



Araştırma Makalesi / Research Article

An Analysis of Some Selected Economic and Social Factors Affecting Wine Sector: A Fuzzy Clustering Analysis^{1*}

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Abstract

The purpose of this study is to analyze some selected economic and social factors affecting the wine industry and to determine the cluster of countries in Europe including Türkiye that produce wine. The study sample comprised 28 countries (the 27 EU members plus Türkiye). Five country-level variables related to the wine industry were analyzed: Excise duty, value added tax, support provided by the European Union to the wine industry, geographical indications, and wine export data. A fuzzy c-means clustering algorithm was used to analyze the data. According to the findings, Türkiye is in the same cluster with 24 other European countries that are similar regarding selected social and economic factors. Thus, these countries are likely to be suitable competitors in terms of wine production. European largest producers Italy, France and Spain are in a different cluster. Economic policies can help Türkiye become an international leader in wine production. For example, the Turkish government can decrease or stop collecting excise duties from the wine industry, support the acquisition of geographical indications for its local wines. provide cash support to the industry, similar to policies throughout the European Union countries.

Keywords: Wine Sector, Geographical Indications, Cluster Analysis.

Şarap Sektörünü Etkileyen Bazı Seçili Ekonomik ve Sosyal Faktörlerin Analizi: Bir Bulanık Kümeleme Analizi

Öz

Bu çalışmanın amacı şarap endüstrisini etkileyen seçili bazı ekonomik ve sosyal faktörleri analiz etmek ve Türkiye de dahil olmak üzere Avrupa'da şarap üreten ülkelerdeki kümelenmeyi belirlemektir. Çalışmanın örneklemini 28 ülkeyi (27 AB üyesi ülke ve Türkiye) içermektedir. Şarap endüstrisi ile ilgili ülke düzeyinde 5 değişken analiz edilmiştir: ÖTV, KDV, Avrupa Birliği'nin şarap endüstrisine sağladığı destekler, coğrafi işaretler ve şarap ihracat verileri. Verilerin analizinde bulanık c-ortalama kümeleme algoritması kullanılmıştır. Elde edilen bulgulara göre Türkiye seçili sosyal ve ekonomik faktörler açısından benzer olan 24 diğer Avrupa ülkesi ile aynı kümede yer almaktadır. Dolayısıyla bu ülkeler ile rakip olması muhtemeldir. Avrupa'nın en büyük üreticileri İtalya, Fransa ve İspanya farklı bir kümede yer almaktadırlar. Ekonomi politikaları Türkiye'nin şarap üretiminde uluslararası bir lider olmasına yardımcı olabilir. Örneğin Türk hükümeti AB ülkelerinde olduğu gibi şarap endüstrisinden alınan özel tüketim vergisinin azaltabilir veya kaldırabilir, yerli şaraplar için coğrafi işaret alımlarını destekleyebilir, sektöre nakit destek sağlayabilir.

Anahtar Kelimeler: Şarap Sektörü, Coğrafi İşaretler, Kümeleme Analizi.

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INTRODUCTION

Türkiye is an ideal location for grape production (i.e., viticulture) due to its climate and soil structure. In addition to world-renowned grape varieties, such as cabernet sauvignon, merlot, and shiraz, Türkiye also produces many other domestic wine-grape varieties, such as patkara, kalecik karası, merzifon karası, urla karası, foça karası, and bornova misketi. However, although Türkiye is the fifth largest in the world in terms of vineyard space, the area of land dedicated to grape production has decreased in recent years (International Organisation of Vine and Wine [OIV], 2021). In Türkiye, in 2021, grapes are grown in only 10.4% of the total agricultural area. Only 10.4% of the total grapes are produced as wine grapes. 89.6% of the total grapes are presented to the market as table and dried grapes (Ministry of Agriculture and Forestry, 2022). This study thus aimed to examine some economic and social factors that are relevant in terms of successful wine production and to determine which European Union member countries have similar economic environment to that of Türkiye's wine industry by clustering of countries based on selected economic and social factors.

In recent years, many companies have taken interest in local wine varieties and established modern vineyard facilities in Türkiye that produce and export fine wines using traditional grapes as well as local grapes that are not yet well known in the world. Despite these positive developments, Türkiye lags behind many other countries in wine production and exportation. From 2016 to 2020, vineyard areas increased in Greece, Italy, Bulgaria, France, and Germany but decreased in Portugal, Romania, Spain, Hungary, and Türkiye, which had the highest decrease of 7.9% (OIV, 202), as summarized in Table 1. High construction and maintenance costs, lack of sufficient economic support, and difficulties in the marketing of grape products contributed to the decline (Semerci et al., 2015).

Table 1: Change in Vineyard Area in 10 EU Countries, 2016–2020

Countries	2016 (kha)	2020 (kha)	Rate of Change (%)
Greece	105	109	3.8
Italy	693	719	3.7
Bulgaria	64	66	3.1
France	786	797	1.3
Germany	102	103	0.9
Portugal	195	194	-0.5
Romania	191	190	-0.5
Spain	975	961	-1.4
Hungary	68	65	-4.4
Türkiye	468	431	-7.9

Source: International Organisation of Vine and Wine [OIV] (2021, p.5).

Europe has a long history of wine production (Harutyunyan and Ferreira, 2022). Wine is a major part of the culture and economy in many European countries. In 2020, Italy, France, and Spain rank first in terms of wine production (Table 2).

Table 2: Wine Production in Various Countries in 2020, in Millions of Hectoliters

Country	Wine production (millions of hectoliters)
Italy	49.1
France	46.6
Spain	40.7
Germany	8.4
Portugal	6.4
Romania	3.6
Hungary	2.4
Greece	2.3
Türkiye	0.68

Source: International Organisation of Vine and Wine [OIV] (2021, p.8), except Türkiye, statistics for which were obtained from the Department of Alcoholic Beverages of the Ministry of Agriculture and Forestry.

The wine industry is affected by various factors including climate change, soil structure, and precipitation levels. Some grape varieties grow more efficiently in certain regions (Foguem-Kamsu et al., 2015). However, the suitability of climatic conditions is not always the most important factor in domestic wine production. For example, the world-famous Bordeaux region is not uniquely well-suited for wine development (Joy et al., 2021), but high demand among British merchants has helped the Bordeaux wine industry grow (Ludington, 2018). Other country-level economic and social factors, such as state-imposed taxes and commercial branding, also can support or hinder wine production. Therefore, in this study we examined the wine industries of countries only in terms of some economic and social factors.

The purpose of this study is to analyze some selected economic and social factors affecting wine industry and to determine the cluster of countries in Europe including Türkiye that produce wine. In the first part of the study, some economic and social factors that can affect wine production were identified and relevant literature examined. In the second part of the study, a cluster analysis was conducted using country-level data on economic environments of the wine industry in European countries and Türkiye. Countries were clustered based on five variables measuring various aspects of the wine industry, including 1) excise tax rates, 2) value added tax rates, 3) level of support to the wine industry provided by the European Union, 4) geographical indications and protections, and 5) wine exports.

1. ECONOMIC AND SOCIAL FACTORS AFFECTING WINE PRODUCTION

In this study some taxes (excise tax and value added tax), geographic indications, European union supports, wine export data, have been selected as economic and social factors that are thought to affect the wine sector in countries.

Taxes

Taxes are one of the most important factors affecting the wine industry as in other industries. They cause an increase in the price of products, reduce the profits margins of the producers and their desire to produce. Besides high prices decreases demand of these product.

It is well known that tax policies are one of the ways to control alcohol consumption in countries. Many studies show that using excessive alcohol is very unhealthy (Berdzuli et al., 2020). Taxes on addictive products are also called sin taxes in the literature. Raising sin taxes is socially accepted more easily in underdeveloped and low-income countries (Pérez-Morón, 2022). However, in developed countries also it is supported to put high excise tax on alcoholic beverages in order to protect public health. It is noteworthy that in February 2022, the European Parliament agreed to take measures to regulate alcohol consumption in Europe's vote to "strengthen the fight against cancer" (Schulz et al., 2022).

The main taxes on wine are generally excise tax and value added tax. Excise taxes are imposed on the production of wine. Excise tax is an important source of income for states. It is frequently applied on harmful products to consume such as tobacco and alcohol. When an excise tax is placed on goods whose consumption is undesirable, the price of these goods increases and this causes a decrease in demand. But because of the demand elasticity of addictive products such as alcohol and tobacco is low, excise taxes on these products may cause an increase in the revenue of the state instead of reducing the demand (Prieger and Kullick, 2018; Chaloupka et al., 2012). European Union rules do not force countries to impose a minimum excise tax on wine but do force for other alcoholic beverages. This inequality regarding the taxation of alcoholic beverages is also among the issues discussed in the literature (Srivastava et al., 2022).

Another tax on wine is value added tax (VAT), which is an indirect, consumption tax. Studies in the literature show that value added tax constitute an important burden for enterprises. Although the value added tax is a tax collected from the consumer it triggers the tax avoidance behaviors of the companies (Olexová et al., 2022). In EU countries, each member state imposes its own standard rate, paid by the consumer. Generally, this rate should not be less than 15%, though exceptions apply according to the Directive 2006/112/EC of November 28, 2006.

Geographical indications

Geographical indications are signs that protect intellectual property rights. They are used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin. Geographical indications known as protected designation of origin (PDO) or protected geographical indications (PGI). PDO is used to identify a product that has been produced in a specific region. PGI is used to identify a product that has been produced, processed and prepared in a specific region using traditional methods and ingredients (European Commission, 2023a). Consumers can be affected by geographic indications of wine. Because these indicators can be perceived as a high quality (Frost et al., 2020). Therefore, it is important for countries to obtain geographical indications and protections for their wines to ensure stronger industries.

European Union supports

Wine production is a very laborious and expensive process. It requires quality grapes, machinery, knowledge and human resources. Although the cost of this process is high the products obtained as a result create a significant income. A restriction on the costs in these processes leads to a bad product, a loss of labor, capital and time. Therefore, wine production is also a risky investment. In such a risky investment institutional financial supports are important for the development of the sector.

The European Union provides significant financial supports to the wine industry. The aims of European Union within these supports are basically to increase the reputation of European wines and to make wine producers more competitive and regaining market share within and outside the EU. EU cares also about to inform consumers about EU quality standards, advocate responsible consumption, developing new production processes, green harvesting. During the corona virus pandemic, the sector, which was in great trouble due to the closure of restaurants, has also provided with much more than normal supports (European Commission, 2020).

Wine export data of countries

Being able to export wine produced in a country may be one of the most important reasons for the growth of the sector. Even for countries like Türkiye where the majority of the population is Muslim and where little wine is consumed, exports may become the most important factor reviving the existence of the wine industry. But the grapes in Türkiye are mostly exported as raisin. When this situation is evaluated from an economic point of view, the contribution of raisin exports to the economy is much lower than when the grapes are turned into wine and sold (Karaoğlu, 2007).

A comparison between European Union countries and Türkiye regarding the factors mentioned above is shown in Table 3. As can be seen in this table, Türkiye applies a higher amount of excise tax to the wine industry than many other countries. Türkiye applies a similar or even slightly lower value added tax rate to the wine industry. There is no geographical indication for the wines produced in Türkiye.

Table 3: Comparison of Some Factors Affecting Wine Industry in EU Countries and Türkiye

Countries	Excise Duty*	VAT**	Geog. Indications•	Supports+	Export++
Austria (AT)	0	20	37	14	132,638
Belgium (BE)	74.9086	21	10	0	654,288
Bulgaria (BG)	0	20	54	27	51,723
Croatia (HR)	0	25	11	-	23,111
Cyprus (CY)	0	19	13	5	2,861
Czechia (CZ)	0	21	46	5	3,788
Denmark (DK)	202.631	25	5	0	34,819
Estonia (EE)	147.82	20	0	0	18,204
Finland (FI)	421	24	0	0	14,903
France (FR)	3.91	20	455	281	7,883,589
Germany (DE)	0	19	46	39	925,386
Greece (EL)	0	24	148	24	73,728
Hungary (HU)	0	27	56	29	141,717
Ireland (IE)	424.84	23	0	0	3,504
Italy (IT)	0	22	549	337	10,993,306
Latvia (LV)	111	21	3	0.05	971,173
Lithuania (LT)	164.67	21	0	0.05	689,433
Luxembourg (LU)	0	17	1	0	3,085
Malta (MT)	20.5	18	21	0	16
Netherland (NL)	88.3	21	21	0	673,571
Poland (PL)	38.7226	23	0	0	157,002
Portugual (PT)	0	13	54	65	1,825,058
Romania (RO)	0	19	56	48	45,406
Slovak Republic (SK)	0	20	9	5	2,735
Slovenia (SI)	0	22	17	6	21,474
Spain (ES)	0	21	150	210	6,757,832
Sweeden (SE)	249.6829	25	0	0	16,119
Türkiye (TR)	118.46	18	0	0	17,759

*: Excise duty on table wine (euro) per hectoliter; **: Value added tax rates on table wine;
•: Geographical Indications; +: European Union yearly supports to wine sector since 2017 (million euro);
++: Total wine export in 2020-2021 (hectoliter).

Source:

*European Commission (2021). Note: Data for Türkiye; Minimum Specific Excise Duty: 21,6821 Official Gazette:27 May 2022 Number: 31848 Central Bank Effective Sales 1 euro: 18,3058 (23 July 2022).

**European Commission (2021).

•European Commission (2023a).

+European Commission (2020)

++European Commission (2023b). [T.C. Tarım ve Orman Bakanlığı Tütün ve Alkol Dairesi Başkanlığı \(2023\).](#)

2. MATERIALS AND METHODS

This study aimed to determine which EU member states have a similar economic environment to Türkiye's wine industry to identify which countries are viable competitors in this market. Data on the economic environment of the wine industry in the 27 EU member states and Türkiye were examined. Five country-level variables related to wine production were examined: 1) Excise duty, 2) VAT, 3) financial support from the EU, 4) number of geographic protections, and 5) volume of wine exports. Table 4 summarizes the variables.

Table 4: Summary Statistics of the Variables

Variable	Mean±SD	Median	Min-Max
Excise duty (€ per hl)	73.43±121.48	0.00	0.00-424.84
Value added tax (%)	21.04±2.90	21.00	13.00-27.00
Protected designation of origin, protected geographical indication	61.18±131.26	12.00	0.00-549.00
Annual EU support to wine industry since 2017 (€ million)	39.50±86.83	5.00	0.00-337.00
Export amount (2020-2021 total) (hl)	1,147,793.86±2,710,386.97	48,564.50	16-10,993,306

Mean±SD: mean±standard deviation, Min: lowest value, Max: highest value.

For statistical analysis, the fuzzy c-means clustering algorithm was used along with *fclust*, *ppclust*, and *factoextra* packages in R (version 3.6.1) software. The partition coefficient (Bezdek, 1973), partition entropy index (Bezdek, 1981), modified partition coefficient (Dave, 1996), silhouette index (Kaufman & Rousseeuw, 1990), fuzzy silhouette index (Campello & Hruschka, 2006), and Xie–Beni index (Xie & Beni, 1991) were used in the validity study to determine the appropriate numbers of clusters and fuzzy degrees after the variables were standardized.

3. RESULTS

If fuzzy degree $m = 1.4, 1.7, 2.0, 2.4$, then $m^* = 2.4$. If $m^* = 2.4$, the number of clusters is $c = 2, 3, \dots, 10$ validity indexes. Table V summarizes the fuzzy c-means clustering validity values. The highest values of the partition coefficient, modified partition coefficient, silhouette index, and fuzzy silhouette index and the lowest values of the partition entropy index and Xie–Beni index indicate the number of validation clusters. Therefore, the number of clusters was determined to be $c^* = 2$ (Table 5).

After determining the appropriate values of the number of clusters and the fuzzy degree, fuzzy c-mean clustering algorithms were applied. Membership values of countries to clusters are given in Table 6.

Table 5: Fuzzy C-Means Clustering Validity Values

Index	Number of Clusters								
	2	3	4	5	6	7	8	9	10
Partition coefficient	0.788	0.627	0.517	0.509	0.478	0.494	0.429	0.446	0.444
Partition entropy index	0.354	0.648	0.887	0.970	1.095	1.100	1.308	1.295	1.367
Modified partition coefficient	0.576	0.440	0.357	0.386	0.373	0.410	0.347	0.377	0.382
Silhouette index	0.835	0.608	0.505	0.474	0.485	0.470	0.339	0.334	0.306
Fuzzy silhouette index	0.857	0.737	0.590	0.465	0.616	0.554	0.362	0.459	0.246
Xie-Beni index	0.078	0.170	0.396	0.379	0.316	0.223	0.461	0.251	0.508

Table 6: Membership Values of Countries to Clusters

Country	Cluster 1	Cluster 2	Country	1. Cluster	2. Cluster
Austria (AT)	0.063	0.937	Italy (IT)	0.826	0.174
Belgium (BE)	0.012	0.988	Latvia (LV)	0.036	0.964
Bulgaria (BG)	0.074	0.926	Lithuania (LT)	0.074	0.926
Croatia (HR)	0.161	0.839	Luxembourg (LU)	0.153	0.847
Cyprus (CY)	0.085	0.915	Malta (MT)	0.109	0.891
Czechia (CZ)	0.050	0.950	Netherlands (NL)	0.015	0.985
Denmark (DK)	0.180	0.820	Poland (PL)	0.070	0.930
Estonia (EE)	0.064	0.936	Portugal (PT)	0.344	0.656
Finland (FI)	0.284	0.716	Romania (RO)	0.116	0.884
France (FR)	0.921	0.079	Slovakia (SK)	0.060	0.940
Germany (DE)	0.114	0.886	Slovenia (SI)	0.062	0.938
Greece (EL)	0.196	0.804	Spain (ES)	0.749	0.251
Hungary (HU)	0.247	0.753	Sweden (SE)	0.204	0.796
Ireland (IE)	0.279	0.721	Türkiye (TR)	0.103	0.897

Table 7 lists the distribution of countries in clusters: three countries are in cluster 1, and 25 are in cluster 2. Table 8 summarizes the information for each cluster. Figure 1 illustrate the distribution of countries in the two clusters.

Table 7: Distribution of Countries to Nearest Clusters

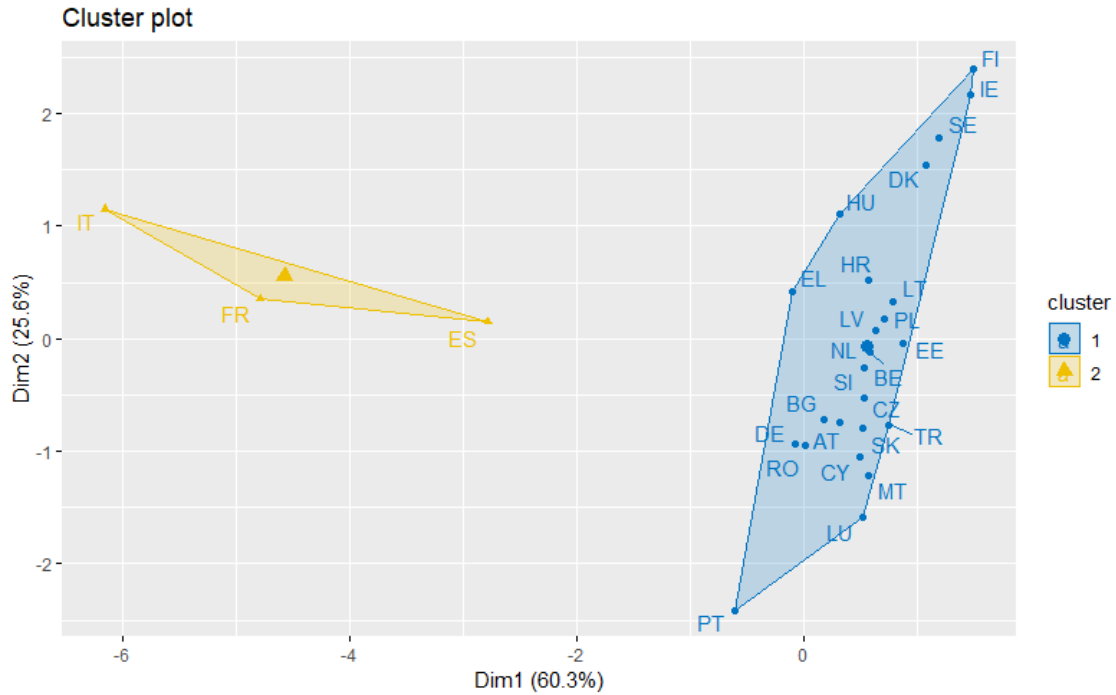
Cluster	Countries
1	France, Spain, Italy
2	Germany, Austria, Belgium, Bulgaria, Czechia, Denmark, Estonia, Finland, Croatia, Netherlands, Ireland, Sweden, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Poland, Portugal, Romania, Slovenia, Slovakia, Türkiye, Greece

Table 8: Summary Statistics of the Variables on the Clusters

Variable	Cluster 1	Cluster 2
	Mean±SD	Mean±SD
Excise duty (€ per hl)	1.30±2.26	82.08±125.99
Value added tax (%)	21.00±1.00	21.04±3.06
Protected designation of origin, protected geographical indication	384.67±208.59	22.36±33.26
Annual EU support to wine industry since 2017 (€ million)	276.00±63.65	11.12±17.71
Export amount (2020-2021 total) (hl)	8,544,909.00±2,193,813.60	260,140.04±450,533.37

Mean±SD: mean±standard deviation.

Figure 1: Distribution of Countries into Two Clusters



4. DISCUSSION

The main aim of this study was to find out which EU countries have similar economic indicators to Türkiye in terms of their wine industry. The findings help to identify which EU countries have wine industries that are similar to Türkiye, thus aiding in policymaking regarding how the industry can be developed. A cluster analysis was conducted using data on five key aspects of the wine industry (excise duties, VATs, financial support from the EU, geographic protections, and export data).

According to the findings, Türkiye is similar to 24 EU countries in terms of these five measures. The three remaining countries, Italy, France, and Spain, represent the largest wine producers in Europe. Although Türkiye has a similarly suitable geographical location and climate for wine grape production, with wide coasts and access to the Mediterranean Sea, its wine industry lags far behind Italy, France, and Spain. This finding indicates that location is not the only determinant of successful wine production.

Of the 28 countries examined, 15 do not impose an excise duty on wine production (Austria, Bulgaria, Cyprus, Croatia, Czechia, Germany, Greece, Hungary, Spain, Italy, Luxembourg, Portugal, Romania, Slovenia, and the Slovak Republic). France, which ranks second in wine production in Europe, imposes a very low excise duty. These low tax rates help to protect wine producers and develop the industry. According to EU regulations, VATs on goods and services should not be less than 15%, and countries are free to increase this rate. All examined countries impose VATs, albeit at different rates. Only one country, Portugal, imposes a reduced VAT of 13% on table wine, compared to its standard VAT rate. Portugal also has a high volume of wine exports, a high number of geographic protections on wine, and receives more support from the EU for wine production, compared to other countries.

France, Spain, and Italy are well known throughout the world for their wines. These countries also issue a high number of geographical indications and receive a higher than average amount of support from the European Union for wine production. Unsurprisingly, their wine export amounts are also much higher than other countries. These countries also compete under similar conditions. In comparison, countries such as Czechia, Hungary, and the Slovak Republic, which are smaller than Türkiye in terms of size and do not have a Mediterranean climate, have geographic protections for their wines and are gaining widespread brand recognition. Although Türkiye produces and exports wine and has favorable geography for viticulture, it has no geographic protections. Wine producers in Türkiye should take initiatives in this regard, and the state should support these efforts to benefit the country's economy. For example, the state could seek more support from the EU. Many member states use EU resources for wine production.

The closest competitors to Italy, France, and Spain are Greece, Germany, and Romania, respectively. Among these three countries, Greece has more geographical protections, Germany has a higher volume of exports, and Romania receives higher than average EU support, compared to other countries in the same cluster. Future studies should determine the specific country-level policies and variables that can help identify viable competition for Türkiye's wine industry. Only two clusters were identified in this study, but significant differences exist in the characteristics of the 25 countries in the first cluster. Determining which of these characteristics are most important in terms of domestic wine production can help policy makers in Türkiye design incentives for vintners and remove barriers to success.

AUTHOR STATEMENT

Statement of Research and Publication Ethics

This study has been prepared in accordance with scientific research and publication ethics.

Author Contributions

The authors contributed equally to the study.

Conflict of Interest

There is no conflict of interest for the authors or third parties arising from the study.

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