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Long-Term Trends of Global Wine Market

Noa Ohana-Levi [1,*] and Yishai Netzer [2,3,*]

[1] Independent Researcher, Variability, Ashalim 85512, Israel
[2] Chemical Engineering Department, Ariel University, Ariel 40700, Israel
[3] Eastern Regional R&D Center, Ariel 40700, Israel
* Correspondence: variability.noa@gmail.com (N.O.-L.); ynetzer@gmail.com (Y.N.)

Abstract: The major factors of wine trade have been showing distinct patterns of temporal trends worldwide in past decades. Wine consumption, production, imports, and exports differ according to their location and classification to Old World and New World wine markets. Using datasets from various sources, this work focused on quantifying long-term trends (1995–2021) of these wine industry factors for each country, including long-term means and temporal trends, using the Mann-Kendall trend test, and resulting in Z-scores. The temporal relationships between these global factors were quantified by applying Pearson correlation to the original values, as well as by correlating the Z-scores. Our findings show that Old World wine consumers and producers (e.g., Spain, France, and Italy) have been experiencing gradual decreasing trends of wine consumption and production. In New World countries, some of the largest wine-consuming countries were found to have strong, significant increases in wine consumption and new wine production markets show rapid growth trends. About 80% of the countries demonstrated increasing trends of wine imports, signifying the impact of globalization on the wine market and the growing demand for foreign wine. Globally, consumption per capita was found to have significantly decreased. Wine production showed a strong, significant, and lagged dependence on wine consumption, which was also related to the temporal trends of wine imports and exports. The major forces driving the wine market are possibly economic growth and wider competition, with climate change acting as a disruptive force.

Keywords: trend analysis; wine consumption; wine exports; wine imports; wine production

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1. Introduction

The geography of the wine industry has been the subject of ongoing revolution. Wine consumption in Asian, Northern European, and North American countries (i.e., New World) has been experiencing an ongoing growth since the 1990s, alongside a consistent decrease in wine demand in the Southern European countries (i.e., Old World) [1]. The wine sector is affected by multiple drivers, such as the regional and temporal patterns of consumer demand [2], policy and regulations [3], public health and food safety [4], and economic growth [1]. The major factors of the wine trade are wine consumption, production, imports, and exports, each of which have been experiencing varying degrees of changes during recent decades [5] with respect to their location. Globalization processes were shown to affect these wine industry factors through time [6], introducing major changes in New World and Old World wine markets. Global wine trade is shifting from domestic wine consumption to growing trends of demand for imported wine [7]. These changes are characterized by the constant growth of New World wine production volumes and steadily increasing numbers of consumer markets. Meanwhile, Old World producing countries are experiencing decreasing rates of domestic wine consumption, resulting in declining production [8].

Income was found by multiple studies to be a major driver of wine consumption both at the country scale and in the consumption structure of households, mainly in New World countries [8–10]. Liu and Song (2021) [11], for example, found that income was a significant

factor affecting wine consumption in the Chinese wine market. Hussain et al. (2007) [12] analyzed multiple factors affecting wine consumption and found a positive, significant effect of income on consumption in the United States of America (USA). In the United Kingdom (UK), the expected slower income growth as a result of Brexit is projected to have a decreasing effect on the wine market [13]. A study on drivers of wine consumption in Norway found that income was one of the factors associated with a higher probability of drinking wine [14]. Old World countries, however, do not follow these patterns. Although countries such as France and Italy have been experiencing income growth, they were shown to have strong decline in wine consumption [15]. According to Gual and Colom (1997) [16], alcohol consumption, and specifically, the demand for wine in Old World countries (Italy, France, Greece, Portugal, and Spain), has been decreasing rapidly due to various factors. These factors include lack of advertising; encroachment of new beverages, including beer (as well as sodas, juices, etc.); public health policies and awareness of the threats in alcohol consumption; alcohol policies; and increased pricing of wines (especially in Spain). None of these factors are related to levels of income. These diverging wine consumption patterns are assumed in many studies to reflect regional and global processes of convergence [10,17] and narrowing of dissimilarities in wine consumption [18] as a result of globalization and intercultural diffusion in drinking patterns [15]. This trend towards convergence is emphasized by the fact that currently, the USA (in 2021) is the largest wine consuming country in the world, while Italy, France, and Spain together account for 47% of the world wine production in 2021 [19], although experiencing consistent decreases in production [1]. Despite these convergence trends, the EU is still the top wine-consuming region in the world and accounts for 48% of the world consumption [19]. The research hypothesis is therefore that convergence patterns will be quantitatively found at the country level, with Old World countries and New World countries showing contradicting trends of wine consumption and wine production. Furthermore, it is hypothesized that wine production is responsive to other wine-market factors (i.e., consumption, imports, and exports).

Viticulture is facing the growing implications of climate change, as multiple regions are subjected to increasing temperatures, altered precipitation patterns, prolonged drought periods, and higher variabilities in meteorological attributes [20–22]. Since vine phenology is driven by temperatures, phenological stages and maturation are advancing in the presence of a warmer climate [23,24]. Temperature increases affect yield components, berry composition, wine quality, and pest activities [25], having major implications for wine production. Climate change affects wine-producing regions non-uniformly. Vineyards in regions characterized by a warm climate, high evapo-transpiration levels, and low water availability are becoming more dependent on irrigation [26]. Contrarily, more temperate regions may benefit from temperature rise as wine quality is expected to improve [23]. These shifts are uncertain and unstable, and strongly affect the wine market [27].

Efforts to quantify the temporal trends of wine industry factors at the global scale have been very few [28]. The vast majority of the quantitative scientific papers on temporal dynamics of wine consumption, consumption per capita, production, imports, and exports have been limited to specific regions or countries [29–31] and did not quantify statistical relationships among these factors. Furthermore, providing a method to quantify the current state of trends in the wine market at the country level can serve as a decision-making tool for a wide array of professionals, including winemakers, investors, wine growers, retailers, and scientists. In this current work, the innovation stems from suggesting a framework overviewing the trends of the five wine industry factors for each country and enable a full global comparison and insights. This work aims to determine the trends of these factors for each country in the world for the first time, allowing to test the hypothesis of convergence patterns of wine consumption and wine production. The main objective was therefore to determine the mean values, long-term trends, and relationships between the wine industry factors for each country around the world and globally. The specific objectives were twofold: (1) to rank the countries according to the different wine industry

factors and analyze the temporal trends for each country; and (2) to explore the temporal relationships between the global wine industry factors.

2. Methodology

The dataset used in this study was acquired mainly from the International Organisation of Vine and Wine (OIV) database, available online (https://www.oiv.int/what-we-do/statistics (accessed on 23 October 2022)). It was utilized to perform long-term trend analysis and determine correlations among the wine industry factors.

2.1. Data Collection

This current study utilized datasets from a few sources to enable the analysis of wine market trends. Data regarding wine consumption, production, imports, and exports (all provided in 1000 hl) for each country were derived from the OIV database, available online from 1995 to 2021. To calculate wine consumption per capita, a dataset consisting of annual population records for each country was downloaded from the World Bank Group (WBG) website (https://databank.worldbank.org/home.aspx (accessed on 23 October 2022)). The wine consumption time series for each country was then divided by the corresponding set of population values to receive wine consumption per capita. Surface area planted with vines for all purposes (i.e., wine and juices, table grapes, and dried grapes) was also used [19]. The resulting statistics for each country were illustrated using a world map, available through the "ggplot2" package in R [32]. Some of the wine market factors are illustrated in Figure 1, featuring the temporal dynamics for consumption, consumption per capita, and production (Figure 1, panels a, b, and c, respectively) of the top four countries in 2021 in each continent, as well as global consumption and production trendlines (Figure 1d). Preprocessing of the data was conducted using the "dplyr" package in R [33].

There were some gaps in the data, resulting from a simultaneous lack of records from the OIV dataset and absence of population records in the World Bank dataset. Furthermore, the recorded vineyard surface areas included also table grapes [19], thus preventing a precise analysis of the surface area allocated for wine production.

2.2. Country Ranking and Temporal Trend Analysis of Wine Market Factors

For each of the five wine market factors (e.g., consumption, consumption per capita, production, imports, and exports) recorded for each country, the multi-annual means were computed in order to illustrate the rank of the wine industry factors by country. The temporal data for each country were used to perform a trend analysis. The long-term trend of each wine market factor was conducted using a two-sided Mann–Kendall (MK) trend test. The MK trend test is a non-parametric test, ranking the magnitude and direction of the temporal trend of a predefined variable [34]. The significance of the trends is provided in the standardized test statistic Z, enabling the identification of the direction of the trend (negative, none, or positive), its significance (p-values corresponding to critical values of the Z statistic), and magnitude (Z scores farther from zero denote stronger magnitudes of trend). The MK test has been widely used for assessing trends in environmental studies [35,36], hydrological processes [37], meteorological factors [38,39], and food systems [40]. The MK was applied using the "trend" package in R [41].

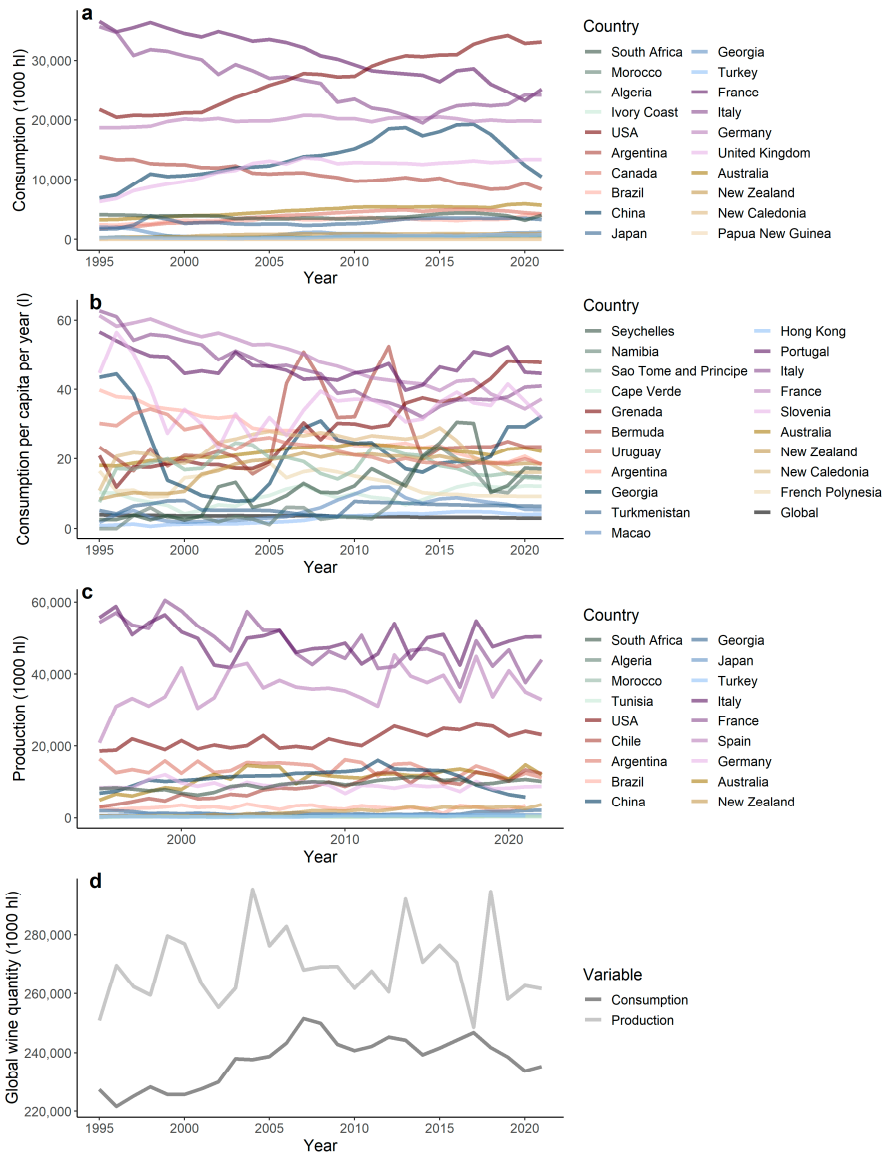

Figure 1. Long-term records of wine industry factors, consisting of four countries from each continent with the highest quantities in 2021 for wine consumption (**a**); wine consumption per capita (**b**); and wine production (**c**). Global trend lines of wine consumption and production are shown in panel (**d**). Countries located in Europe, Africa, America, Oceania, and Asia are denoted by scales of purple, green, maroon, golden-brown, and blue, respectively.

2.3. Relationships among Wine Industry Factors

To analyze the linear association among several wine industry factors at the country scale, Pearson's correlation was conducted for paired factors, including production against consumption, production against consumption per capita, consumption against imports, and production against exports. This analysis was illustrated once more in a world map, with a correlation coefficient (r) for each country denoting the direction of relationship and degree of similarity among the time series dynamics [42].

Furthermore, the country means and resulting Z-scores from the MK test for all countries were used for analyzing the relationships among the wine industry factors. A correlation matrix was derived for country means and a second matrix was computed for the Z-scores. In this manner, the relationships between wine industry factors could be interpreted both for the original values of the factors (multi-annual means), and for their trends (i.e., Z-score values) at the global scale.

An additional analysis was conducted to determine the lagged response of some wine industry factors to other market-affecting factors using only the global time series. In other words, this analysis attempted to quantify the time it takes (years) for the dynamics of certain factors to affect the temporal course of other factors. To explore these relationships the Granger causality test was applied [43]. The Granger causality test is a non-parametric test for characterizing dependence relations in bivariate time series, one which determines whether past and current values of a certain variable contain additional information on future dynamics of a response variable, controlling for the temporal autocorrelation of the response variable [44]. The Granger causality test follows the formula:

$$Y(t) = b0 + b1Y(t-1) + b2X(t-1) + e(t)$$

where $Y(t)$ is the dependent variable during time t, $X(t-1)$ is the predictor variable, and $e(t)$ is the error term. The coefficients ($b0$, $b1$ and $b2$) account for the importance of each variable in predicting $Y(t)$. If $b2$ is found to be significantly different than 0, it suggests that $X(t-1)$ has Granger causality over $Y(t)$. The lag may be adjusted according to the desired lag-effect. Specifically, the analysis focused on the lagged effects that wine consumption, consumption per capita, exports and imports have on wine production; the lagged effects of wine consumption on imports and surface area; and the lagged response of surface area on consumption per capita. This analysis was conducted using the "lmtest" package in R [45].

3. Results

3.1. Temporal Analysis of Wine Industry Factors

The multi-annual mean values and Z-scores following the MK trend test for each country are illustrated using world maps in Figures 2–6. Each of these figures displays the means and trends for a different wine industry factor. Figure 2 shows the means and trends of multi-annual wine consumption, with clear representation of the highest consumers, which include France, with over 30,823 $\times$ 10^3 hl on average, USA, with 27,027 $\times$ 10^3 hl, followed by Italy, Germany, China, Spain, UK, Argentina, Russia, Romania, Portugal, Australia, Canada, and South Africa (full list and mean values are available in Appendix A, Table A1). The leading European countries demonstrate ongoing significant decreasing trends of wine consumption, with France, Spain, and Italy receiving Z-Scores lower than -5, Argentina and Uruguay with Z = -6.25 and Z = -5.31, respectively, and Croatia with Z = -5.25. The highest increases in wine consumption were found in Norway, Mexico, Colombia, The Philippines, Maldives, Peru, and the USA, each with Z > 6.5 (the full list of Z-scores is available in Appendix A, Table A2). Of the largest consumers on average, Australia, Russia, UK, China, and Canada were found to have significant increases in wine consumption over 27 years. The global mean of multi-annual wine consumption between 1995 and 2021 was over 237,315 $\times$ 10^3 hl, ranging between 227,425 $\times$ 10^3 hl in 1995 and 235,318 $\times$ 10^3 hl in 2021, and peaking during 2007 with 251,518 $\times$ 10^3 hl (Figure 1d). The global trend was found to be positive and significant (Z = 3).

The results for wine consumption per capita position France, Portugal, Italy, Switzerland, Slovenia, Croatia, Denmark, and Austria as top wine consumers per unit of population, with 48.53, 46.98, 44.95, 36.94, 35.69, 34.39, 29.51 and 29.46 liters per year, respectively (Figure 3a) (the full list is available in Appendix A, Table A1). For countries with a wine consumption per capita that is higher than the global average (i.e., 3.53 liters year 1), the long-term trend (Figure 3b) shows strong, significant decrease in consumption per capita. Examples for notable countries are Argentina, France, Uruguay, Switzerland, Spain, and Italy, with Z-scores of -6.71, -6.13, -5.96, -5.84, -5.59, and -5.0, respectively. Strong positive trends were found for Mexico, Colombia, Poland, the Philippines, South Korea, Belarus, Peru, Norway, and Hong Kong, all with Z > 6 (the complete list of Z-scores can be found in Appendix A, Table A2). The global wine consumption per capita was 3.53 liters per year (ranging between 3.99 liters per year in 1995 and 3.00 liters per year in 2021),

resulting in a strong, significant decrease (Z = −6.13), with a sharper decreasing trendline after 2007.

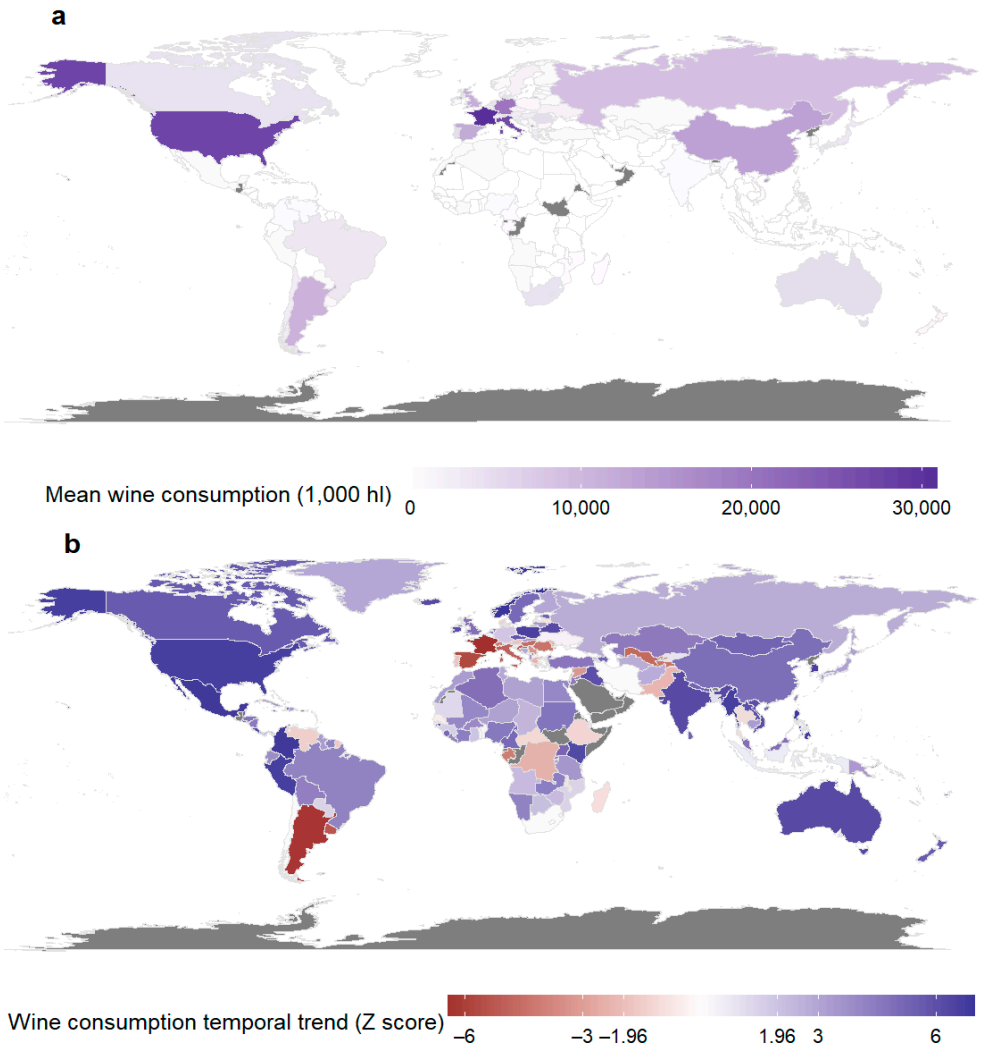

Figure 2. Wine consumption representation for each country, including mean long-term quantities (**a**); and Z-score for each country, signifying the extent of the temporal trend over 27 years (**b**). Countries in grey represent no data.

Multi-annual means of wine production worldwide are illustrated in Figure 4a, with the primary producing countries being Italy, France, Spain, USA, Argentina, Australia, China, South Africa, Germany, Chile, and Portugal, with values in 10^3 hl of 49,468, 48,421, 35,906, 21,805, 13,709, 11,180, 11,084, 9369, 9123, 8715 and 6698, respectively. The five leading countries in wine production account for 62.91% of the global wine market. Most African countries, excluding South Africa, do not have records of wine production during the studied period. The sharpest increasing trends of winemaking were found for Peru, Chile, New Zealand, Belarus, Belgium, Canada, and UK, with Z-scores of 6.76, 5.95, 5.87, 5.78, 5.65, 5.24 and 4.9, respectively. Decreasing trends of wine production were found for Cyprus, Bulgaria, Croatia, and Greece, all with $Z < -5$. The main producers have been experiencing various degrees of trends. Italy, Spain, and Portugal were found to have non-significant trends; France and Argentina experienced a significant decrease in wine production; and South Africa, USA, Australia, China, and Chile showed a significant production increase (Figure 4b, Appendix A, Table A2). Globally, mean multi-annual production for 1995–2021 was 269,122 × 10^3 hl, ranging between 250,874 × 10^3 hl in 1995

and 261,737 × 10^3 hl in 2021, peaking at 295,441 × 10^3 hl in 2004 while showing very strong variability through time (Figure 1d). The trend was non-significant over the studied period.

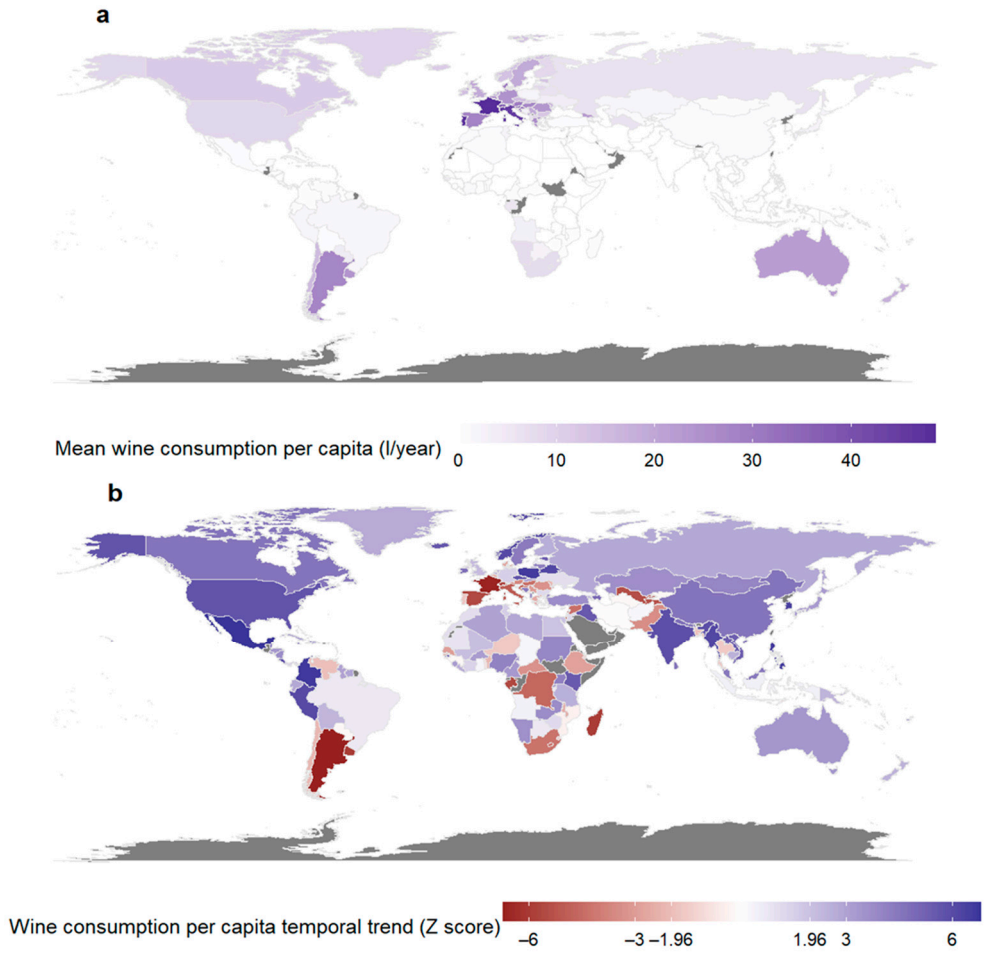

Figure 3. Wine consumption per capita representation for each country, including mean long-term quantities (**a**); and Z-score for each country, signifying the extent of the temporal trend over 27 years (**b**). Countries in grey represent no data.

Wine imports are attributed mainly to Germany, UK, the USA, France, Russia, and the Netherlands (Figure 5a), summing up to an average of 47,162 × 10^3 hl a year, consisting of 56.4% of world wine imports. Most countries have shown increasing trends of wine imports during 1995–2021, with only 15 countries showing significant negative trends of imports, all of them considered low wine consumers. The strongest positive trend was attributed to Canada (Z = 7.05), followed by the USA, Colombia, Poland, and Norway (Figure 5b, Appendix A, Table A2). A global average of wine imports was found to be 83,650 × 10^3 hl, ranging between 51,771 × 10^3 hl in 1995 and 108,714 × 10^3 hl in 2021, peaking in 2017 with 111,010 × 10^3 hl. The increasing trend was therefore very strong and significant, with Z = 6.67.

During the period between 1995 and 2021, wine exports were highest in Italy, Spain, and France (Figure 6a), with 18,225, 15,803 and 14,417 × 10^3 hl per year in average, respectively, consisting of 56% of global exports. The strongest decrease was attributed to Cyprus (mean of 60 × 10^3 hl per year). Most major exporters have experienced significant positive trends, including Australia (Z = 4.75), Chile (Z = 6.26), South Africa (Z = 5.21), USA (Z = 3.13), Germany (Z = 4.62), Portugal (Z = 3.21), Italy (Z = 4.54), and Spain (Z = 5.79), while France was found to have a non-significant, negative trend (Figure 6b). Global exports consisted of a multi-annual average of 86,585 × 10^3 hl per year, ranging between

55,016 × 10^3 hl in 1995 and 112,654 × 10^3 hl in 2021, similar to the global imports. The trend was therefore positive and significant, with Z = 6.55.

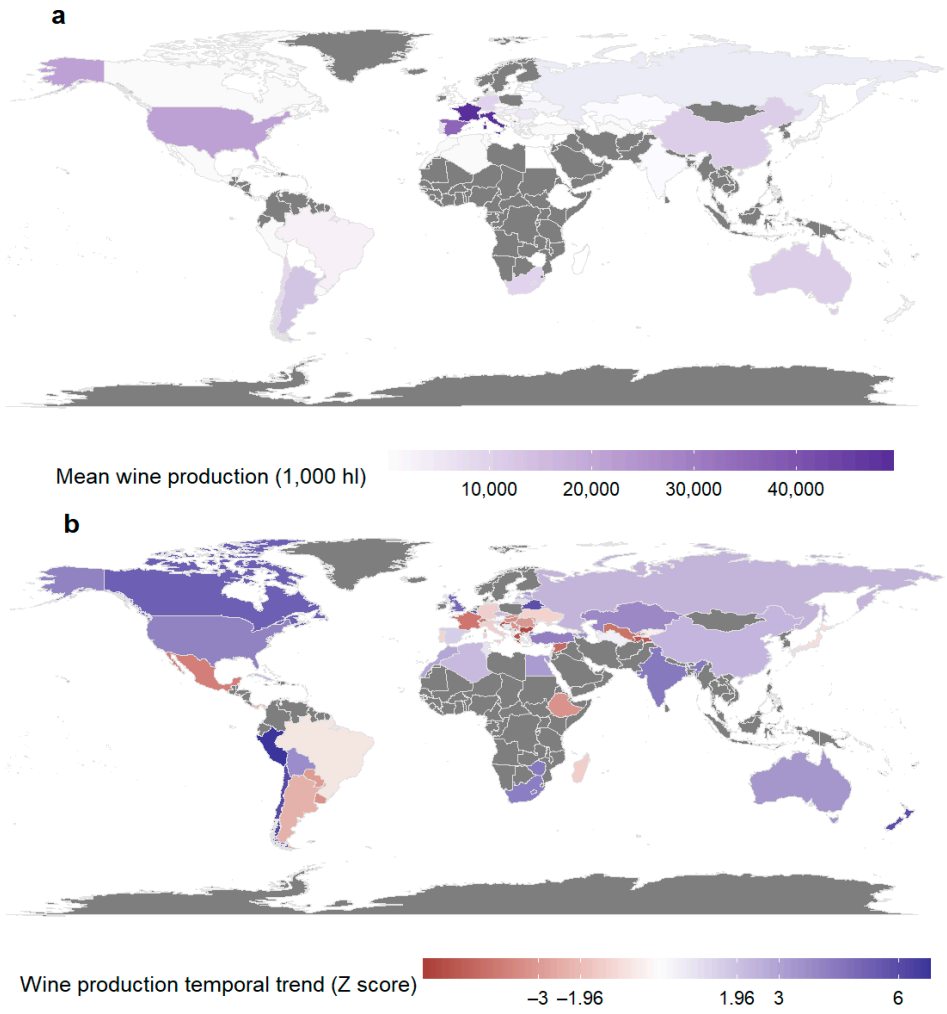

Figure 4. Wine production representation for each country, including mean long-term quantities (**a**); and Z-score for each country, signifying the extent of the temporal trend over 27 years (**b**). Countries in grey represent no data.

3.2. Relationships among Wine Market Factors

The country-level correlation analysis revealed the association among some paired wine industry factors (Figure 7). Wine production and consumption were found to have positive relationships in most countries, with Cyprus having a strong negative correlation (r = −0.86), and Mexico, Slovakia, Israel, and Paraguay having moderate negative correlations (r = −0.70, −0.65, −0.60, −0.58, respectively). Countries such as Spain, Austria, South Africa, Brazil, Germany, Chile, Argentina, Portugal, and Japan were found to have negligible coefficients, denoting no relationships (Figure 7a). Similar patterns were found for the correlations between wine production and consumption per capita, except for South Africa with a correlation of r = −0.64 (Figure 7b). Wine consumption and imports were positively related, with 80% of cases displaying a value of r > 0.3. Strong negative relationships were found for Croatia and Italy (both with r = −0.87), Romania (r = −0.65), and France (r = −0.63). Negligible associations were found between wine consumption and imports in Portugal, Argentina, Switzerland, Chile, Spain, South Africa, Ukraine, Austria, Greece, and Georgia (Figure 7c). Finally, the relationships between wine production and exports were found to have various patterns of associations (Figure 7d), with about 12% of the countries showing values of r < −0.3, about 35% with r > 0.3, and 49% with low (or

none) associations. The strongest positive relationships were found for New Zealand, Chile, South Africa, and Australia ($r > 0.8$), while the strongest negative relationships between wine production and exports were found for Lebanon ($r < -0.8$).

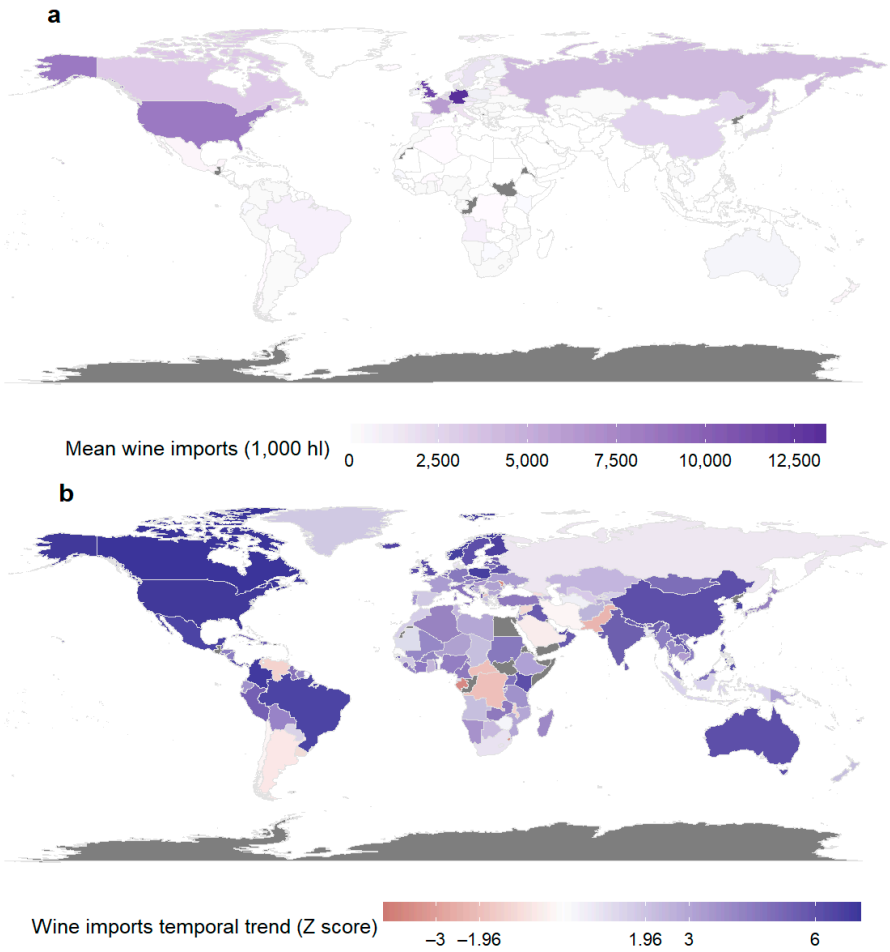

Figure 5. Wine import representation for each country, including mean long-term quantities (**a**); and Z-score for each country, signifying the extent of the temporal trend over 27 years (**b**). Countries in grey represent no data.

To quantify the relationships among the wine industry factors, Pearson correlation was conducted among each pair of factors for multi-annual mean values (Figure 8a), and Z-scores (Figure 8b). Countries that had no data regarding one or more of the paired variables were excluded from the analysis. The results show that no negative relationships were found between the factors' means or trends. The mean wine exports factor was highly correlated to mean wine production (Figure 8a), with $r = 0.95$. Other medium-high correlations among multi-annual means were found for wine consumption against exports, imports, and production. Correlations among trends (Figure 8b) were overall low or moderate, except for a strong link between consumption and consumption per capita ($r = 0.95$). The consumption trend was found to have a moderate to strong association with trends of imports and production with correlations of 0.67 and 0.61, respectively. A moderate relationship was also found between the trend of wine imports and consumption per capita ($r = 0.67$).

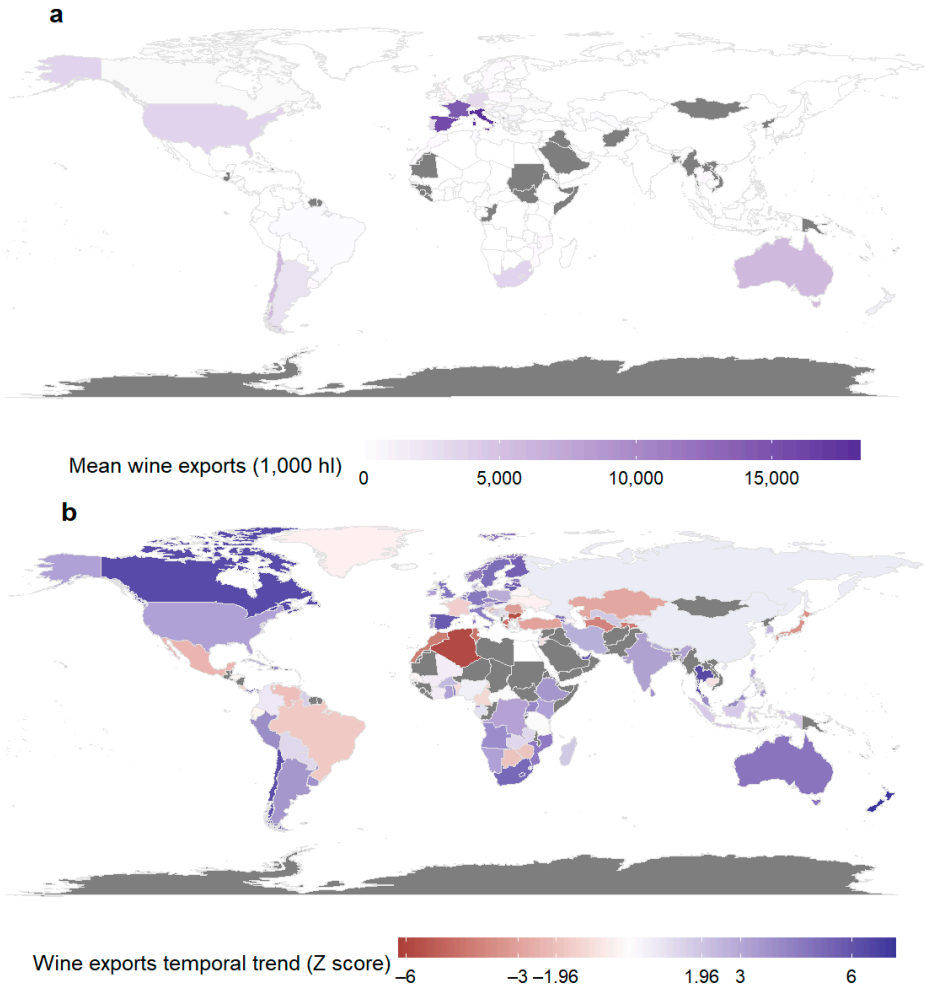

Figure 6. Wine export representation for each country, including mean long-term quantities (**a**); and Z-score for each country, signifying the extent of the temporal trend over 27 years (**b**). Countries in grey represent no data.

Finally, the Granger causality test was performed for the global time series of various factors to assess the lagged response of certain factors to other wine industry factors. Table 1 illustrates that the temporal dependencies of wine consumption on wine production were significant for lags of 4 and 5 years, and consumption patterns were affected by surface area in lags of 3 and 4 years (i.e., it takes 3–5 years for these factors to respond to wine consumption demands). Exports and imports were both significant drivers of wine production for lag = 4, and consumption per capita affected production at lags 4 and 5. Consumption was not found to be a future determinant of wine imports, and consumption per capita did not affect future time patterns of surface area under vineyards.

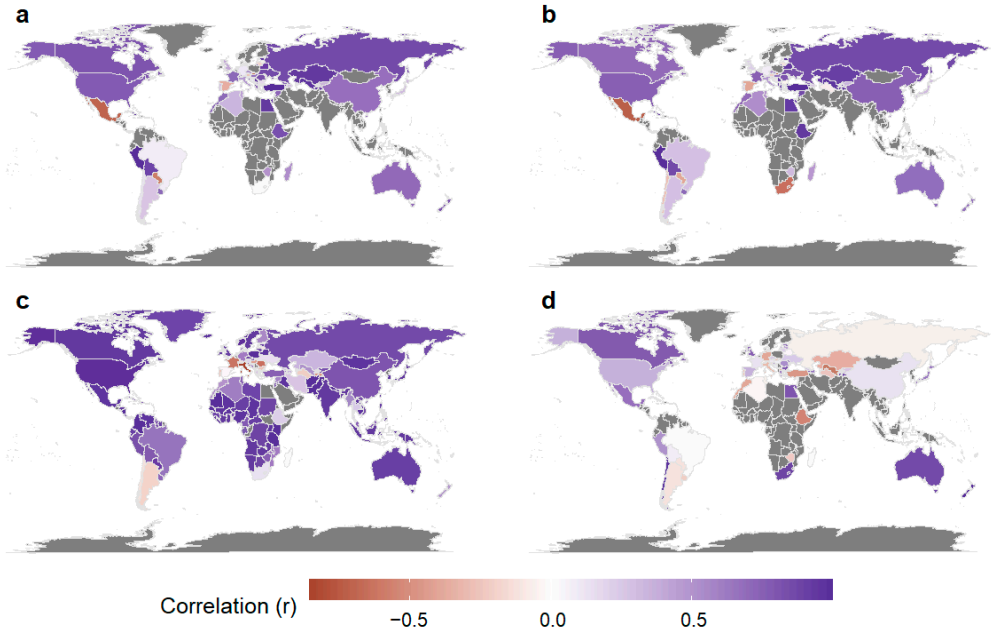

Figure 7. Pearson correlation coefficients between wine industry factors for each country, including correlations between production and consumption (**a**); production and consumption per capita (**b**); consumption and imports (**c**); and production and exports (**d**).

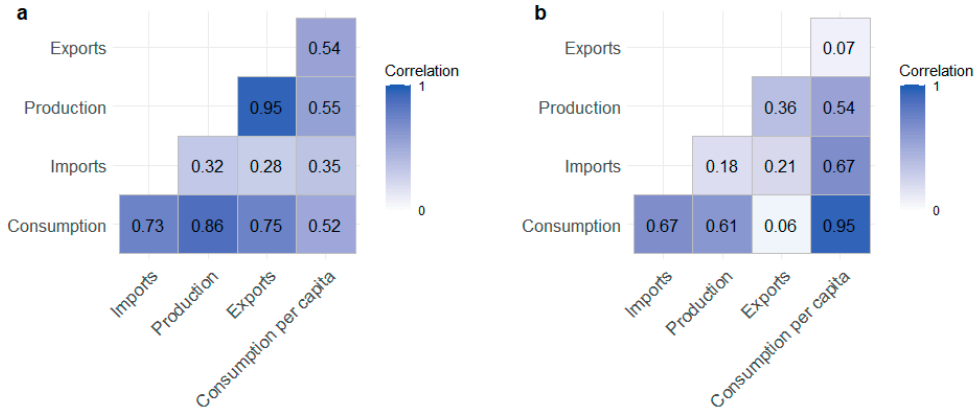

Figure 8. Correlation matrices exploring the relationships among the mean wine industry variables (**a**); and mean wine industry Z-scored variables (**b**).

Table 1. Granger causality test results for bivariate global time series, with results for lags of 2–5. Results marked in bold denote significant relationship ($\alpha = 0.05$) among the factors (driving and response wine industry factors).

Driving Factor	Response of Wine Industry Factor	Granger Causality Lag 2	Granger Causality Lag 3	Granger Causality Lag 4	Granger Causality Lag 5
Consumption	Production	F = 1.52 (p = 0.24)	F = 1.55 (p = 0.24)	**F = 10.03 (p < 0.001)**	**F = 8.89 (p < 0.001)**
Consumption per capita	Production	F = 1.04 (p = 0.37)	F = 1. 41 (p = 0.28)	**F = 5.98 (p = 0.006)**	**F = 4.52 (p = 0.02)**
Exports	Production	F = 0.37 (p = 0.73)	F = 0.71 (p = 0.56)	**F = 2.81 (p = 0.067)**	F = 1.72 (p = 0.21)
Imports	Production	F = 1.43 (p = 0.26)	F= 1.84 (p = 0.18)	**F = 3.76 (p = 0.028)**	**F = 2.64 (p = 0.08)**
Consumption	Imports	F = 0.17 (p = 0.85)	F = 1.39 (p = 0.28)	F = 1.24 (p = 0.34)	F = 0.37 (p = 0.86)
Consumption	Surface area	F = 2.07 (p = 0.15)	**F = 4.93 (p = 0.01)**	**F = 5.87 (p = 0.005)**	F = 1.69 (p = 0.22)
Consumption per capita	Surface area	F = 2.95 (p = 0.076)	F = 1.98 (p = 0.16)	F = 2.26 (p = 0.11)	F = 1.11 (p = 0.41)

4. Discussion

This study presents a trend analysis at the country level of five wine-market factors. Although the information derived from these analyses may be useful as an overview of global processes in the wine industry, it lacks the specificity of the processes within each country. The scope of this study did not enable it to address the causes and effects of each wine-market factor in each country, and the findings attempt to provide a wide and limited view on these processes. Furthermore, the period selected for this analysis (1995–2021) only provides answers to trends that took place during this timeframe. Thus, earlier trends and patterns are not accounted for, nor are future projections.

The worldwide analysis conducted in this current research shows a sharp decrease in wine consumption in traditional wine-consuming countries (e.g., France, Italy, and Spain) and some other high-consuming countries, such as Argentina and Uruguay (Figure 2b). Drinking patterns in Southern European countries have been gradually shifting for some decades, with studies reporting on decreases from the early 1970's [28]. These trends were claimed to be due to marketing factors, public health policies, pricing and taxing, and agricultural policies. For instance, beer and spirits consumption has been shown to have increased in these countries during the 1970s and 1980s, as opposed to traditional preferences [16]. Wine consumption in Italy has been reportedly decreasing since the 1970s, due to various reasons, such as shifts to new drinks among younger generations, decreases in drinking among male heavy drinkers who were the main contributors to wine consumption, migration from the countryside, where wine is a part of the culinary tradition, to the city, and more [46]. Contrarily, some of the largest wine-consuming countries were found to have strong, significant increases in wine consumption between 1995 and 2021, as also reported by many studies published in recent years [28]. For instance, Australia has also been experiencing a sharp increase in wine consumption over the past several years [19]. García-Cortijo et al. (2019) [47] reported that the Chinese increase in wine consumption between 2000 and 2014 was due to multiple factors, including the improved standard of living of the middle class, which resulted in an overall increase in alcohol consumption, including wine. The entry of China into the World Trade Organization in 2001 resulted in a reduction in wine import tariffs and introduced the Chinese market to foreign wines. The increase in wine consumption is therefore associated with higher incomes, along with other contributors such as the expansion of urban areas and tourism. Although Chinese wine consumption was projected to increase and surpass all other wine-consuming countries [1,48], our analysis shows a decreasing pattern since 2018. This downward trend has been accelerated by COVID-19 effects and lack of tourism and may have global effects on wine consumption [19]. In the USA, studies have shown a negative demand in response to increasing wine prices. Wine demand is also subjected to adjustment in wine marketing regulations [49]. Overall, countries that are experiencing rapid economic growth have shown the fastest-growing wine consumption (Figure 2a) and strong relationships to wine imports (Figure 7c), where wealthy and middle-class sectors were reported to be significant wine consumers [1]. These wine import trends were not shown during earlier decades [28], and are attributed to the past 30 years. Our findings suggest an overall significant increasing global trend of wine consumption, despite the sharp decreases in wine consumption among the traditional European countries. With that said, the increasing patterns have been moderated since 2008 (Figure 1d), possibly following the great recession which had a negative impact on income.

Wine consumption per capita, however, was found to significantly decrease during the examined period at the global scale, following sharp decreases in the most highly-consuming wine countries. These findings do not align with the work of Anderson and Nelgen (2011), which reported a mild global decrease in wine consumption per capita between 2000 and 2009, and it is therefore assumed that the sharper decrease is more recent. The trends of consumption and consumption per capita were found to be highly correlated (Figure 8b). The findings show that Old World countries experienced decreasing trends of wine consumption per capita, corresponding to the trends shown between the 1970s and

2000 in previous studies [6,50]. New World countries, on the other hand, were found to have increasing levels of individual wine consumption, suggesting that this may eventually lead to a convergence towards similar levels and an overall homogenization pattern, as previously suggested by other studies [15,51]. Several mechanisms underlying the decreasing trends in traditional wine-consuming countries have been previously suggested, including the indistinct cultural boundaries as a function of globalization. In this current study, wine consumption was found to be closely linked to wine imports in most countries (Figure 7b). Indeed, wine preferences appear to be driven less by regional traditions than in the past, and are more open to cultural change [18]. Increasing growth rates in Eastern Europe, Asia, and parts of Africa are responsible for rising levels of wine consumption per capita [1], while cultural shifts, health policies, alcohol policies, and pricing were the reported drivers of reduction in wine consumption per capita in the Southern European countries [16].

Wine consumption was found to be a driving factor of wine production (Table 1) and was also related to imports and exports temporal trends (Figure 8). Our findings show very high fluctuations in global wine production over time (Figure 1d), leading to an insignificant trend. Wine production has been partially driven by the rapid expansion of wealthy and middle classes in fast-growing economies, leading to an increase in the New World wine industry, including developing countries [1]. In the USA, the growing consumer demand for table wines in the past decades has reportedly led to a sharp increase in the establishment of wineries [52], thus increasing productivity. These past findings correspond with our study, showing a high correlation between wine consumption and production ($r = 0.77$) in the USA (Figure 7a). South Africa was also found to have high increasing trends of wine production, with suggested underlying causes such as affordable high-quality production, unique products, and continuous innovation, as well as intense competition in the local market [53]; wine consumption in South Africa, however, is stable through time (Figure 2b), thus displaying no relationship between consumption (no trend) and production (strong positive trend). On the other hand, Argentina has been experiencing vineyard surface area decline since 2015, supposedly due to climate change issues [19] including water scarcity [54], increasing temperatures, and drought conditions [55], negatively affecting its wine production (Figure 4b). France has been experiencing a reduction in wine production due to unfavorable meteorological conditions [19], which are expected to continue [56], as well as changing marketing practices [57], and the correlation between wine consumption (sharp decrease) and production (also decreasing) was found to be positive ($r = 0.71$). China's wine production levels have been declining since 2017 (Figure 1c) as a consequence, among other factors, of China's decreasing consumption levels ($r = 0.67$, Figure 7a), challenging climate conditions, and technological constraints [19]. The global levels of production have been mostly higher than the levels of consumption (Figure 1d), introducing problems of overproduction in the wine industry. To deal with this excess capacity, EU countries are offering subsidies to uproot vines, turn lower-quality wine to fuel additives for industrial alcohol [58], and use distillation practices for extracting wine-based products [59] or industrial alcohol [60].

At the global scale, imports and exports were found to have lagged effects on wine production. During recent decades, decreasing tariffs, reduction in logistical costs, and the lowering of some trade barriers have presented the opportunity for wine producers to export their products [61]. Wine imports and exports have therefore shown global increasing trends, with $Z > 6.5$, and more than 80% of the countries showing a positive trend of wine imports (Figure 5b) and positive correlations between wine consumption and wine imports (Figure 7c). Wine consumers in Canada, with the strongest positive trend of wine imports, perceive local wines as over-priced, as compared to imports [62]. Therefore, as Canadian wine consumption increases, imports are also rising. Although wine production was also found to significantly increase, imports exceed wine exports in Canada by 2761×10^3 hl in average, a pattern also observed by Madill et al. (2003) [63]. The USA has also been showing rising trends of wine imports and now accounts for 10%

of world wine imports, in average, as also reported in various studies [12,64]. Poland was likewise found to have a strong increasing trend of wine imports, largely from Georgia [65]; indeed, Georgia displayed a corresponding high exporting trend (Z = 4.63). In Norway, wine imports were found to have increased sharply (Z = 6.65) and have a very strong correlation to wine consumption (r = 0.97) due to deregulations of wine imports in 1995, enabling private wine importers to expand their trade [66].

The largest exporters are consistently France, Italy, and Spain (Figure 6a). While Spain and Italy continue to demonstrate significant increases in wine exports (Z = 5.8 and Z = 4.54, respectively, Appendix A, Table A2), France has been experiencing an insignificant decrease (Z = −1.46, Appendix A, Table A2), as also shown by Anderson and Nelgen (2011) [28]. Cardebat and Figuet (2019) [67] suggest that this reduction in wine exports stems from exchange rate variations, although higher-quality wines are not affected by decreasing trends of overall wine export volumes. The relationship between wine production and exports in France, however, is negligible (Figure 7d) since the rate of decrease in production (Z = −4.17) is much stronger than the rate of export decrease, probably signifying that the domestic reduction in wine consumption is a strong contributor to the decline in wine production (r = 0.71, Figure 7a). Australian exports have been consistently increasing since the 1980s [6], and the amount of exported wine consists of half of the country's wine produce (Appendix A, Table A1), as also found by Duncan and Greenaway (2008) [58]. Approximately 75% of these wine exports reach the USA, UK, and Canada [68], which all show very strong increasing trends in wine imports (Z > 6, Appendix A, Table A2) and strong correlations between wine consumption and imports (USA with r = 0.98, UK with 0.90, and Canada with 0.94). In Chile, the production volumes have doubled since the 1980s [58], and exports consist of about 60% of wine produce (Appendix A, Table A1), with a correlation of 0.92 between wine production and exports (Figure 7d). The large increase in exports have led to rising wine prices in the country, turning wine into a luxury and decreasing Chile's domestic wine consumption (Z = −2.13, Appendix A, Table A2) [68]. With the transition to a post-apartheid regime of South Africa in the early 1990s, the international markets were opened for exports including wine [69], and South Africa is exporting an average of about 35% of its produce (Appendix A, Table A1), at an increasing rate (Z = 5.21, Appendix A, Table A2), and a correlation of 0.84 between wine production and exports.

Our findings regarding lagged effects of surface area under vineyards and wine consumption on production processes (Table 1) are supported by previous works. Hussain et al. (2008) [61] and Cholette et al. (2005) [60] stated that the lag between vineyard planting and increasing production results in a supply of wine grapes that is asynchronous with demand. Oczkowski (2014) [70] also suggested a mechanism of a four-year production lag between vine planting and grape output and four-year lagged quantities. Wine imports did not show any global lagged response to wine consumption; however, the country means of these two factors were found to be correlated (r = 0.73, Figure 8a), as well as their trends (r = 0.67, Figure 8b), and it is possible that there is less than a two-year lag effect between wine consumption and imports.

5. Summary and Conclusions

This work attempted to quantify the temporal trends of various wine industry factors (i.e., consumption, consumption per capita, production, imports, and exports) and the relationships among these factors. The methods used in this study were applied for each country and included: computation of mean values for the wine-market factors throughout the study period; applying the MK trend test to quantify the direction, magnitude and significance of the trend for each wine-market factor; computing correlations among the factors for each country, as well as computing the correlations among the factors' Z-scores to receive global-scale interrelations among the factors' trends; and using the Granger causality test to determine lagged effects between factors. The findings show that there is an overall distinction between the trend levels of wine consumption, consumption

per capita, and production between the Old World and the New World, as globalization processes generate suitable conditions for homogenization in wine trade. These findings support the hypothesis and claims of previous works that raised a theory regarding a converging trend in wine consumption and wine production. Although sharp increases were quantified in some New World countries, the Southern European countries still serve as major wine consumers and producers in the global wine market. Imports have been rising in most countries, signifying the growing demand for foreign wine and a cross-cultural pattern. Furthermore, current increases of wine consumption seem to be linked to modern, developed, and wealthy countries, and characterized by urban populations and high-income. Therefore, the major forces driving the wine market are economic growth and wider competition.

Climate change is a disruptive force that continues threatening the agricultural sector. The wine market is suffering from increasing levels of inter-annual variations in production due to unfavorable and unpredictable weather conditions. Adaptation to the new meteorological characteristics includes alteration of wine production areas and farming practices, re-establishment of wine grape varieties, and managing irregular cycles of the growing seasons, thus affecting the costs of production, revenues, and profits, and causing instabilities in the wine market. Future research should therefore focus on suitable adaptation measures and policies, in order to secure the wine market from potential climate change impacts.

The analysis performed in this study and the corresponding findings may assist the wine-industry sector to make informed decisions about the production processes of wine, answer questions regarding the distribution of wine and the utilization of land for allocation of vineyards, and identify new opportunities within the market. Policymakers may benefit from the methods presented in this study, as they are useful for understanding the trends, patterns, and relationships that shape the industry. Finally, the framework presented in this study may be applied to any other market to achieve a global understanding of temporal patterns and trends.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Multi-annual mean values of wine consumption, consumption per capita, production, imports, and exports for each country.

Continent	Country	Consumption (1000 hl)	Mean Consumption Per Capita (l)	Production (1000 hl)	Imports (1000 hl)	Exports (1000 hl)
Asia	Afghanistan	1.44	0.01	NA	1.41	NA
Europe	Albania	183.85	6.21	158.46	24.93	0.00
Africa	Algeria	327.19	0.91	566.78	38.52	32.33
Oceania	American Samoa	0.04	0.07	NA	0.04	NA
Africa	Angola	677.00	3.03	NA	686.04	4.63
America	Antigua	10.00	11.10	NA	10.70	0.33
America	Argentina	10,865.59	27.53	13,708.79	71.44	2379.63
Asia	Armenia	57.22	1.91	67.81	3.26	11.78
America	Aruba	NA	NA	NA	24.48	1.44
Oceania	Australia	4745.85	21.82	11,179.61	547.00	5871.78
Europe	Austria	2458.74	29.46	2394.36	634.37	485.26
Asia	Azerbaijan	53.33	0.58	98.78	2.74	55.89
America	Bahamas	26.15	7.48	NA	30.78	0.04
Asia	Bahrain	14.96	1.40	NA	15.07	0.15
Asia	Bangladesh	1.04	0.00	NA	1.00	NA
America	Barbados	18.59	6.61	NA	19.78	0.52
Europe	Belarus	589.33	6.17	220.61	385.37	15.78
Europe	Belgium	2753.73	25.25	5.63	2358.93	343.43
America	Belize	6.56	1.91	NA	6.56	0.00
Africa	Benin	35.48	0.41	NA	38.19	2.63
America	Bermuda	17.37	27.20	NA	19.26	NA
Asia	Bhutan	NA	NA	NA	1.48	0.00
America	Bolivia	59.30	0.59	56.48	6.81	0.04
Europe	Bosnia and Herzegovina	99.11	2.76	51.81	69.11	25.56
Africa	Botswana	52.00	2.71	NA	48.07	0.37
America	Brazil	3237.37	1.70	2924.44	651.11	63.59
Asia	Brunei	0.11	0.03	NA	0.19	NA
Europe	Bulgaria	921.04	12.18	1703.46	71.07	856.89
Africa	Burkina Faso	38.07	0.23	NA	39.19	0.78
Africa	Burundi	2.04	0.02	NA	2.07	0.00
Africa	Ivory Coast	282.74	1.39	NA	292.48	0.63
Africa	Cape Verde	45.44	9.34	NA	46.81	0.04
Asia	Cambodia	9.00	0.06	NA	9.15	0.07
Africa	Cameroon	83.11	0.41	NA	80.44	5.44
America	Canada	3838.89	11.33	532.54	3154.30	393.30
America	Cayman Islands	NA	NA	NA	10.00	NA
Africa	Central African Republic	5.59	0.14	NA	5.52	0.04
Africa	Chad	6.41	0.05	NA	6.22	0.00
America	Chile	2502.22	15.04	8715.04	31.67	5761.63
Asia	China	13,635.44	1.02	11,084.15	2544.48	40.00
America	Colombia	124.37	0.27	NA	127.56	0.15
Africa	Comoros	1.67	0.24	NA	1.70	NA
Africa	Democratic Republic of the Congo	34.67	0.06	NA	35.74	1.41
Oceania	Cook Islands	1.48	NA	NA	1.52	NA
America	Costa Rica	69.93	1.52	NA	71.15	0.04
Europe	Croatia	1485.52	34.39	1360.89	145.07	63.96
America	Cuba	143.30	1.27	98.44	42.96	0.11
Europe	Cyprus	140.30	13.09	251.75	43.22	60.74
Europe	Czech Republic	1541.56	14.73	570.57	1241.26	100.70

Table A1. *Cont.*

Continent	Country	Consumption (1000 hl)	Mean Consumption Per Capita (l)	Production (1000 hl)	Imports (1000 hl)	Exports (1000 hl)
Europe	Denmark	1626.15	29.51	NA	1845.81	275.04
Africa	Djibouti	2.59	0.32	NA	2.56	0.00
America	Dominica	2.37	3.36	NA	2.52	0.07
America	Dominican Republic	74.70	0.78	NA	91.44	15.96
America	Ecuador	57.56	0.39	NA	61.63	0.22
Africa	Egypt	54.48	0.07	55.52	0.00	0.22
America	El Salvador	17.37	0.28	NA	17.59	0.00
Africa	Equatorial Guinea	NA	NA	NA	76.56	2.04
Europe	Estonia	175.89	13.16	54.70	155.37	28.67
Africa	Eswatini	12.93	1.27	NA	14.26	2.00
Africa	Ethiopia	19.59	0.02	15.15	4.78	0.37
Europe	Faroe Islands	3.44	7.21	NA	3.44	NA
Oceania	Fiji	11.26	1.33	NA	11.48	NA
Europe	Finland	463.37	8.67	NA	546.70	33.07
Europe	France	30,823.37	48.53	48,421.25	6051.22	14,417.15
America	French Guiana	9.44	NA	NA	6.86	NA
Oceania	French Polynesia	33.59	13.05	NA	36.44	NA
Africa	Gabon	80.15	5.52	NA	82.41	0.37
Africa	Gambia	0.88	0.05	NA	1.04	NA
Asia	Georgia	889.44	22.40	1326.93	6.30	284.59
Europe	Germany	19,912.04	24.26	9123.25	13,372.26	3219.41
Africa	Ghana	68.22	0.29	NA	72.33	4.37
Europe	Greece	2806.19	25.80	3210.54	134.78	356.89
America	Greenland	5.48	9.71	NA	6.56	1.00
America	Grenada	30.70	28.54	NA	33.78	3.07
America	Guadeloupe	25.56	NA	NA	6.37	NA
Oceania	Guam	0.44	0.28	NA	0.37	NA
Africa	Guinea	6.81	0.07	NA	7.07	NA
Africa	Guinea-Bissau	55.19	3.51	NA	55.04	NA
America	Guyana	0.56	0.07	NA	1.00	0.41
America	Haiti	8.22	0.08	NA	10.81	NA
America	Honduras	13.22	0.16	NA	13.52	0.04
Asia	Hong Kong	204.74	2.87	NA	317.70	108.33
Europe	Hungary	2709.07	26.98	3260.39	147.52	816.26
Europe	Iceland	35.04	11.02	NA	36.52	0.11
Asia	India	111.07	0.01	149.50	23.70	7.96
Asia	Indonesia	8.00	0.00	NA	9.93	1.37
Asia	Iran	0.07	0.00	NA	0.11	1.41
Asia	Iraq	3.30	0.01	NA	3.41	NA
Europe	Ireland	618.30	13.95	NA	629.26	17.52
Asia	Israel	58.67	0.85	177.11	48.78	74.33
Europe	Italy	26,232.96	44.95	49,468.29	1592.44	18,225.00
America	Jamaica	23.07	0.81	NA	28.41	4.44
Asia	Japan	2905.00	2.29	850.79	2079.19	3.63
Asia	Jordan	1.70	0.02	NA	2.07	0.33
Asia	Kazakhstan	316.33	1.91	239.36	92.37	3.85
Africa	Kenya	41.30	0.10	NA	48.26	5.89
Oceania	Kiribati	0.04	0.04	NA	0.04	NA
Asia	South Korea	236.22	0.47	NA	256.63	0.89
Asia	Kuwait	NA	NA	NA	NA	NA
Asia	Kyrgyzstan	32.52	0.61	20.74	14.04	2.59
Asia	Laos	11.07	0.17	NA	11.56	NA
Europe	Latvia	96.07	4.44	19.44	387.63	328.04
Asia	Lebanon	116.74	2.57	130.81	10.00	16.89
Africa	Lesotho	5.19	0.25	NA	5.44	NA
Africa	Liberia	3.15	0.08	NA	3.22	NA

Table A1. *Cont.*

Continent	Country	Consumption (1000 hl)	Mean Consumption Per Capita (l)	Production (1000 hl)	Imports (1000 hl)	Exports (1000 hl)
Africa	Libya	0.19	0.00	NA	0.15	0.00
Europe	Lithuania	256.74	8.32	51.96	519.19	320.74
Europe	Luxemburg	262.41	NA	120.82	172.56	74.24
Asia	Macao	31.33	5.70	NA	34.07	2.93
Africa	Madagascar	88.41	0.46	80.44	6.44	0.30
Africa	Malawi	3.93	0.03	NA	4.00	0.00
Asia	Malaysia	43.85	0.16	NA	71.59	16.81
Asia	Maldives	10.52	2.62	NA	10.89	0.00
Africa	Mali	5.33	0.03	NA	5.59	0.04
Europe	Malta	59.41	13.91	34.04	38.78	1.63
America	Martinique	17.78	NA	NA	5.68	0.00
Africa	Mauritania	0.19	0.01	NA	0.19	NA
Africa	Mauritius	16.63	1.35	NA	17.26	0.81
America	Mexico	646.48	0.55	748.93	408.22	14.07
Oceania	Micronesia	NA	NA	NA	0.37	NA
Europe	Moldova	464.70	16.20	1843.46	71.11	1384.30
Asia	Mongolia	12.11	0.43	NA	12.15	NA
Europe	Montenegro	109.50	17.66	126.25	19.65	60.29
America	Montserrat	0.15	NA	NA	0.15	NA
Africa	Morocco	379.19	1.18	352.82	80.41	47.89
Africa	Mozambique	71.59	0.31	NA	118.04	46.07
Asia	Myanmar	22.26	0.04	NA	10.70	NA
Africa	Namibia	171.26	7.58	NA	191.96	14.19
Oceania	Nauru	0.00	0.00	NA	0.00	NA
Asia	Nepal	4.78	0.02	NA	4.93	0.11
Europe	Netherlands	3249.26	19.65	NA	3595.44	354.59
America	Netherlands Antilles	13.41	NA	NA	12.78	NA
Oceania	New Caledonia	55.48	22.97	NA	56.30	NA
Oceania	New Zealand	762.78	17.47	1803.18	365.00	1178.19
America	Nicaragua	8.78	0.15	NA	8.85	0.00
Africa	Niger	6.56	0.04	NA	6.74	0.00
Africa	Nigeria	149.89	0.09	NA	143.85	0.74
Oceania	Niue	0.00	NA	NA	0.00	NA
Oceania	Norfolk Island	NA	NA	NA	0.78	NA
Europe	Norway	654.19	13.35	NA	715.89	13.52
Asia	Oman	NA	NA	NA	4.26	0.00
Asia	Pakistan	0.41	0.00	NA	0.41	0.00
America	Panama	24.19	0.69	1.26	32.07	23.48
Oceania	Papua New Guinea	11.15	0.15	NA	11.56	NA
America	Paraguay	255.93	4.23	35.74	232.22	0.04
America	Peru	595.63	2.02	528.33	76.93	2.04
Asia	Philippines	105.81	0.11	NA	105.22	0.93
Europe	Poland	831.41	2.18	NA	869.11	48.89
Europe	Portugal	4866.96	46.98	6697.82	1710.48	2695.11
Asia	Qatar	NA	NA	NA	62.81	0.00
Europe	North Macedonia	201.44	9.87	899.67	5.52	744.15
Asia	Turkey	430.41	0.58	444.33	11.96	37.52
Africa	Reunion	30.74	NA	NA	43.70	0.00
Europe	Romania	4902.04	23.39	4898.29	285.96	262.04
Europe	Russia	9071.59	6.29	4542.37	4145.37	31.00
Africa	Rwanda	5.52	0.05	NA	6.63	1.41
Africa	Saint Helena	0.18	NA	NA	0.18	NA
America	Saint Kitts	1.96	4.07	NA	1.93	0.00
America	Saint Lucia	10.41	6.11	NA	13.26	2.00
America	Saint Pierre And Miquelon	1.89	NA	NA	1.85	NA

Table A1. *Cont.*

Continent	Country	Consumption (1000 hl)	Mean Consumption Per Capita (l)	Production (1000 hl)	Imports (1000 hl)	Exports (1000 hl)
America	Saint Vincent	1.78	1.63	NA	1.81	0.00
Oceania	Samoa	0.41	0.21	NA	0.52	NA
Africa	Sao Tome and Principe	31.30	18.18	NA	31.74	NA
Asia	Saudi Arabia	0.00	0.00	NA	0.04	NA
Africa	Senegal	65.00	0.54	NA	65.37	1.19
Europe	Serbia	1356.31	18.84	1179.31	237.53	115.88
Africa	Seychelles	10.81	11.96	NA	11.81	0.00
Africa	Sierra Leone	1.78	0.03	NA	1.78	NA
Asia	Singapore	105.78	2.16	NA	206.48	100.33
Europe	Slovakia	629.30	11.65	377.50	435.52	200.07
Europe	Slovenia	724.70	35.69	601.29	101.67	66.93
Oceania	Solomon Islands	0.78	0.14	NA	0.81	NA
Africa	Somalia	0.00	0.00	NA	0.00	NA
Africa	South Africa	3790.96	7.62	9369.00	137.67	3406.07
Europe	Spain	12,190.59	27.93	35,906.54	707.96	15,803.04
Asia	Sri Lanka	6.04	0.03	NA	6.56	0.26
Asia	Palestine	0.26	NA	NA	0.37	0.44
Africa	Sudan	0.96	0.00	NA	1.00	NA
America	Suriname	3.96	0.74	NA	3.96	NA
Europe	Sweden	1786.44	18.87	NA	1731.59	46.96
Europe	Switzerland	2841.52	36.94	1038.75	1843.67	15.67
Asia	Syria	2.74	0.02	1.81	1.07	0.00
Asia	Taiwan	150.96	NA	NA	153.63	1.00
Asia	Tajikistan	30.30	0.47	29.00	1.67	3.93
Africa	Tanzania	28.22	0.06	NA	28.41	0.41
Asia	Thailand	47.30	0.07	NA	91.93	48.78
Asia	Timor-Leste	1.93	0.18	NA	1.85	NA
Africa	Togo	41.30	0.69	NA	68.44	36.96
Oceania	Tonga	0.67	0.66	NA	0.67	NA
America	Trinidad	10.70	NA	NA	11.11	0.15
Africa	Tunisia	241.89	2.30	313.32	1.07	69.19
Asia	Turkmenistan	310.63	6.10	388.71	2.93	14.04
Oceania	Tuvalu	0.19	1.69	NA	0.19	NA
Africa	Uganda	9.81	0.03	NA	11.22	1.30
Europe	Ukraine	1686.96	3.62	1826.63	306.63	365.19
Asia	United Arab Emirates	NA	NA	NA	180.56	44.33
Europe	United Kingdom	11,705.07	18.75	30.00	11,715.15	571.59
America	USA	27,027.00	8.88	21,805.43	8282.74	3384.59
America	Uruguay	796.70	23.81	828.21	43.33	51.89
Asia	Uzbekistan	300.11	1.15	351.50	1.33	84.00
Oceania	Vanuatu	3.85	1.67	NA	3.74	NA
America	Venezuela	139.26	0.53	NA	125.93	0.26
Asia	Vietnam	76.41	0.09	NA	60.22	NA
America	Virgin Islands	NA	NA	NA	2.44	NA
Asia	Yemen	0.00	0.00	NA	0.00	0.00
Africa	Zambia	13.56	0.09	NA	14.15	0.04
Africa	Zimbabwe	30.93	0.24	18.33	11.19	0.56
Global	Global	237,314.89	3.53	269,122.48	83,650.11	86,585.19

Table A2. Z-score values resulting from the Mann-Kendall trend test, calculated for wine consumption, consumption per capita, production, imports, and exports for each country. Values above 1.96 and below −1.96 are considered significant ($\alpha = 0.05$).

Continent	Country	Consumption	Consumption Per Capita	Production	Imports	Exports
Asia	Afghanistan	2.69	0.21	NA	2.52	NA
Europe	Albania	3.44	3.96	0.69	5.24	NA
Africa	Algeria	4.80	2.96	2.15	4.17	−5.86
Oceania	American Samoa	0.19	0.19	NA	0.19	NA
Africa	Angola	2.23	0.42	NA	2.13	3.88
America	Antigua	5.31	5.09	NA	5.34	−0.23
America	Argentina	−6.25	−6.71	−2.39	−0.65	3.63
Asia	Armenia	2.02	2.25	2.94	2.91	4.75
America	Aruba	NA	NA	NA	6.07	−0.22
Oceania	Australia	6.21	3.38	3.38	6.07	4.75
Europe	Austria	−1.82	−3.63	−0.06	4.09	2.63
Asia	Azerbaijan	5.34	5.00	3.49	2.37	0.21
America	Bahamas	5.05	3.38	NA	4.00	0.96
Asia	Bahrain	2.93	−0.63	NA	2.55	2.73
Asia	Bangladesh	1.07	−1.84	NA	0.64	NA
America	Barbados	5.71	5.42	NA	5.17	2.01
Europe	Belarus	6.13	6.13	5.78	6.03	−0.21
Europe	Belgium	0.08	−2.37	5.65	4.89	4.60
America	Belize	5.41	4.38	NA	5.14	NA
Africa	Benin	0.21	−2.13	NA	−0.06	−0.98
America	Bermuda	2.19	2.13	NA	−0.55	NA
Asia	Bhutan	NA	NA	NA	4.69	NA
America	Bolivia	4.27	2.33	3.65	4.14	1.35
Europe	Bosnia and Herzegovina	3.01	4.42	0.63	2.74	1.67
Africa	Botswana	2.11	0.71	NA	2.28	−1.81
America	Brazil	4.23	0.71	−0.71	6.50	−1.69
Asia	Brunei	−0.81	−0.92	NA	−0.66	NA
Europe	Bulgaria	0.00	1.17	−5.55	2.92	−5.74
Africa	Burkina Faso	3.92	3.17	NA	4.28	2.38
Africa	Burundi	2.92	0.67	NA	2.82	NA
Africa	Ivory Coast	4.36	1.42	NA	4.48	0.54
Africa	Cape Verde	4.20	2.88	NA	4.22	−0.96
Asia	Cambodia	3.26	2.50	NA	3.23	−0.83
Africa	Cameroon	5.06	3.29	NA	4.49	−1.23
America	Canada	5.69	4.54	5.24	7.05	6.30
America	Cayman Islands	NA	NA	NA	2.28	NA
Africa	Central African Republic	−1.23	−3.29	NA	−1.96	0.06
Africa	Chad	2.43	0.25	NA	2.15	NA
America	Chile	0.13	−2.13	5.95	−0.19	6.26
Asia	China	4.88	4.54	2.29	6.00	0.61
America	Colombia	6.82	6.63	NA	6.82	0.73
Africa	Comoros	3.43	0.00	NA	3.51	NA
Africa	Democratic Republic of the Congo	−2.40	−4.63	NA	−1.99	3.10
Oceania	Cook Islands	4.31	NA	NA	4.24	NA
America	Costa Rica	6.28	5.92	NA	6.37	−1.35
Europe	Croatia	−5.25	−4.96	−5.30	5.34	−2.44
America	Cuba	3.21	3.00	2.33	4.97	2.74
Europe	Cyprus	3.51	1.42	−5.89	5.99	−6.20
Europe	Czech Republic	5.75	5.67	2.15	4.92	4.26

Table A2. *Cont.*

Continent	Country	Consumption	Consumption Per Capita	Production	Imports	Exports
Europe	Denmark	−1.54	−2.67	NA	0.69	2.67
Africa	Djibouti	0.92	−1.33	NA	0.12	NA
America	Dominica	−4.39	−5.34	NA	−4.08	−0.60
America	Dominican Republic	3.32	2.63	NA	5.32	4.16
America	Ecuador	3.80	2.79	NA	3.74	−0.32
Africa	Egypt	4.01	1.92	3.14	NA	0.00
America	El Salvador	5.21	4.42	NA	5.28	NA
Africa	Equatorial Guinea	NA	NA	NA	1.05	3.23
Europe	Estonia	5.34	5.38	3.16	5.61	4.62
Africa	Eswatini	−0.30	−1.52	NA	−3.64	0.83
Africa	Ethiopia	−1.26	−2.84	−3.27	3.08	3.59
Europe	Faroe Islands	5.37	3.34	NA	5.35	NA
Oceania	Fiji	4.06	3.38	NA	3.96	NA
Europe	Finland	3.00	2.59	NA	6.59	5.51
Europe	France	−6.42	−6.63	−4.17	3.25	−1.46
America	French Guiana	−1.64	NA	NA	0.00	NA
Oceania	French Polynesia	−1.28	−3.00	NA	−3.36	NA
Africa	Gabon	−4.11	−5.59	NA	−3.71	0.98
Africa	Gambia	−4.02	−4.44	NA	−2.63	NA
Asia	Georgia	0.04	0.29	−0.32	−1.00	4.63
Europe	Germany	1.86	1.50	−1.36	4.63	4.63
Africa	Ghana	1.96	0.29	NA	2.46	3.16
Europe	Greece	−2.38	−2.54	−5.27	2.13	−4.65
America	Greenland	2.94	2.75	NA	1.78	−0.38
America	Grenada	5.87	5.42	NA	5.89	3.88
America	Guadeloupe	−4.24	NA	NA	−2.27	NA
Oceania	Guam	1.01	0.29	NA	0.50	NA
Africa	Guinea	1.56	−0.17	NA	1.80	NA
Africa	Guinea-Bissau	5.82	5.13	NA	5.71	NA
America	Guyana	3.29	2.97	NA	4.86	1.60
America	Haiti	5.54	4.54	NA	5.35	NA
America	Honduras	4.73	3.34	NA	4.39	−0.32
Asia	Hong Kong	6.15	6.00	NA	4.88	3.45
Europe	Hungary	−4.61	−4.34	−3.46	3.42	0.25
Europe	Iceland	6.18	5.59	NA	6.46	−0.04
Asia	India	6.21	5.86	4.44	5.58	3.23
Asia	Indonesia	0.61	0.39	NA	1.39	1.73
Asia	Iran	−0.05	−0.09	NA	−0.28	2.73
Asia	Iraq	5.92	5.53	NA	5.70	NA
Europe	Ireland	6.05	4.75	NA	6.09	3.11
Asia	Israel	−4.77	−5.46	0.94	5.34	5.01
Europe	Italy	−5.03	−5.00	−1.40	4.67	4.54
America	Jamaica	5.61	5.46	NA	5.68	1.65
Asia	Japan	3.09	3.21	−0.97	4.17	−3.53
Asia	Jordan	4.44	1.19	NA	4.08	−0.81
Asia	Kazakhstan	4.46	3.63	3.80	2.44	−2.74
Africa	Kenya	6.30	5.46	NA	6.12	3.12
Oceania	Kiribati	−0.06	−0.06	NA	−0.06	NA
Asia	South Korea	6.51	6.38	NA	6.50	2.42
Asia	Kuwait	NA	NA	NA	NA	NA
Asia	Kyrgyzstan	0.94	−0.21	−0.42	1.57	0.74
Asia	Laos	5.94	5.46	NA	5.73	NA
Europe	Latvia	−0.77	0.63	2.41	5.96	5.55
Asia	Lebanon	−4.28	−5.50	−3.99	5.00	6.03

Table A2. *Cont.*

Continent	Country	Consumption	Consumption Per Capita	Production	Imports	Exports
Africa	Lesotho	2.66	1.76	NA	2.68	NA
Africa	Liberia	4.16	2.61	NA	3.99	NA
Africa	Libya	3.15	2.82	NA	2.90	NA
Europe	Lithuania	3.53	4.17	1.05	5.03	5.68
Europe	Luxemburg	0.77	NA	−3.28	4.01	−2.96
Asia	Macao	3.97	3.38	NA	3.69	3.49
Africa	Madagascar	−0.95	−5.92	−1.45	3.97	1.83
Africa	Malawi	−0.85	−2.46	NA	−1.38	NA
Asia	Malaysia	4.84	4.42	NA	4.80	3.93
Asia	Maldives	6.67	5.00	NA	6.52	NA
Africa	Mali	4.05	2.04	NA	4.11	0.58
Europe	Malta	3.22	1.21	−4.07	5.32	0.37
America	Martinique	−4.24	NA	NA	−2.19	NA
Africa	Mauritania	1.15	0.84	NA	1.15	NA
Africa	Mauritius	4.16	3.59	NA	3.84	2.03
America	Mexico	6.84	6.80	−3.90	6.53	−2.37
Oceania	Micronesia	NA	NA	NA	3.94	NA
Europe	Moldova	−2.49	−2.25	−2.51	−3.80	−0.81
Asia	Mongolia	5.26	3.98	NA	5.01	NA
Europe	Montenegro	−0.77	−0.77	−3.24	3.55	1.49
America	Montserrat	−3.11	NA	NA	−3.11	NA
Africa	Morocco	3.32	1.04	2.89	1.63	−4.22
Africa	Mozambique	1.46	−0.38	NA	3.04	4.57
Asia	Myanmar	6.56	6.13	NA	4.40	NA
Africa	Namibia	4.24	3.61	NA	3.59	3.14
Oceania	Nauru	NA	NA	NA	NA	NA
Asia	Nepal	5.29	4.72	NA	5.74	2.74
Europe	Netherlands	4.55	2.46	NA	5.51	4.34
America	Netherlands Antilles	0.02	NA	NA	−0.28	NA
Oceania	New Caledonia	2.79	−0.08	NA	1.97	NA
Oceania	New Zealand	5.67	2.46	5.87	2.13	7.17
America	Nicaragua	4.43	3.67	NA	4.43	NA
Africa	Niger	3.11	−1.63	NA	3.18	NA
Africa	Nigeria	4.55	4.04	NA	4.34	0.40
Oceania	Niue	NA	NA	NA	NA	NA
Oceania	Norfolk Island	NA	NA	NA	−0.85	NA
Europe	Norway	6.96	6.00	NA	6.65	4.63
Asia	Oman	NA	NA	NA	5.73	NA
Asia	Pakistan	−2.25	−3.43	NA	−2.25	NA
America	Panama	2.28	1.50	−2.57	5.82	4.46
Oceania	Papua New Guinea	3.36	2.38	NA	3.09	NA
America	Paraguay	1.46	−0.17	−3.03	1.46	1.22
America	Peru	6.59	6.00	6.76	5.44	3.92
Asia	Philippines	6.76	6.55	NA	5.98	3.31
Europe	Poland	6.55	6.55	NA	6.71	2.84
Europe	Portugal	−1.75	−1.71	−1.32	3.46	3.21
Asia	Qatar	NA	NA	NA	3.16	NA
Europe	North Macedonia	0.38	−0.04	−0.19	−1.76	−0.23
Asia	Turkey	4.61	3.67	4.17	4.53	−2.93
Africa	Reunion	−4.24	NA	NA	−4.24	NA
Europe	Romania	−4.38	−3.29	−3.14	3.22	−3.11
Europe	Russia	2.79	2.79	2.38	0.75	0.61
Africa	Rwanda	5.00	3.82	NA	5.61	3.38
Africa	Saint Helena	−0.94	NA	NA	−0.89	NA

Table A2. *Cont.*

Continent	Country	Consumption	Consumption Per Capita	Production	Imports	Exports
America	Saint Kitts	1.95	−0.83	NA	1.75	NA
America	Saint Lucia	2.39	1.58	NA	4.23	1.85
America	Saint Pierre And Miquelon	1.09	NA	NA	0.98	NA
America	Saint Vincent	3.61	2.17	NA	3.62	NA
Oceania	Samoa	2.61	2.02	NA	1.59	NA
Africa	Sao Tome and Principe	2.78	−1.25	NA	2.53	NA
Asia	Saudi Arabia	NA	NA	NA	−0.58	NA
Africa	Senegal	−0.50	−2.92	NA	−0.06	−0.30
Europe	Serbia	−3.38	−3.02	−3.21	−0.21	1.11
Africa	Seychelles	5.18	4.59	NA	3.83	NA
Africa	Sierra Leone	5.07	3.17	NA	4.89	NA
Asia	Singapore	6.40	5.59	NA	6.36	5.90
Europe	Slovakia	3.36	3.21	−3.44	5.59	5.43
Europe	Slovenia	0.33	−0.04	1.98	0.88	−1.38
Oceania	Solomon Islands	2.64	0.09	NA	2.75	NA
Africa	Somalia	NA	NA	NA	NA	NA
Africa	South Africa	0.08	−4.25	4.29	0.88	5.21
Europe	Spain	−5.76	−5.59	1.48	1.83	5.80
Asia	Sri Lanka	5.26	4.59	NA	5.30	3.71
Asia	Palestine	2.68	NA	NA	−2.60	−1.42
Africa	Sudan	4.71	3.90	NA	4.58	NA
America	Suriname	4.23	2.88	NA	3.99	NA
Europe	Sweden	5.09	4.34	NA	6.09	5.03
Europe	Switzerland	−4.13	−5.84	−4.03	0.17	−0.15
Asia	Syria	−3.22	−4.38	−4.52	−1.21	NA
Asia	Taiwan	4.11	NA	NA	4.23	1.08
Asia	Tajikistan	−4.38	−5.25	−5.19	2.78	−4.25
Africa	Tanzania	3.52	2.54	NA	3.74	0.06
Asia	Thailand	−1.09	−1.58	NA	4.05	6.39
Asia	Timor-Leste	0.15	−1.48	NA	−0.70	NA
Africa	Togo	−0.27	−0.85	NA	4.03	4.31
Oceania	Tonga	0.33	−2.43	NA	0.39	NA
America	Trinidad	4.37	NA	NA	4.13	−1.16
Africa	Tunisia	2.88	1.54	0.89	2.42	−4.55
Asia	Turkmenistan	2.78	−0.17	0.46	0.47	−4.00
Oceania	Tuvalu	1.84	1.52	NA	1.53	NA
Africa	Uganda	5.17	4.13	NA	4.74	4.13
Europe	Ukraine	0.38	1.04	−1.27	3.38	−0.33
Asia	United Arab Emirates	NA	NA	NA	6.13	5.79
Europe	United Kingdom	4.79	2.17	4.90	6.05	4.88
America	USA	6.59	5.67	4.09	6.88	3.13
America	Uruguay	−5.32	−5.96	−3.36	−1.09	3.80
Asia	Uzbekistan	−4.74	−5.38	−4.29	1.69	1.79
Oceania	Vanuatu	2.57	−0.13	NA	2.20	NA
America	Venezuela	−1.55	−1.88	NA	−1.36	−2.08
Asia	Vietnam	5.97	5.34	NA	4.44	NA
America	Virgin Islands	NA	NA	NA	0.83	NA
Asia	Yemen	NA	NA	NA	NA	NA
Africa	Zambia	4.42	3.71	NA	4.50	1.22
Africa	Zimbabwe	2.20	1.17	4.40	0.25	−1.86
Global	Global	3.00	−6.13	0.00	6.67	6.55

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