Chianti and Brunello in 1716, though the time passes and law system adapts to the country development. Italy firstly obeys to EU legislations that were discussed before. In this chapter Italian internal regulations are performed (Robinson,2015).

4.4.1 Italian wine modern regulations

Italian wine and grape industry is regulated by the decrees and laws of Ministry of Agriculture of Italy (Ministro delle Risorse Agrocole, Alimentari e Forestali), which is in charge for accepting and implementing National Wine and Grape Regulation in accordance with EEC regulations. The organ controls also production from Controlled and Denominated origins.

The last modernized version of EU regulations upon wine trade is 2013 EU regulations described in the theory part.

In 2016 Italy adopts Law no. 238, so-called “Consolidated Wine Law” (“Organic Regulation of the grapes’ cultivation and wine’s production and trade" The document proclaims: “Wine, Vineyards and Wine producing areas [..] are a cultural heritage that has to be protected and promoted in its aspects of social, economic, productive, environmental

and cultural sustainability". In brief the law brings novelty to the wine main statements, starts with Italian Unique Registry of the Inspection Control, introduces so-called "tax redemption", allowing to pay reduced penalties if a formal infringement is regularized before any control happen (Semprebon,2017).

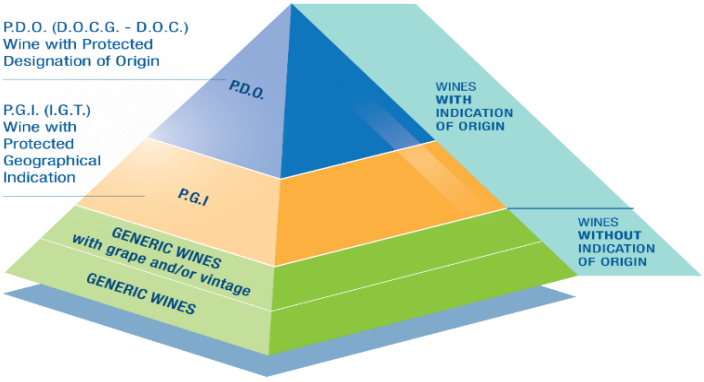
4.4.2 Italian appellation system and regionalization

In 1963 when government establishes common "Regulation to protect appellation of production origin of wine and wine grape juice".It primarily defines the geographic area of the appellation, grapes and proportions admitted for a specific wine production, the maximum yield per hectare, minimum percentage of alcohol by volume, the styles and types of wines recognized by the appellation system, the minimum time of aging before the wine can be sold, chemical and physical characteristics as well as organoleptic qualities.

The quality system is made of appellation categories defining distinct quality classes ideally structured in a "pyramid of quality" where the apex represents the highest quality level possible. The categories defined by the system, are as follows, visible on the figure 8 below:

- IGT (Indicazione Geografica Tipica, Typical Geographic Indication), was introduced for wines that cannot meet all of the requirements for DOC and DOCG wines, but are often of excellent quality. Wines classified as IGT must be produced within the stated region, but are allowed certain freedoms, with respect to grape varieties and production methods.
- DOC (Denominazione di Origine Controllata, Appellation of Controlled Origin), must meet strict requirements for quality, production standards, geographic area and grape varieties, among other criteria.
- DOCG (Denominazione di Origine Controllata e Garantita, Appellation of Controlled and Guaranteed Origin), is reserved for wines of the highest quality.
- The VDT (Vino da Tavola) or "table wine" classification, is the least regulated wine category in Italy. VDT wines are not required to state the geographic area, nor are they bound by specific quality standards or production methods. This does not mean that VDT wines are inferior, merely that these wines are produced outside the rules governing the higher classifications.

Figure 8: Pyramid of Italian wine classification system



Source: Federdoc(2019)

Some appellation laws also allow optional use of special types, usually used for special wines made by particular production techniques and they must be written in the label with the following terms (Carbone and Henke, 2012).:

- **Classico (Classic)** - is a wine produced in the most typical and renowned area of the appellation, for example Orvieto Classico
- **Superiore (Superior)** - is a wine having a percentage of alcohol by volume higher than the normal requirement for the appellation, for example Valpolicella Superiore
- **Riserva (Reserve)** - typically used as a production quality standard most often referring to extended aging of a wine prior to release.
- **Millesimato** - the term indicates that the sparkling wine is produced with wines obtained from grapes of a single harvest, vintage, in this case called "millesimo". Inherently it also means that those grapes are of particular value and the wine is worth to be bottled without assembling with other vintages, for example Prosecco Millesimato

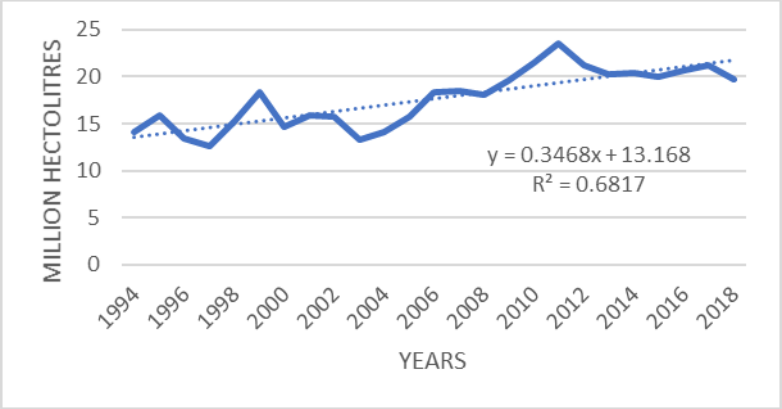
4.5 Analysis of chosen variables

For econometric analysis of Italian wine export conduction, there were following variables chosen: Italian wine export quantity, Italian wine export value, the US total population first differences, the US wine production quantity, Italian wine production. All variables are analyzed through data set of time series in the period from 1994 to 2018.

4.5.1 Italian wine export quantity

Figure 9 shows the development of Italian wine quantity in the period of 25 years from 1994 to 2018.

Figure 9: Italian wine export quantity in million hectoliters 1994-2018



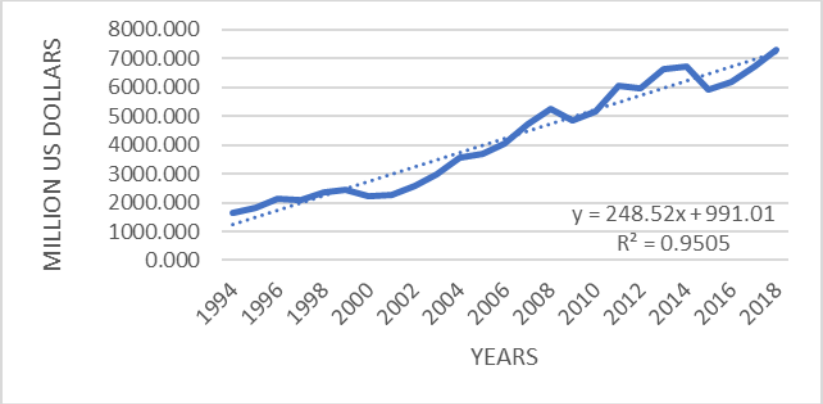
Source: own elaboration, OIV(2019)

As illustrated on the graph within 25 years the exports quantity is growing, but last 5 years were hard times and the curve slowly streams down. Average annual wine export from Italy is 17.68 million hectoliters. The lowest number within these 25 years was 12.55 million hectoliters in 1997, when due to the lack of subsidies for Southern Italy producers and maximum 23.5 million hectoliters in 2011. In 2018 recorded number is only 7.23 million hectoliters higher from the minimum. During the chosen time period exports rose by 5.6 million hectoliters. Based on the linear trend function is possible to expect that the quantity of the Italian wine export quantity with the reliability of 68.7% will increase in the following years.

4.5.2 Italian wine export value

Figure 10 shows the development of Italian wine value in the period of 25 years from 1994 to 2018.

Figure 10: 1 Italian wine export value in million US dollars 1994-2018



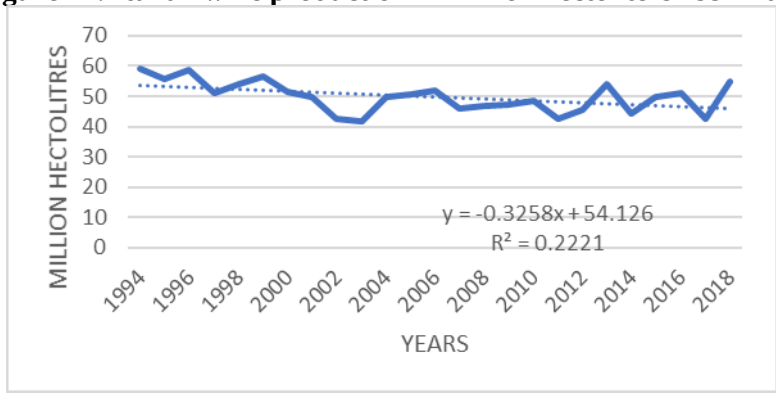
Source: own elaboration, OIV(2019)

As visible on the graph the export value of Italian wine is increasing, the highest number is 7.29 billion US dollars in 2018. Since 1994 the values have grown on 5.66 billons US dollars from 1.64 billion in the beginning of the period. Average annual number for the export is 4.22 billion US dollars. Based on the linear trend function is possible to expect that the quantity of the Italian wine export value with the reliability of 95.05% will increase in the following years.

4.5.3 Italian wine production quantity

Figure 11 shows the development of Italian wine production in the period of 25 years from 1994 to 2018. As it was discussed previously Italy is the leader in wine world production and according to the economic theory determines trade trends.

Figure 11: Italian wine production in million hectoliters 1994-2018



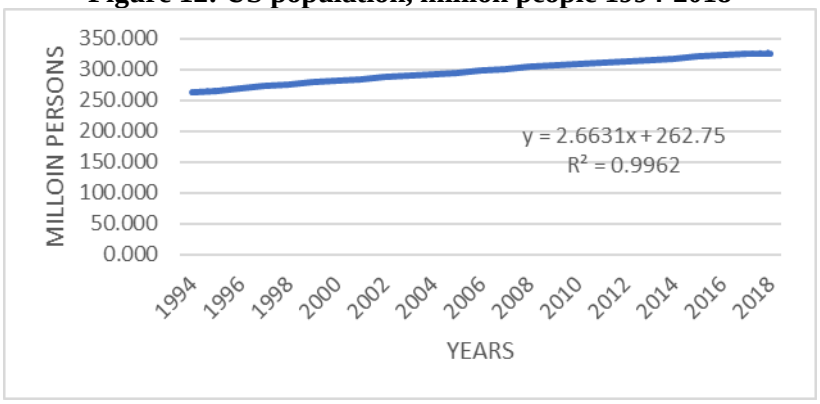
Source: own elaboration, OIV(2019)

From figure 11 is readable that there is a slightly increasing trend and fluctuation of Italian wine production during the studied period and based on trend line there will be a growth of wine production in Italy with 21.2% of reliability. Average annual wine production from Italy is 49.89 milion hectoliters. Unfortunately, the greatest number of 59.27 was evidenced in 1994 and the lowest- 41.807 in 2003, due to bad winter weather conditions causing the poor harvest in the whole South Europe.

4.5.4 Population of the US

Population of the US over 1994-2018 (figure 12) is also one of the variables of the economic analysis as Americans are the first consumers of wine and the second importers of Italian wine.

Figure 12: US population, million people 1994-2018

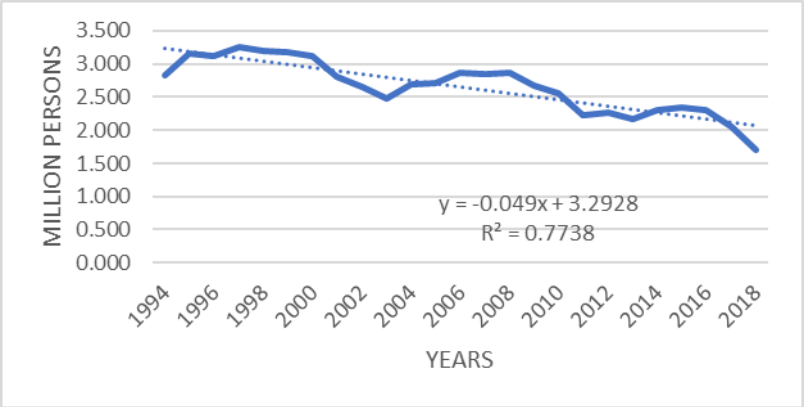


Source: own elaboration, Faostat(2019)

During selected period US population rose by 63.56 million people from 263.126 to 326.688 with an average 297.37 million persons, the reliability of trend function here is not applicable, as data are collected from Faostat database and estimated.

To dynamize economic model the first differences of US population were computed, as the growth of population is relevant for the export and production variables, the calculations are proposed on the figure 13.

Figure 13: US population, million people 1994-2018



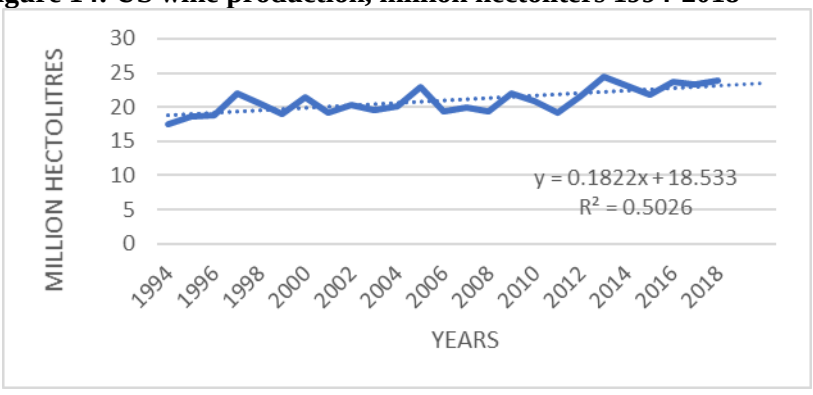
Source: own elaboration, Faostat(2019)

The graph illustrates population growth within 25 years has been declining and with reliability of the trend line of 77.38% it will not grow. The highest population increase was noticed in 1997 with 3.263 million people the lowest increase was in 2018 of 1.702 million.

4.5.5 Wine production quantity of the US

The US is the forth wine producing country in the world after the Old world leaders-Italy, France, Spain. For Italian wine trade also depends on its production. The data collected from OIV demonstrate the trend in the chosen period of 25 years from 1994 to 2018 on the figure 14.

Figure 14: US wine production, million hectoliters 1994-2018



Source: own elaboration, OIV(2019)

From figure 14 is readable that there is a slightly increasing trend and fluctuation of American wine production during the studied period and based on trend line there will be a growth of wine production with 50.26% of reliability. Average annual wine production of

the US is 20.9 milion hectoliters. The maximum production of 24.366 9 milion hectoliters was evidenced in 2013 and the lowest of 17.559 milion hectoliters in 1994, that indicates that American wine industry is developing within time.

4.6 Linear regression model

Linear regression is used to model the relations between variables. Gretl software program is employed for this reason, as it offers complex tools for data analyzing. Annual data are utilized for interpretation of the time series with 25 observations from 1994 to 2018. Model construction is dispensed into steps which are mentioned in the literature review.

4.6.1 Construction of economic model

Economic model of Italian wine export quantity was created on the basis of economic theories and economic theories aspects of economic reality. The economic model used in this thesis has been formulated as shown in the following formula.

$$y_{1t} = f(x_{0t}, x_{1t}, x_{2t}, x_{3t}, \Delta x_{4t})$$

Where:

y_{1t} … Italian wine export quantity (million hectoliters)

x_{0t} … Unitary vector or constant

x_{1t} … Italian wine export value (million US dollars)

x_{2t} … Italian wine production quantity (million hectoliters)

x_{3t} … US wine production quantity (million hectoliters)

Δx_{4t} … first differences of US total population (million people)

The main assumption of the economic model is the dependency of Italian wine export quantity as an endogenous variable on the exogenous variables. In accordance with economic theory, the relationships among variables are assumed as:

- If Italian wine export value increases, the Italian wine export quantity increases.
- If the first differences of total population of the US increases, the Italian wine export quantity increases.
- If the US wine production increases, the Italian wine export quantity decreases.
- If Italian wine production increases, the Italian wine export quantity increases.

4.6.2 Creation of econometric model

For econometric model creation one-equation econometric model with one endogenous (y_{1t}),five exogenous (x_{0t} - Δx_{4t}) and one stochastic(random component u_{1t}) variables is applied. Table 4 shows the collected data for parameter estimation in 1994-2018. One-equation econometric model form is expressed with the following equation:

$$y_{1t} = \gamma_0 x_{0t} + \gamma_1 x_{1t} + \gamma_2 x_{2t}\ \gamma_3 x_{3t} + \gamma_4 \Delta x_{4t} + u_{1t}$$

Table 4: Data set of selected variables

	Italian wine export quantity (million hectoliters)	Italian wine export value (million US dollars)	Italian wine production quantity (million hectoliters)	US wine production quantity (million hectoliters)	first differences of US total population (million people)
Year	Y	X1	X2	X3	ΔX4
1994	14.166	1641.008	59.270	17.550	263.126
1995	15.832	1815.771	55.702	18.668	3.152
1996	13.415	2130.132	58.772	18.877	3.116
1997	12.550	2098.590	50.894	22.000	3.263
1998	15.191	2365.195	54.188	20.504	3.197
1999	18.320	2463.772	56.454	19.050	3.186
2000	14.675	2229.584	51.620	21.500	3.122411
2001	15.856	2289.075	49.865	19.200	2.806544
2002	15.794	2589.934	42.507	20.300	2.656238
2003	13.283	2986.474	41.807	19.500	2.48274
2004	14.123	3550.372	49.935	20.109	2.697365
2005	15.721	3717.972	50.566	22.888	2.711301
2006	18.390	4038.408	52.036	19.440	2.863313
2007	18.507	4741.609	45.981	19.870	2.851295
2008	18.067	5277.540	46.970	19.340	2.862759
2009	19.519	4843.769	47.314	21.965	2.677563
2010	21.482	5170.569	48.525	20.887	2.550137
2011	23.500	6075.404	42.772	19.140	2.235208
2012	21.227	5990.725	45.616	21.650	2.274116
2013	20.254	6647.498	54.029	24.366	2.162725
2014	20.424	6747.565	44.229	23.098	2.307293
2015	20.016	5938.484	49.996	21.731	2.334155
2016	20.636	6176.622	50.920	23.715	2.306148
2017	21.200	6722.364	42.500	23.300	2.044228
2018	19.780	7296.589	54.800	23.900	1.701962

Source: Own elaboration based on Gretl software and data from OIV, Faostat (2019)

Multicollinearity and correlation matrix

Before proceeding with econometric analysis of the mode the multicollinearity presence should be checked, for this the correlation matrix is computed. It shows the dependency between exogenous variables. Multicollinearity takes place in case the range of correlation coefficients is equal or higher than |0.85| absolute value.

Table 5 Correlation matrix of chosen exogenous variables.

X1	X2	X3	ΔX4	
1.0000	-0.4136	0.6709	-0.2932	X1
	1.0000	-0.1863	0.3870	X2
		1.0000	-0.3736	X3
			1.0000	ΔX4

Source: Own elaboration based on Gretl software and data from OIV, Faostat (2019)

Based on the Gretl output there is no multicollinearity among the dataset variables, so the linear regression analysis is to be proceeded.

4.6.3 Parameters estimation using Ordinary Least Squares method.

Table 6 describes values resulted after Ordinary Least Squares method parameters estimation in Gretl software. Original Gretl output is placed in Appendix 1 of the thesis.

Table 6:Estimated parameters of selected variables

Parameters	Value
γ_0 -unitary vector	19.8658
γ_1 - Italian wine export value	0.00176056
γ_2- Italian wine production quantity	0.0270973
γ_3 - US wine production quantity	−0.522567
γ_4 first differences of US total population	−0.00387520

Source: Own elaboration based on Gretl software and data from OIV, Faostat (2019)

At this moment achieved coefficients of estimated variables can be included into the econometric model. So final one-equation econometric model can be composed as following:

$$y_{1t} = 19.8658 + 0.00176056x_{1t} + 0.0270973x_{2t} - 0.522567x_{3t} - 0.00387520\Delta x_{4t} + u_{1t}$$

4.7 Economic verification

Economic verification assesses directions, intensity of impact of exogenous variables on endogenous one. Besides this it evaluates if estimated parameters are compatible with economic theory on the same equal conditions:

1. If all exogenous variables are equal to zero, Italian wine export quantity is 19.8658 million hectoliters, ceteris paribus.
2. If Italian wine export value increases by one million US dollars Italian wine export quantity increases by 0.00176056 million hectoliters, ceteris paribus.
3. If Italian wine production quantity increases by one million hectoliters, Italian wine export quantity increases by 0.0270973 million hectoliters, ceteris paribus.
4. If - US wine production quantity increases by one million hectoliters, Italian wine export quantity decreases by 0.522567million hectoliters, ceteris paribus.
5. If first differences of US total population increases by one million people, Italian wine export quantity decreases by 0.00387520million hectoliters, ceteris paribus.

All assumptions above are compatible with economic theory, so the variables are economically significant.

4.8 Statistical verification

Statistical verification examines the significance of evaluated parameters and a model as a whole. The statistical significance of the estimates at the level of significance is tested by means of the t-test and the F-test and p-values are compared with the significance level α. Coefficients of determinations are evaluated in case of model verification.

4.8.1 Statistical verification of estimates

Statistical significance of estimates is defined by the t-test, and these results are compared with table values. The output from Gretl software also shows p-values for each estimate, which has information about the significance level at which a null hypothesis is rejected. These values can be found in the Appendix 1. The null hypothesis declares that the parameter is not statistically significant at the level of significance which is chosen. In

the case that p-value is is lower than the chosen level of significance, then the null hypothesis is rejected.

Table 7:P-values of chosen variables

Parameters	p-value
γ_0 -unitary vector	0.0014
γ_1 - Italian wine export value	<0.0001
γ_2- Italian wine production quantity	0.7231
γ_3 - US wine production quantity	0.0455
γ_4 first differences of US total population	0.5952

Source: Own elaboration based on Gretl software and data from OIV, Faostat (2019)

With settled significance level α= 0.05 Italian wine export value and US wine production quantity variables are significant, that proclaims that the relations between are caused not just by random occurrence. From the output goes that parameters of first differences of US total population and Italian wine production quantity are not statistically significant.

4.8.2 Statistical verification of the model

The determination coefficient R^2 is a measure meaning if the data are good fitted with the regression line. R^2 for the diploma thesis one equation model is 0.780551, according to Gretl software output placed in Appendix 1.The interpretation of the value is that 78.06% of changes of endogenous variable are explained by exogenous variables. Adjusted R^2 ($\bar{R}^2$) of 0.736661 means the same but as R^2, but takes in consideration number of observations in the model. So 73.67% of changes of independent variables can explain variations of dependent variable.

4.9 Econometric verification

To utilize econometric model and check if it meets the assumptions of linear regression model econometric verification is used. Tests of autocorrelation, normality of residuals and heteroscedasticity tests are implemented for econometric verification. Overview is portrayed in the table 8, detailed output from Gretl is in Appendix 1.

Table 8: Econometric verification output

Test	P-value	sign	α	decision
Autocorrelation				
Breusch-Godfrey test				
H0: no autocorrelation H1: autocorrelation	0.105	>	0.05	The H0 cannot be rejected => there is no autocorrelation in the model
Heteroscedasticity				
White test				
H0: No heteroscedasticity H1: Heteroscedasticity	0.78497	>	0.05	The H0 cannot be rejected => there is no heteroscedasticity in the model (there is homoscedasticity in the model)
Normailty				
Jarque-Bera test				
H0: Normal distribution of residuals H1: Not normal	0.52278	>	0.05	The H0 cannot be rejected => the residuals are normally distributed

Source: own elaboration based on Gretl software and Faostat. OIV (2019)

4.9.1 Autocorrelation

Correlation of the errors is checked with Durbin Watson and Breusch-Godfrey tests, when first is for the autocorrelation first-order residues, higher order autocorrelation can be tested with the second one. The scope for Durbin-Watson test is always between 0 and 4. In the econometric model value of Durbin-Watson statistic is 1.339115, lower limit is 1.0381, upper limit is 1.7666 and p =0.0153836<0.05, so there is positive autocorrelation. Breusch-Godfrey test was set for verifying the autocorrelation of residuals of second order. The p-value according to the test is 0.105> α, (α=0.05), so there is no autocorrelation of second order and null hypothesis is not rejected. According to the received tests values, its is evident that there is no spuriosity in the regression, as DW> R^2 and data are stochastic - mean, variance are the same within the time period.

4.9.2 Heteroscedasticity

Heteroscedasticity is a core issue for econometric verification, indicating that modelling errors are distributed dependently. White's test is used to test this assumption. Null hypothesis of no heteroscedasticity presence will be rejected if test statistics have p-value below significance level α, (α=0.05). For the model p-value of the test is 0.78497, so there is homoscedasticity in the model. Breusch Pagan test, used for testing the same conjecture, see in the Appendix 1, has p-value of 0.390740, which is higher than α, (α=0.05). According to both tests there is homoscedasticity in the model.

4.9.3 Normality of residues

Normality of residues distribution is also one of the conjectures for linear regression model. If they are normally distributed, model can be counted as trustful and can be used for trend generalization. In other words we can use the model for different time series. Jarque-Bera test is used for normality examination. Null hypothesis of the test states that residues are normally distributed. Again p-value received from Gretl output is compared with the significance level α, (α=0.05). Graph of normal distribution is placed in Appendix 1. P-value is 0.5228 which is greater than significance level, so null hypothesis is not rejected and errors are normally distributed.

4.10 Model application

Last step of the econometric modelling is the model application. Elasticities of exogenous variables and prognosis of endogenous variables are calculated and interpreted as well at this stage.

4.10.1 Elasticity

Elasticity is a measurement of the variable's sensitivity to a change of another variables. Table 8 shows values for elasticities computation and the outcome. Gretl's summary statistics obtaining the values in the table are placed to Appendix 1,Appendix 2.

Table 9: Elasticities

Variable	Mean value	Theoretical value of endogenous variable	Value of parameter	Elasticities
X1	4221.80	17.68	0.001761	0.42047
X2	49.89	17.68	0.027097	0.07648
X3	20.90	17.68	-0.522567	-0.6179
Δx4	13.07	17.68	-0.003875	-0.0029

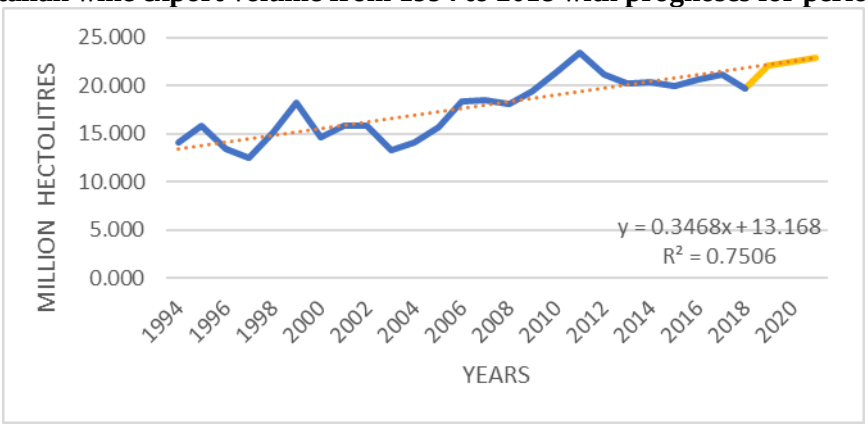
Source: Own elaboration based on MS Excel software and data from Faostat (2019)

According to the obtained elasticities US wine production volume has the most significant impact on the export quantity of Italian wine, actually if the US wine production quantity increases by 1% Italian wine export quantity decreases on 0.62%. If export value of Italian wine increases by 1% Italian wine export quantity increases on 0.42%. If growth of US population increase by 1% Italian wine export quantity decreases on 0.003%. If volume of Italian wine production increases by 1% Italian wine export quantity increases on 0.076%.

4.10.2 Forecast

One of the objectives of the diploma thesis is to forecast Italian wine export quantity of for 2019-2021, for which estimated linear regression model is used. Gretl has special tools for the computation and the results are placed in Appendix 3. Figure 11 below demonstrates the future trend of the Italian wine export volume till 2021 marked as orange. With the reliability of trendline function of 75.06% the export volume of Italian wine will grow, though the obtained estimates do not guarantee the real situation, as there are much more constrains that may influence on the real export volume.

Figure 15: Italian wine export volume from 1994 to 2018 with prognoses for period 2019-2021



Source: own elaboration based on Gretl software and Faostat. OIV (2019)

5 Results and Discussion

First part of practical part of the thesis is devoted to the overview of Italy and its trade in 2018 according to agricultural point of view. Based on literature review Italy is the 9th biggest economy in the world with positive trade balance, which structure relies mainly on services and manufacturing. Main industrial products are pharmaceuticals, machinery, petroleum products. Besides, country sells 1/3 of its agricultural production that makes it be the second producer and exporter in Europe. Main exported goods "Made in Italy" is wine, pasta, tomatoes from Veneto, Apulia, Calabria, Sicily. Italy is the first wine producer in the world with exports of 19.78 million hectoliters, 13.8 of them are still, that brought 7.92 billion US dollars to the economy. The top importers of the beverage are Germany, the US and UK. Italy was the significant leader in export volume of wine for the year 2018 with only 1.3 million hectoliters less than the first largest exporter, namely Spain. French expensive wines were first in exported value with just 3.7 billion US dollars earned more than Italy.

Second part of the practical part of the thesis is devoted to the observation of Italian wine export quantity trends and determinants within time period of 1994-2018, that were chosen for econometric analysis with one-equation econometric model. Average export of studied commodity is 17.68 million hectoliters. The poorest number within these 25 years was 12.55 million hectoliters in 1997. The increasing trend of the Italian wine export volume, endogenous variable in the model, according to the data analysis and prognosis will continue for the next 3 years. Exogenous variables chosen for the model were namely Italian wine export value, Italian wine production volume, US wine production quantity, first differences of US total population. All determinants have inclining trend except American population first differences. Comparing to 2017 in 2018 US population grew only by 0.62% that is even less than within the Great Recession in 2007-2009 when the value was 0.80%.

One-equation econometric model of the thesis includes one dependent endogenous variable and exogenous independent variables. After creating a sample for econometric model and exogenous variables were tested for multicollinearity, which was not evident between determinants. The Ordinary Least Squares method (OLS or OLSM) was applied for parameters estimation and creation of econometric model, that was subsequently verified. According to assumptions settled in the theoretical part, economic verification

evaluated intensity and direction of dependency of endogenous variable from exogenous ones. The results underlined that all variables are economically significant. Next step of the analysis was statistical verification of each parameter and the whole model. The interpretation of model verification is that changes of explained variable are explained by exogenous variables by 78.06%. The whole model is statistically significant as p-value is 2.28e-06, which is lower than the significance level α of 0.05. P-value of each coefficient was compared to the significance level α of 0.05 in case of statistical verification. Parameters of Italian wine export value and US wine production quantity are statistically significant, but Italian wine production quantity, first differences of US total population are not significant. Tests for heteroscedasticity, normality of residuals and autocorrelation were done for econometric verification in Gretl program. P-values of the tests were compared with the significance level α to reject or not tests' hypotheses. Econometric verification tests' results revealed no autocorrelation, spuriosity, no heteroscedasticity, normality of residuals in the model. Computed elasticities identified which exogenous variable has the highest impact on Italian wine export quantity. US wine production volume has the most significant influence on the export quantity of Italian wine, actually if the US wine production quantity increases by 1% Italian wine export quantity decreases on 0.62%, ceteris paribus. The prognosis of Italian wine export quantity showed increasing trend for next 3 years, specifically the value will grow to 22.19 million hectoliters in 2019, then again increase by 0.35 million hectoliters in 2020, reaching 22.88 million hectoliters in 2021.

6 Conclusion

Diploma thesis discusses the foreign trade of Italy, focusing on wine sector in time period of 1994-2018. The first aim of the study was to determine Italian position on the worlds markets, overview globally wine industry and its main representatives, then to underline the particularities of the country and specialty of its wine.

World wine industry is represented by two different traditions of wine production: Old World(Italy, France, Spain) and New World (the US, Chile, New Zealand), while the first one id very traditional and highly evaluated through centuries, the second one is very promising and fast developing. The Old World is still taking the first places in the production, Italy with 54.8 million hectoliters, then France 48.6 million hectoliters and Spain with 44.4 million hectoliters. The wine consumption is also significant variable on the market, estimated at 246 million hectoliters, the US is leading with here with 33 million hectoliters yearly. The Americans appreciate middle price or expensive wines, that's why they are the leaders in imports by value, when Germans are the first importers by volume. According to the analysis was found that Italy is not only the first world wine producer, but also the second country by exports both by quantity and value to the biggest markets of Germany and the US.

Italy is the 9th largest economy in the world, which structure relies mainly on services and manufacturing, that had a positive trade balance in 2018. Italy is the 9th largest exporter in the world, in 2018 the country gained 541 billion US dollars and imported goods on 480 billion US dollars, having a good trend in trade balance within last ten years. Trade of goods and services makes 31% of countries GDP. Agriculture creates 1.94% of GDP, though Italy is after Spain biggest producer and exporter of agri-food commodities. Being always associated with wine culture and Italy is the second world exporter of wine. Signatural wines from Veneto, Apulia, Sicily are the most valuable on German, American and English markets.

The second aim of the thesis was to identify the factors influencing on the export quantity of Italian wine and detect their intensity and significance. Gretl program was chosen as a statistical program to create and verify one-equation econometric model. Italian wine export value, Italian wine production volume, the US wine production quantity, first differences of the US total population were selected as determinants. Parameters of Italian wine export value and US wine production quantity are statistically

significant, but Italian wine production quantity, first differences of US total population are not significant at the significance level α of 0.05. Despite the outcome of analysis Italian wine production is very substantial for the Italian wine export and trade, position in the world wine industry. It plays also important role for the rank of agriculture of the economy. After econometric model application was revealed that the US wine production volume has the most significant influence on the export quantity of Italian wine. The US is a leading Italian wine consumer and importer, but also the 4th worlds producer, so for Italy growth of the American wine production could be big threat for its trade. The prognosis of the future of Italian wine export quantity showed increasing trend for next 3 years, reaching 22.88 million hectoliters in 2021. Italy is a wine trade partner for 73 countries and is the world leader of the wine industry, but there are much more factors but there are much more factors that can influence its position to be investigated.

This country, industrialized in 1860th, which economy is based on pharmaceuticals, cars, petroleum oils production is still considered as agricultural. As a strong member of the EU it is very dependent on the Union regulations and this could be considered as both positive and negative. Italy should strengthen the Union relations and play itself also internationally, as there are always challenges in such particularly developing wine market.

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8 Appendix

Appendix 1: Ordinary Least Squares method, output from Gretl 2021

Model 1: OLSM, using observations 1994-2018 (T = 25)
Dependent variable: Y

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	19.8658	5.37133	3.698	0.0014	***
X1	0.00176056	0.000254507	6.918	<0.0001	***
X2	0.0270973	0.0754162	0.3593	0.7231	
X3	−0.522567	0.244928	−2.134	0.0455	**
aX4	−0.00387520	0.00717712	−0.5399	0.5952	

Mean dependent var	17.67712	S.D. dependent var	3.091596
Sum squared resid	50.33973	S.E. of regression	1.586501
R-squared	0.780551	Adjusted R-squared	0.736661
F(4, 20)	17.78431	P-value(F)	2.28e-06
Log-likelihood	−44.22245	Akaike criterion	98.44490
Schwarz criterion	104.5393	Hannan-Quinn	100.1352
rho	0.317032	Durbin-Watson	1.339115

Test for residuals normal distribution:
Null hypothesis: residuals are normally distributed
Chi-square(2) = 1.297 with p-value 0.52278

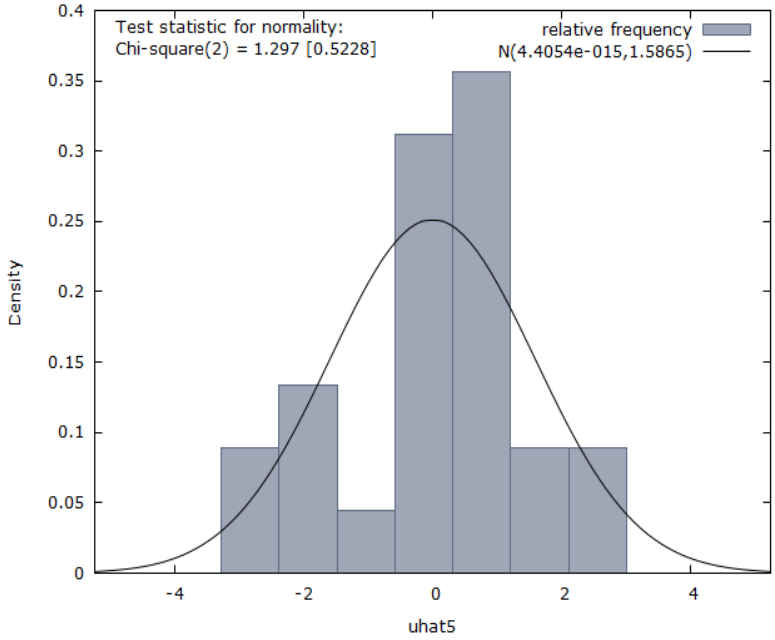
Tests for autocorrelation:
Null hypothesis: no autocorrelation
Durbin-Watson statistic = 1.33912
p-value = 0.0153836

Breusch-Godfrey test for first-order autocorrelation
Test statistic: LMF = 2.215162,
with p-value = P(F(1,19) > 2.21516) = 0.153
Breusch-Godfrey test for autocorrelation up to order 2
Test statistic: LMF = 2.556736,
with p-value = P(F(2,18) > 2.55674) = 0.105

White's test for heteroskedasticity
Null hypothesis: there is no heteroskedasticity
Test statistic: TR^2 = 9.683041,
with p-value = P(Chi-square(14) > 9.683041) = 0.784970

Breusch-Pagan test for heteroskedasticity
Null hypothesis: there is no heteroskedasticity
Test statistic: LM = 4.114440,
with p-value = P(Chi-square(4) > 4.114440) = 0.390740

The normal distribution of residuals



Source: output from Gretl software 2021

Appendix 2: Summary Statistics, using the observations 1994 – 2018

Variable	Mean	Median	Minimum	Maximum
Y	17.677	18.320	12.550	23.500
X1	4221.8	4038.4	1641.0	7296.6
X2	49.891	49.996	41.807	59.270
X3	20.902	20.504	17.550	24.366
aX4	13.068	2.6974	1.7020	263.13
Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Y	3.0916	0.17489	-0.028524	-1.2012
X1	1876.1	0.44439	0.11893	-1.4967
X2	5.0881	0.10198	0.074713	-0.88152
X3	1.8916	0.090498	0.25944	-1.0447
aX4	52.097	3.9868	4.6944	20.039
Variable	5% Perc.	95% Perc.	IQ range	Missing obs.
Y	12.770	22.895	5.4060	0
X1	1693.4	7131.9	3705.9	0
X2	42.015	59.121	8.3100	0
X3	17.885	24.226	3.1740	0
aX4	1.8046	185.17	0.81248	0

Source: output from Gretl software 2021

Appendix 3: Forecasting output 2019-2021

For 95% confidence intervals, t(23, 0.025) = 2.069

Obs	Y	prediction	std. error	95% interval
2019	undefined	22.1860	1.92713	(18.1994, 26.1726)
2020	undefined	22.5328	1.94416	(18.5110, 26.5546)
2021	undefined	22.8797	1.96228	(18.8204, 26.9390)

Source: output from Gretl software 2021